BRISBANE WATER

PUMPING STATION SP126

BW70103-001 YOUNGS ROAD HEMMANT

ELECTRICAL SWITCHBOARD

OPERATION AND MAINTENANCE MANUAL

Developed by:

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1.1.1. Copyright, Limitation of Liability and Revision Rights

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Danfoss reserves the right to revise this publication at any time and to make changes to its contents without prior notice or any obligation to notify former or present users of such revisions or changes.

These Operating Instructions will introduce all aspects of your VLT AQUA Drive.

Available literature for VLT AQUA Drive:

- Operating Instructions MG.20.MX.YY provide the neccessary information for getting the drive up and running.
- Design Guide MG.20.NX.YY entails technical information about the drive design and customer applications.
- Programming Guide MG.20.OX.YY provides information on how to programme and includes complete parameter descriptions.

X = Revision number

YY = Language code

Danfoss Drives technical literature is also available online at www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.

1.1.2. Approvals

C€ c UL US

1.1.3. Symbols

Symbols used in these Operating Instructions.

NB!
Indicates something to be noted by the reader.

Indicates a general warning.

Indicates a high-voltage warning.

•	Indicates default setting

2. Safety

2.1.1. Safety note

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

Safety Regulations

1. The frequency converter must be disconnected from mains if repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
2. The [STOP/RESET] key on the control panel of the frequency converter does not disconnect the equipment from mains and is thus not to be used as a safety switch.
3. Correct protective earthing of the equipment must be established, the user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The earth leakage currents are higher than 3.5 mA.
5. Protection against motor overload is set by par. 1-90 *Motor Thermal Protection*. If this function is desired, set par. 1-90 to data value [ETR trip] (default value) or data value [ETR warning]. Note: The function is initialised at 1.16 x rated motor current and rated motor frequency. For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.
6. Do not remove the plugs for the motor and mains supply while the frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
7. Please note that the frequency converter has voltage inputs other than L1, L2 and L3, when load sharing (linking of DC intermediate circuit) and external 24 V DC have been installed. Check that all voltage inputs have been disconnected and that the necessary time has passed before commencing repair work.

Installation at High Altitudes

By altitudes above 2 km, please contact Danfoss regarding PELV.

Warning against Unintended Start

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

Warning:
Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.

Also make sure that other voltage inputs have been disconnected, such as external 24 V DC, load sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic back up.

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2.1.2. General Warning

Warning:

Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.

Also make sure that other voltage inputs have been disconnected, (linkage of DC intermediate circuit), as well as the motor connection for kinetic back-up.

Before touching any potentially live parts of the VLT AQUA Drive FC 200, wait at least as follows:

200 - 240 V, 0.25 - 3.7 kW: wait at least 4 minutes.
200 - 240 V, 5.5 - 45 kW: wait at least 15 minutes.
380 - 480 V, 0.37 - 7.5 kW: wait at least 4 minutes.
380 - 480 V, 11 - 90 kW, wait at least 15 minutes.
525 - 600 V, 1.1 - 7.5 kW, wait at least 4 minutes.
525 - 600 V, 110 - 250 kW, wait at least 20 minutes.
525 - 600 V, 315 - 560 kW, wait at least 30 minutes.

Shorter time is allowed only if indicated on the nameplate for the specific unit.

Leakage Current

The earth leakage current from the VLT AQUA Drive FC 200 exceeds 3.5 mA. According to IEC 61800-5-1 a reinforced Protective Earth connection must be ensured by means of: a min. 10mm² Cu or 16mm² Al PE-wire or an addtional PE wire - with the same cable cross section as the Mains wiring - must be terminated separately.

Residual Current Device

This product can cause a D.C. current in the protective conductor. Where a residual current device (RCD) is used for extra protection, only an RCD of Type B (time delayed) shall be used on the supply side of this product. See also RCD Application Note MN.90.GX.02. Protective earthing of the VLT AQUA Drive FC 200 and the use of RCD's must always follow national and local regulations.

2.1.3. Before Commencing Repair Work

1. Disconnect the frequency converter from mains
2. Disconnect DC bus terminals 88 and 89
3. Wait at least the time mentioned in section 2.1.2
4. Remove motor cable

2.1.4. Special conditions

Electrical ratings:

The rating indicated on the nameplate of the frequency converter is based on a typical 3-phase mains power supply, within the specified voltage, current and temperature range, which is expected to be used in most applications.

The frequency converters also support other special applications, which affect the electrical ratings of the frequency converter. Special conditions which affect the electrical ratings might be:

- Single phase applications
- High temperature applications which require derating of the electrical ratings
- Marine applications with more severe environmental conditions.

Consult the relevant clauses in these instructions and in the **VLT® AQUA Drive Design Guide** for information about the electrical ratings.

Installation requirements:

The overall electrical safety of the frequency converter requires special installation considerations regarding:

- Fuses and circuit breakers for over-current and short-circuit protection
- Selection of power cables (mains, motor, brake, loadsharing and relay)
- Grid configuration (IT,TN, grounded leg, etc.)
- Safety of low-voltage ports (PELV conditions).

Consult the relevant clauses in these instructions and in the **VLT® AQUA Drive Design Guide** for information about the installation requirements.

2.1.5. Caution

The frequency converter DC link capacitors remain charged after power has been disconnected. To avoid an electrical shock hazard, disconnect the frequency converter from the mains before carrying out maintenance. Wait at least as follows before doing service on the frequency converter:

Voltage	Min. Waiting Time			
	4 min.	15 min.	20 min.	30 min.
200 - 240 V	0.25 - 3.7 kW	5.5 - 45 kW		
380 - 480 V	0.37 - 7.5 kW	11 - 90 kW	110 - 250 kW	315 - 450 kW
525-600 V	0.75 kW - 7.5 kW		110 - 250 kW	315 - 560 kW
525-690 V			45 - 400 kW	450 - 630 kW

Be aware that there may be high voltage on the DC link even when the LEDs are turned off.

2.1.6. Avoid unintended Start

While the frequency converter is connected to mains, the motor can be started/stopped using digital commands, bus commands, references or via the Local Control Panel.

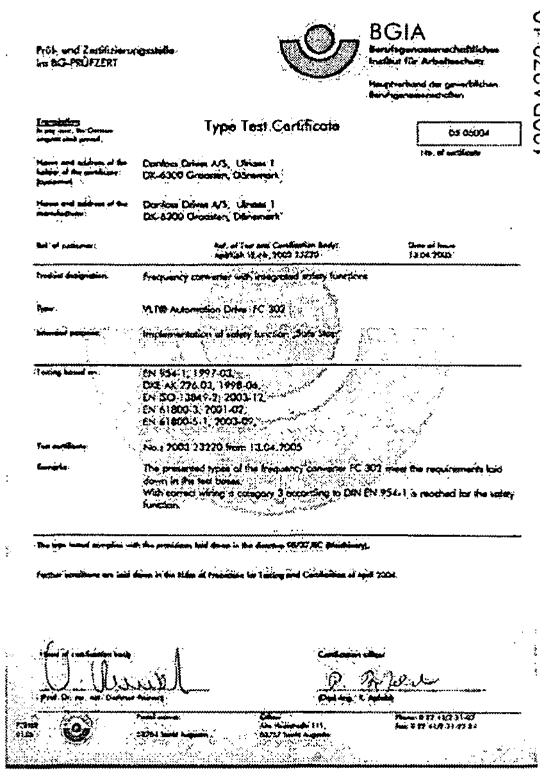
- Disconnect the frequency converter from mains whenever personal safety considerations make it necessary to avoid unintended start.
- To avoid unintended start, always activate the [OFF] key before changing parameters.
- Unless terminal 37 is turned off, an electronic fault, temporary overload, a fault in the mains supply, or lost motor connection may cause a stopped motor to start.

2.1.7. Safe Stop of the Frequency Converter (optional)

For versions fitted with a Safe Stop terminal 37 input, the frequency converter can perform the safety function *Safe Torque Off* (As defined by draft CD IEC 61800-5-2) or *Stop Category 0* (as defined in EN 60204-1).

It is designed and approved suitable for the requirements of Safety Category 3 in EN 954-1. This functionality is called Safe Stop. Prior to integration and use of Safe Stop in an installation, a thorough risk analysis on the installation must be carried out in order to determine whether the Safe Stop functionality and safety category are appropriate and sufficient. In order to install and use the Safe Stop function in accordance with the requirements of Safety Category 3 in EN 954-1, the related information and instructions of the VLT AQUA Drive Design Guide MG.20.NX.YY must be followed! The information and instructions of the Operating Instructions are not sufficient for a correct and safe use of the Safe Stop functionality!

2



130BA373.10

2.1.8. IT Mains

IT Mains

Do not connect 400 V frequency converters with RFI-filters to mains supplies with a voltage between phase and earth of more than 440 V.

For IT mains and delta earth (grounded leg), mains voltage may exceed 440 V between phase and earth.

par. 14-50 RFI *Filter* can be used to disconnect the internal RFI capacitiors from the RFI filter to ground. If this is done it will reduce the RFI performance to A2 level.

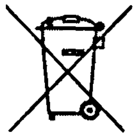
2.1.9. Software Version and Approvals

VLT AQUA Drive

Software version: 1.24

This manual can be used with all VLT AQUA Drive frequency converters with software version 1.24.
The software version number can be found in parameter 15-43.

2.1.10. Disposal Instruction



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

3. Introduction

3.1. Introduction

3.1.1. Type Code String

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39

FC-202P T H XXSXXXXA B C D

130BA484.10

Description	Pos	Possible choice
Product group & VLT Series	1-6	FC 202
Power rating	8-10	0.25 - 630 kW
Number of phases	11	Three phases (T)
Mains voltage	11-12	S2: 220-240 VAC single phase S4: 380-480 VAC single phase T 2: 200-240 VAC T 4: 380-480 VAC T 6: 525-600 VAC T 7: 525-690 VAC
Enclosure	13-15	E20: IP20 E21: IP 21/NEMA Type 1 E55: IP 55/NEMA Type 12 E2M: IP21/NEMA Type 1 w/mains shield E5M: IP 55/NEMA Type 12 w/mains shield E66: IP66 F21: IP21 kit without backplate G21: IP21 kit with backplate P20: IP20/Chassis with backplate P21: IP21/NEMA Type 1 w/backplate P55: IP55/NEMA Type 12 w/backplate
RFI filter	16-17	HX: No RFI filter H1: RFI filter class A1/B H2: RFI filter class A2 H3: RFI filter class A1/B (reduced cable length) H4: RFI filter class A2/A1
Brake	18	X: No brake chopper included B: Brake chopper included T: Safe Stop U: Safe + brake
Display	19	G: Graphical Local Control Panel (GLCP) N: Numeric Local Control Panel (NLCP) X: No Local Control Panel
Coating PCB	20	X. No coated PCB C: Coated PCB
Mains option	21	D: Loadsharing X: No Mains disconnect switch 1: With Mains disconnect switch 8: Mains Disconnect + Loadsharing
Adaptation	22	Reserved
Adaptation	23	Reserved
Software release	24-27	Actual software
Software language	28	
A options	29-30	AX: No options A0: MCA 101 Profibus DP V1 A4: MCA 104 DeviceNet
B options	31-32	BX: No option BK: MCB 101 General purpose I/O option BP: MCB 105 Relay option BO:MCB 109 Analog I/O option
C0 options MCO	33-34	CX: No options
C1 options	35	X: No options
C option software	36-37	XX: Standard software
D options	38-39	DX: No option D0: DC back-up
The various options are described further in the *VLT AQUA Drive Design Guide*.		

Table 3.1: Type code description.

3.1.2. Frequency Converter Identification

Below is an example of an identification label. This label is situated on the frequency converter and shows the type and options fitted to the unit. See table 2.1 for details of how to read theType code string (T/C).

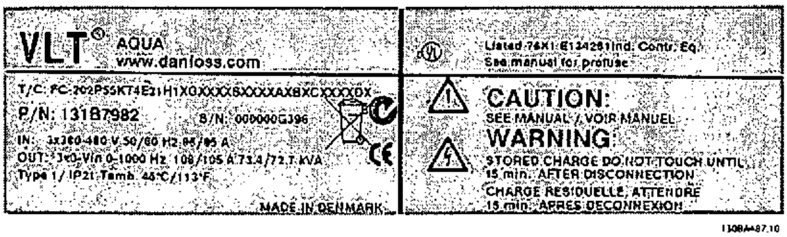


Illustration 3.1: This example shows an identification label for VLT AQUA Drive.

Please have T/C (type code) number and serial number ready before contacting Danfoss.

3.1.3. Abbreviations and Standards

Abbreviations:	Terms:	SI-units:	I-P units:
	Acceleration	m/s²	ft/s²
AWG	American wire gauge		
Auto Tune	Automatic Motor Tuning		
°C	Celsius		
	Current	A	Amp
I_{LIM}	Current limit		
	Energy	J = N·m	ft-lb, Btu
°F	Fahrenheit		
FC	Frequency Converter		
	Frequency	Hz	Hz
kHz	Kilohertz		
LCP	Local Control Panel		
mA	Milliampere		
ms	Millisecond		
min	Minute		
MCT	Motion Control Tool		
M-TYPE	Motor Type Dependent		
Nm	Newton Metres		in-lbs
$I_{M,N}$	Nominal motor current		
$f_{M,N}$	Nominal motor frequency		
$P_{M,N}$	Nominal motor power		
$U_{M,N}$	Nominal motor voltage		
par.	Parameter		
PELV	Protective Extra Low Voltage		
	Power	W	Btu/hr, hp
	Pressure	Pa = N/m²	psi, psf, ft of water
I_{INV}	Rated Inverter Output Current		
RPM	Revolutions Per Minute		
SR	Size Related		
	Temperature	C	F
	Time	s	s,hr
T_{LIM}	Torque limit		
	Voltage	V	V

Table 3.2: Abbreviation and Standards table .

4. Mechanical installation

4.1. Before starting

4.1.1. Checklist

When unpacking the frequency converter, ensure that the unit is undamaged and complete. Use the following table to identify the packaging:

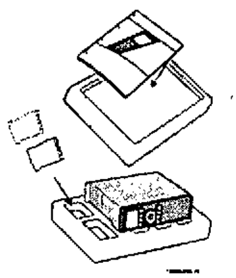
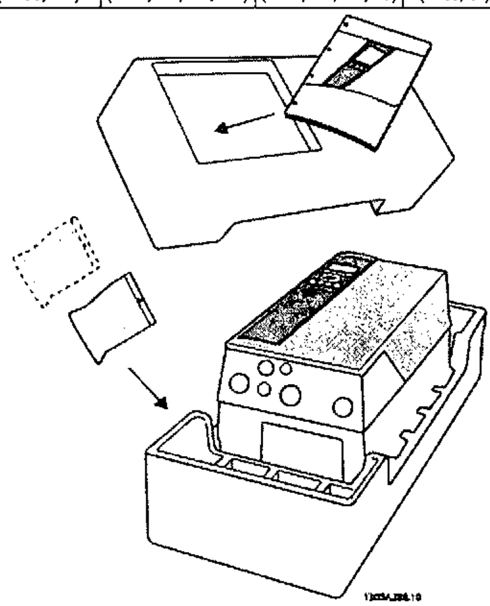
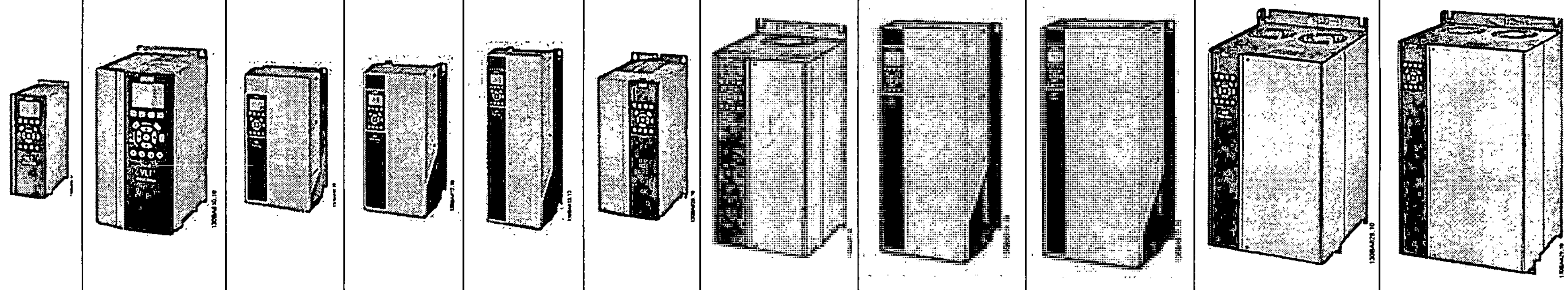
Enclosure type:	A2 (IP 20/ 21)	A3 (IP 20/21)	A5 (IP 55/ 66)	B1/B3 (IP20/ 21/ 55/ 66)	B2/B4 (IP20/ 21/ 55/66)	C1/C3 (IP20/21/ 55/66)	C2/C4 (IP20/21/ 55/66)
							
Unit size (kW):							
200-240 V	0.25-3.0	3.7	0.25-3.7	5.5-11/ 5.5-11	15/ 15-18.5	18.5-30/ 22-30	37-45/ 37-45
380-480 V	0.37-4.0	5.5-7.5	0.37-7.5	11-18.5/ 11-18.5	22-30/ 22-37	37-55/ 45-55	75 - 90/ 75-90
525-600 V	0.75-4.0	5.5-7.5	0.75-7.5	11-18.5/ 11-18.5	22-37/ 22-37	45-55/ 45-55	75 - 90/ 75-90

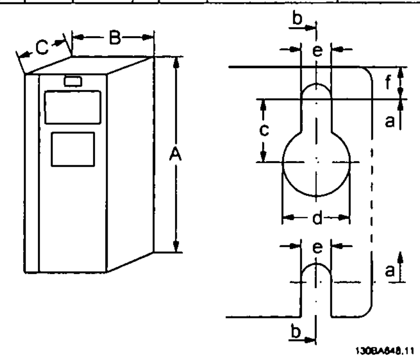
Table 4.1: Unpacking table

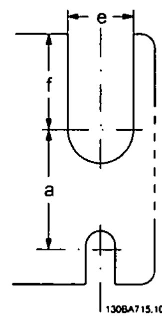
Please note that a selection of screwdrivers (philips or cross-thread screwdriver and torx), a side-cutter, drill and knife is also recommended to have handy for unpacking and mounting the frequency converter. The packaging for these enclosures contains, as shown: Accessories bag(s), documentation and the unit. Depending on options fitted there may be one or two bags and one or more booklets.

4.2.1. Mechanical Front Views

A2	A3	A5	B1	B2	B3	B4	C1	C2	C3	C4
IP20/21	IP20/21	IP55/66	IP21/55/66	IP21/55/66	IP20	IP20	IP21/55/66	IP21/55/66	IP20	IP20







Accessory bags containing necessary brackets, screws and connectors are included with the drives upon delivery.

Top and bottom mounting holes. (C3+C4 only)

All measurements in mm.
* A5 in IP55/66 only!

4.2.2. Mechanical Dimensions

Mechanical dimensions

Frame size (kW):		A2		A3		A5	B1	B2	B3	B4	C1	C2	C3	C4
200-240 V		**0.25-3.0**		**3.7**		**0.25-3.7**	**5.5-11**	**15**	**5.5-11**	**15-18.5**	**18.5-30**	**37-45**	**22-30**	**37-45**
380-480 V		**0.37-4.0**		**5.5-7.5**		**0.37-7.5**	**11-18.5**	**22-30**	**11-18.5**	**22-37**	**37-55**	**75-90**	**45-55**	**75-90**
525-600 V		**-**		**0.75-7.5**		**0.75-7.5**	**11-18.5**	**22-30**	**11-18.5**	**22-37**	**37-55**	**75-90**	**45-55**	**75-90**
IP NEMA		20 Chassis	21 Type 1	20 Chassis	21 Type 1	55/66 Type 12	21/ 55/66 Type 1/12	21/55/66 Type 1/12	20 Chassis	20 Chassis	21/55/66 Type 1/12	21/55/66 Type 1/12	20 Chassis	20 Chassis
Height (mm)														
Enclosure	A**	246	372	246	372	420	480	650	350	460	680	770	490	600
..with de-coupling plate	A2	374	-	374	-	-	-	-	419	595	-	-	630	800
Back plate	A1	268	375	268	375	420	480	650	399	520	680	770	550	660
Distance between mount. holes	a	257	350	257	350	402	454	624	380	495	648	739	521	631
Width (mm)														
Enclosure	B	90	90	130	130	242	242	242	165	231	308	370	308	370
With one C option	B	130	130	170	170	242	242	242	205	231	308	370	308	370
Back plate	B	90	90	130	130	242	242	242	165	231	308	370	308	370
Distance between mount. holes	b	70	70	110	110	215	210	210	140	200	272	334	270	330
Depth (mm)														
Without option A/B	C	205	205	205	205	200	260	260	248	242	310	335	333	333
With option A/B	C*	220	220	220	220	200	260	260	262	242	310	335	333	333
Screw holes (mm)														
	c	8.0	8.0	8.0	8.0	8.2	12	12	8	-	12	12	-	-
Diameter ø	d	11	11	11	11	12	19	19	12	-	19	19	-	-
Diameter ø	e	5.5	5.5	5.5	5.5	6.5	9	9	6.8	8.5	9.0	9.0	8.5	8.5
	f	9	9	9	9	9	9	9	7.9	15	9.8	9.8	17	17
Max weight (kg)		4.9	5.3	6.6	7.0	14	23	27	12	23.5	45	65	35	50

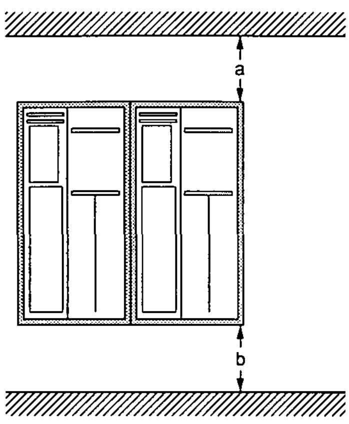
* Depth of enclosure will vary with different options installed.
** The free space requirements are above and below the bare enclosure height measurement A. See section 3.2.3 for further information.

4.2.3. Mechanical mounting

All IP20 enclosure sizes as well as IP21/ IP55 enclosure sizes except A2 and A3 allow side-by-side installation.

If the IP 21 Enclosure kit (130B1122 or 130B1123) is used on enclosure A2 or A3, there must be a clearance between the drives of min. 50 mm.

For optimal cooling conditions allow a free air passage above and below the frequency converter. See table below.



Air passage for different enclosures

Enclosure:	A2	A3	A5	B1	B2	B3	B4	C1	C2	C3	C4
a (mm):	100	100	100	200	200	200	200	200	225	200	225
b (mm):	100	100	100	200	200	200	200	200	225	200	225

1. Drill holes in accordance with the measurements given.
2. You must provide screws suitable for the surface on which you want to mount the frequency converter. Retighten all four screws.

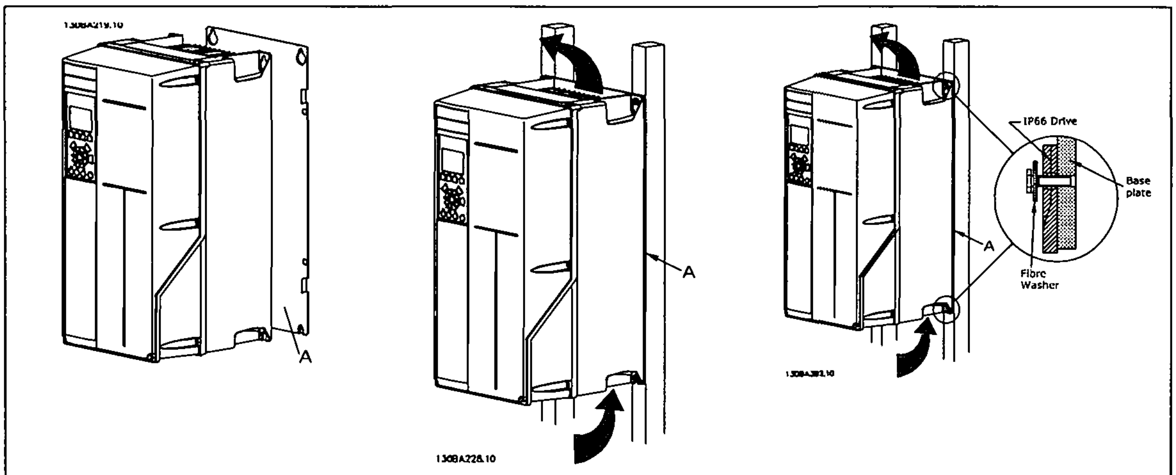


Table 4.2: Mounting frame sizes A5, B1, B2, B3, B4, C1, C2, C3 and C4 on a non-solid back wall, the drive must be provided with a back plate A due to insufficient cooling air over the heat sink.

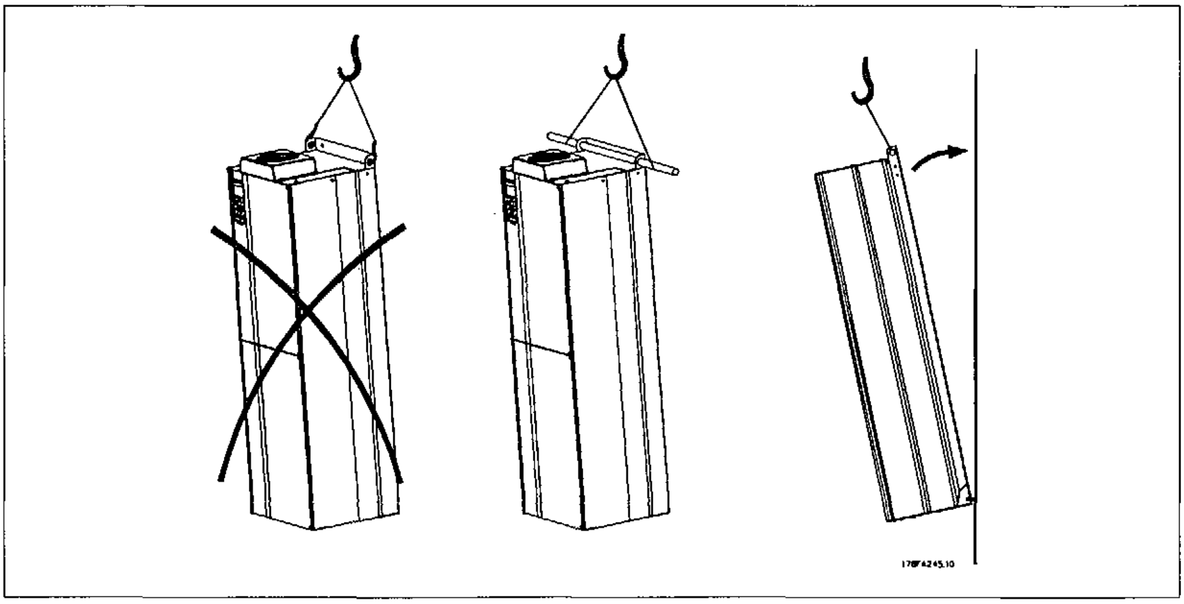


Illustration 4.1: With heavier drives, use a lift. First wall-mount the 2 lower bolts - then lift the drive onto the lower bolts - finally fasten the drive against the wall with the 2 top bolts.

4.2.4. Safety Requirements of Mechanical Installation

Pay attention to the requirements that apply to integration and field mounting kit. Observe the information in the list to avoid serious damage or injury, especially when installing large units.

The frequency converter is cooled by means of air circulation.
To protect the unit from overheating, it must be ensured that the ambient temperature *does not exceed the maximum temperature stated for the frequency converter* and that the 24-hour average temperature *is not exceeded*. Locate the maximum temperature and 24-hour average in the paragraph *Derating for Ambient Temperature*.
If the ambient temperature is in the range of 45 °C - 55 ° C, derating of the frequency converter will become relevant, see *Derating for Ambient Temperature*.
The service life of the frequency converter is reduced if derating for ambient temperature is not taken into account.

4.2.5. Field Mounting

For field mounting the IP 21/IP 4X top/TYPE 1 kits or IP 54/55 units are recommended.

4.2.6. Panel Through Mounting

A Panel Through Mount Kit is available for frequency converter series , VLT Aqua Drive and .

In order to increase heatsink cooling and reduce panel depth, the frequency converter may be mounted in a through panel. Furthermore the in-built fan can then be removed.

The kit is available for enclosures A5 through C2.

NB!
This kit cannot be used with cast front covers. No cover or imminent plastic cover must be used instead.

Information on ordering numbers is found in the *Design Guide*, section *Ordering Numbers.*
More detailed information is available in the *Panel Through Mount Kit instruction, MI.33.H1.YY,* where yy=language code.

5. Electrical installation

5.1. How to connect

5.1.1. Cables General

NB!
Always comply with national and local regulations on cable cross-sections.

Details of terminal tightening torques.

	Power (kW)			Torque (Nm)					
Enclosure	200-240 V	380-480 V	525-600 V	Line	Motor	DC connection	Brake	Earth	Relay
A2	0.25 - 3.0	0.37 - 4.0	0.75 - 4.0	1.8	1.8	1.8	1.8	3	0.6
A3	3.7	5.5 - 7.5	5.5 - 7.5	1.8	1.8	1.8	1.8	3	0.6
A5	0.25 - 3.7	0.37 - 7.5	0.75 - 7.5	1.8	1.8	1.8	1.8	3	0.6
B1	5.5 - 11	11 - 18.5	-	1.8	1.8	1.5	1.5	3	0.6
B2	-	22	-	4.5	4.5	3.7	3.7	3	0.6
	15	30	-	4.5[2)]	4.5[2)]	3.7	3.7	3	0.6
B3	5.5 - 11	11 - 18.5	11 - 18.5	1.8	1.8	1.8	1.8	3	0.6
B4	11 - 18.5	18.5 - 37	18.5 - 37	4.5	4.5	4.5	4.5	3	0.6
C1	18.5 - 30	37 - 55	-	10	10	10	10	3	0.6
C2	37	75	-	14	14	14	14	3	0.6
	45	90		24	24	14	14	3	0.6
C3	18.5 - 30	37 - 55	37 - 55	10	10	10	10	3	0.6
C4	30 - 45	55 - 90	55 - 90	14/24[1]	14/24[1]	14	14	3	0.6

Table 5.1: Tightening of terminals

1. For different cable dimensions x/y where x≤95 mm² and y≥95 mm².
2. Cable dimensions above 18.5 kW ≥ 35 mm² and below 22 kW ≤ 10 mm²

5.1.2. Enclosure Knock-outs

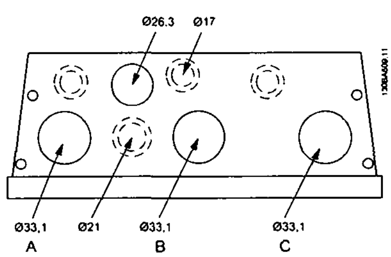


Illustration 5.1: Cable entry holes for enclosure B1. The suggested use of the holes are purely recommendations and other solutions are possible.

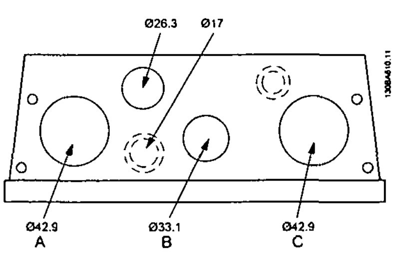


Illustration 5.2: Cable entry holes for enclosure B2. The suggested use of the holes are purely recommendations and other solutions are possible.

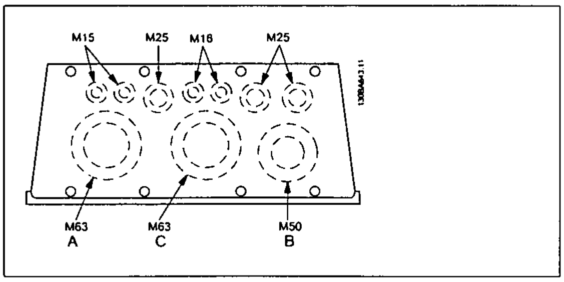


Illustration 5.3: Cable entry holes for enclosure C1. The suggested use of the holes are purely recommendations and other solutions are possible.

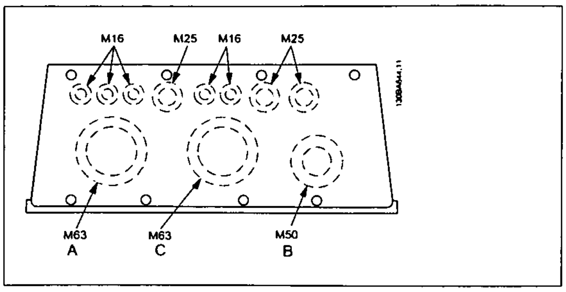


Illustration 5.4: Cable entry holes for enclosure C2. The suggested use of the holes are purely recommendations and other solutions are possible.

5

5.1.3. Fuses

Branch circuit protection:

In order to protect the installation against electrical and fire hazard, all branch circuits in an installation, switch gear, machines etc., must be shortcircuit and overcurrent protected according to the national/international regulations.

Short circuit protection

The frequency converter must be protected against short-circuit to avoid electrical or fire hazard. Danfoss recommends using the fuses mentioned in tables 4.3 and 4.4 to protect service personnel or other equipment in case of an internal failure in the unit. The frequency converter provides full short circuit protection in case of a short-circuit on the motor output.

Over-current protection:

Provide overload protection to avoid fire hazard due to overheating of the cables in the installation. Over current protection must always be carried out according to national regulations. The frequency converter is equipped with an internal over current protection that can be used for upstream overload protection (UL-applications excluded). See par. 4-18. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 A_{rms} (symmetrical), 500 V/600 V maximum.

Non UL compliance

If UL/cUL is not to be complied with, Danfoss recommends using the fuses mentioned in table 4.2, which will ensure compliance with EN50178:
In case of malfunction, not following the recommendation may result in unnecessary damage to the frequency converter.

Frequency converter	Max. fuse size	Voltage	Type
200-240 V			
K25-1K1	16A[1]	200-240 V	type gG
1K5	16A[1]	200-240 V	type gG
2K2	25A[1]	200-240 V	type gG
3K0	25A[1]	200-240 V	type gG
3K7	35A[1]	200-240 V	type gG
5K5	50A[1]	200-240 V	type gG
7K5	63A[1]	200-240 V	type gG
11K	63A[1]	200-240 V	type gG
15K	80A[1]	200-240 V	type gG
18K5	125A[1]	200-240 V	type gG
22K	125A[1]	200-240 V	type gG
30K	160A[1]	200-240 V	type gG
37K	200A[1]	200-240 V	type aR
45K	250A[1]	200-240 V	type aR
380-480 V			
K37-1K5	10A[1]	380-480 V	type gG
2K2-4K0	20A[1]	380-480 V	type gG
5K5-7K5	32A[1]	380-480 V	type gG
11K	63A[1]	380-480 V	type gG
15K	63A[1]	380-480 V	type gG
18K	63A[1]	380-480 V	type gG
22K	63A[1]	380-480 V	type gG
30K	80A[1]	380-480 V	type gG
37K	100A[1]	380-480 V	type gG
45K	125A[1]	380-480 V	type gG
55K	160A[1]	380-480 V	type gG
75K	250A[1]	380-480 V	type aR
90K	250A[1]	380-480 V	type aR

Table 5.2: Non UL fuses 200 V to 480 V

1) Max. fuses - see national/international regulations for selecting an applicable fuse size.

UL Compliance

Frequency converter	Bussmann	Bussmann	Bussmann	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
200-240 V							
Type	Type RK1	Type J	Type T	Type RK1	Type RK1	Type CC	Type RK1
K25-1K1	KTN-R10	JKS-10	JJN-10	5017906-010	KLN-R10	ATM-R10	A2K-10R
1K5	KTN-R15	JKS-15	JJN-15	5017906-015	KLN-R15	ATM-R15	A2K-15R
2K2	KTN-R20	JKS-20	JJN-20	5012406-020	KLN-R20	ATM-R20	A2K-20R
3K0	KTN-R25	JKS-25	JJN-25	5012406-025	KLN-R25	ATM-R25	A2K-25R
3K7	KTN-R30	JKS-30	JJN-30	5012406-030	KLN-R30	ATM-R30	A2K-30R
5K5	KTN-R50	JKS-50	JJN-50	5012406-050	KLN-R50	-	A2K-50R
7K5	KTN-R50	JKS-60	JJN-60	5012406-050	KLN-R60	-	A2K-50R
11K	KTN-R60	JKS-60	JJN-60	5014006-063	KLN-R60		A2K-60R
15K	KTN-R80	JKS-80	JJN-80	5014006-080	KLN-R80		A2K-80R
18K5	KTN-R125	JKS-150	JJN-125	2028220-125	KLN-R125		A2K-125R
22K	KTN-R125	JKS-150	JJN-125	2028220-125	KLN-R125		A2K-125R
30K	FWX-150	-	-	2028220-150	L25S-150		A25X-150
37K	FWX-200	-	-	2028220-200	L25S-200		A25X-200
45K	FWX-250	-	-	2028220-250	L25S-250		A25X-250

Table 5.3: UL fuses 200 - 240 V

Frequency converter	Bussmann	Bussmann	Bussmann	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
380-480 V, 525-600 V							
kW	Type RK1	Type J	Type T	Type RK1	Type RK1	Type CC	Type RK1
K37-1K1	KTS-R6	JKS-6	JJS-6	5017906-006	KLS-R6	ATM-R6	A6K-6R
1K5-2K2	KTS-R10	JKS-10	JJS-10	5017906-010	KLS-R10	ATM-R10	A6K-10R
3K0	KTS-R15	JKS-15	JJS-15	5017906-016	KLS-R16	ATM-R16	A6K-16R
4K0	KTS-R20	JKS-20	JJS-20	5017906-020	KLS-R20	ATM-R20	A6K-20R
5K5	KTS-R25	JKS-25	JJS-25	5017906-025	KLS-R25	ATM-R25	A6K-25R
7K5	KTS-R30	JKS-30	JJS-30	5012406-032	KLS-R30	ATM-R30	A6K-30R
11K	KTS-R40	JKS-40	JJS-40	5014006-040	KLS-R40	-	A6K-40R
15K	KTS-R40	JKS-40	JJS-40	5014006-040	KLS-R40	-	A6K-40R
18K	KTS-R50	JKS-50	JJS-50	5014006-050	KLS-R50	-	A6K-50R
22K	KTS-R60	JKS-60	JJS-60	5014006-063	KLS-R60	-	A6K-60R
30K	KTS-R80	JKS-80	JJS-80	2028220-100	KLS-R80	-	A6K-80R
37K	KTS-R100	JKS-100	JJS-100	2028220-125	KLS-R100		A6K-100R
45K	KTS-R125	JKS-150	JJS-150	2028220-125	KLS-R125		A6K-125R
55K	KTS-R150	JKS-150	JJS-150	2028220-160	KLS-R150		A6K-150R
75K	FWH-220	-	-	2028220-200	L50S-225		A50-P225
90K	FWH-250	-	-	2028220-250	L50S-250		A50-P250

Table 5.4: UL fuses 380 - 600 V

KTS-fuses from Bussmann may substitute KTN for 240 V frequency converters.

FWH-fuses from Bussmann may substitute FWX for 240 V frequency converters.

KLSR fuses from LITTEL FUSE may substitute KLNR fuses for 240 V frequency converters.

L50S fuses from LITTEL FUSE may substitute L50S fuses for 240 V frequency converters.

A6KR fuses from FERRAZ SHAWMUT may substitute A2KR for 240 V frequency converters.

A50X fuses from FERRAZ SHAWMUT may substitute A25X for 240 V frequency converters.

5.1.4. Earthing and IT mains

The earth connection cable cross section must be at least 10 mm² or 2 rated mains wires terminated separately according to *EN 50178 or IEC 61800-5-1* unless national regulations specify differently. Always comply with national and local regulations on cable cross-sections.

The mains is connected to the main disconnect switch if this is included.

NB!
Check that mains voltage corresponds to the mains voltage of the frequency converter name plate.

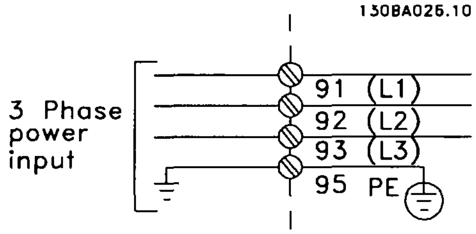


Illustration 5.5: Terminals for mains and earthing.

IT Mains

Do not connect 400 V frequency converters with RFI-filters to mains supplies with a voltage between phase and earth of more than 440 V.

For IT mains and delta earth (grounded leg), mains voltage may exceed 440 V between phase and earth.

5.1.5. Mains wiring overview

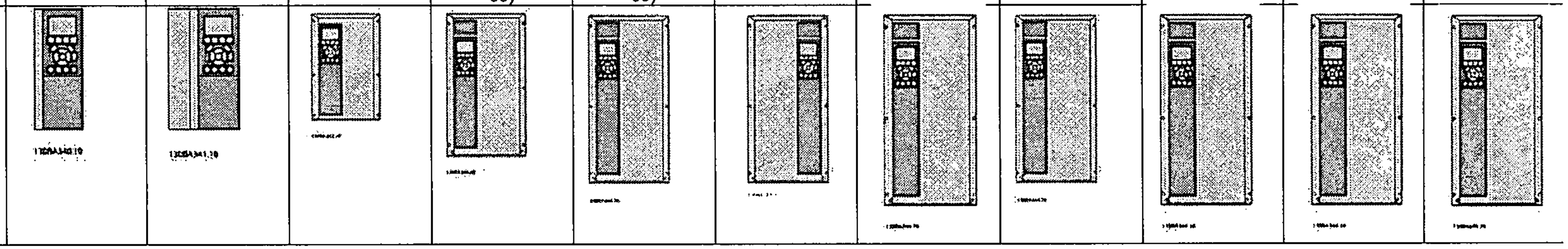
Enclosure:	A2 (IP 20/IP 21)	A3 (IP 20/IP 21)	A5 (IP 55/IP 66)	B1 (IP 21/IP 55/IP 66)	B2 (IP 21/IP 55/IP 66)	B3 (IP 20)	B4 (IP 20)	C1 (IP 21/IP 55/66)	C2 (IP 21/IP 55/66)	C3 (IP 20)	C4 (IP20)
											
Motor size (kW):											
200-240 V	0.25-3.0	3.7	1.1-3.7	5.5-11	15	5.5-11	15-18.5	18.5-30	37-45	22-30	37-45
380-480 V	0.37-4.0	5.5-7.5	1.1-7.5	11-18.5	22-30	11-18.5	22-37	37-55	75-90	45-55	75-90
525-600 V	'	1.1-7.5	1.1-7.5	11-18.5	22-30	11-18.5	22-37	37-55	75-90	45-55	75-90
Goto:	**5.1.6**		**5.1.7**	**5.1.8**			**5.1.9**			**5.1.10**	

Table 5.5: Mains wiring table.

5

5.1.6. Mains connection for A2 and A3

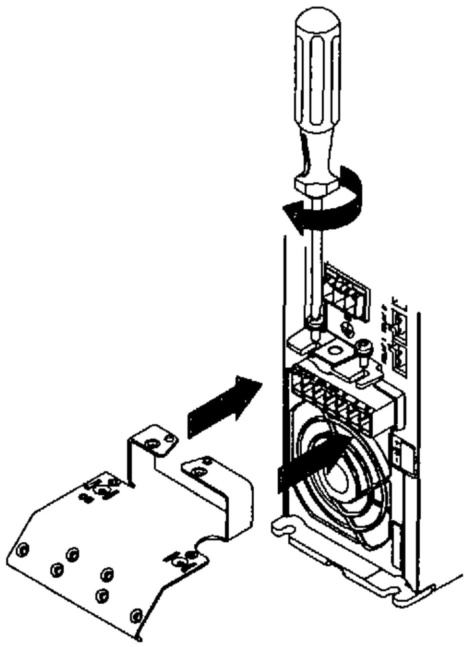


Illustration 5.6: First mount the two screws on the mounting plate, slide it into place and tighten fully.

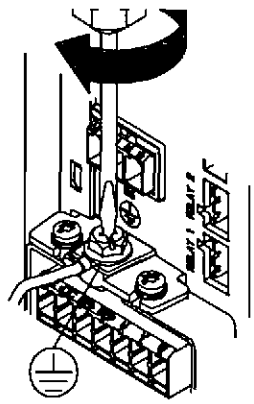


Illustration 5.7: When mounting cables, first mount and tighten earth cable.

The earth connection cable cross section must be at least 10 mm² or 2 rated mains wires terminated separately according to *EN 50178/ IEC 61800-5-1*.

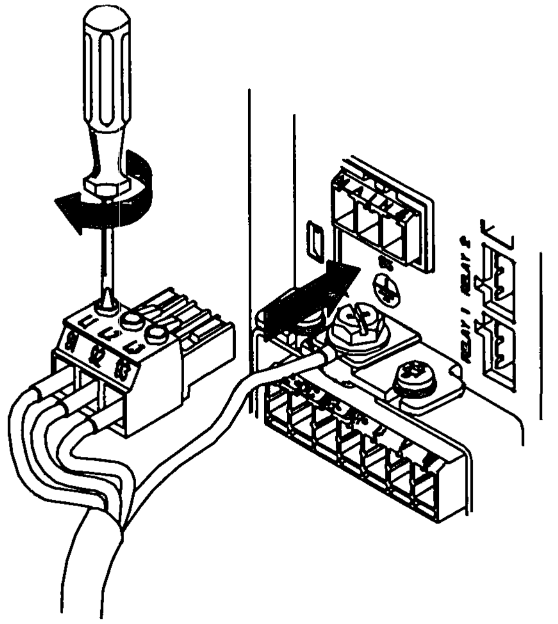


Illustration 5.8: Then mount mains plug and tighten wires.

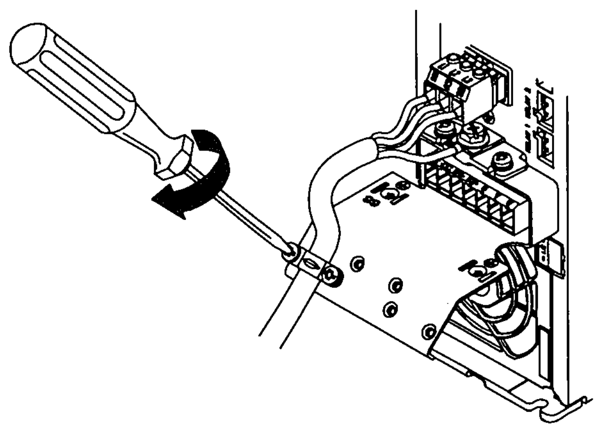


Illustration 5.9: Finally tighten support bracket on mains wires.

5.1.7. Mains connection for A5

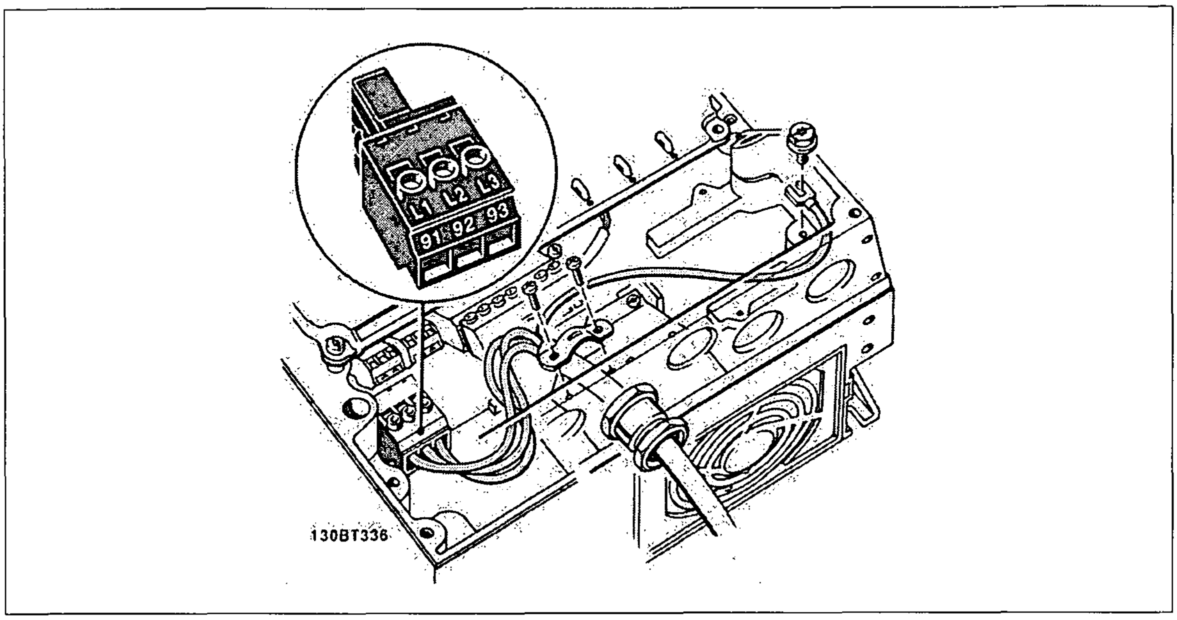


Illustration 5.10: How to connect to mains and earthing without mains disconnect switch. Note that a cable clamp is used.

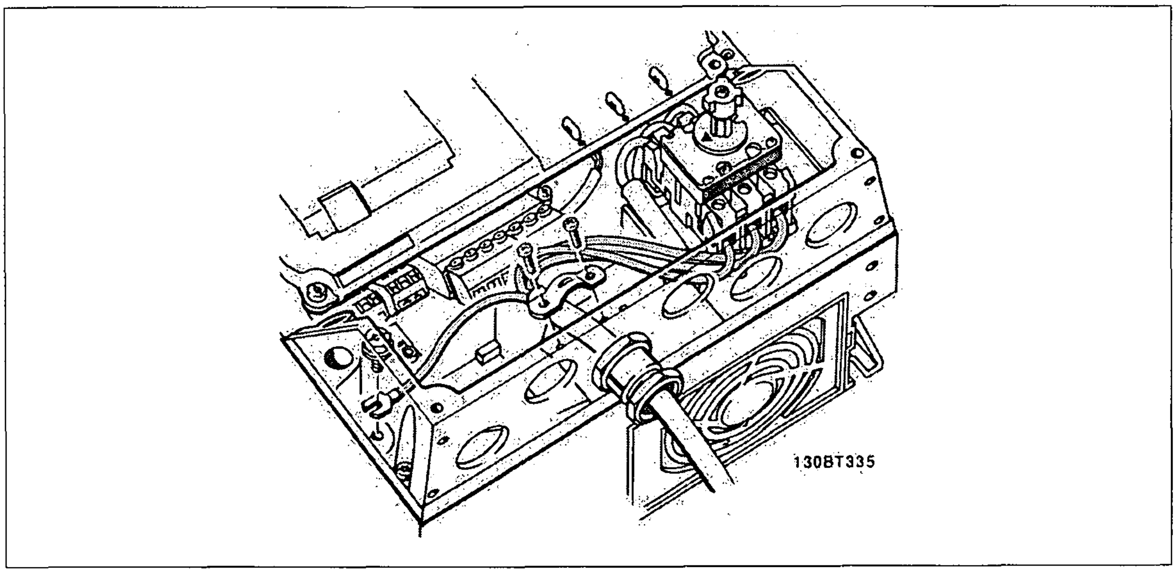


Illustration 5.11: How to connect to mains and earthing with mains disconnect switch.

5.1.8. Mains connection for B1, B2 and B3

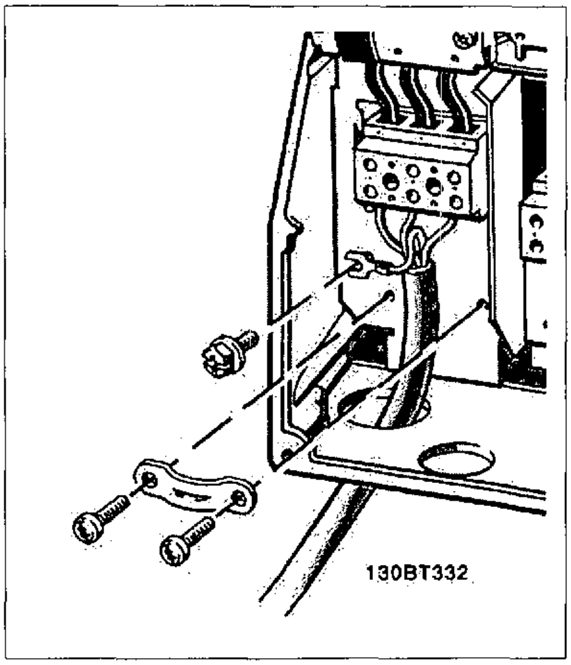


Illustration 5.12: How to connect to mains and earthing for B1 and B2

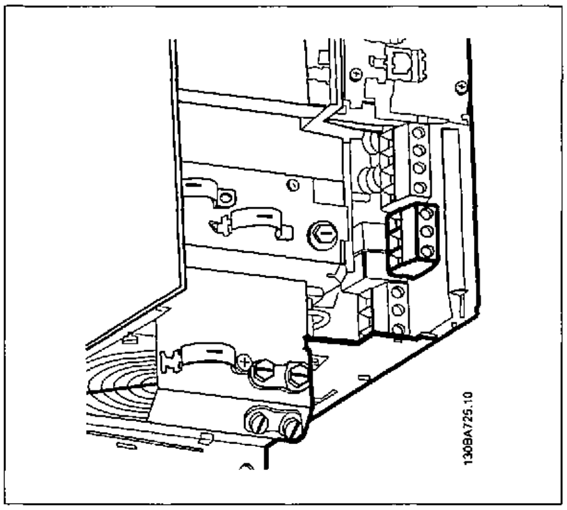


Illustration 5.13: How to connect to mains and earthing for B3 without RFI.

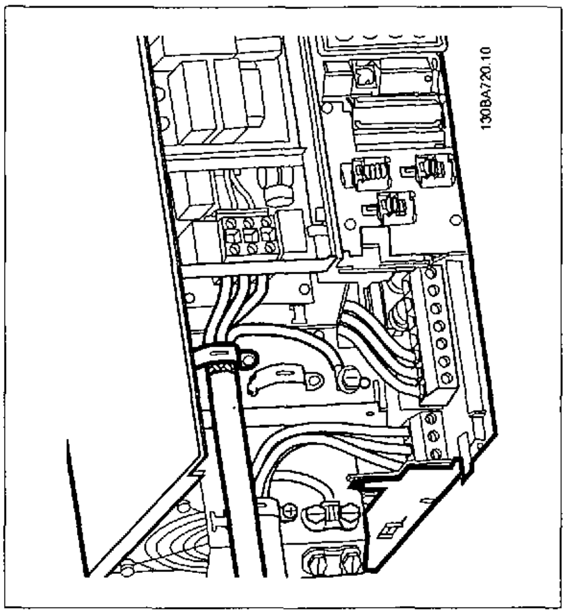


Illustration 5.14: How to connect to mains and earthing for B3 with RFI.

NB!
For correct cable dimensions please see the section General Specifications at the back of this manual.

5.1.9. Mains connection for B4, C1 and C2

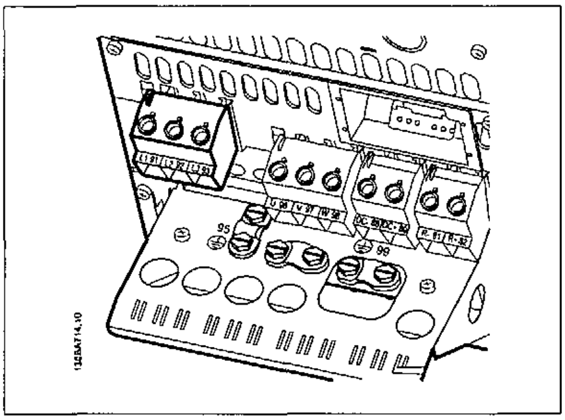


Illustration 5.15: How to connect to mains and earthing for B4.

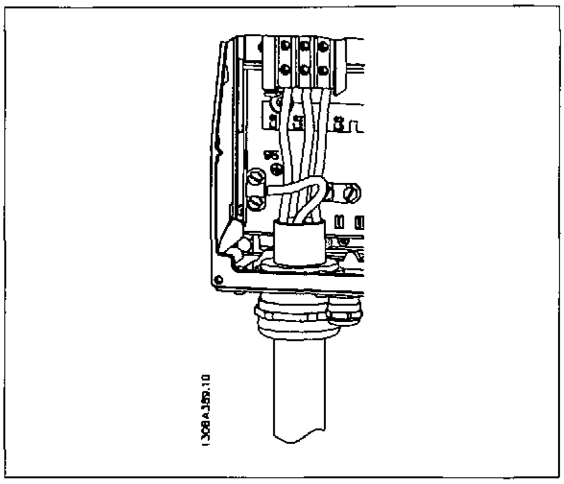


Illustration 5.16: How to connect to mains and earthing for C1 and C2.

5.1.10. Mains connection for C3 and C4

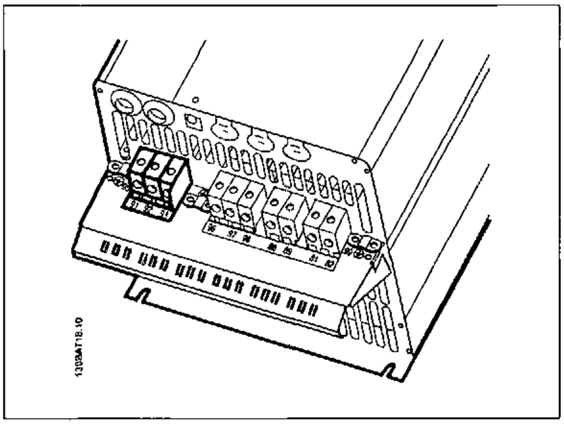


Illustration 5.17: How to connect C3 to mains and earthing.

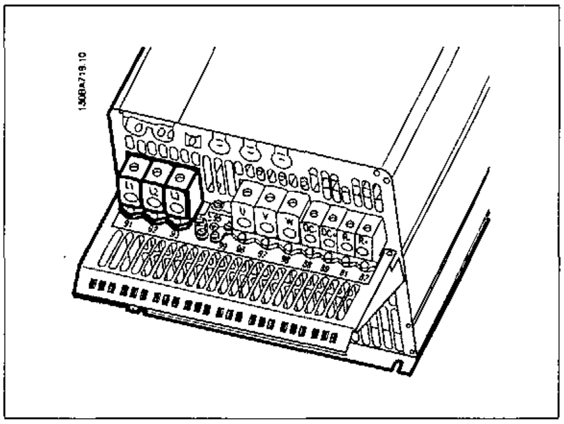


Illustration 5.18: How to connect C4 to mains and earthing.

5.1.11. How to connect motor - foreword

See section *General Specifications* for correct dimensioning of motor cable cross-section and length.

- Use a screened/armoured motor cable to comply with EMC emission specifications (or install the cable in metal conduit).
- Keep the motor cable as short as possible to reduce the noise level and leakage currents.
- Connect the motor cable screen/armour to both the decoupling plate of the frequency converter and to the metal of the motor. (Same applies to both ends of metal conduit if used instead of screen.)
- Make the screen connections with the largest possible surface area (cable clamp or by using an EMC cable gland). This is done by using the supplied installation devices in the frequency converter.
- Avoid terminating the screen by twisting the ends (pigtails), as this will spoil high frequency screening effects.
- If it is necessary to break the continuity of the screen to install a motor isolator or motor relay, the continuity must be maintained with the lowest possible HF impedance.

Cable length and cross-section

The frequency converter has been tested with a given length of cable and a given cross-section of that cable. If the cross-section is increased, the cable capacitance - and thus the leakage current - may increase, and the cable length must be reduced correspondingly.

Switching frequency

When frequency converters are used together with sine wave filters to reduce the acoustic noise from a motor, the switching frequency must be set according to the sine wave filter instruction in par. 14-01 Switching *Frequency*.

Precautions while using Aluminium conductors

Aluminium conductors are not recommended for cable cross sections below 35 mm². Terminals can accept aluminium conductors but the conductor surface has to be clean and the oxidation must be removed and sealed by neutral acid free Vaseline grease before the conductor is connected.

Furthermore, the terminal screw must be retightened after two days due to the softness of the aluminium. It is crucial to ensure the connection makes a gas tight joint, otherwise the aluminium surface will oxidize again.

All types of three-phase asynchronous standard motors can be connected to the frequency converter. Normally, small motors are star-connected (230/400 V, D/Y). Large motors are delta-connected (400/690 V, D/Y). Refer to the motor name plate for correct connection mode and voltage.

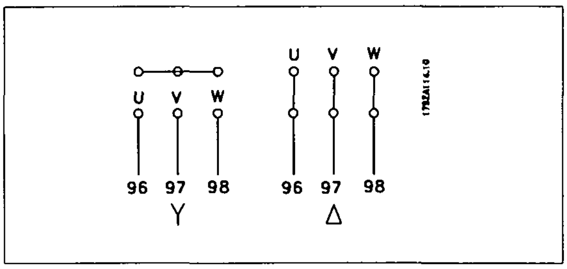


Illustration 5.19: Terminals for motor connection

NB!

In motors without phase insulation paper or other insulation reinforcement suitable for operation with voltage supply (such as a frequency converter), fit a sine-wave filter on the output of the frequency converter. (Motors that comply with IEC 60034-17 do not require an Sine-wave filter).

No.	96	97	98	Motor voltage 0-100% of mains voltage.
	U	V	W	3 cables out of motor
	U1	V1	W1	6 cables out of motor, Delta-connected
	W2	U2	V2	
	U1	V1	W1	6 cables out of motor, Star-connected
				U2, V2, W2 to be interconnected separately (optional terminal block)
No.	99			Earth connection
	PE			

Table 5.6: 3 and 6 cable motor connection.

5.1.12. Motor wiring overview

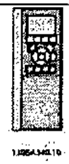
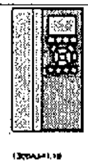
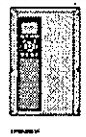
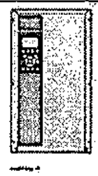
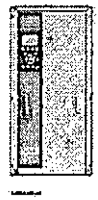
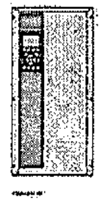
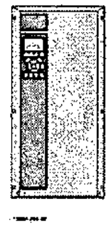
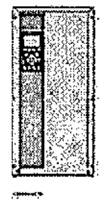
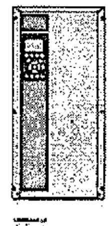
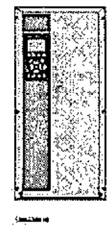
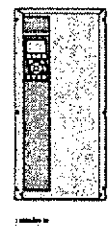
Enclosure:	A2 (IP 20/IP 21)	A3 (IP 20/IP 21)	A5 (IP 55/IP 66)	B1 (IP 21/IP 55/ IP 66)	B2 (IP 21/IP 55/ IP 66)	B3 (IP 20)	B4 (IP 20)	C1 (IP 21/IP 55/66)	C2 (IP 21/IP 55/66)	C3 (IP 20)	C4 (IP20)
											
Motor size (kW):											
200-240 V	0.25-3.0	3.7	1.1-3.7	5.5-11	15	5.5-11	15-18.5	18.5-30	37-45	22-30	37-45
380-480 V	0.37-4.0	5.5-7.5	1.1-7.5	11-18.5	22-30	11-18.5	22-37	37-55	75-90	45-55	75-90
525-600 V		1.1-7.5	1.1-7.5	11-18.5	22-30	11-18.5	22-37	37-55	75-90	45-55	75-90
Goto:	**5.1.13**		**5.1.14**	**5.1.15**		**5.1.16**		**5.1.17**		**5.1.18**	

Table 5.7: Motor wiring table.

5.1.13. Motor connection for A2 and A3

Follow these drawings step by step for connecting the motor to the frequency converter.

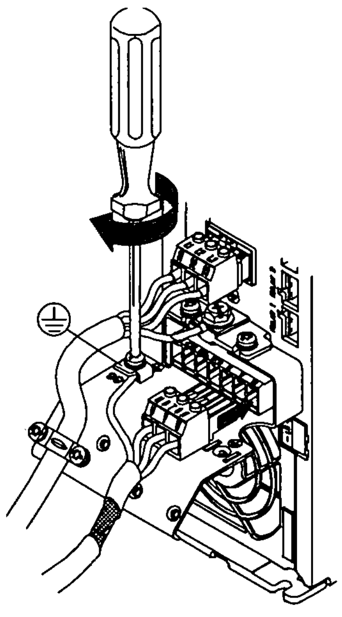


Illustration 5.20: First terminate the motor earth, then place motor U, V and W wires in plug and tighten.

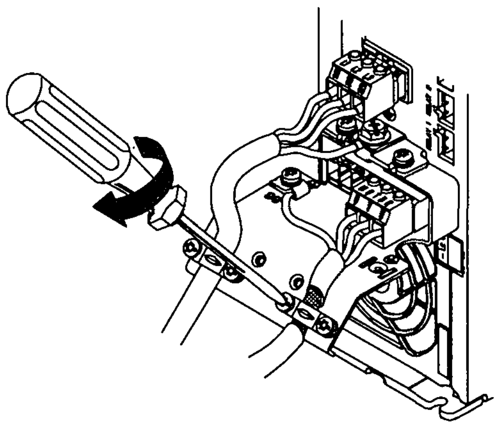


Illustration 5.21: Mount cable clamp to ensure 360 degree connection between chassis and screen, note the outer insulation of the motor cable is removed under the clamp.

5

5.1.14. Motor connection for A5

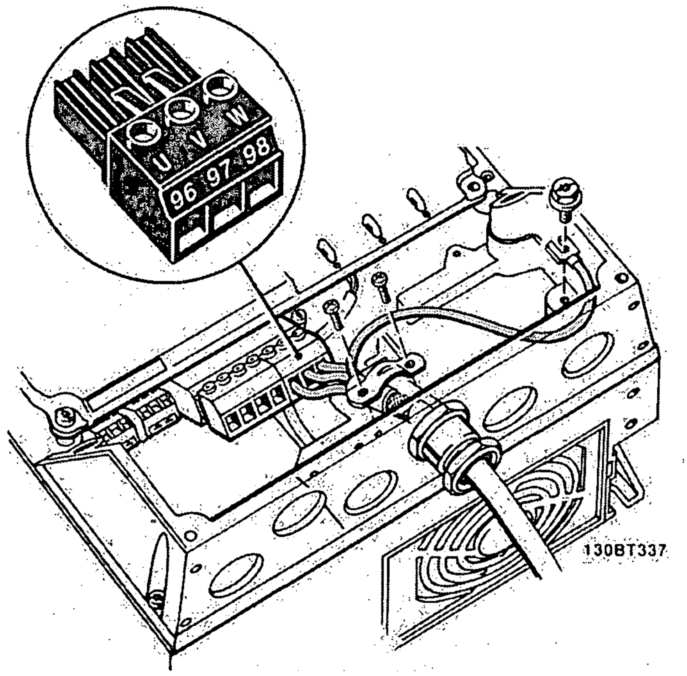


Illustration 5.22: First terminate the motor earth, then place motor U, V and W wires in terminal and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

5.1.15. Motor connection for B1 and B2

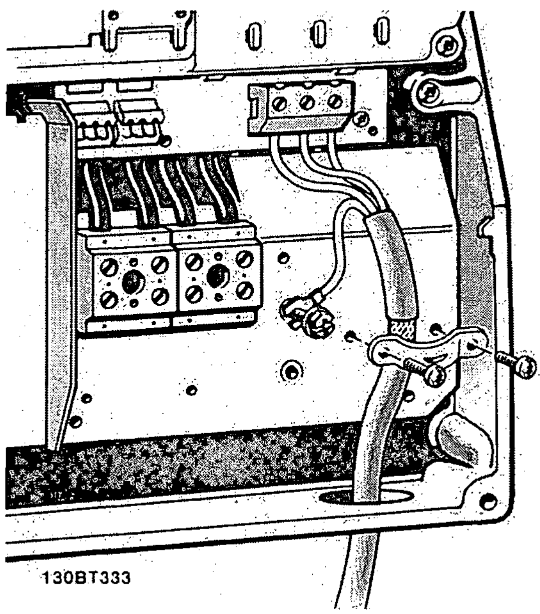


Illustration 5.23: First terminate the motor earth, then Place motor U, V and W wires in terminal and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

5.1.16. Motor connection for B3 and B4

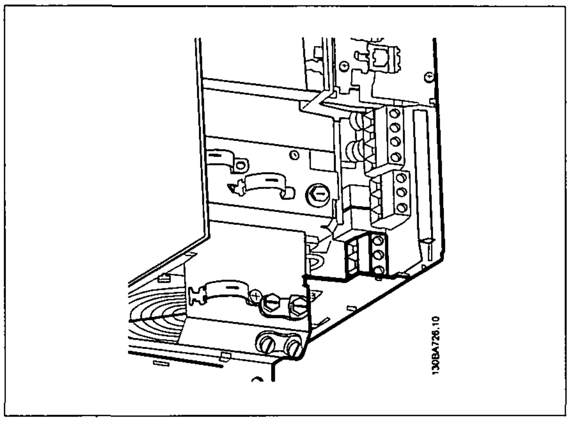


Illustration 5.24: First terminate the motor earth, then Place motor U, V and W wires in terminal and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

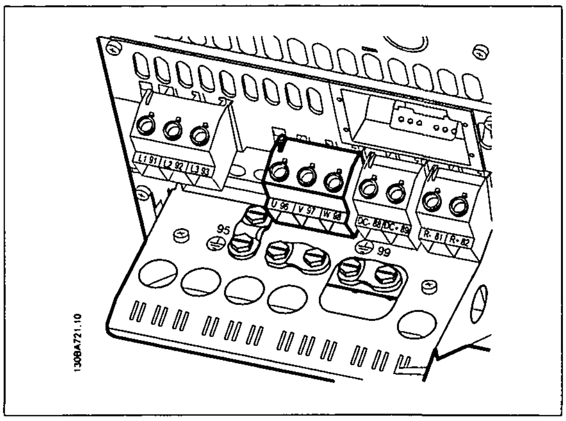


Illustration 5.25: First terminate the motor earth, then Place motor U, V and W wires in terminal and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

5.1.17. Motor connection for C1 and C2

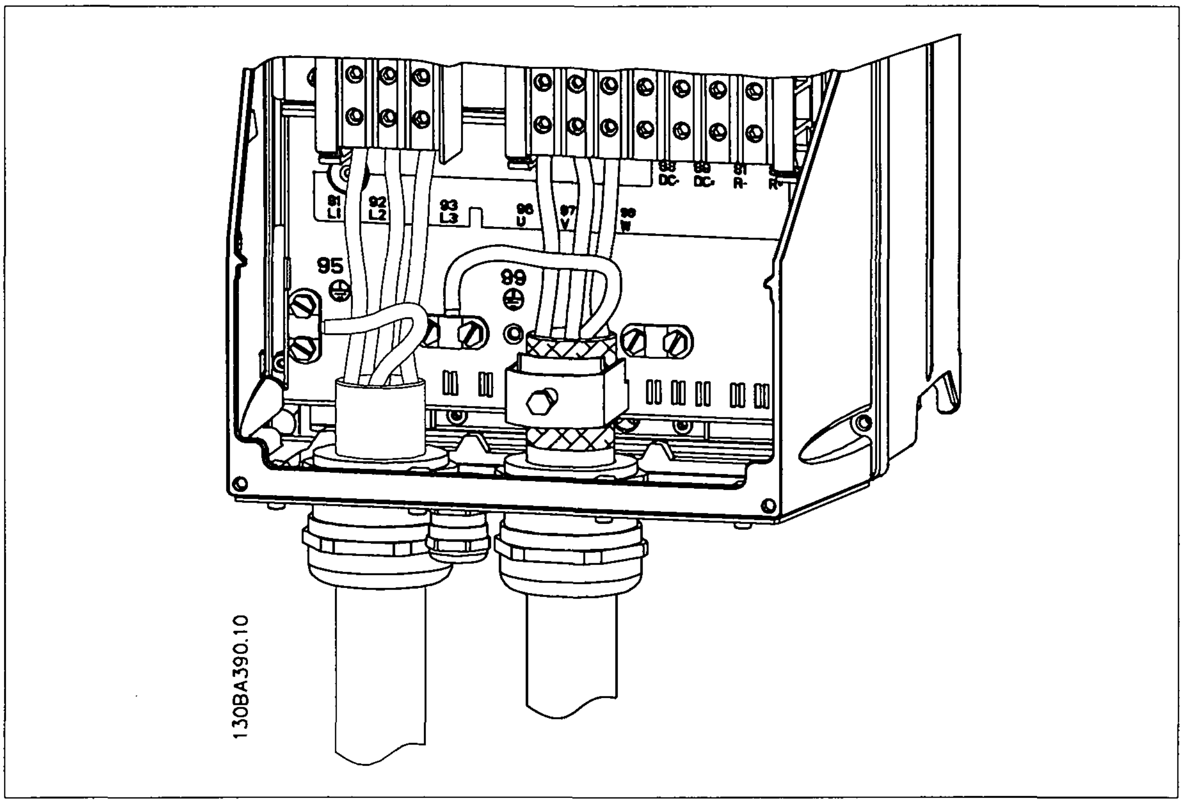


Illustration 5.26: First terminate the motor earth, then Place motor U, V and W wires in terminal and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

5

5.1.18. Motor connection for C3 and C4

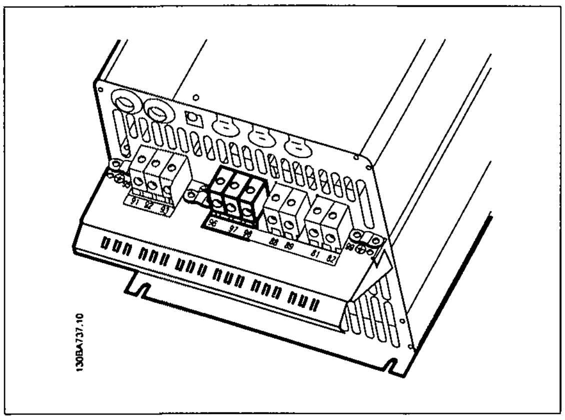


Illustration 5.27: First terminate the motor earth, then Place motor U, V and W wires in terminal and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

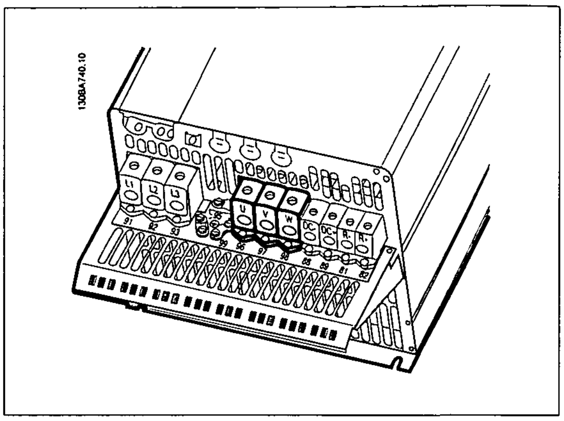


Illustration 5.28: First terminate the motor earth, then Place motor U, V and W wires in terminal and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

5.1.19. DC bus connection

The DC bus terminal is used for DC back-up, with the intermediate circuit being supplied from an external source.

Terminal numbers used: 88, 89

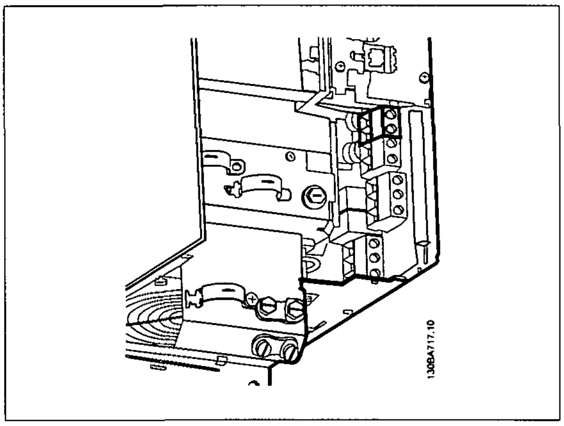


Illustration 5.29: DC bus connections for enclosure B3.

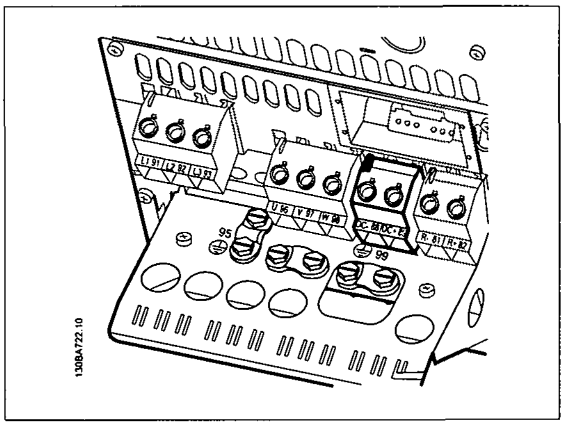


Illustration 5.30: DC bus connections for enclosure B4.

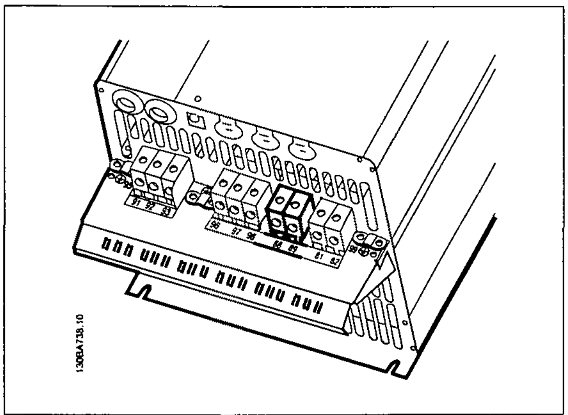


Illustration 5.31: DC bus connections for enclosure C3.

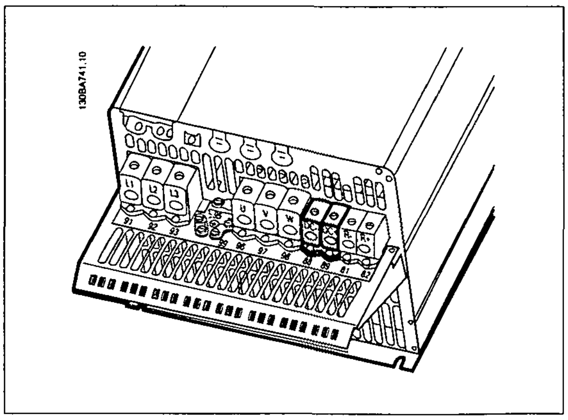


Illustration 5.32: DC bus connections for enclosure enclosure C4.

Please contact Danfoss if you require further information.

5.1.20. Brake Connection Option

The connection cable to the brake resistor must be screened/armoured.

Enclosure	A+B+C+D+F	A+B+C+D+F
Brake resistor	81	82
Terminals	R-	R+

NB!
Dynamic brake calls for extra equipment and safety considerations. For further information, please contact Danfoss.

1. Use cable clamps to connect the screen to the metal cabinet of the frequency converter and to the decoupling plate of the brake resistor.
2. Dimension the cross-section of the brake cable to match the brake current.

NB!
Voltages up to 975 V DC (@ 600 V AC) may occur between the terminals.

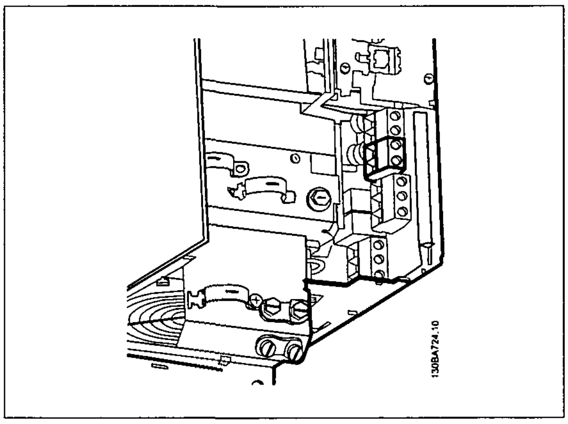


Illustration 5.33: Brake connection terminal for B3.

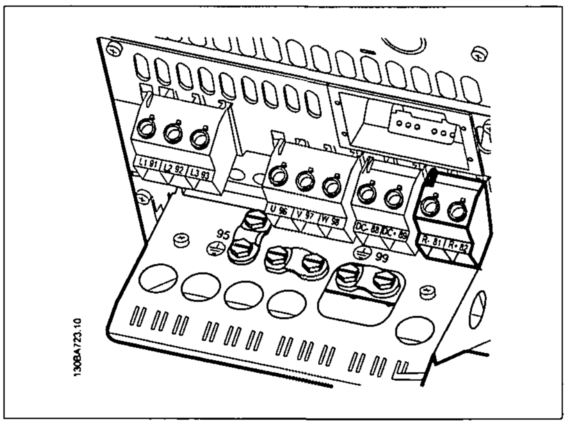


Illustration 5.34: Brake connection terminal for B4.

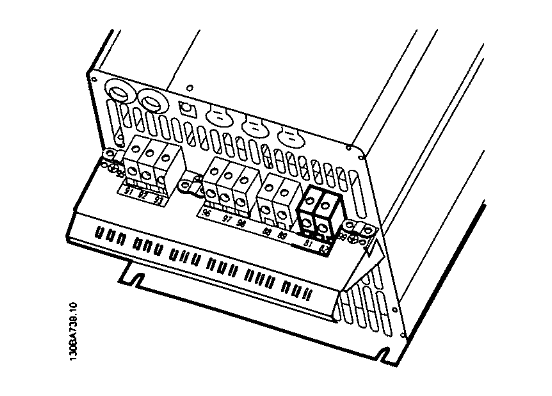


Illustration 5.35: Brake connection terminal for C3.

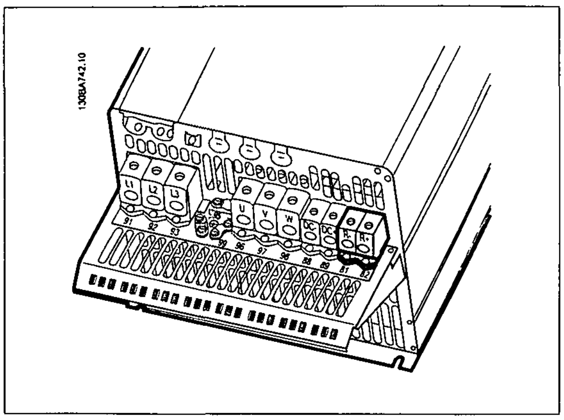


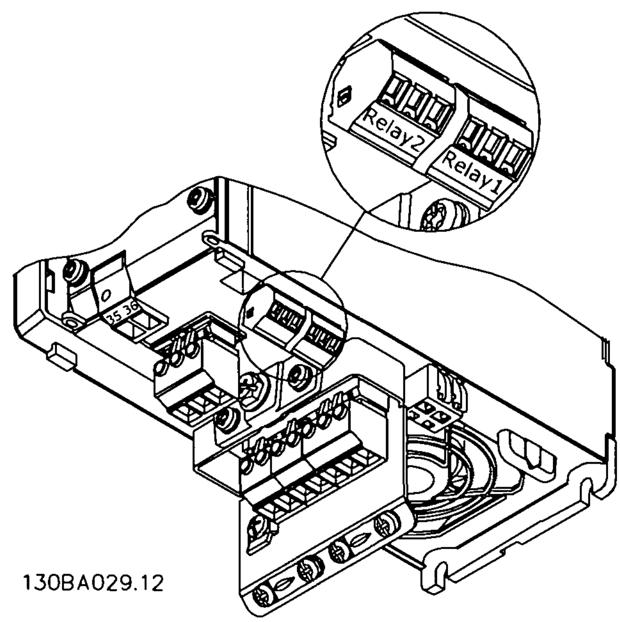
Illustration 5.36: Brake connection terminal for C4.

NB!
If a short circuit in the brake IGBT occurs, prevent power dissipation in the brake resistor by using a mains switch or contactor to disconnect the mains for the frequency converter. Only the frequency converter shall control the contactor.

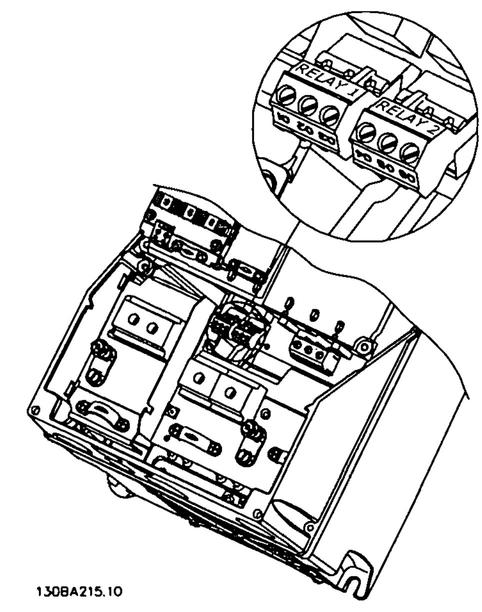
5.1.21. Relay Connection

To set relay output, see par. group 5-4* Relays.

No.		
	01 - 02	make (normally open)
	01 - 03	break (normally closed)
	04 - 05	make (normally open)
	04 - 06	break (normally closed)



Terminals for relay connection
(A2 and A3 enclosures).



Terminals for relay connection
(A5, B1 and B2 enclosures).

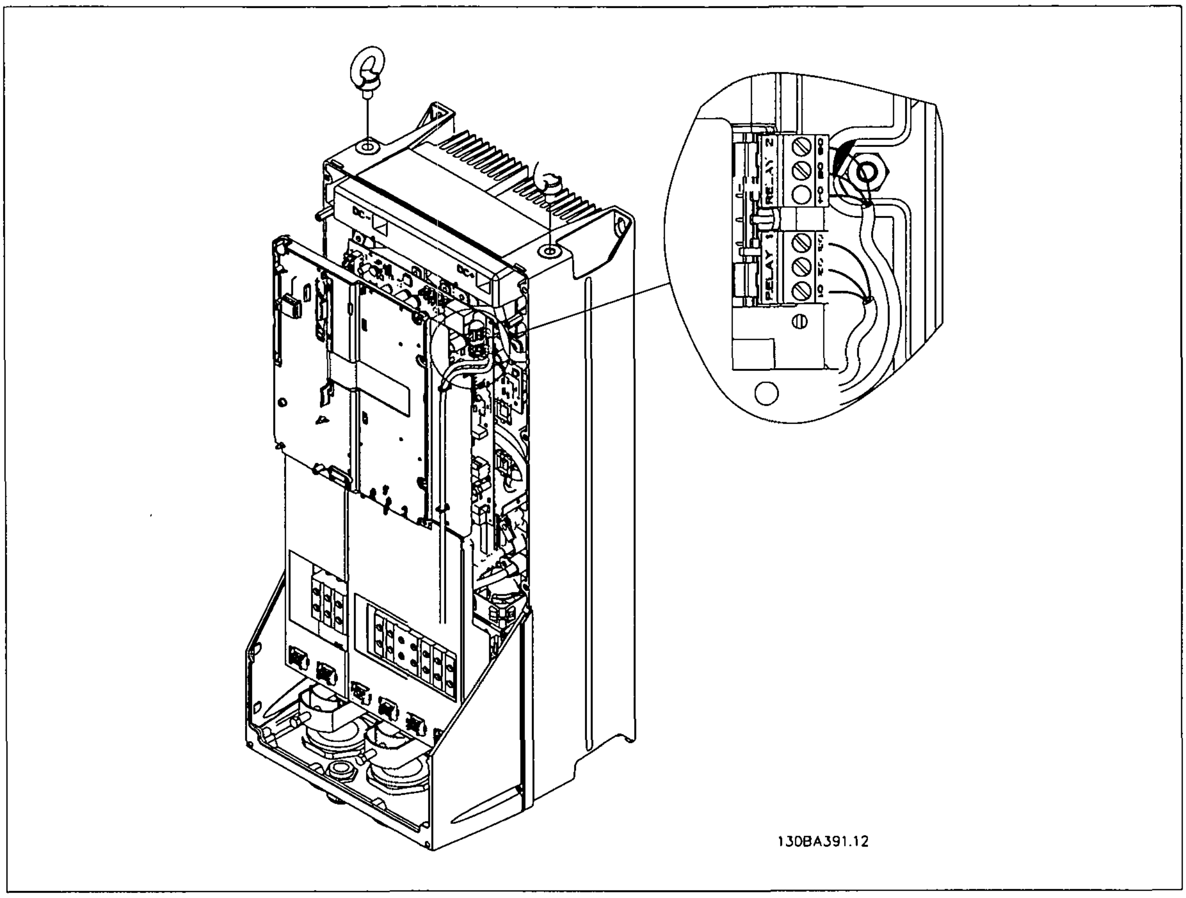


Illustration 5.37: Terminals for relay connection (C1 and C2 enclosures).

The relay connections are shown in the cut-out with relay plugs (from the Accessory Bag) fitted.

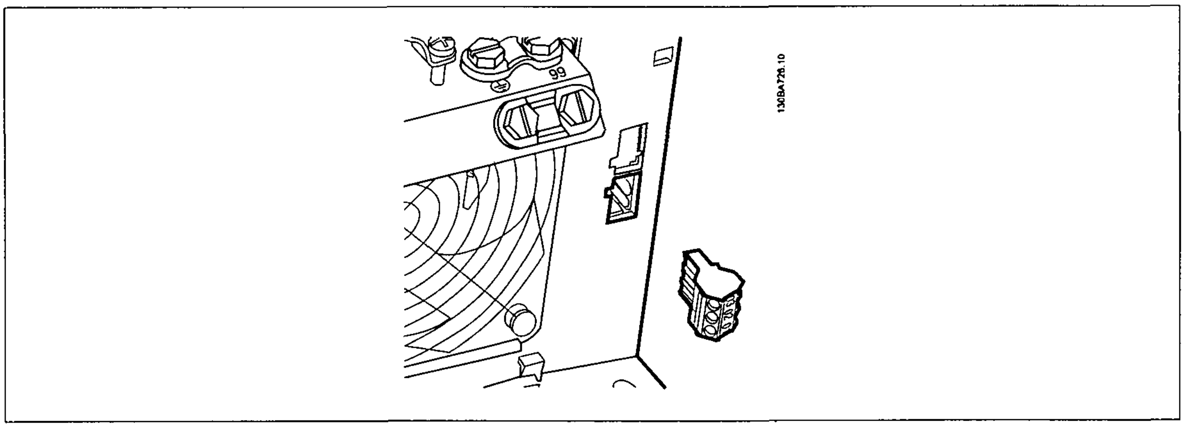


Illustration 5.38: Terminals for relay connections for B3. Only one knock-out is fitted from the factory.

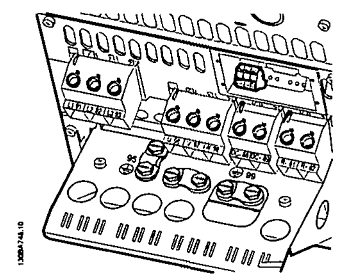


Illustration 5.39: Terminals for relay connections for B4.

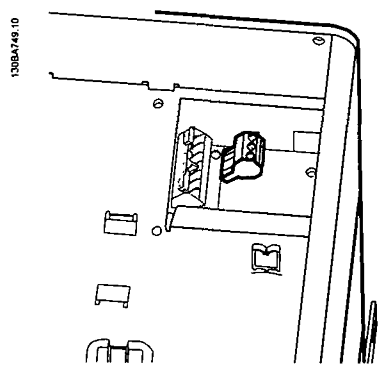


Illustration 5.40: Terminals for relay connections for C3 and C4. Located in the upper right corner of the frequency converter.

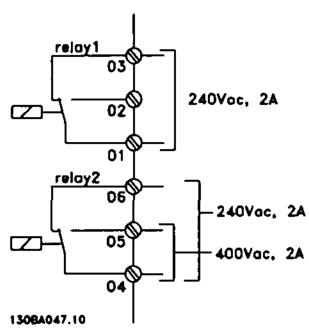
5.1.22. Relay Output

Relay 1

- Terminal 01: common
- Terminal 02: normal open 240 V AC
- Terminal 03: normal closed 240 V AC

Relay 2

- Terminal 04: common
- Terminal 05: normal open 400 V AC
- Terminal 06: normal closed 240 V AC



Relay 1 and relay 2 are programmed in par. 5-40 Function *Relay*, par. 5-41 On *Delay, Relay*, and par. 5-42 Off *Delay, Relay*.

Additional relay outputs by using option module MCB 105.

5.1.23. Wiring Example and Testing

The following section describes how to terminate control wires and how to access them. For an explanation of the function, programming and wiring of the control terminals, please see chapter, *How to programme the frequency converter*.

5.1.24. Access to Control Terminals

All terminals to the control cables are located underneath the terminal cover on the front of the frequency converter. Remove the terminal cover with a screwdriver.

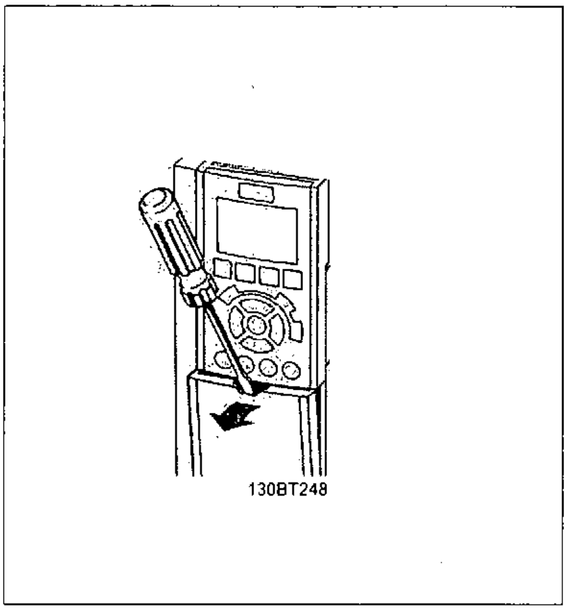


Illustration 5.41: Access to control terminals for A2, A3, B3, B4, C3 and C4 enclosures

Remove front-cover to access control terminals. When replacing the front-cover, please ensure proper fastening by applying a torque of 2 Nm.

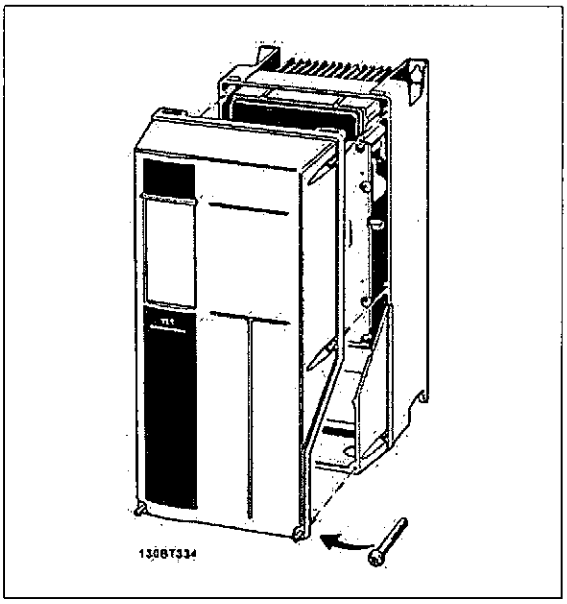


Illustration 5.42: Access to control terminals for A5, B1, B2, C1 and C2 enclosures

5.1.25. Control Terminals

Drawing reference numbers:

1. 10 pole plug digital I/O.
2. 3 pole plug RS-485 Bus.
3. 6 pole analog I/O.
4. USB connection.

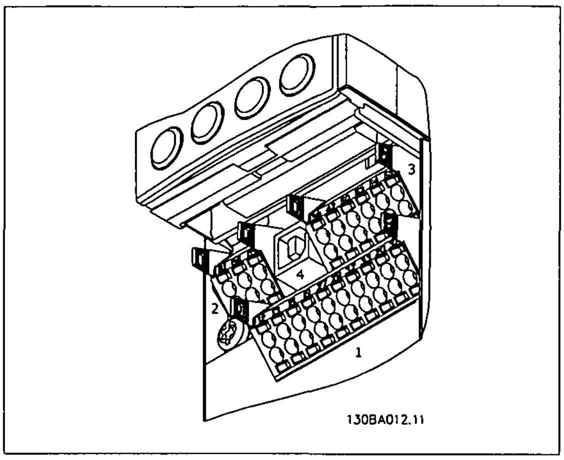


Illustration 5.43: Control terminals (all enclosures)

5.1.26. Control Cable Clamp

1. Use a clamp from the accessory bag to connect screen to frequency converter decoupling plate for control cables.

See section entitled *Earthing of Screened/Armoured Control Cables* for the correct termination of control cables.

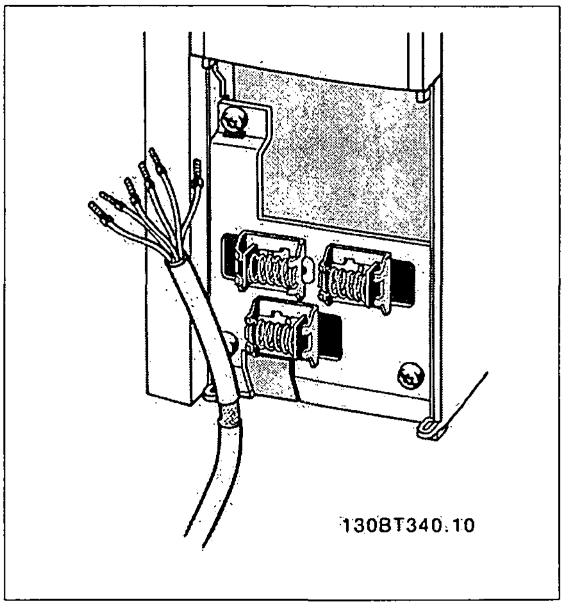


Illustration 5.44: Control cable clamp.

5.1.27. Electrical Installation and Control Cables

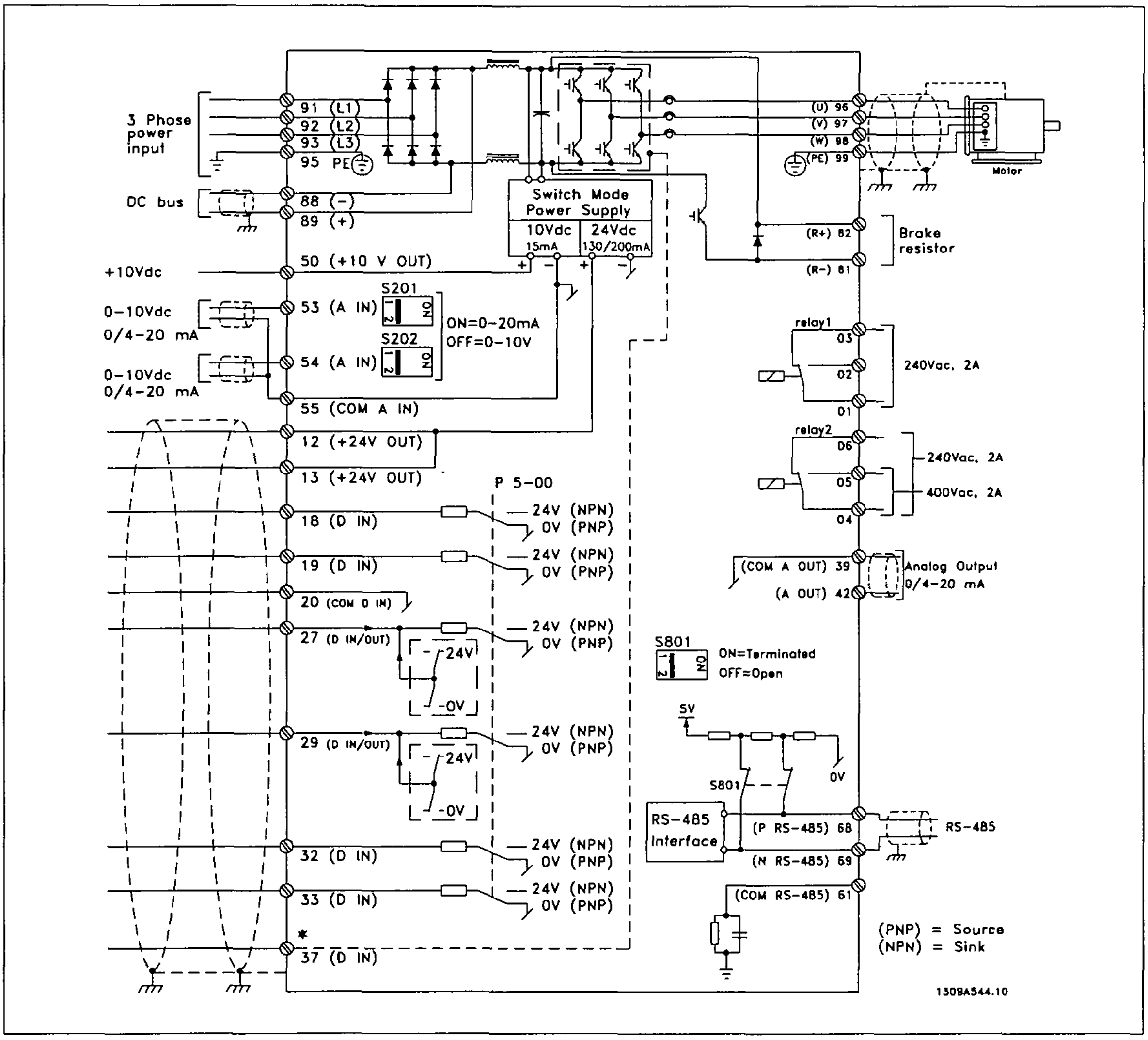


Illustration 5.45: Diagram showing all electrical terminals. (Terminal 37 present for units with Safe Stop Function only.)

Very long control cables and analog signals may, in rare cases and depending on installation, result in 50/60 Hz earth loops due to noise from mains supply cables.

If this occurs, break the screen or insert a 100 nF capacitor between screen and chassis.

NB!
The common of digital / analog inputs and outputs should be connected to separate common terminals 20, 39, and 55. This will avoid ground current interference among groups. For example, it avoids switching on digital inputs disturbing analog inputs.

NB!
Control cables must be screened/armoured.

5.1.28. How to Test Motor and Direction of Rotation.

Note that unintended motor start can occur, ensure no personnel or equipment is in danger!

Please follow these steps to test the motor connection and direction of rotation. Start with no power to the unit.

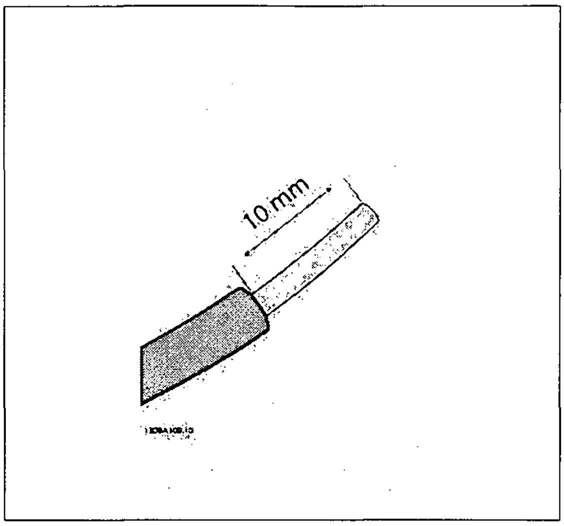


Illustration 5.46:

Step 1: First remove the insulation on both ends of a 50 to 70 mm piece of wire.

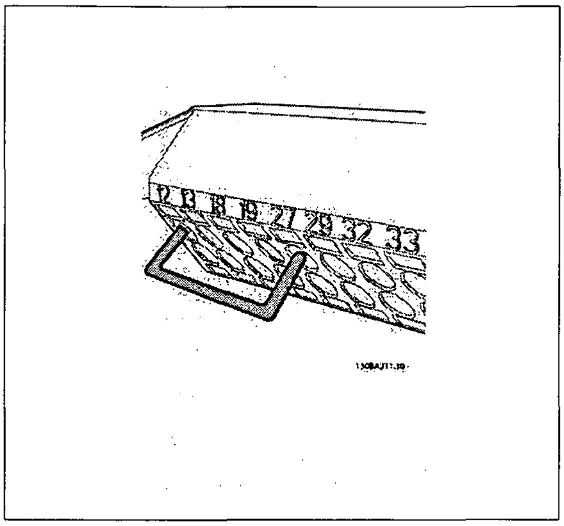


Illustration 5.48:

Step 3: Insert the other end in terminal 12 or 13. (Note: For units with Safe Stop function, the existing jumper between terminal 12 and 37 should not be removed for the unit to be able to run!)

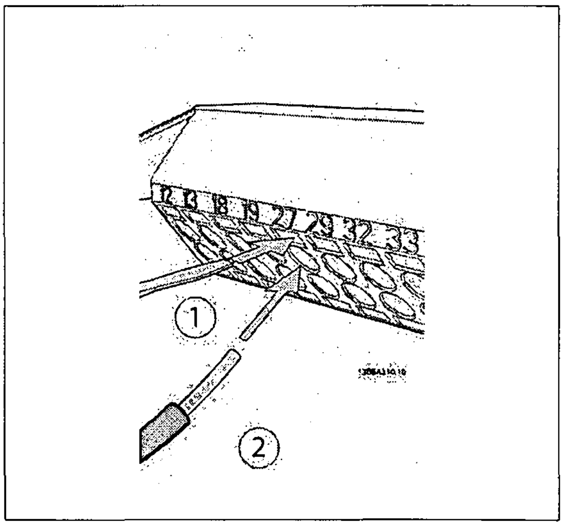


Illustration 5.47:

Step 2: Insert one end in terminal 27 using a suitable terminal screw-driver. (Note: For units with Safe Stop function, the existing jumper between terminal 12 and 37 should not be removed for the unit to be able to run!)

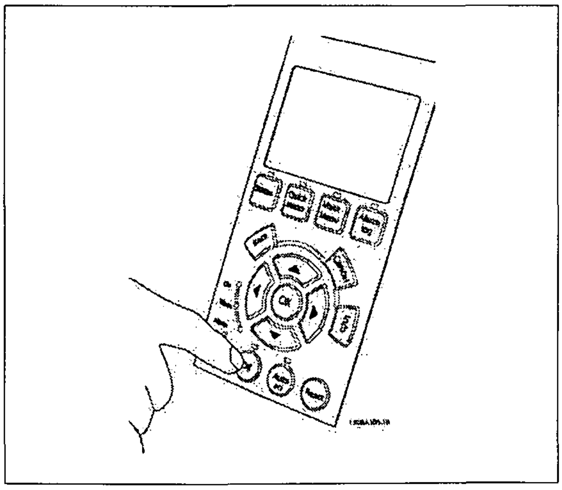


Illustration 5.49:

Step 4: Power-up the unit and press the [Off] button. In this state the motor should not rotate. Press [Off] to stop the motor at any time. Note the LED at the [OFF] button should be lit. If alarms or warnings are flashing, please see chapter 7 regarding these.

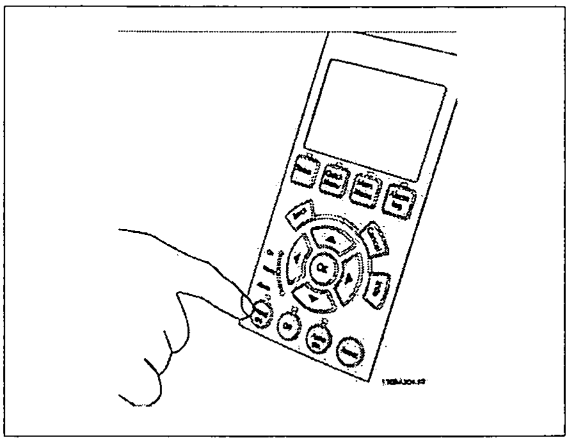


Illustration 5.50:

Step 5: By pressing the [Hand on] button, the LED above the button should be lit and the motor may rotate.

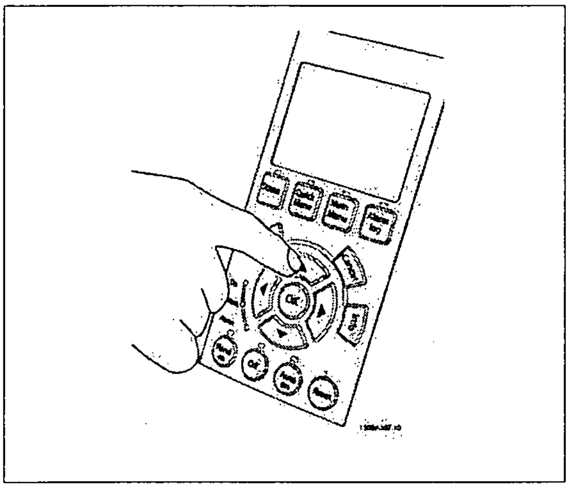


Illustration 5.51:

Step 6: The speed of the motor can be seen in the LCP. It can be adjusted by pushing the up ▲ and down ▼ arrow buttons.

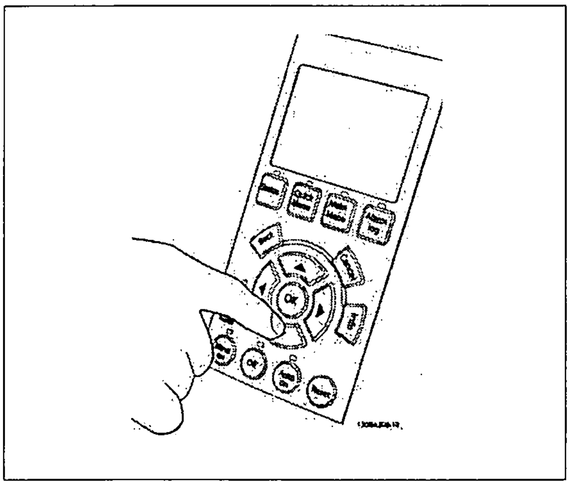


Illustration 5.52:

Step 7: To move the cursor, use the left ◂ and right ▸ arrow buttons. This enables changing the speed in larger increments.

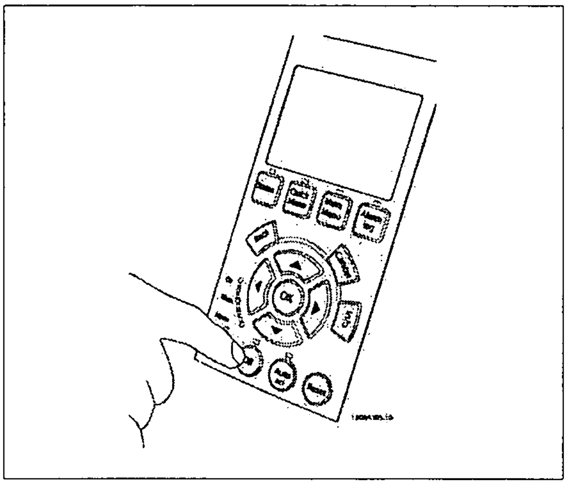


Illustration 5.53:

Step 8: Press the [Off] button to stop the motor again.

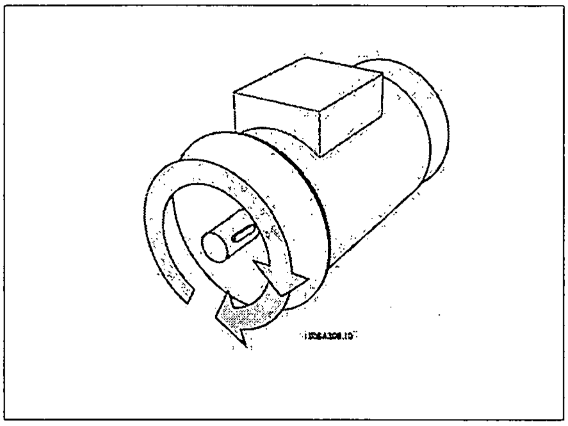


Illustration 5.54:

Step 9: Change two motor wires if the desired rotation of direction is not achieved.

> ⚠ Remove mains power from the frequency converter before changing motor wires.

5.1.29. Switches S201, S202, and S801

Switches S201 (AI 53) and S202 (AI 54) are used to select a current (0-20 mA) or a voltage (0 to 10 V) configuration of the analog input terminals 53 and 54 respectively.

Switch S801 (BUS TER.) can be used to enable termination on the RS-485 port (terminals 68 and 69).

Please note that the switches may be covered by an option, if fitted.

Default setting:

S201 (AI 53) = OFF (voltage input)

S202 (AI 54) = OFF (voltage input)

S801 (Bus termination) = OFF

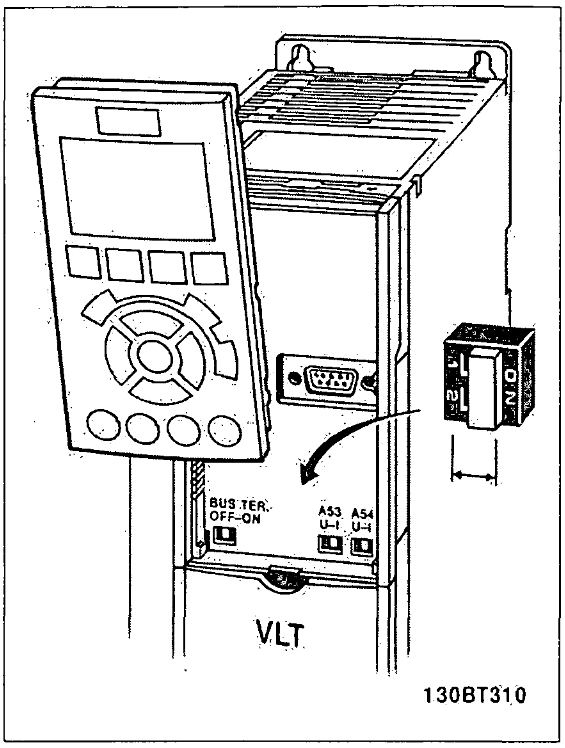


Illustration 5.55: Switches location.

5.2. Final optimization and test

5.2.1. Final optimization and test

To optimize motor shaft performance and optimize the frequency converter for the connected motor and installation, please follow these steps. Ensure that frequency converter and motor are connected, and power is applied to frequency converter.

NB!
Before power up ensure that connected equipment is ready for use.

Step 1. Locate motor name plate.

NB!
The motor is either star- (Y) or delta- connected (Δ). This information is located on the motor name plate data.

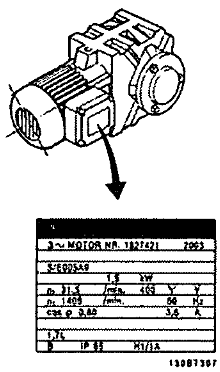


Illustration 5.56: Motor name plate example

Step 2. Enter motor name plate data in following parameter list.
To access list first press [QUICK MENU] key then select "Q2 Quick Setup".

1.	Motor Power [kW] or Motor Power [HP]	par. 1-20 par. 1-21
2.	Motor Voltage	par. 1-22
3.	Motor Frequency	par. 1-23
4.	Motor Current	par. 1-24
5.	Motor Nominal Speed	par. 1-25

Table 5.8: Motor related parameters

Step 3. Activate Automatic Motor Adaptation (AMA)

Performing AMA ensures best possible performance. AMA automatically takes measurements from the specific motor connected and compensates for installation variances.

1. Connect terminal 27 to terminal 12 or use [MAIN MENU] and set Terminal 27 par. 5-12 to *No operation* (par. 5-12 [0])
2. Press [QUICK MENU], select "Q2 Quick Setup", scroll down to AMA par. 1-29.
3. Press [OK] to activate the AMA par. 1-29.
4. Choose between complete or reduced AMA. If sine wave filter is mounted, run only reduced AMA, or remove sine wave filter during AMA procedure.
5. Press [OK] key. Display should show "Press [Hand on] to start".
6. Press [Hand on] key. A progress bar indicates if AMA is in progress.

Stop the AMA during operation

1. Press the [OFF] key - the frequency converter enters into alarm mode and the display shows that the AMA was terminated by the user.

Successful AMA

1. The display shows "Press [OK] to finish AMA".
2. Press the [OK] key to exit the AMA state.

Unsuccessful AMA

1. The frequency converter enters into alarm mode. A description of the alarm can be found in the *Troubleshooting* section.
2. "Report Value" in the [Alarm Log] shows the last measuring sequence carried out by the AMA, before the frequency converter entered alarm mode. This number along with the description of the alarm will assist troubleshooting. If contacting Danfoss Service, make sure to mention number and alarm description.

NB!
Unsuccessful AMA is often caused by incorrectly entered motor name plate data or too big difference between the motor power size and the frequency converter power size.

Step 4. Set speed limit and ramp time

Set up the desired limits for speed and ramp time.

Minimum Reference	par. 3-02
Maximum Reference	par. 3-03

Motor Speed Low Limit	par. 4-11 or 4-12
Motor Speed High Limit	par. 4-13 or 4-14

Ramp 1 Ramp Up Time [s]	par. 3-41
Ramp 1 Ramp Down Time 1 [s]	par. 3-42

6. Application Examples

6.1.1. Start/Stop

Terminal 18 = start/stop par. 5-10 [8] *Start*

Terminal 27 = No operation par. 5-12 [0] *No operation* (Default *coast inverse*

Par. 5-10 *Digital Input, Terminal 18 = Start* (default)

Par. 5-12 *Digital Input, Terminal 27 = coast inverse* (default)

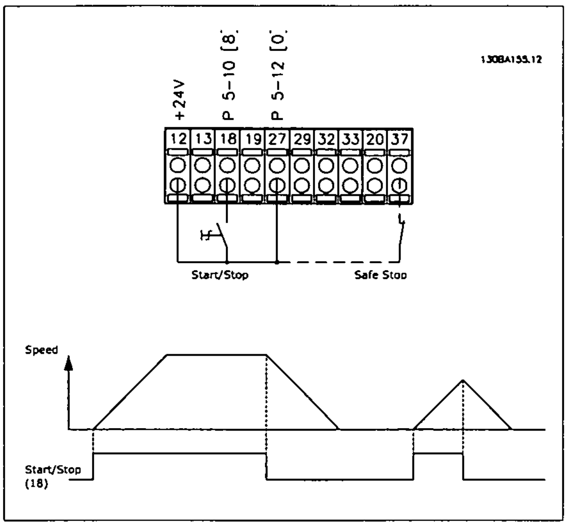


Illustration 6.1: Terminal 37: Available only with Safe Stop Function!

6.1.2. Closed Loop Wiring

Terminal 12 /13: +24V DC

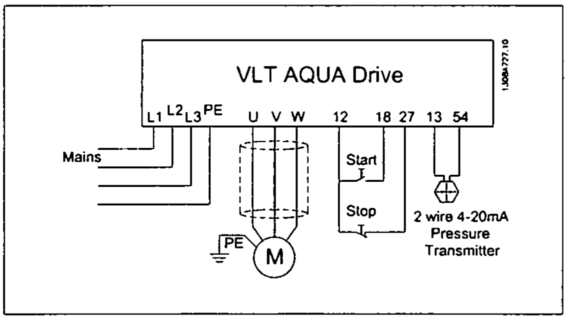
Terminal 18: Start par. 5-18 [8] Start (Default)

Terminal 27: Coast par. 5-12 [2] coast inverse (Default)

Terminal 54: Analog input

L1-L3: Mains terminals

U,V and W: Motor terminals



6.1.3. Submersible Pump Application

The system consists of a submersible pump controlled by a Danfoss VLT AQUA Drive and a pressure transmitter. The transmitter gives a 4-20 mA feedback signal to the VLT AQUA Drive, which keeps a constant pressure by controlling the speed of the pump. To design a drive for a submersible pump application, there are a few important issues to take into consideration. Therefore the drive used must be chosen according to motor current.

1. The motor is a so called "Can motor" with a stainless steel can between the rotor and stator. There is a larger and a more magnetic resistant air-gap than on a normal motor hence a weaker field which results in the motors being designed with a higher rated current than a norm motor with similar rated power.
2. The pump contains thrust bearings which will be damaged when running below minimum speed which normally will be 30 Hz.
3. The motor reactance is nonlinear in submersible pump motors and therefore Automatic Motor Adaption (AMA) may not be possible. However, normally submersible pumps are operated with very long motor cables that might eliminate the nonlinear motor reactance and enable the drive to perform AMA. If AMA fails, the motor data can be set from parameter group 1-3* (see motor datasheet). Be aware that if AMA has succeeded the drive will compensate for voltage drop in the long motor cables, so if the Advanced motor data are set manually, the length of the motor cable must be taken into considerations to optimize system performance.
4. It is important that the system is operated with a minimum of wear and tear of the pump and motor. A Danfoss Sine-Wave filter can lower the motor insulation stress and increase lifetime (check actual motor insulation and the frequency converter du/dt specification). It is recommended to use a filter to reduce the need for service.
5. EMC performance can be difficult to achieve due to the fact that the special pump cable which is able to withstand the wet conditions in the well normally is unscreened. A solution could be to use a screened cable above the well and fix the screen to the well pipe if it is made of steel (can also be made of plastic). A Sine-Wave filter will also reduce the EMI from unscreened motor cables.

The special "can motor" is used due to the wet installation conditions. The drive needs to be designed for the system according to output current to be able to run the motor at nominal power.

To prevent damage to the thrust bearings of the pump, it is important to ramp the pump from stop to min. speed as quick as possible. Well-known manufacturers of submersible pumps recommend that the pump is ramped to min. speed (30 Hz) in max. 2 -3 seconds. The new VLT© AQUA Drive is designed with initial and final Ramp for these applications. The initial and final ramps are 2 individual ramps, where Initial Ramp, if enabled, will ramp the motor from stop to min. speed and automatically switch to normal ramp, when min. speed is reached. Final ramp will do the opposite from min. speed to stop in a stop situation.

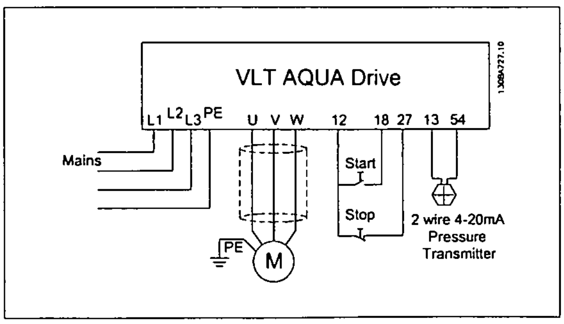
Pipe-Fill mode can be enabled to prevent water hammering. The Danfoss frequency converter is capable of filling vertical pipes using the PID controller to slowly ramp up the pressure with a user specified rate (units/sec). If enabled the drive will, when it reaches min. speed after startup, enter pipe fill mode. The pressure will slowly be ramped up until it reaches a user specified Filled Set Point, where after the drive automatically disables Pipe Fill Mode and continues in normal closed loop operation.
This feature is designed for irrigation applications.

Electrical Wiring

Typical parameter settings
Typical/recommended settings in brackets()

Parameters:	
Motor Rated Power	Par. 1-20 / par. 1-21
Motor Rated Voltage	Par. 1-22
Motor Current	Par. 1-24
Motor Rated Speed	Par. 1-28
Enable Reduced Automatic Motor Adaptation (AMA in par. 1-29)	

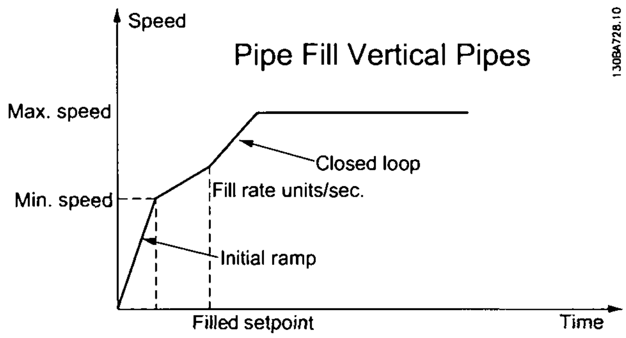
NB!
Note the analog input 2, (terminal (54) format must be set to mA. (switch 202).



Min. Reference	Par. 3-01	(30 Hz)
Max. Reference	Par. 3-02	(50/60 Hz)
Initial Ramp Up Time	Par. 3-84	(2 sec.)
Final Ramp Down Time	Par. 3-88	(2 sec.)
Normal Ramp Up Time	Par. 3-41	(8 sec. depending on size)
Normal Ramp Down Time	Par. 3-42	(8 sec. depending on size)
Motor Min. Speed	Par. 4-11	(30 Hz)
Motor Max. Speed	Par. 4-13	(50/60 Hz)

Use the "Closed Loop" wizard under "Quick Menu_Funtion_Setup", to easily set up the feedback settings in the PID controller.

Pipe Fill Mode		
Pipe Fill Enable	Par. 29-00	
Pipe Fill Rate	Par. 29-04	(Feedback units/sec.)
Filled Set Point	Par. 29-05	(Feedback units)



6

7

7. How to operate the frequency converter

7.1. Ways of Operation

7.1.1. Ways of Operation

The frequency converter can be operated in 3 ways:

1. Graphical Local Control Panel (GLCP), see 6.1.2
2. Numeric Local Control Panel (NLCP), see 6.1.3
3. RS-485 serial communication or USB, both for PC connection, see 6.1.4

If the frequency converter is fitted with fieldbus option, please refer to relevant documentation.

7.1.2. How to operate graphical LCP (GLCP)

The following instructions are valid for the GLCP (LCP 102).

The GLCP is divided into four functional groups:

1. Graphical display with Status lines.
2. Menu keys and indicator lights (LED's) - selecting mode, changing parameters and switching between display functions.
3. Navigation keys and indicator lights (LEDs).
4. Operation keys and indicator lights (LEDs).

Graphical display:
The LCD-display is back-lit with a total of 6 alpha-numeric lines. All data is displayed on the LCP which can show up to five operating variables while in [Status] mode.

Display lines:

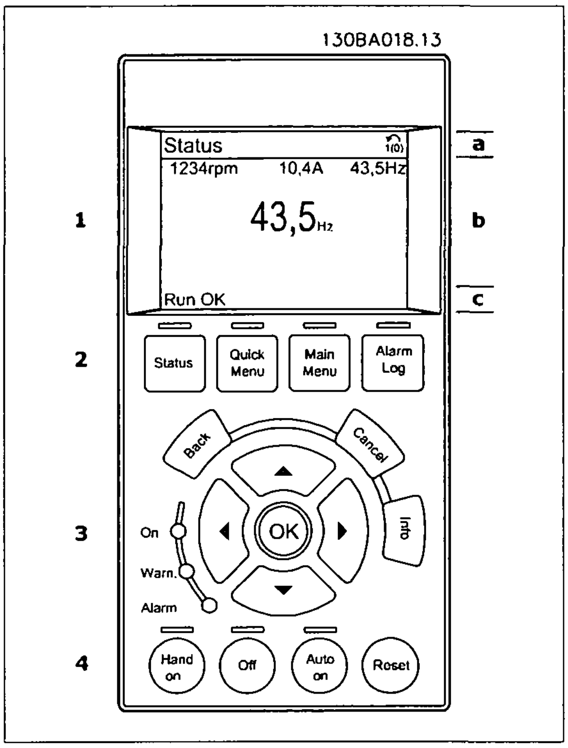
a. **Status line:** Status messages displaying icons and graphics.

b. **Line 1-2:** Operator data lines displaying data and variables defined or chosen by the user. By pressing the [Status] key, up to one extra line can be added.

c. **Status line:** Status messages displaying text.

The display is divided into 3 sections:

Top section (a)
shows the status when in status mode or up to 2 variables when not in status mode and in the case of Alarm/Warning.



The number of the Active Set-up (selected as the Active Set-up in par. 0-10) is shown. When programming in another Set-up than the Active Set-up, the number of the Set-up being programmed appears to the right in brackets.

Middle section (b)

shows up to 5 variables with related unit, regardless of status. In case of alarm/warning, the warning is shown instead of the variables.

It is possible to toggle between three status read-out displays by pressing the [Status] key.
Operating variables with different formatting are shown in each status screen - see below.

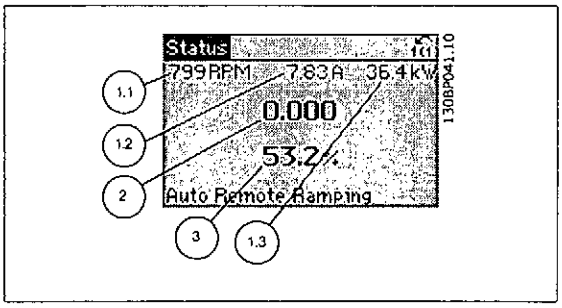
Several values or measurements can be linked to each of the displayed operating variables. The values / measurements to be displayed can be defined via par. 0-20, 0-21, 0-22, 0-23, and 0-24, which can be accessed via [QUICK MENU], "Q3 Function Setups", "Q3-1 General Settings", "Q3-11 Display Settings".

Each value / measurement readout parameter selected in par. 0-20 to par. 0-24 has its own scale and number of digits after a possible decimal point. Larger numeric values are displayed with few digits after the decimal point.
Ex.: Current readout
5.25 A; 15.2 A 105 A.

7

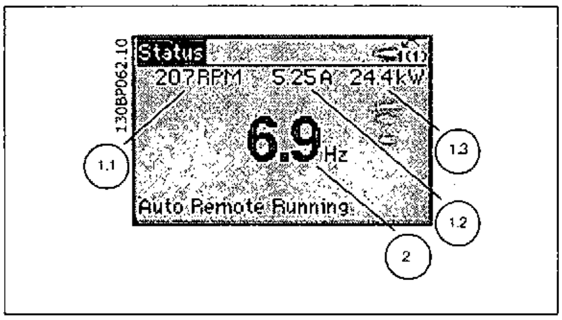
Status display I

This read-out state is standard after start-up or initialization.
Use [INFO] to obtain information about the value/measurement linked to the displayed operating variables (1.1, 1.2, 1.3, 2, and 3).
See the operating variables shown in the display in this illustration. 1.1, 1.2 and 1.3 are shown in small size. 2 and 3 are shown in medium size.



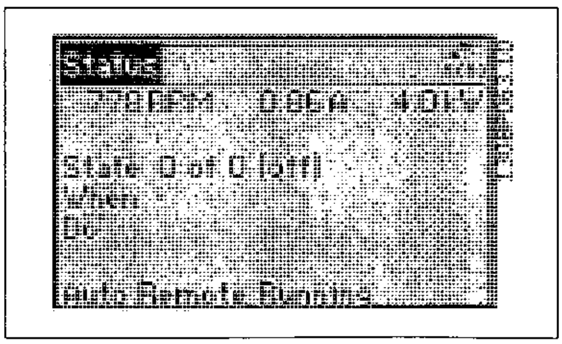
Status display II

See the operating variables (1.1, 1.2, 1.3, and 2) shown in the display in this illustration.
In the example, Speed, Motor current, Motor power and Frequency are selected as variables in the first and second lines.
1.1, 1.2 and 1.3 are shown in small size. 2 is shown in large size.



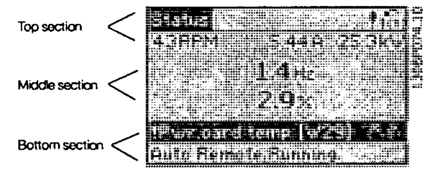
Status display III:

This state displays the event and action of the Smart Logic Control. For further information, see section *Smart Logic Control.*



Bottom section

always shows the state of the frequency converter in Status mode.



Display Contrast Adjustment

Press [status] and [▲] for darker display

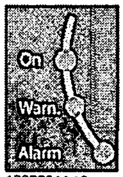
Press [status] and [▼] for brighter display

Indicator lights (LEDs):

If certain threshold values are exceeded, the alarm and/or warning LED lights up. A status and alarm text appear on the control panel.

The On LED is activated when the frequency converter receives power from mains voltage, a DC bus terminal, or an external 24 V supply. At the same time, the back light is on.

- Green LED/On: Control section is working.
- Yellow LED/Warn.: Indicates a warning.
- Flashing Red LED/Alarm: Indicates an alarm.



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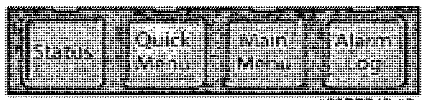
7

GLCP keys

Menu keys

The menu keys are divided into functions. The keys below the display and indicator lamps are used for parameter set-up, including choice of display indication during normal operation.



[Status]

Indicates the status of the frequency converter and/or the motor. 3 different readouts can be chosen by pressing the [Status] key:

5 line readouts, 4 line readouts or Smart Logic Control.

Use **[Status]** for selecting the mode of display or for changing back to Display mode from either the Quick Menu mode, the Main Menu mode or Alarm mode. Also use the [Status] key to toggle single or double read-out mode.

[Quick Menu]

Allows quick set-up of the frequency converter. **The most common functions can be programmed here.**

The [Quick Menu] consists of:

- **Q1: My Personal Menu**
- **Q2: Quick Setup**
- **Q3: Function Setups**
- **Q5: Changes Made**
- **Q6: Loggings**

The Function set-up provides quick and easy access to all parameters required for the majority of water and wastewater applications including variable torque, constant torque, pumps, dossing pumps, well pumps, booster pumps, mixer pumps, aeration blowers and other pump and fan applications. Amongst other features it also includes parameters for selecting which variables to display on the LCP, digital preset speeds, scaling of analog references, closed loop single zone and multi-zone applications and specific functions related to water and wastewater applications.

The Quick Menu parameters can be accessed immediately unless a password has been created via par. 0-60, 0-61, 0-65 or 0-66.

It is possible to switch directly between Quick Menu mode and Main Menu mode.

[Main Menu]
is used for programming all parameters.
The Main Menu parameters can be accessed immediately unless a password has been created via par. 0-60, 0-61, 0-65 or 0-66. For the majority of water and wastewater applications it is not necessary to access the Main Menu parameters but instead the Quick Menu, Quick Setup and Function Setups provides the simplest and quickest access to the typical required parameters.
It is possible to switch directly between Main Menu mode and Quick Menu mode.
Parameter shortcut can be carried out by pressing down the **[Main Menu]** key for 3 seconds. The parameter shortcut allows direct access to any parameter.

[Alarm Log]
displays an Alarm list of the five latest alarms (numbered A1-A5). To obtain additional details about an alarm, use the arrow keys to manoeuvre to the alarm number and press [OK]. Information is displayed about the condition of the frequency converter before it enters the alarm mode.

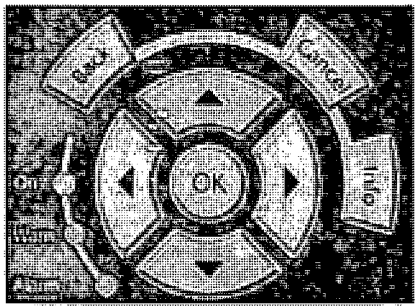
[Back]
reverts to the previous step or layer in the navigation structure.

[Cancel]
last change or command will be cancelled as long as the display has not been changed.

[Info]
displays information about a command, parameter, or function in any display window. [Info] provides detailed information when needed.
Exit Info mode by pressing either [Info], [Back], or [Cancel].

Navigation Keys
The four navigation arrows are used to navigate between the different choices available in **[Quick Menu]**, **[Main Menu]** and **[Alarm Log]**. Use the keys to move the cursor.

[OK]
is used for choosing a parameter marked by the cursor and for enabling the change of a parameter.



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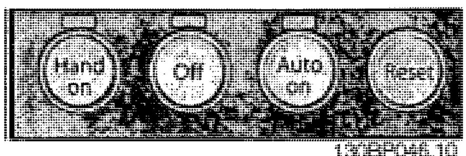
Operation Keys
for local control are found at the bottom of the control panel.



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[Hand On]
enables control of the frequency converter via the GLCP. [Hand on] also starts the motor, and it is now possible to give the motor speed reference by means of the arrow keys. The key can be *Enabled* [1] or *Disabled* [0] via par. *0-40 [Hand on] Key on LCP.*

The following control signals will still be active when [Hand on] is activated:

- [Hand on] - [Off] - [Auto on]
- Reset
- Coasting stop inverse (motor coasting to stop)

- Reversing
- Set-up select lsb - Set-up select msb
- Stop command from serial communication
- Quick stop
- DC brake

NB!
External stop signals activated by means of control signals or a serial bus will override a "start" command via the LCP.

[Off]
stops the connected motor. The key can be *Enabled* [1] or *Disabled* [0] via par. *0-41 [Off] key on LCP.* If no external stop function is selected and the [Off] key is inactive the motor can only be stopped by disconnecting the mains supply.

[Auto On]
enables the frequency converter to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or the bus, the frequency converter will start. The key can be *Enabled* [1] or *Disabled* [0] via par. *0-42 [Auto on] key on LCP.*

NB!
An active HAND-OFF-AUTO signal via the digital inputs has higher priority than the control keys [Hand on] – [Auto on].

[Reset]
is used for resetting the frequency converter after an alarm (trip). The key can be *Enabled* [1] or *Disabled* [0] via par. 0-43 *Reset Keys on LCP.*

The parameter shortcut
can be carried out by holding down the [Main Menu] key for 3 seconds. The parameter shortcut allows direct access to any parameter.

7.1.3. How to operate numeric LCP (NLCP)

The following instructions are valid for the NLCP (LCP 101).

The control panel is divided into four functional groups:

1. Numeric display.
2. Menu key and indicator lights (LEDs) - changing parameters and switching between display functions.
3. Navigation keys and indicator lights (LEDs).
4. Operation keys and indicator lights (LEDs).

> **NB!**
> Parameter copy is not possible with Numeric Local Control Panel (LCP101).

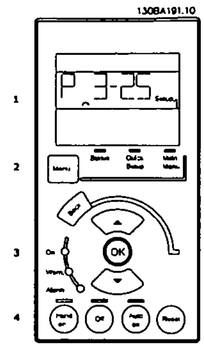

Illustration 7.1: Numerical LCP (NLCP)

Select one of the following modes:

Status Mode: Displays the status of the frequency converter or the motor.
If an alarm occurs, the NLCP automatically switches to status mode.
A number of alarms can be displayed.

Quick Setup or Main Menu Mode: Display parameters and parameter settings.

Illustration 7.2: Status display example

Illustration 7.3: Alarm display example

Indicator lights (LEDs):

- Green LED/On: Indicates if control section is on.
- Yellow LED/Wrn.: Indicates a warning.
- Flashing red LED/Alarm: Indicates an alarm.

Menu key

[Menu] Select one of the following modes:

- Status
- Quick Setup
- Main Menu

Main Menu

is used for programming all parameters.
The parameters can be accessed immediately unless a password has been created via par. 0-60 Main *Menu Password*, par. 0-61 Access *to Main Menu w/o Password*, par. 0-65 Personal *Menu Password* or par. 0-66 Access *to Personal Menu w/o Password*.
Quick Setup is used to set up the frequency converter using only the most essential parameters.
The parameter values can be changed using the up/down arrows when the value is flashing.
Select Main Menu by pressing the [Menu] key a number of times until the Main Menu LED is lit.
Select the parameter group [xx-__] and press [OK]
Select the parameter [__-xx] and press [OK]
If the parameter is an array parameter select the array number and press [OK]
Select the wanted data value and press [OK]

Navigation Keys

[Back]
for stepping backwards

Arrow [▲] [▼]
keys are used for manoeuvring between parameter groups, parameters and within parameters

[OK]
is used for choosing a parameter marked by the cursor and for enabling the change of a parameter.

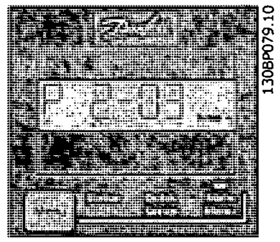

Illustration 7.4: Display example

Operation Keys
Keys for local control are found at the bottom of the control panel.

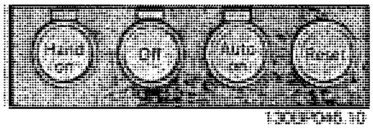

Illustration 7.5: Operation keys of the numerical LCP (NLCP)

[Hand on]
enables control of the frequency converter via the LCP. [Hand on] also starts the motor and it is now possible to enter the motor speed data by means of the arrow keys. The key can be *Enabled* [1] or *Disabled* [0] via par. 0-40 [Hand *on] Key on LCP*.

External stop signals activated by means of control signals or a serial bus will override a 'start' command via the LCP.

The following control signals will still be active when [Hand on] is activated:

- [Hand on] - [Off] - [Auto on]
- Reset
- Coasting stop inverse
- Reversing
- Set-up select lsb - Set-up select msb
- Stop command from serial communication
- Quick stop
- DC brake

[Off]
stops the connected motor. The key can be *Enabled* [1] or *Disabled* [0] via par. 0-41 [Off] *Key on LCP*.

If no external stop function is selected and the [Off] key is inactive the motor can be stopped by disconnecting the mains supply.

[Auto on]
enables the frequency converter to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or the bus, the frequency converter will start. The key can be *Enabled* [1] or *Disabled* [0] via par. 0-42 [Auto *on] Key on LCP*.

NB!
An active HAND-OFF-AUTO signal via the digital inputs has higher priority than the control keys [Hand on] [Auto on].

[Reset]
is used for resetting the frequency converter after an alarm (trip). The key can be *Enabled* [1] or *Disabled* [0] via par. 0-43 [Reset] *Key on LCP*.

7.1.4. Changing Data

1. Press [Quick Menu] or [Main Menu] key.

2. Use [▲] and [▼] keys keys to find parameter group to edit.
3. Press [OK] key.
4. Use [▲] and [▼] keys to find parameter to edit.
5. Press [OK] key.
6. Use [▲] and [▼] keys to select correct parameter setting. Or, to move to digits within a number, use keys. Cursor indicates digit selected to change. [▲] key increases the value, [▼] key decreases the value.
7. Press [Cancel] key to disregard change, or press [OK] key to accept change and enter new setting.

7.1.5. Changing a Text Value

If the selected parameter is a text value, change the text value by means of the up/down navigation keys.
The up key increases the value, and the down key decreases the value. Place the cursor on the value to be saved and press [OK].

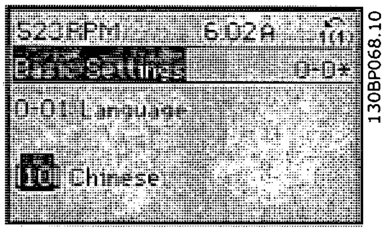

Illustration 7.6: Display example.

7.1.6. Changing a Group of Numeric Data Values

If the chosen parameter represents a numeric data value, change the chosen data value by means of the <> navigation keys as well as the up/down navigation keys. Use the <> navigation keys to move the cursor horizontally.

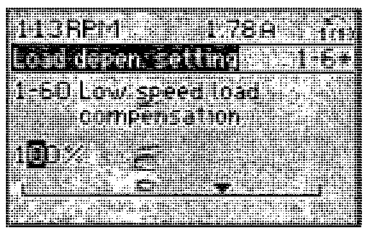

Illustration 7.7: Display example.

Use the up/down navigation keys to change the data value. The up key enlarges the data value, and the down key reduces the data value. Place the cursor on the value to be saved and press [OK].

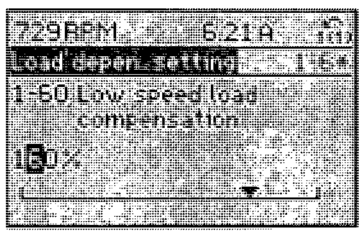

Illustration 7.8: Display example.

7.1.7. Changing of Data Value, Step-by-Step

Certain parameters can be changed step by step or infinitely variably. This applies to par. 1-20 *Motor Power [kW]*, par. 1-22 *Motor Voltage* and par. 1-23 *Motor Frequency*.
The parameters are changed both as a group of numeric data values and as numeric data values infinitely variably.

7.1.8. Read-out and Programming of Indexed Parameters

Parameters are indexed when placed in a rolling stack.
par. 15-30 Alarm *Log: Error Code* to par. 15-32 Alarm *Log: Time* contain a fault log which can be read out. Choose a parameter, press [OK], and use the up/down navigation keys to scroll through the value log.

Use par. 3-10 *Preset Reference* as another example:
Choose the parameter, press [OK], and use the up/down navigation keys keys to scroll through the indexed values. To change the parameter value, select the indexed value and press [OK]. Change the value by using the up/down keys. Press [OK] to accept the new setting. Press [Cancel] to abort. Press [Back] to leave the parameter.

7.1.9. Tips and tricks

*	For the majority of water and wastewater applications the Quick Menu, Quick Setup and Function Setups provides the simplest and quickest access to all the typical parameters required.
*	Whenever possible, performing an AMA, will ensure best shaft performance
*	Contrast of the display can be adjusted by pressing [Status] and [▲] for darker display or by pressing [Status] and [▼] for brighter dispaly
*	Under [Quick Menu] and [Changes Made] all parameters that have been changed from factory settings are displayed
*	Press and hold [Main Menu] key for 3 seconds for access to any parameter
*	For service purposes it is recommended to copy all parameters to the LCP, see par. 0-50 for further information

Table 7.1: Tips and tricks

7

7.1.10. Quick Transfer of Parameter Settings when using GLCP

Once the set-up of a frequency converter is complete, it is recommended to store (backup) the parameter settings in the GLCPkeypad or on a PC via MCT 10 Set-up Software Tool.

NB!
Stop the motor before performing any of these operations.

Data storage in LCP:

1. Go to par. 0-50 LCP *Copy*
2. Press the [OK] key
3. Select "All to LCP"
4. Press the [OK] key

All parameter settings are now stored in the GLCP indicated by the progress bar. When 100% is reached, press [OK].

The GLCP can now be connected to another frequency converter and the parameter settings copied to this frequency converter.

Data transfer from LCP to Frequency converter:

1. Go to par. 0-50 LCP *Copy*
2. Press the [OK] key
3. Select "All from LCP"
4. Press the [OK] key

The parameter settings stored in the GLCP are now transferred to the frequency converter indicated by the progress bar. When 100% is reached, press [OK].

7.1.11. Initialisation to Default Settings

There are two ways to initialise the frequency converter to default: Recommended initialisation and manual initialisation.
Please be aware that they have different impact according to the below description.

Recommended initialisation (via par. 14-22 Operation *Mode*)

1. Select par. 14-22 Operation *Mode*
2. Press [OK]
3. Select "Initialisation" (for NLCP select "2")
4. Press [OK]
5. Remove power to unit and wait for display to turn off.
6. Reconnect power and the frequency converter is reset. Note that first start-up takes a few more seconds.
7. Press [Reset]

par. 14-22 Operation *Mode* initialises all except:
par. 14-50 RFI *Filter*
par.
par.
par. 8-32 Baud *Rate*
par. 8-35 Minimum *Response Delay*
par. 8-36 Maximum *Response Delay*
par. 8-37 Maximum *Inter-Char Delay*
par. 15-00 Operating *Hours* to par. 15-05 Over *Volt's*
par. 15-20 Historic *Log: Event* to par. 15-22 Historic *Log: Time*
par. 15-30 Alarm *Log: Error Code* to par. 15-32 Alarm *Log: Time*

NB!
Parameters selected in par. 0-25 My *Personal Menu*, will stay present, with default factory setting.

Manual initialisation

NB!
When carrying out manual initialisation, serial communication, RFI filter settings and fault log settings are reset.
Removes parameters selected in par. 0-25 My *Personal Menu*.

1. Disconnect from mains and wait until the display turns off.

2a. Press [Status] - [Main Menu] - [OK] at the same time while power up for Graphical LCP (GLCP).

2b. Press [Menu] while power up for LCP 101, Numerical Display

3. Release the keys after 5 s.

4. The frequency converter is now programmed according to default settings.

This parameter initialises all except:
par. 15-00 Operating *Hours*
par. 15-03 Power *Up's*
par. 15-04 Over *Temp's*
par. 15-05 Over *Volt's*

7.1.12. RS-485 Bus Connection

One or more frequency converters can be connected to a controller (or master) using the RS-485 standard interface. Terminal 68 is connected to the P signal (TX+, RX+), while terminal 69 is connected to the N signal (TX-,RX-).

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

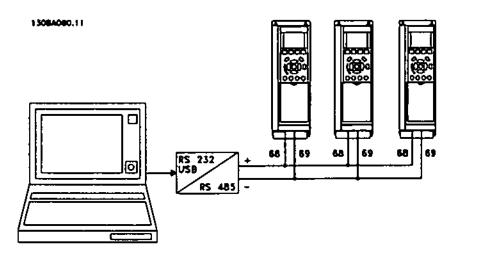

Illustration 7.9: Connection example.

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

Bus termination
The RS-485 bus must be terminated by a resistor network at both ends. If the drive is the first or the last device in the RS-485 loop, set the switch S801 on the control card for ON.
For more information, see the paragraph *Switches S201, S202, and S801.*

7.1.13. How to Connect a PC to the frequency converter

To control or program the frequency converter from a PC, install the PC-based Configuration Tool MCT 10.
The PC is connected via a standard (host/device) USB cable, or via the RS-485 interface as shown in the *Design Guide, chapter How to Install > Installation of misc. connections.*

NB!
The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. The USB connection is connected to protection earth on the frequency converter. Use only isolated laptop as PC connection to the USB connector on the frequency converter.

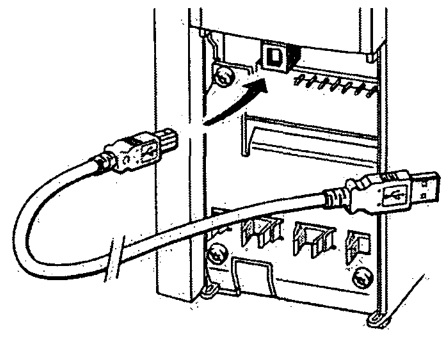

Illustration 7.10: For control cable connections, see section on *Control Terminals.*

7.1.14. PC Software tools

PC-based Configuration Tool MCT 10
All Frequency converters are equipped with a serial communication port. Danfoss provides a PC tool for communication between PC and frequency converter, PC-based Configuration Tool MCT 10. Please check the section on *Available Literature* for detailed information on this tool.

MCT 10 Set-up Software
MCT 10 has been designed as an easy to use interactive tool for setting parameters in our frequency converters. The software can be downloaded from the Danfoss internet site *http://www.Danfoss.com/BusinessAreas/DrivesSolutions/Softwaredownload/DDPC+Software+Program.htm.*
The MCT 10 Set-up software will be useful for:

- Planning a communication network off-line. MCT 10 contains a complete frequency converter database
- Commissioning frequency converters on line
- Saving settings for all frequency converters
- Replacing a frequency converter in a network
- Simple and accurate documentation of frequency converter settings after commissioning.
- Expanding an existing network
- Future developed frequency converters will be supported

MCT 10 set-up software supports Profibus DP-V1 via a Master class 2 connection. It makes it possible to on line read/write parameters in a frequency converter via the Profibus network. This will eliminate the need for an extra communication network.

Save Frequency Converter Settings:

1. Connect a PC to the unit via USB com port. (Note: Use a PC, which is isolated from the mains, in conjunction with the USB port. Failure to do so may damage equipment.)

2. Open MCT 10 Set-up Software
3. Choose "Read from drive"
4. Choose "Save as"

All parameters are now stored in the PC.

Load Frequency Converter Settings:

1. Connect a PC to the frequency converter via USB com port
2. Open MCT 10 Set-up software
3. Choose "Open"– stored files will be shown
4. Open the appropriate file
5. Choose "Write to drive"

All parameter settings are now transferred to the frequency converter.

A separate manual forMCT 10 Set-up Software is available: *MG.10.Rx.yy.*

The MCT 10 Set-up Software Modules

The following modules are included in the software package:

MCT	**MCT Set-up 10 Software** Setting parameters Copy to and from frequency converters Documentation and print out of parameter settings incl. diagrams
	Ext. User Interface Preventive Maintenance Schedule Clock settings Timed Action Programming Smart Logic Controller Set-up

Ordering number:

Please order the CD containing MCT 10 Set-up Software using code number 130B1000.

MCT 10 can also be downloaded from the Danfoss Internet: *WWW.DANFOSS.COM, Business Area: Motion Controls.*

8. How to programme the frequency converter

8.1. How to programme

8.1.1. Parameter Set-Up

Overview of parameter groups

Group	Title	Function
0-	Operation / Display	Parameters related to the fundamental functions of the frequency converter, function of the LCP buttons and configuration of the LCP display.
1-	Load / Motor	Parameter group for motor settings.
2-	Brakes	Parameter group for setting brake features in the frequency converter.
3-	Reference / Ramps	Parameters for reference handling, definitions of limitations, and configuration of the reaction of the frequency converter to changes.
4-	Limits / Warnings	Parameter group for configuring limits and warnings.
5-	Digital In/Out	Parameter group for configuring the digital inputs and outputs.
6-	Analog In/Out	Parameter group for configuration of the analog inputs and outputs.
8-	Communication and Options	Parameter group for configuring communications and options.
9-	Profibus	Parameter group for Profibus-specific parameters.
10-	DeviceNet Fieldbus	Parameter group for DeviceNet-specific parameters.
11-	LonWorks	Parameter group for LonWorks parameters
13-	Smart Logic	Parameter group for Smart Logic Control
14-	Special Functions	Parameter group for configuring special frequency converter functions.
15-	Drive Information	Parameter group containing frequency converter information such as operating data, hardware configuration and software versions.
16-	Data Readouts	Parameter group for data read-outs, e.g. actual references, voltages, control, alarm, warning and status words.
18-	Info and Readouts	This parameter group contains the last 10 Preventive Maintenance logs.
20-	Drive Closed Loop	This parameter group is used for configuring the closed loop PID Controller that controls the output frequency of the unit.
21-	Extended Closed Loop	Parameters for configuring the three Extended Closed Loop PID Controllers.
22-	Application Functions	These parameters monitor water applications.
23-	Time-based Functions	These parameters are for actions needed to be performed on a daily or weekly basis, e.g. different references for working hours/non-working hours.
25-	Basic Cascade Controller Functions	Parameters for configuring the Basic Cascade Controller for sequence control of multiple pumps.
26-	Analog I/O Option MCB 109	Parameters for configuring the Analog I/O Option MCB 109.
27-	Extended Cascade Control	Parameters for configuring the Extended Cascade Control.
29-	Water Application Functions	Parameters for setting water specific functions.
31-	Bypass Option	Parameters for configuring the Bypass Option

Table 8.1: Parameter Groups

Parameter descriptions and selections are displayed on the graphic (GLCP) or numeric (NLCP) in the display area. (See Section 5 for details.) Access the parameters by pressing the [Quick Menu] or [Main Menu] key on the control panel. The quick menu is used primarily for commissioning the unit at start-up by providing those parameters necessary to start operation. The main menu provides access to all parameters for detailed application programming.

All digital input/output and analog input/output terminals are multifunctional. All terminals have factory default functions suitable for the majority of water applications but if other special functions are required, they must be programmed in parameter group 5 or 6.

8.1.2. Quick Menu Mode

The GLCP provides access to all parameters listed under the Quick Menus. To set parameters using the [Quick Menu] button:

Pressing [Quick Menu] the list indicates the different areas contained in the Quick menu.

Efficient Parameter Set-up for Water Applications
The parameters can easily be set up for the vast majority of the water and wastewater applications only by using the **[Quick Menu]**.

The optimum way to set parameters through the [Quick Menu] is by following the below steps:

1. Press [Quick Setup] for selecting basic motor settings, ramp times, etc.
2. Press [Function Setups] for setting up the required functionality of the frequency converter - if not already covered by the settings in [Quick Setup].
3. Choose between *General Settings*, *Open Loop Settings* and *Closed Loop Settings*.

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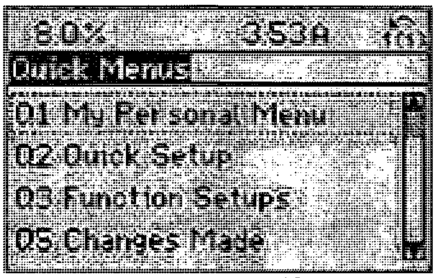
It is recommended to do the set-up in the order listed.



130BP064.11

Illustration 8.1: Quick menu view.

Par.	Designation	[Units]
0-01	Language	
1-20	Motor Power	[kW]
1-22	Motor Voltage	[V]
1-23	Motor Frequency	[Hz]
1-24	Motor Current	[A]
1-25	Motor Nominal Speed	[RPM]
3-41	Ramp 1 Ramp up Time	[s]
3-42	Ramp 1 Ramp down Time	[s]
4-11	Motor Speed Low Limit	[RPM]
4-13	Motor Speed High Limit	[RPM]
1-29	Automatic Motor Adaptation (AMA)	

Table 8.2: Quick Setup parameters

If *No Operation* is selected in terminal 27 no connection to +24 V on terminal 27 is necessary to enable start.
If *Coast Inverse* (factory default value) is selected in Terminal 27, a connection to +24V is necessary to enable start.

NB!
For detailed parameter descriptions, please see the following section on *Commonly Used Parameters - Explanations.*

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8.1.3. Q1 My Personal Menu

Parameters defined by the user can be stored in Q1 My Personal Menu.

Select *My Personal Menu* to display only the parameters, which have been pre-selected and programmed as personal parameters. For example, a pump or equipment OEM may have pre-programmed these to be in My Personal Menu during factory commissioning to make on site commissioning / fine tuning simpler.. These parameters are selected in par. 0-25 *My Personal Menu.* Up to 20 different parameters can be defined in this menu.

Q1 My Personal Menu
20-21 Setpoint 1
20-93 PID Proportional Gain
20-94 PID Integral Time

8.1.4. Q2 Quick Setup

The parameters in Q2 Quick Setup are the basic parameters which are always needed to set-up the frequency converter to operation.

Q2 Quick Setup	
Parameter number and name	**Unit**
0-01 Language	
1-20 Motor Power	kW
1-22 Motor Voltage	V
1-23 Motor Frequency	Hz
1-24 Motor Current	A
1-25 Motor Nominal Speed	RPM
3-41 Ramp 1 Ramp Up Time	s
3-42 Ramp 1 Ramp Down Time	s
4-11 Motor Speed Low Limit	RPM
4-13 Motor Speed High Limit	RPM
1-29 Automatic Motor Adaptation (AMA)	

8.1.5. Q3 Function Setups

The Function Setup provides quick and easy access to all parameters required for the majority of water and wastewater applications including variable torque, constant torque, pumps, dossing pumps, well pumps, booster pumps, mixer pumps, aeration blowers and other pump and fan applications. Amongst other features it also includes parameters for selecting which variables to display on the LCP, digital preset speeds, scaling of analog references, closed loop single zone and multi-zone applications and specific functions related to water and wastewater applications.

How to access Function Set-up - example

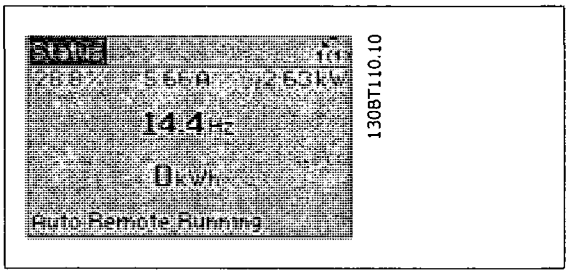

Illustration 8.2: Step 1: Turn on the frequency converter (On LED lights)

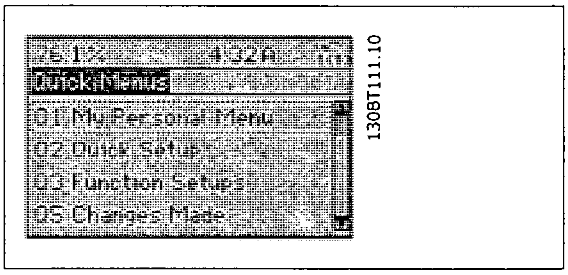

Illustration 8.3: Step 2: Press the [Quick Menus] button (Quick Menus choices appear).

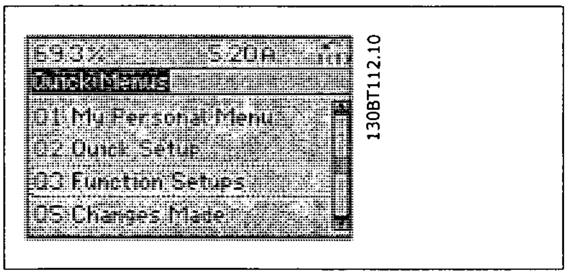

Illustration 8.4: Step 3: Use the up/down navigation keys to scroll down to Function Setups. Press [OK].

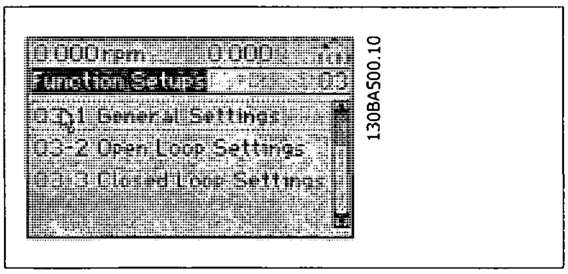

Illustration 8.5: Step 4: Function Setups choices appear. Choose 03-1 *General Settings*. Press [OK].

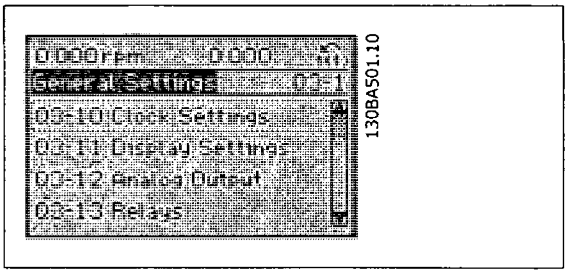

Illustration 8.6: Step 5: Use the up/down navigation keys to scroll down to i.e. 03-12 *Analog Outputs*. Press [OK].

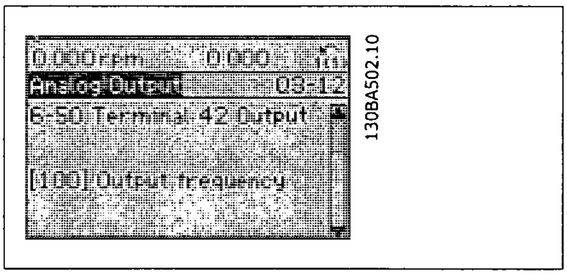

Illustration 8.7: Step 6: Choose parameter 6-50 *Terminal 42 Output*. Press [OK].

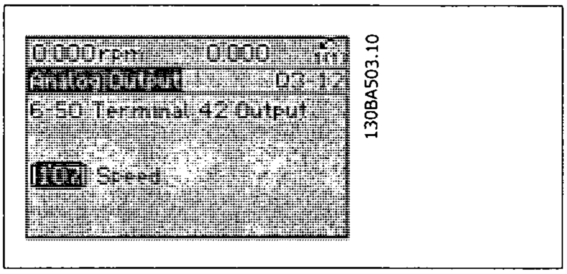

Illustration 8.8: Step 7: Use the up/down navigation keys to select between the different choices. Press [OK].

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The Function Setup parameters are grouped in the following way:

Q3-1 General Settings			
Q3-10 Clock Settings	**Q3-11 Display Settings**	**Q3-12 Analog Output**	**Q3-13 Relays**
0-70 Set Date and Time	0-20 Display Line 1.1 Small	6-50 Terminal 42 Output	Relay 1 ⇒ 5-40 Function Relay
0-71 Date Format	0-21 Display Line 1.2 Small	6-51 Terminal 42 Output Min Scale	Relay 2 ⇒ 5-40 Function Relay
0-72 Time Format	0-22 Display Line 1.3 Small	6-52 Terminal 42 Output Max Scale	Option relay 7 ⇒ 5-40 Function Relay
0-74 DST/Summertime	0-23 Display Line 2 Large		Option relay 8 ⇒ 5-40 Function Relay
0-76 DST/Summertime Start	0-24 Display Line 3 Large		Option relay 9 ⇒ 5-40 Function Relay
0-77 DST/Summertime End	0-37 Display Text 1		
	0-38 Display Text 2		
	0-39 Display Text 3		

Q3-2 Open Loop Settings	
Q3-20 Digital Reference	**Q3-21 Analog Reference**
3-02 Minimum Reference	3-02 Minimum Reference
3-03 Maximum Reference	3-03 Maximum Reference
3-10 Preset Reference	6-10 Terminal 53 Low Voltage
5-13 Terminal 29 Digital Input	6-11 Terminal 53 High Voltage
5-14 Terminal 32 Digital Input	6-14 Terminal 53 Low Ref/Feedb. Value
5-15 Terminal 33 Digital Input	6-15 Terminal 53 High Ref/Feedb. Value

Q3-3 Closed Loop Settings	
Q3-30 Feedback Settings	**Q3-31 PID Settings**
1-00 Configuration Mode	20-81 PID Normal/Inverse Control
20-12 Reference/Feedb.Unit	20-82 PID Start Speed [RPM]
3-02 Minimum Reference	20-21 Setpoint 1
3-03 Maximum Reference	20-93 PID Proportional Gain
6-20 Terminal 54 Low Voltage	20-94 PID Integral Time
6-21 Terminal 54 High Voltage	
6-24 Terminal 54 Low Ref/Feedb Value	
6-25 Terminal 54 High Ref/Feedb Value	
6-00 Live Zero Timeout Time	
6-01 Live Zero Timeout Function	

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8.1.6. Q5 Changes Made

Q5 Changes Made can be used for fault finding.

Select *Changes made* to get information about:

- the last 10 changes. Use the up/down navigation keys to scroll between the last 10 changed parameters.
- the changes made since default setting.

Select *Loggings* to get information about the display line read-outs. The information is shown as graphs.
Only display parameters selected in par. 0-20 and par. 0-24 can be viewed. It is possible to store up to 120 samples in the memory for later reference.

Please notice that the parameters listed in the below tables for Q5 only serve as examples as they will vary depending on the programming of the particular frequency converter.

Q5-1 Last 10 Changes
20-94 PID Integral Time
20-93 PID Proportional Gain

Q5-2 Since Factory Setting
20-93 PID Proportional Gain
20-94 PID Integral Time

Q5-3 Input Assignments
Analog Input 53
Analog Input 54

8.1.7. Q6 Loggings

Q6 Loggings can be used for fault finding.

Please notice that the parameters listed in the below table for Q6 only serve as examples as they will vary depending on the programming of the particular frequency converter.

Q6 Loggings
Reference
Analog Input 53
Motor Current
Frequency
Feedback
Energy Log
Trending Cont Bin
Trending Timed Bin
Trending Comparison

8.1.8. Main Menu Mode

Both the GLCP and NLCP provide access to the main menu mode. Select the Main Menu mode by pressing the [Main Menu] key. Illustration 6.2 shows the resulting read-out, which appears on the display of the GLCP. Lines 2 through 5 on the display show a list of parameter groups which can be chosen by toggling the up and down buttons.

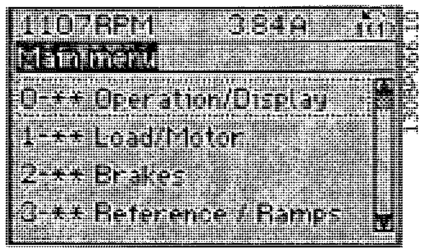

Illustration 8.9: Display example.

Each parameter has a name and number which remain the same regardless of the programming mode. In the Main Menu mode, the parameters are divided into groups. The first digit of the parameter number (from the left) indicates the parameter group number.

All parameters can be changed in the Main Menu. The configuration of the unit (par. 1-00 *Configuration Mode*) will determine other parameters available for programming. For example, selecting Closed Loop enables additional parameters related to closed loop operation. Option cards added to the unit enable additional parameters associated with the option device.

8

8.1.9. Parameter Selection

In the Main Menu mode, the parameters are divided into groups. Select a parameter group by means of the navigation keys.
The following parameter groups are accessible:

Group no.	Parameter group:
0	Operation/Display
1	Load/Motor
2	Brakes
3	References/Ramps
4	Limits/Warnings
5	Digital In/Out
6	Analog In/Out
8	Comm. and Options
9	Profibus
10	CAN Fieldbus
11	LonWorks
13	Smart Logic
14	Special Functions
15	Drive Information
16	Data Readouts
18	Data Readouts 2
20	Drive Closed Loop
21	Ext. Closed Loop
22	Application Functions
23	Time-based Functions
24	Fire Mode
25	Cascade Controller
26	Analog I/O Option MCB 109

Table 8.3: Parameter groups.

After selecting a parameter group, choose a parameter by means of the navigation keys.
The middle section on the GLCP display shows the parameter number and name as well as the selected parameter value.

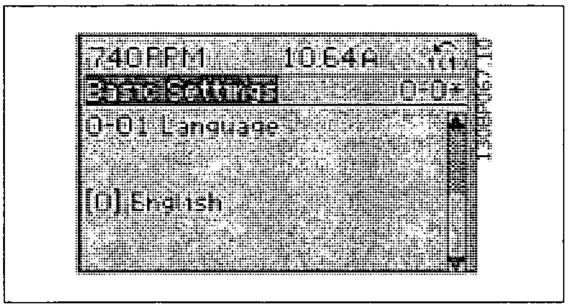

Illustration 8.10: Display example.

8.2. Commonly Used Parameters - Explanations

8.2.1. Main Menu

The Main Menu includes all available parameters in the VLT® AQUA Drive FC 200 frequency converter.
All parameters are grouped in a logic way with a group name indicating the function of the parameter group.
All parameters are listed by name and number in the section *Parameter Options* in these Operating Instructions.

All parameters included in the Quick Menus (Q1, Q2, Q3, Q5 and Q6) can be found in the following.

Some of the most used parameters for VLT® AQUA Drive applications are also explained in the following section.

For a detailed explanation of all parameters, please refer to the VLT® AQUA Drive Programming Guide MG.20.OX.YY which is available on www.danfoss.com or by ordering at the local Danfoss office.

8.2.2. 0-** Operation / Display

Parameters related to the fundamental functions of the frequency converter, function of the LCP buttons and configuration of the LCP display.

8

0-01 Language

Option:		Function:
		Defines the language to be used in the display. The frequency converter can be delivered with 4 different language packages. English and German are included in all packages. English cannot be erased or manipulated.
[0] *	English	Part of Language packages 1 - 4
[1]	German	Part of Language packages 1 - 4
[2]	French	Part of Language package 1
[3]	Danish	Part of Language package 1
[4]	Spanish	Part of Language package 1
[5]	Italian	Part of Language package 1
[6]	Swedish	Part of Language package 1
[7]	Dutch	Part of Language package 1
[10]	Chinese	Language package 2
[20]	Finnish	Part of Language package 1
[22]	English US	Part of Language package 4
[27]	Greek	Part of Language package 4
[28]	Portuguese	Part of Language package 4
[36]	Slovenian	Part of Language package 3
[39]	Korean	Part of Language package 2
[40]	Japanese	Part of Language package 2
[41]	Turkish	Part of Language package 4
[42]	Traditional Chinese	Part of Language package 2
[43]	Bulgarian	Part of Language package 3
[44]	Serbian	Part of Language package 3
[45]	Romanian	Part of Language package 3
[46]	Hungarian	Part of Language package 3
[47]	Czech	Part of Language package 3
[48]	Polish	Part of Language package 4
[49]	Russian	Part of Language package 3
[50]	Thai	Part of Language package 2
[51]	Bahasa Indonesian	Part of Language package 2

0-20 Display Line 1.1 Small

Option:		Function:
		Select a variable for display in line 1, left position.
[0]	None	No display value selected
[37]	Display Text 1	Present control word
[38]	Display Text 2	Enables an individual text string to be written, for display in the LCP or to be read via serial communication.
[39]	Display Text 3	Enables an individual text string to be written, for display in the LCP or to be read via serial communication.
[89]	Date and Time Readout	Displays the current date and time.
[953]	Profibus Warning Word	Displays Profibus communication warnings.
[1005]	Readout Transmit Error Counter	View the number of CAN control transmission errors since the last power-up.
[1006]	Readout Receive Error Counter	View the number of CAN control receipt errors since the last power-up.
[1007]	Readout Bus Off Counter	View the number of Bus Off events since the last power-up.

[1013]	Warning Parameter	View a DeviceNet-specific warning word. One separate bit is assigned to every warning.
[1115]	LON Warning Word	Shows the LON-specific warnings.
[1117]	XIF Revision	Shows the version of the external interface file of the Neuron C chip on the LON option.
[1118]	LON Works Revision	Shows the software version of the application program of the Neuron C chip on the LON option.
[1500]	Operating Hours	View the number of running hours of the frequency converter.
[1501]	Running Hours	View the number of running hours of the motor.
[1502]	kWh Counter	View the mains power consumption in kWh.
[1600]	Control Word	View the Control Word sent from the frequency converter via the serial communication port in hex code.
[1601] *	Reference [Unit]	Total reference (sum of digital/analog/preset/bus/freeze ref./catch up and slow-down) in selected unit.
[1602]	Reference %	Total reference (sum of digital/analog/preset/bus/freeze ref./catch up and slow-down) in percent.
[1603]	Status Word	Present status word
[1605]	Main Actual Value [%]	One or more warnings in a Hex code
[1609]	Custom Readout	View the user-defined readouts as defined in par. 0-30, 0-31 and 0-32.
[1610]	Power [kW]	Actual power consumed by the motor in kW.
[1611]	Power [hp]	Actual power consumed by the motor in HP.
[1612]	Motor Voltage	Voltage supplied to the motor.
[1613]	Motor Frequency	Motor frequency, i.e. the output frequency from the frequency converter in Hz.
[1614]	Motor Current	Phase current of the motor measured as effective value.
[1615]	Frequency [%]	Motor frequency, i.e. the output frequency from the frequency converter in percent.
[1616]	Torque [Nm]	Present motor load as a percentage of the rated motor torque.
[1617]	Speed [RPM]	Speed in RPM (revolutions per minute) i.e. the motor shaft speed in closed loop based on the entered motor nameplate data, the output frequency and the load on the frequency converter.
[1618]	Motor Thermal	Thermal load on the motor, calculated by the ETR function. See also parameter group 1-9* Motor Temperature.
[1622]	Torque [%]	Shows the actual torque produced, in percentage.
[1630]	DC Link Voltage	Intermediate circuit voltage in the frequency converter.
[1632]	BrakeEnergy/s	Present brake power transferred to an external brake resistor. Stated as an instantaneous value.
[1633]	BrakeEnergy/2 min	Brake power transferred to an external brake resistor. The mean power is calculated continuously for the most recent 120 seconds.
[1634]	Heatsink Temp.	Present heat sink temperature of the frequency converter. The cut-out limit is 95 ±5 oC; cutting back in occurs at 70 ±5° C.
[1635]	Thermal Drive Load	Percentage load of the inverters
[1636]	Inv. Nom. Current	Nominal current of the frequency converter
[1637]	Inv. Max. Current	Maximum current of the frequency converter
[1638]	SL Control State	State of the event executed by the control
[1639]	Control Card Temp.	Temperature of the control card.
[1650]	External Reference	Sum of the external reference as a percentage, i.e. the sum of analog/pulse/bus.
[1652]	Feedback [Unit]	Signal value in units from the programmed digital input(s).
[1653]	Digi Pot Reference	View the contribution of the digital potentiometer to the actual reference Feedback.
[1654]	Feedback 1 [Unit]	View the value of Feedback 1. See also par. 20-0*.
[1655]	Feedback 2 [Unit]	View the value of Feedback 2. See also par. 20-0*.
[1656]	Feedback 3 [Unit]	View the value of Feedback 3. See also par. 20-0*.
[1660]	Digital Input	Displays the status of the 6 digital input terminals (18, 19, 27, 29, 32 and 33). Input 18 corresponds to the bit at the far left. Signal low = 0; Signal high = 1
[1661]	Terminal 53 Switch Setting	Setting of input terminal 53. Current = 0; Voltage = 1.

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[1662]	Analog Input 53	Actual value at input 53 either as a reference or protection value.
[1663]	Terminal 54 Switch Setting	Setting of input terminal 54. Current = 0; Voltage = 1.
[1664]	Analog Input 54	Actual value at input 54 either as reference or protection value.
[1665]	Analog Output 42 [mA]	Actual value at output 42 in mA. Use par. 6-50 to select the variable to be represented by output 42.
[1666]	Digital Output [bin]	Binary value of all digital outputs.
[1667]	Freq. Input #29 [Hz]	Actual value of the frequency applied at terminal 29 as a pulse input.
[1668]	Freq. Input #33 [Hz]	Actual value of the frequency applied at terminal 33 as a pulse input.
[1669]	Pulse Output #27 [Hz]	Actual value of pulses applied to terminal 27 in digital output mode.
[1670]	Pulse Output #29 [Hz]	Actual value of pulses applied to terminal 29 in digital output mode.
[1671]	Relay Output [bin]	View the setting of all relays.
[1672]	Counter A	View the present value of Counter A.
[1673]	Counter B	View the present value of Counter B.
[1675]	Analog input X30/11	Actual value of the signal on input X30/11 (General Purpose I/O Card. Option)
[1676]	Analog input X30/12	Actual value of the signal on input X30/12 (General Purpose I/O Card. Optional)
[1677]	Analog output X30/8 [mA]	Actual value at output X30/8 (General Purpose I/O Card. Optional) Use Par. 6-60 to select the variable to be shown.
[1680]	Fieldbus CTW 1	Control word (CTW) received from the Bus Master.
[1682]	Fieldbus REF 1	Main reference value sent with control word via the serial communications network e.g. from the BMS, PLC or other master controller.
[1684]	Comm. Option STW	Extended fieldbus communication option status word.
[1685]	FC Port CTW 1	Control word (CTW) received from the Bus Master.
[1686]	FC Port REF 1	Status word (STW) sent to the Bus Master.
[1690]	Alarm Word	One or more alarms in a Hex code (used for serial communications)
[1691]	Alarm Word 2	One or more alarms in a Hex code (used for serial communications)
[1692]	Warning Word	One or more warnings in a Hex code (used for serial communications)
[1693]	Warning Word 2	One or more warnings in a Hex code (used for serial communications)
[1694]	Ext. Status Word	One or more status conditions in a Hex code (used for serial communications)
[1695]	Ext. Status Word 2	One or more status conditions in a Hex code (used for serial communications)
[1696]	Maintenance Word	The bits reflect the status for the programmed Preventive Maintenance Events in parameter group 23-1*
[1830]	Analog Input X42/1	Shows the value of the signal applied to terminal X42/1 on the Analog I/O card.
[1831]	Analog Input X42/3	Shows the value of the signal applied to terminal X42/3 on the Analog I/O card.
[1832]	Analog Input X42/5	Shows the value of the signal applied to terminal X42/5 on the Analog I/O card.
[1833]	Analog Out X42/7 [V]	Shows the value of the signal applied to terminal X42/7 on the Analog I/O card.
[1834]	Analog Out X42/9 [V]	Shows the value of the signal applied to terminal X42/9 on the Analog I/O card.
[1835]	Analog Out X42/11 [V]	Shows the value of the signal applied to terminal X42/11 on the Analog I/O card.
[2117]	Ext. 1 Reference [Unit]	The value of the reference for extended Closed Loop Controller 1
[2118]	Ext. 1 Feedback [Unit]	The value of the feedback signal for extended Closed Loop Controller 1
[2119]	Ext. 1 Output [%]	The value of the output from extended Closed Loop Controller 1
[2137]	Ext. 2 Reference [Unit]	The value of the reference for extended Closed Loop Controller 2
[2138]	Ext. 2 Feedback [Unit]	The value of the feedback signal for extended Closed Loop Controller 2
[2139]	Ext. 2 Output [%]	The value of the output from extended Closed Loop Controller 2
[2157]	Ext. 3 Reference [Unit]	The value of the reference for extended Closed Loop Controller 3
[2158]	Ext. 3 Feedback [Unit]	The value of the feedback signal for extended Closed Loop Controller 3
[2159]	Ext. Output [%]	The value of the output from extended Closed Loop Controller 3
[2230]	No-Flow Power	The calculated No Flow Power for the actual operating speed
[2580]	Cascade Status	Status for the operation of the Cascade Controller

[2581]	Pump Status	Status for the operation of each individual pump controlled by the Cascade Controller

NB!

Please consult the **VLT® AQUA Drive Programming Guide, MG.20.OX.YY** for detailed information.

0-21 Display Line 1.2 Small

Option:	Function:
	Select a variable for display in line 1, middle position.
[1662] * Analog input 53	The options are the same as those listed for par. 0-20 *Display Line 1.1 Small*.

0-22 Display Line 1.3 Small

Option:	Function:
	Select a variable for display in line 1, right position.
[1614] * Motor Current	The options are the same as those listed for par. 0-20 *Display Line 1.1 Small*.

0-23 Display Line 2 Large

Option:	Function:
	Select a variable for display in line 2. The options are the same as those listed for par. 0-20 *Display Line 1.1 Small*.
[1615] * Frequency	

0-24 Display Line 3 Large

Option:	Function:
[1652] * Feedback [Unit]	Select a variable for display in line 2. The options are the same as those listed for par. 0-20 *Display Line 1.1 Small*.

0-37 Display Text 1

Range:	Function:
0 N/A* [0 - 0 N/A]	In this parameter it is possible to write an individual text string for display in the LCP or to be read via serial communication. If to be displayed permanently select Display Text 1 in par. 0-20 Display *Line 1.1 Small*, par. 0-21 Display *Line 1.2 Small*, par. 0-22 Display *Line 1.3 Small*, par. 0-23 Display *Line 2 Large* or par. 0-24 Display *Line 3 Large*. Use the ▲ or ▼ buttons on the LCP to change a character. Use the ◄ and ► buttons to move the cursor. When a character is highlighted by the cursor, it can be changed. Use the ▲ or ▼ buttons on the LCP to change a character. A character can be inserted by placing the cursor between two characters and pressing ▲ or ▼.

0-38 Display Text 2

Range:	Function:
0 N/A* [0 - 0 N/A]	In this parameter it is possible to write an individual text string for display in the LCP or to be read via serial communication. If to be displayed permanently select Display Text 2 in par. 0-20 Display *Line 1.1 Small*, par. 0-21 Display *Line 1.2 Small*, par. 0-22 Display *Line 1.3 Small*, par. 0-23 Display *Line 2 Large* or par. 0-24 Display *Line 3 Large*. Use the ▲ or ▼ buttons on the LCP to change a character. Use the ◄ and ► buttons to move the cursor. When a character is highlighted by the cursor, this character can be changed. A character can be inserted by placing the cursor between two characters and pressing ▲ or ▼.

0-39 Display Text 3

Range:		Function:
0 N/A*	[0 - 0 N/A]	In this parameter it is possible to write an individual text string for display in the LCP or to be read via serial communication. If to be displayed permanently select Display Text 3 in par. 0-20 Display *Line 1.1 Small*, par. 0-21 Display *Line 1.2 Small*, par. 0-22 Display *Line 1.3 Small*, par. 0-23 Display *Line 2 Large* or par. 0-24 Display *Line 3 Large*. Use the ▲ or ▼ buttons on the LCP to change a character. Use the ◄ and ► buttons to move the cursor. When a character is highlighted by the cursor, this character can be changed. A character can be inserted by placing the cursor between two characters and pressing ▲ or ▼.

0-70 Set Date and Time

Range:		Function:
2000-01-01 00:00 – 2099-12-01 23:59 *	[2000-01-01 00:00]	Sets the date and time of the internal clock. The format to be used is set in par. 0-71 and 0-72.

NB!
This parameter does not display the actual time. This can be read in par. 0-89. The clock will not begin counting until a setting different from default has been made.

0-71 Date Format

Option:		Function:
[0] *	YYYY-MM-DD	Sets the date format to be used in the LCP.
[1]	DD-MM-YYYY	Sets the date format to be used in the LCP.
[2]	MM/DD/YYYY	Sets the date format to be used in the LCP.

0-72 Time Format

Option:		Function:
		Sets the time format to be used in the LCP.
[0] *	24 h	
[1]	12 h	

0-74 DST/Summertime

Option:		Function:
		Choose how Daylight Saving Time/Summertime should be handled. For manual DST/Summertime enter the start date and end date in par. 0-76 *DST/Summertime Start* and par. 0-77 *DST/Summertime End*.
[0] *	Off	
[2]	Manual	

0-76 DST/Summertime Start

Range:		Function:
0 N/A*	[0 - 0 N/A]	Sets the date and time when summertime/DST starts. The date is programmed in the format selected in par. 0-71 Date *Format*.

0-77 DST/Summertime End

Range:		Function:
0 N/A*	[0 - 0 N/A]	Sets the date and time when summertime/DST ends. The date is programmed in the format selected in par. 0-71 Date *Format*.

8.2.3. General Settings, 1-0*

Define whether the frequency converter operates in open loop or closed loop.

1-00 Configuration Mode

Option:		Function:
[0] *	Open Loop	Motor speed is determined by applying a speed reference or by setting desired speed when in Hand Mode. Open Loop is also used if the frequency converter is part of a closed loop control system based on an external PID controller providing a speed reference signal as output.
[3]	Closed Loop	Motor Speed will be determined by a reference from the built-in PID controller varying the motor speed as part of a closed loop control process (e.g. constant pressure or flow). The PID controller must be configured in par. 20-** or via the Function Setups accessed by pressing the [Quick Menus] button.

NB!
This parameter cannot be changed when motor is running.

NB!
When set for Closed Loop, the commands Reversing and Start Reversing will not reverse the direction of the motor.

8

1-20 Motor Power [kW]

Range:		Function:
4.00 kW*	[0.09 - 3000.00 kW]	Enter the nominal motor power in kW according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. This parameter cannot be adjusted while the motor is running. Depending on the choices made in par. 0-03 *Regional Settings*, either par. 1-20 *Motor Power [kW]* or par. 1-21 *Motor Power [HP]* is made invisible.

1-22 Motor Voltage

Range:		Function:
400. V*	[10. - 1000. V]	Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. This parameter cannot be adjusted while the motor is running.

1-23 Motor Frequency

Range:	Function:
[illegible]	[illegible]

> **NB!**
> This parameter cannot be adjusted while the motor is running.

1-24 Motor Current

Range:	Function:
[illegible]	[illegible]

> **NB!**
> This parameter cannot be adjusted while the motor is running.

8

1-25 Motor Nominal Speed

Range:	Function:
1420 RPM* [100 - 60000 RPM]	Enter the nominal motor speed value from the motor nameplate data. This data is used for calculating automatic motor compensations.

> **NB!**
> This parameter cannot be changed while the motor is running.

1-29 Automatic Motor Adaptation (AMA)

Option:		Function:
		[illegible]
[0] *	Off	No function
[1]	Enable complete AMA	performs AMA of the stator resistance R_S, the rotor resistance R_r, the stator leakage reactance X_1, the rotor leakage reactance X_2 and the main reactance X_h.
[2]	Enable reduced AMA	performs a reduced AMA of the stator resistance R_s in the system only. Select this option if an LC filter is used between the frequency converter and the motor.

Activate the AMA function by pressing [Hand on] after selecting [1] or [2]. See also the section *Automatic Motor Adaptation*. After a normal sequence, the display will read: "Press [OK] to finish AMA". After pressing the [OK] key the frequency converter is ready for operation.

Note:

- For the best adaptation of the frequency converter, run AMA on a cold motor
- AMA cannot be performed while the motor is running

NB!
It is important to set motor par. 1-2* Motor Data correctly, since these form part of the AMA algorithm. An AMA must be performed to achieve optimum dynamic motor performance. It may take up to 10 min., depending on motor power rating.

NB!
Avoid generating external torque during AMA

NB!
If one of the settings in par. 1-2* Motor Data is changed, par. 1-30 Stator *Resistance (Rs)* to par. 1-39 Motor *Poles*, the advanced motor parameters, will return to default setting.
This parameter cannot be adjusted while the motor is running

NB!
Full AMA should be run without filter only while reduced AMA should be run with filter.

See section *Automatic Motor Adaptation* - application example.

8.2.4. 3-0* Reference Limits

Parameters for setting the reference unit, limits and ranges.

3-02 Minimum Reference

Range:	Function:
0.000 Ref-erenceFeed-backUnit* [-999999.999 - par. 3-03 Referen-ceFeedbackUnit]	Enter the Minimum Reference. The Minimum Reference is the lowest value obtainable by summing all references. The Minimum Reference value and unit matches the configuration choice made in par. 1-00 *Configuration Mode* and par. 20-12 Reference/Feedback *Unit*, respectively. **NB!** This parameter is used in open loop only.

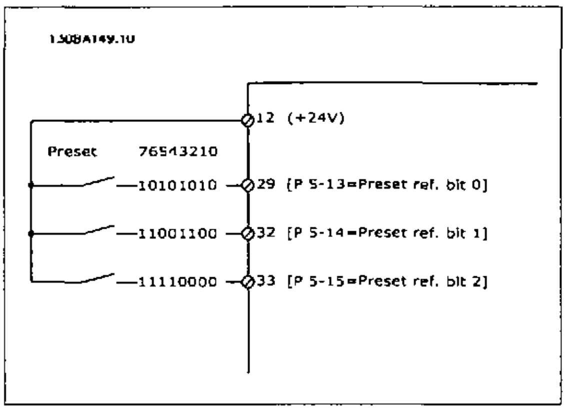
3-03 Maximum Reference

Range:	Function:
50.000 Ref-erenceFeed-backUnit* [par. 3-02 - 999999.999 Referen-ceFeedbackUnit]	Enter the Maximum Reference. The Maximum Reference is the highest value obtainable by summing all references. The Maximum Reference value and unit matches the configuration choice made in par. 1-00 *Configuration Mode* and par. 20-12 Reference/Feedback *Unit*, respectively. **NB!** This parameter is used in open loop only.

3-10 Preset Reference

Array [8]

Range:		Function:
0.00 %*	[-100.00 - 100.00 %]	Enter up to eight different preset references (0-7) in this parameter, using array programming. The preset reference is stated as a percentage of the value Ref_{MAX} (par. 3-03 Maximum Reference) or as a percentage of the other external references. If a Ref_{MIN} different from 0 (Par. 3-02 Minimum Reference) is programmed, the preset reference is calculated as a percentage of the full reference range, i.e. on the basis of the difference between Ref_{MAX} and Ref_{MIN}. Afterwards, the value is added to Ref_{MIN}. When using preset references, select Preset ref. bit 0 / 1 / 2 [16], [17] or [18] for the corresponding digital inputs in parameter group 5.1* Digital Inputs.



3-41 Ramp 1 Ramp Up Time

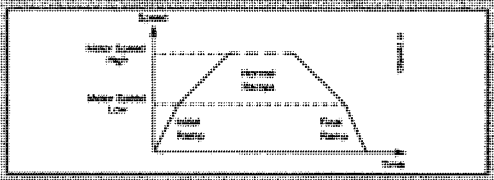
Range:		Function:
10.00 s*	[1.00 - 3600.00 s]	Enter the ramp-up time, i.e. the acceleration time from 0 RPM to par. 1-25. Choose a ramp-up time such that the output current does not exceed the current limit in par. 4-18 during ramping. See ramp-down time in par. 3-42 *Ramp 1 Ramp Down Time*. $par.3-41 = \frac{tacc \times nnorm\,[par.1-25]}{ref\,[rpm]}[s]$ See drawing above!

3-42 Ramp 1 Ramp Down Time

Range:		Function:
20.00 s*	[1.00 - 3600.00 s]	Enter the ramp-down time, i.e. the deceleration time from par. 1-25 *Motor Nominal Speed* to 0 RPM. Choose a ramp-down time such that no over-voltage arises in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in par. 4-18 Current *Limit*. See ramp-up time in par. 3-41 *Ramp 1 Ramp Up Time*. $par.3-42 = \frac{tdec \times nnorm\,[par.1-25]}{ref\,[rpm]}[s]$

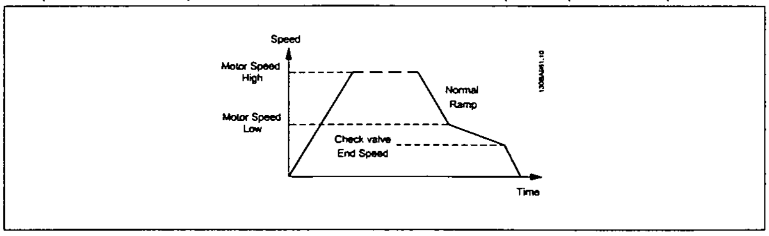
3-84 Initial Ramp Time

Range:		Function:
0 s*	[0 - 60 s]	Enter the initial ramp up time from zero speed to Motor Speed Low Limit, par. 4-11 or 4-12. Submersible deep well pumps can be damaged by running below minimum speed. A fast ramp time below minimum pump speed is recommended. This parameter may be applied as a fast ramp rate from zero speed to Motor Speed Low Limit.



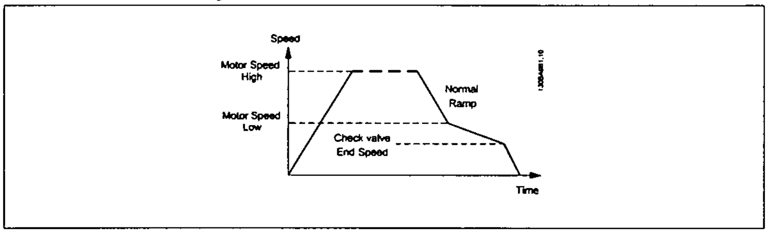
3-85 Check Valve Ramp Time

Range:		Function:
0 s*	[0 – 60 s]	In order to protect ball check valves in a stop situation, the check valve ramp can be utilized as a slow ramp rate from par. 4-11 *Motor Speed Low Limit [RPM]* or par. 4-12 Motor *Speed Low Limit [Hz]*, to Check Valve Ramp End Speed, set by the user in par. 3-86 or par. 3-87. When par. 3-85 is different from 0 seconds, the Check Valve Ramp Time is effectuated and will be used to ramp down the speed from Motor Speed Low Limit to the Check Valve End Speed in par. 3-86 or par. 3-87.



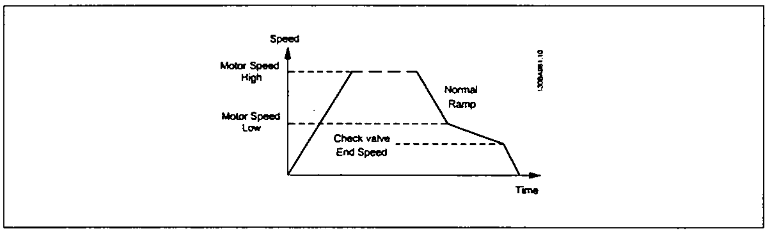
3-86 Check Valve Ramp End Speed [RPM]

Range:		Function:
0 [RPM]*	[0 – Motor Speed Low Limit [RPM]]	Set the speed in [RPM] below Motor Speed Low Limit where the Check Valve is expected to be closed and the Check Valve no longer shall be active.



3-87 Check Valve Ramp End Speed [Hz]

Range:		Function:
0 [Hz]*	[0 – Motor Speed Low Limit [Hz]]	Set the speed in [Hz] below Motor Speed Low Limit where the Check Valve Ramp will no longer be active.

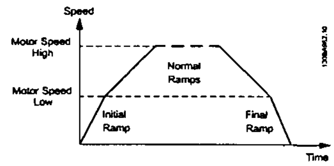


3-88 Final Ramp Time

Range:		Function:
0 [s]*	[0 – 60 [s]]	Enter the Final Ramp Time to be used when ramping down from Motor Speed Low Limit, par. 4-11 or 4-12, to zero speed.

8

Submersible deep well pumps can be damaged by running below minimum speed. A fast ramp time below minimum pump speed is recommended. This parameter may be applied as a fast ramp rate from Motor Speed Low Limit to zero speed.



8.2.5. 4-** Limits and Warnings

Parameter group for configuring limits and warnings.

4-11 Motor Speed Low Limit [RPM]

Range:		Function:
0 RPM*	[0 - par. 4-13 RPM]	Enter the minimum limit for motor speed. The Motor Speed Low Limit can be set to correspond to the manufacturer's recommended minimum motor speed. The Motor Speed Low Limit must not exceed the setting in par. 4-13 *Motor Speed High Limit [RPM]*.

4-13 Motor Speed High Limit [RPM]

Range:		Function:
1500. RPM*	[par. 4-11 - 60000. RPM]	Enter the maximum limit for motor speed. The Motor Speed High Limit can be set to correspond to the manufacturer's maximum rated motor. The Motor Speed High Limit must exceed the setting in par. 4-11 *Motor Speed Low Limit [RPM]*. Only par. 4-11 *Motor Speed Low Limit [RPM]* or par. 4-12 *Motor Speed Low Limit [Hz]* will be displayed depending on other parameters in the Main Menu and depending on default settings dependant on global location.

NB!

The output frequency value of the frequency converternot exceed a value higher than 1/10 of the switching frequency.

NB!

Any changes in par. 4-13 *Motor Speed High Limit [RPM]* will reset the value in par. 4-53 Warning *Speed High* to the same value as set in par. 4-13 *Motor Speed High Limit [RPM]*.

8.2.6. 5-** Digital In/Out

Parameter group for configuring the digital input and output.

5-01 Terminal 27 Mode		
Option:		**Function:**
[0] *	Input	Defines terminal 27 as a digital input.
[1]	Output	Defines terminal 27 as a digital output.

This parameter cannot be adjusted while the motor is running.

8.2.7. 5-1* Digital Inputs

Parameters for configuring the input functions for the input terminals.

The digital inputs are used for selecting various functions in the frequency converter. All digital inputs can be set to the following functions:

Digital input function	Select	Terminal
No operation	[0]	All *term 32, 33
Reset	[1]	All
Coast inverse	[2]	All
Coast and reset inverse	[3]	All
DC-brake inverse	[5]	All
Stop inverse	[6]	All
External interlock	[7]	All
Start	[8]	All *term 18
Latched start	[9]	All
Reversing	[10]	All *term 19
Start reversing	[11]	All
Jog	[14]	All *term 29
Preset reference on	[15]	All
Preset ref bit 0	[16]	All
Preset ref bit 1	[17]	All
Preset ref bit 2	[18]	All
Freeze reference	[19]	All
Freeze output	[20]	All
Speed up	[21]	All
Speed down	[22]	All
Set-up select bit 0	[23]	All
Set-up select bit 1	[24]	All
Pulse input	[32]	term 29, 33
Ramp bit 0	[34]	All
Mains failure inverse	[36]	All
Run Permissive	[52]	
Hand start	[53]	
Auto start	[54]	
DigiPot Increase	[55]	All
DigiPot Decrease	[56]	All
DigiPot Clear	[57]	All
Counter A (up)	[60]	29, 33
Counter A (down)	[61]	29, 33
Reset Counter A	[62]	All
Counter B (up)	[63]	29, 33
Counter B (down)	[64]	29, 33
Reset Counter B	[65]	All
Sleep Mode	[66]	
Reset Maintenance Word	[78]	
Lead Pump Start	[120]	
Lead Pump Alternation	[121]	
Pump 1 Interlock	[130]	
Pump 2 Interlock	[131]	
Pump 3 Interlock	[132]	

All = Terminals 18, 19, 27, 29, 32, X30/2, X30/3, X30/4. X30/ are the terminals on MCB 101.

Functions dedicated to only one digital input are stated in the associated parameter.

All digital inputs can be programmed to these functions:

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[0]	No operation	No reaction to signals transmitted to terminal.
[1]	Reset	Resets frequency converter after a TRIP/ALARM. Not all alarms can be reset.
[2]	Coast inverse	Leaves motor in free mode. Logic '0' => coasting stop. (Default Digital input 27): Coasting stop, inverted input (NC).
[3]	Coast and reset inverse	Reset and coasting stop Inverted input (NC). Leaves motor in free mode and resets the frequency converter. Logic '0' => coasting stop and reset.
[5]	DC-brake inverse	Inverted input for DC braking (NC). Stops motor by energizing it with a DC current for a certain time period. See par. 2-01 to par. 2-03. The function is only active when the value in par. 2-02 is different from 0. Logic '0' => DC braking.
[6]	Stop inverse	Stop Inverted function. Generates a stop function when the selected terminal goes from logical level '1' to '0'. The stop is performed according to the selected ramp time (par. 3-42, par. 3-52, par. 3-62, par. 3-72).

NB!
When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *Torque limit & stop* [27] and connect this digital output to a digital input that is configured as coast.

[7]	External Interlock	Same function as Coasting stop, inverse, but External Interlock generates the alarm message 'external fault' on the display when the terminal which is programmed for Coast Inverse is logic '0'. The alarm message will also be active via digital outputs and relay outputs, if programmed for External Interlock. The alarm can be reset using a digital input or the [RESET] key if the cause for the External Interlock has been removed. A delay can be programmed in par. 22-00, External Interlock Time. After applying a signal to the input, the reaction described above will be delayed with the time set in par. 22-00.
[8]	Start	Select start for a start/stop command. Logic '1' = start, logic '0' = stop. (Default Digital input 18)
[9]	Latched start	Motor starts, if a pulse is applied for min. 2 ms. Motor stops when Stop inverse is activated
[10]	Reversing	Changes direction of motor shaft rotation. Select Logic '1' to reverse. The reversing signal only changes the direction of rotation. It does not activate the start function. Select both directions in par. 4-10 *Motor Speed Direction*. (Default Digital input 19).
[11]	Start reversing	Used for start/stop and for reversing on the same wire. Signals on start are not allowed at the same time.
[14]	Jog	Used for activating jog speed. See par. 3-11. (Default Digital input 29)
[15]	Preset reference on	Used for shifting between external reference and preset reference. It is assumed that *External/preset* [1] has been selected in par. 3-04. Logic '0' = external reference active; logic '1' = one of the eight preset references is active.
[16]	Preset ref bit 0	Enables a choice between one of the eight preset references according to the table below.
[17]	Preset ref bit 1	Enables a choice between one of the eight preset references according to the table below.
[18]	Preset ref bit 2	Enables a choice between one of the eight preset references according to the table below.

Preset ref. bit	2	1	0
Preset ref. 0	0	0	0
Preset ref. 1	0	0	1
Preset ref. 2	0	1	0
Preset ref. 3	0	1	1
Preset ref. 4	1	0	0
Preset ref. 5	1	0	1
Preset ref. 6	1	1	0
Preset ref. 7	1	1	1

[19]	Freeze ref	Freezes actual reference. The frozen reference is now the point of enable/condition for Speed up and Speed down to be used. If Speed up/down is used, the speed change always follows ramp 2 (par. 3-51 and 3-52) in the range 0 - par. 3-03 *Maximum Reference*.

[20]	Freeze output	Freezes actual motor frequency (Hz). The frozen motor frequency is now the point of enable/condition for Speed up and Speed down to be used. If Speed up/down is used, the speed change always follows ramp 2 (par. 3-51 and 3-52) in the range 0 - par. 1-23 *Motor Frequency*. **NB!** When Freeze output is active, the frequency converter cannot be stopped via a low 'start [13]' signal. Stop the frequency converter via a terminal programmed for Coasting inverse [2] or Coast and reset, inverse [3].
[21]	Speed up	For digital control of the up/down speed is desired (motor potentiometer). Activate this function by selecting either Freeze reference or Freeze output. When Speed up is activated for less than 400 msec. the resulting reference will be increased by 0.1 %. If Speed up is activated for more than 400 msec. the resulting reference will ramp according to Ramp 1 in par. 3-41.
[22]	Speed down	Same as Speed up [21].
[23]	Set-up select bit 0	Selects one of the four set-ups. Set par. 0-10 *Active Set-up* to Multi Set-up.
[24]	Set-up select bit 1	Same as Set-up select bit 0 [23]. (Default Digital input 32)
[32]	Pulse input	Select Pulse input when using a pulse sequence as either reference or feedback. Scaling is done in par. group 5-5*.
[34]	Ramp bit 0	Select which ramp to use. Logic "0" will select ramp 1 while logic "1" will select ramp 2.
[36]	Mains failure inverse	Activates par. 14-10 *Mains Failure*. Mains failure inverse is active in the Logic "0" situation.
[52]	Run Permissive	The input terminal, for which the Run permissive has been programmed must be logic "1" before a start command can be accepted. Run permissive has a logic 'AND' function related to the terminal which is programmed for *START* [8], *Jog* [14] or *Freeze Output* [20], which means that in order to start running the motor, both conditions must be fulfilled. If Run Permissive is programmed on multiple terminals, Run permissive needs only be logic '1' on one of the terminals for the function to be carried out. The digital output signal for Run Request (*Start* [8], *Jog* [14] or *Freeze output* [20]) programmed in par. 5-3* Digital outputs, or par. 5-4* Relays, will not be affected by Run Permissive.
[53]	Hand start	A signal applied will put the frequency converter into Hand mode as if button *Hand On* on the LCP has been pressed and a normal stop command will be overridden. If disconnecting the signal, the motor will stop. To make any other start commands valid, another digital input must be assign to *Auto Start* and a signal applied to this. The *Hand On* and *Auto On* buttons on the LCP has no impact. The *Off* button on the LCP will override *Hand Start* and *Auto Start*. Press either the *Hand On* or *Auto On* button to make *Hand Start* and *Auto Start* active again. If no signal on neither *Hand Start* nor *Auto Start*, the motor will stop regardless of any normal Start command applied. If signal applied to both *Hand Start* and *Auto Start*, the function will be *Auto Start*. If pressing the *Off* button on the LCP the motor will stop regardless of signals on *Hand Start* and *Auto Start*.
[54]	Auto start	A signal applied will put the frequency converter into Auto mode as if the LCP button *Auto On* has been pressed. See also *Hand Start* [53]
[55]	DigiPot Increase	Uses the input as an INCREASE signal to the Digital Potentiometer function described in parameter group 3-9*
[56]	DigiPot Decrease	Uses the input as a DECREASE signal to the Digital Potentiometer function described in parameter group 3-9*
[57]	DigiPot Clear	Uses the input to CLEAR the Digital Potentiometer reference described in parameter group 3-9*
[60]	Counter A (up)	(Terminal 29 or 33 only) Input for increment counting in the SLC counter.
[61]	Counter A (down)	(Terminal 29 or 33 only) Input for decrement counting in the SLC counter.
[62]	Reset Counter A	Input for reset of counter A.
[63]	Counter B (up)	(Terminal 29 and 33 only) Input for increment counting in the SLC counter.
[64]	Counter B (down)	(Terminal 29 and 33 only) Input for decrement counting in the SLC counter.
[65]	Reset Counter B	Input for reset of counter B.
[66]	Sleep Mode	Forces frequency converter into Sleep Mode (see par. 22-4*, Sleep Mode). Reacts on the rising edge of signal applied!
[78]	Reset Preventive Maintenance Word	Resets all data in par. 16-96, Preventive Maintenance Word, to 0.

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The below setting options are all related to the Cascade Controller. Wiring diagrams and settings for parameter, see group 25-** for more details.

[120]	Lead Pump Start	Starts/Stops the Lead Pump (controlled by the frequency converter). A start requires that also a System Start signal has been applied e.g. to one of the digital inputs set for *Start* [8]!
[121]	Lead Pump Alternation	Forces alternation of the lead pump in a Cascade Controller. *Lead Pump Alternation,* par. 25-50, must be set to either *At Command* [2] or *At Staging or At Command* [3]. *Alternation Event,* par. 25-51, can be set to any of the four options.
[130 - 138]	Pump1 Interlock - Pump9 Interlock	For the above 9 setting options, par. 25-10, Pump Interlock, must be set to *On* [1]. The function will also depend on the setting in par. 25-06, Fixed Lead Pump. If set to *No* [0], then Pump1 refers to the pump controlled by relay RELAY1 etc. If set to *Yes* [1], Pump1 refers to the pump controlled by the frequency converter only (without any of the build in relays involved) and Pump2 to the pump controlled by the relay RELAY1. Variable speed pump (lead) cannot be interlocked in the basic Cascade Controller. See below table:

Setting in Par. 5-1*	Setting in Par. 25-06	
	[0] No	[1] Yes
[130] Pump1 Interlock	Controlled by RELAY1 (only if not lead pump)	Frequency Converter controlled (cannot be interlocked)
[131] Pump2 Interlock	Controlled by RELAY2	Controlled by RELAY1
[132] Pump3 Interlock	Controlled by RELAY3	Controlled by RELAY2
[133] Pump4 Interlock	Controlled by RELAY4	Controlled by RELAY3
[134] Pump5 Interlock	Controlled by RELAY5	Controlled by RELAY4
[135] Pump6 Interlock	Controlled by RELAY6	Controlled by RELAY5
[136] Pump7 Interlock	Controlled by RELAY7	Controlled by RELAY6
[137] Pump8 Interlock	Controlled by RELAY8	Controlled by RELAY7
[138] Pump9 Interlock	Controlled by RELAY9	Controlled by RELAY8

5-13 Terminal 29 Digital Input

Option:		Function:
[0] *	No Operation	Same options and functions as par. 5-1* *Digital Inputs*.

5-14 Terminal 32 Digital Input

Option:		Function:
[0] *	No operation	Same options and functions as par. 5-1*, except for *Pulse input*.
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	

[19]	Freeze reference
[20]	Freeze output
[21]	Speed up
[22]	Speed down
[23]	Set-up select bit 0
[24]	Set-up select bit 1
[34]	Ramp bit 0
[36]	Mains failure inverse
[37]	Fire Mode
[52]	Run permissive
[53]	Hand start
[54]	Auto start
[55]	DigiPot increase
[56]	DigiPot decrease
[57]	DigiPot clear
[62]	Reset Counter A
[65]	Reset Counter B
[66]	Sleep Mode
[78]	Reset Maint. Word
[120]	Lead Pump Start
[121]	Lead Pump Alternation
[130]	Pump 1 Interlock
[131]	Pump 2 Interlock
[132]	Pump 3 Interlock

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5-15 Terminal 33 Digital Input

Option:		Function:
[0] *	No operation	Same options and functions as par. 5-1* Digital Inputs.
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	

[23]	Set-up select bit 0
[24]	Set-up select bit 1
[30]	Counter input
[32]	Pulse input
[34]	Ramp bit 0
[36]	Mains failure inverse
[37]	Fire Mode
[52]	Run permissive
[53]	Hand start
[54]	Auto start
[55]	DigiPot increase
[56]	DigiPot decrease
[57]	DigiPot clear
[60]	Counter A (up)
[61]	Counter A (down)
[62]	Reset Counter A
[63]	Counter B (up)
[64]	Counter B (down)
[65]	Reset Counter B
[66]	Sleep Mode
[78]	Reset Maint. Word
[120]	Lead Pump Start
[121]	Lead Pump Alternation
[130]	Pump 1 Interlock
[131]	Pump 2 Interlock
[132]	Pump 3 Interlock

5-30 Terminal 27 Digital Output

Option:		Function:
[0] *	No operation	Same options and functions as par. 5-3*.
[1]	Control ready	
[2]	Drive ready	
[3]	Drive rdy/rem ctrl	
[4]	Standby / no warning	
[5]	Running	
[6]	Running / no warning	
[8]	Run on ref/no warn	
[9]	Alarm	
[10]	Alarm or warning	
[11]	At torque limit	
[12]	Out of current range	
[13]	Below current, low	
[14]	Above current, high	
[15]	Out of speed range	
[16]	Below speed, low	
[17]	Above speed, high	
[18]	Out of feedb. range	

[19]	Below feedback, low
[20]	Above feedback, high
[21]	Thermal warning
[25]	Reverse
[26]	Bus OK
[27]	Torque limit & stop
[28]	Brake, no brake war
[29]	Brake ready, no fault
[30]	Brake fault (IGBT)
[35]	External Interlock
[40]	Out of ref range
[41]	Below reference, low
[42]	Above ref, high
[45]	Bus ctrl.
[46]	Bus ctrl, 1 if timeout
[47]	Bus ctrl, 0 if timeout
[55]	Pulse output
[60]	Comparator 0
[61]	Comparator 1
[62]	Comparator 2
[63]	Comparator 3
[64]	Comparator 4
[65]	Comparator 5
[70]	Logic rule 0
[71]	Logic rule 1
[72]	Logic rule 2
[73]	Logic rule 3
[74]	Logic rule 4
[75]	Logic rule 5
[80]	SL digital output A
[81]	SL digital output B
[82]	SL digital output C
[83]	SL digital output D
[84]	SL digital output E
[85]	SL digital output F
[160]	No alarm
[161]	Running reverse
[165]	Local ref active
[166]	Remote ref active
[167]	Start command act.
[168]	Hand mode
[169]	Auto mode
[180]	Clock Fault
[181]	Prev. Maintenance
[190]	No-Flow
[191]	Dry Pump
[192]	End Of Curve

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[193]	Sleep Mode
[194]	Broken Belt
[195]	Bypass Valve Control
[196]	Fire Mode
[197]	Fire Mode was Act.
[198]	Drive Bypass
[200]	Full capacity
[201]	Pump 1 running
[202]	Pump 2 running
[203]	Pump 3 running

5-40 Function Relay

Array [8]	(Relay 1 [0], Relay 2 [1], Relay 7 [6], Relay 8 [7], Relay 9 [8])

Select options to define the function of the relays.

The selection of each mechanical relay is realised in an array parameter.

[0]	No Operation
[1]	Control Ready
[2]	Drive Ready
[3]	Drive Ready/Remote
[4]	Stand-by/No Warning
[5] *	Running
[6]	Running/No Warning
[8]	Run on Ref./No Warning
[9]	Alarm
[10]	Alarm or Warning
[11]	At Torque Limit
[12]	Out of Current Range
[13]	Below Current, low
[14]	Above Current, high
[15]	Out of Speed Range
[16]	Below Speed, low
[17]	Above Speed, high
[18]	Out of Feedb. Range
[19]	Below Feedback, low
[20]	Above Feedback, high
[21]	Thermal Warning
[25]	Reverse
[26]	Bus OK
[27]	Torque Limit & Stop
[28]	Brake, No Warning
[29]	Brake Ready, No Fault
[30]	Brake Fault (IGBT)
[35]	External Interlock
[36]	Control Word Bit 11
[37]	Control Word Bit 12

[40]	Out of Ref. Range
[41]	Below Reference, low
[42]	Above Ref. high
[45]	Bus ctrl
[46]	Bus ctrl, 1 if timeout
[47]	Bus ctrl, 0 if timeout
[60]	Comparator 0
[61]	Comparator 1
[62]	Comparator 2
[63]	Comparator 3
[64]	Comparator 4
[65]	Comparator 5
[70]	Logic Rule 0
[71]	Logic Rule 1
[72]	Logic Rule 2
[73]	Logic Rule 3
[74]	Logic Rule 4
[75]	Logic Rule 5
[80]	SL Digital Output A
[81]	SL Digital Output B
[82]	SL Digital Output C
[83]	SL Digital Output D
[84]	SL Digital Output E
[85]	SL Digital Output F
[160]	No Alarm
[161]	Running Reverse
[165]	Local Ref. Active
[166]	Remote Ref. Active
[167]	Start Cmd. Active
[168]	Drive in Hand Mode
[169]	Drive in Auto Mode
[180]	Clock Fault
[181]	Prev. Maintenance
[190]	No-Flow
[191]	Dry Pump
[192]	End of Curve
[193]	Sleep Mode
[194]	Broken Belt
[195]	Bypass Valve Control
[199]	Pipe Filling
[211]	Cascade Pump1
[212]	Cascade Pump2
[213]	Cascade Pump3
[223]	Alarm, Trip Locked
[224]	Bypass Mode Active

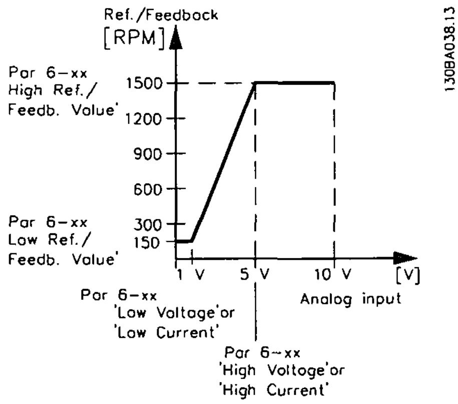
5-53 Term. 29 High Ref./Feedb. Value	
Range:	**Function:**
100.000 N/A* [-999999.999 - 999999.999 N/A]	Enter the high reference value [RPM] for the motor shaft speed and the high feedback value, see also par. 5-58 Term. *33 High Ref./Feedb. Value*.

8.2.8. 6-** Analog In/Out

Parameter group for configuration of the analog input and output.

6-00 Live Zero Timeout Time	
Range:	**Function:**
[illegible]	[illegible]

6-01 Live Zero Timeout Function	
Option:	**Function:**
	[illegible]
[0] *	Off
[1]	Freeze output
[2]	Stop
[3]	Jogging
[4]	Max. speed
[5]	Stop and trip



6-10 Terminal 53 Low Voltage

Range:		Function:
0.07 V*	[0.00 - par. 6-11 V]	Enter the low voltage value. This analog input scaling value should correspond to the low reference/ feedback value set in par. 6-14 *Terminal 53 Low Ref./Feedb. Value*.

6-11 Terminal 53 High Voltage

Range:		Function:
10.00 V*	[par. 6-10 - 10.00 V]	Enter the high voltage value. The analog input scaling value should correspond to the high reference/feedback value set in par. 6-15 *Terminal 53 High Ref./Feedb. Value*.

6-14 Terminal 53 Low Ref./Feedb. Value

Range:		Function:
0.000 N/A*	[-999999.999 - 999999.999 N/A]	Enter the analog input scaling value that corresponds to the low voltage/low current set in par. 6-10 *Terminal 53 Low Voltage* and par. 6-12 *Terminal 53 Low Current*.

6-15 Terminal 53 High Ref./Feedb. Value

Range:		Function:
50.000 N/A*	[-999999.999 - 999999.999 N/A]	Enter the analog input scaling value that corresponds to the high voltage/high current value set in par. 6-11 *Terminal 53 High Voltage* and par. 6-13 *Terminal 53 High Current*.

6-20 Terminal 54 Low Voltage

Range:		Function:
0.07 V*	[0.00 - par. 6-21 V]	Enter the low voltage value. This analog input scaling value should correspond to the low reference/ feedback value, set in par. 6-24 *Terminal 54 Low Ref./Feedb. Value*.

6-21 Terminal 54 High Voltage

Range:		Function:
10.00 V*	[par. 6-20 - 10.00 V]	Enter the high voltage value. This analog input scaling value should correspond to the high reference/feedback value set in par. 6-25 *Terminal 54 High Ref./Feedb. Value*.

6-24 Terminal 54 Low Ref./Feedb. Value

Range:		Function:
0.000 N/A*	[-999999.999 - 999999.999 N/A]	Enter the analog input scaling value that corresponds to the low voltage/low current value set in par. 6-20 *Terminal 54 Low Voltage* and par. 6-22 *Terminal 54 Low Current*.

6-25 Terminal 54 High Ref./Feedb. Value

Range:	Function:
100.000 N/A* [-999999.999 - 999999.999 N/A]	Enter the analog input scaling value that corresponds to the high voltage/high current value set in par. 6-21 *Terminal 54 High Voltage* and par. 6-23 *Terminal 54 High Current*.

6-50 Terminal 42 Output

Option:		Function:
		Select the function of Terminal 42 as an analog current output.
[0] *	No operation	
[100]	Output freq. 0-100	: 0 - 100 Hz
[101]	Reference Min-Max	: Minimum reference - Maximum reference
[102]	Feedback +-200%	: -200% to +200% of par. 2-14
[103]	Motor cur. 0-Imax	: 0 - Inverter Max. Current (par. 16-37)
[104]	Torque 0-Tlim	: 0 - Torque limit (par. 4-16)
[105]	Torque 0-Tnom	: 0 - Motor rated torque
[106]	Power 0-Pnom	: 0 - Motor rated power
[107]	Speed 0-HighLim	: 0 - Speed High Limit (par. 4-13 and par. 4-14)
[113]	Ext. Closed Loop 1	0 - 100%
[114]	Ext. Closed Loop 2	0 - 100%
[115]	Ext. Closed Loop 3	0 - 100%
[130]	Out frq 0-100 4-20mA	:0 - 100 Hz
[131]	Reference 4-20mA	Minimum Reference - Maximum Reference
[132]	Feedback 4-20mA	-200% to +200% of par. 2-14
[133]	Motor cur. 4-20mA	0 - Inverter Max. Current (par. 16-37 Inv. *Max. Current*)
[134]	Torq.0-lim 4-20 mA	:0 - Torque limit (par. 4-16)
[135]	Torq.0-nom 4-20mA	:0 - Motor rated torque
[136]	Power 4-20mA	0 - Motor rated power
[137]	Speed 4-20mA	0 - Speed High Limit (par. 4-13 and par. 4-14)
[139]	Bus ctrl.	0 - 100%
[140]	Bus ctrl. 4-20 mA	0 - 100%
[141]	Bus ctrl t.o.	0 - 100%
[142]	Bus ctrl t.o. 4-20mA	0 - 100%
[143]	Ext. CL 1 4-20mA	0 - 100%
[144]	Ext. CL 2 4-20mA	0 - 100%
[145]	Ext. CL 3 4-20mA	0 - 100%

NB!
Values for setting the Minimum Reference is found in par. 3-02 *Minimum Reference* and par. 20-13 Minimum *Reference/Feedb.* - values for Maximum Reference is found in par. 3-03 *Maximum Reference* and par. 20-14 Maximum *Reference/Feedb.*.

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6-51 Terminal 42 Output Min Scale

Range: **Function:**

6-52 Terminal 42 Output Max Scale

Range: **Function:**

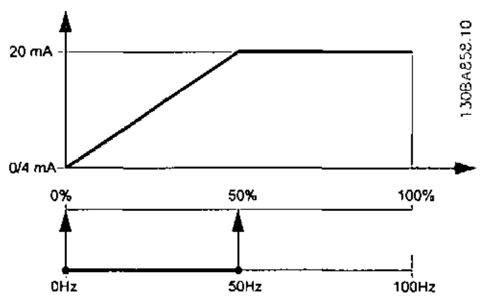
EXAMPLE 1:

Variable value= OUTPUT FREQUENCY, range = 0-100 Hz

Range needed for output = 0-50 Hz

Output signal 0 or 4 mA is needed at 0 Hz (0% of range) - set par. 6-51 *Terminal 42 Output Min Scale* to 0%

Output signal 20 mA is needed at 50 Hz (50% of range) - set par. 6-52 *Terminal 42 Output Max Scale* to 50%



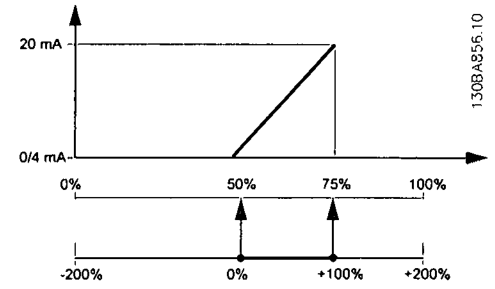
EXAMPLE 2:

Variable= FEEDBACK, range= -200% to +200%

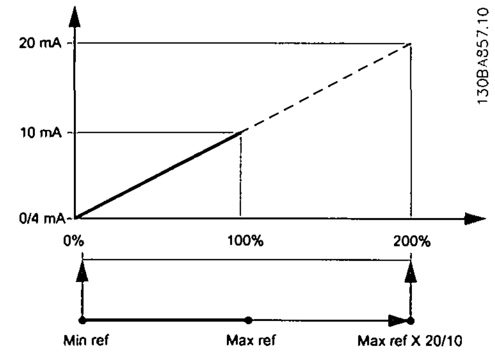
Range needed for output= 0-100%

Output signal 0 or 4 mA is needed at 0% (50% of range) - set par. 6-51 *Terminal 42 Output Min Scale* to 50%

Output signal 20 mA is needed at 100% (75% of range) - set par. 6-52 *Terminal 42 Output Max Scale* to 75%



EXAMPLE 3:
Variable value= REFERENCE, range= Min ref - Max ref
Range needed for output= Min ref (0%) - Max ref (100%), 0-10 mA
Output signal 0 or 4 mA is needed at Min ref - set par. 6-51 *Terminal 42 Output Min Scale* to 0%
Output signal 10 mA is needed at Max ref (100% of range) - set par. 6-52 *Terminal 42 Output Max Scale* to 200%
(20 mA / 10 mA x 100%=200%).



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8.2.9. Drive Closed Loop, 20-**

This parameter group is used for configuring the closed loop PID Controller, that controls the output frequency of the frequency converter.

20-12 Reference/Feedback Unit

Option:		Function:
[0]	None	
[1] *	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	

[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in Hg	
[180]	HP	This parameter determines the unit that is used for the setpoint reference and feedback that the PID Controller will use for controlling the output frequency of the frequency converter.

20-21 Setpoint 1

Range:		Function:
0.000 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	Setpoint 1 is used in Closed Loop Mode to enter a setpoint reference that is used by the frequency converter's PID Controller. See the description of par. 20-20 Feedback Function. **NB!** Setpoint reference entered here is added to any other references that are enabled (see par. group 3-1*).

20-81 PID Normal/Inverse Control

Option:		Function:
[0] *	Normal	
[1]	Inverse	*Normal* [0] causes the frequency converter's output frequency to decrease when the feedback is greater than the setpoint reference. This is common for pressure-controlled supply fan and pump applications. *Inverse* [1] causes the frequency converter's output frequency to increase when the feedback is greater than the setpoint reference.

20-82 PID Start Speed [RPM]

Range:		Function:
0 RPM*	[0 - par. 4-13 RPM]	When the frequency converter is first started, it initially ramps up to this output speed in Open Loop Mode, following the active Ramp Up Time. When the output speed programmed here is reached, the frequency converter will automatically switch to Closed Loop Mode and the PID Controller will begin to function. This is useful in applications in which the driven load must first quickly accelerate to a minimum speed when it is started. **NB!** This parameter will only be visible if par. 0-02 *Motor Speed Unit* is set to [0], RPM.

20-93 PID Proportional Gain

Range:		Function:
0.50 N/A*	[0.00 - 10.00 N/A]	When the difference between the feedback and the setpoint reference is less than the value of this parameter, the frequency converter's display will show "Run on Reference". This status can be communicated externally by programming the function of a digital output for *Run on Reference/No Warning* [8]. In addition, for serial communications, the On Reference status bit of the frequency converter's Status Word will be high (1). The *On Reference Bandwidth* is calculated as a percentage of the setpoint reference.

20-94 PID Integral Time

Range:		Function:
20.00 s*	[0.01 - 10000.00 s]	The integrator adds over time (integrates) the error between the feedback and the setpoint reference. This is required to ensure that the error approaches zero. Quick frequency converter speed adjustment is obtained when this value is small. However, if too small of a value is used, the frequency converter's output frequency may become unstable.

8.2.10. 22-** Miscellaneous

This group contains parameters used for monitoring water/ wastewater applications.

22-20 Low Power Auto Set-up

Option:		Function:
		When set for *Enabled*, an auto set up sequence is activated, automatically setting speed to approx. 50 and 85% of rated motor speed (par. 4-13 *Motor Speed High Limit [RPM]*, par. 4-14 Motor *Speed High Limit [Hz]*). At those two speeds, the power consumption is automatically measured and stored. Before enabling Auto Set Up: 1. Close valve(s) in order to create a no flow condition 2. The frequency converter must be set for Open Loop (par. 1-00 *Configuration Mode*). Note that it is important also to set par. 1-03 Torque *Characteristics*.
[0] *	Off	
[1]	Enabled	

NB!
Auto Set Up must be done when the system has reached normal operating temperature!

NB!
It is important that the par. 4-13 *Motor Speed High Limit [RPM]* or par. 4-14 Motor *Speed High Limit [Hz]* is set to the max. operational speed of the motor!
It is important to do the Auto Set-up before configuring the integrated PI Contoller as settings will be reset when changing from Closed to Open Loop in par. 1-00 *Configuration Mode*.

NB!
Carry out the tuning with the same settings in par. 1-03 Torque *Characteristics*, as for operation after the tuning.

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22-21 Low Power Detection

Option:		Function:
[0] *	Disabled	
[1]	Enabled	If selecting Enabled, the Low Power Detection commissioning must be carried out in order to set the parameters in group 22-3* for proper operation!

22-22 Low Speed Detection

Option:		Function:
[0] *	Disabled	
[1]	Enabled	Select Enabled for detecting when the motor operates with a speed as set in par. 4-11 *Motor Speed Low Limit [RPM]* or par. 4-12 Motor *Speed Low Limit [Hz]*.

22-23 No-Flow Function

Option:		Function:
		Common actions for Low Power Detection and Low Speed Detection (Individual selections not possible).
[0] *	Off	
[1]	Sleep Mode	
[2]	Warning	Messages in the Local Control Panel display (if mounted) and/or signal via a relay or a digital output.
[3]	Alarm	The frequency converter trips and motor stays stopped until reset.

22-24 No-Flow Delay

Range:		Function:
10 s*	[1 - 600 s]	Set the time Low Power/Low Speed must stay detected to activate signal for actions. If detection disappears before run out of the timer, the timer will be reset.

22-26 Dry Pump Function

Option:		Function:
		Low Power Detection must be Enabled (par. 22-21 *Low Power Detection*) and commissioned (using either par. 22-3*, *No Flow Power Tuning*, or par. 22-20 *Low Power Auto Set-up*) in order to use Dry Pump Detection.
[0] *	Off	
[1]	Warning	Messages in the Local Control Panel display (if mounted) and/or signal via a relay or a digital output.
[2]	Alarm	The frequency converter trips and motor stays stopped until reset.

22-27 Dry Pump Delay

Range:		Function:
10 s*	[0 - 600 s]	Defines for how long the Dry Pump condition must be active before activating Warning or Alarm

8

22-30 No-Flow Power

Range:		Function:
0.00 kW*	[0.00 - 0.00 kW]	Read out of calculated No Flow power at actual speed. If power drops to the display value the frequency converter will consider the condition as a No Flow situation.

22-31 Power Correction Factor

Range:		Function:
100 %*	[1 - 400 %]	Make corrections to the calculated power at par. 22-30 *No-Flow Power*. If No Flow is detected, when it should not be detected, the setting should be decreased. However, if No Flow is not detected, when it should be detected, the setting should be increased to above 100%.

22-32 Low Speed [RPM]

Range:		Function:
0 RPM*	[0 - par. 22-36 RPM]	To be used if par. 0-02 Motor *Speed Unit* has been set for RPM (parameter not visible if Hz selected). Set used speed for the 50% level. This function is used for storing values needed to tune No Flow Detection.

22-33 Low Speed [Hz]

Range:		Function:
0 Hz*	[0.0 - par. 22-37 Hz]	To be used if par. 0-02 Motor *Speed Unit* has been set for Hz (parameter not visible if RPM selected). Set used speed for the 50% level. The function is used for storing values needed to tune No Flow Detection.

22-34 Low Speed Power [kW]

Range:		Function:
0 kW*	[0.00 - 0.00 kW]	To be used if par. 0-03 Regional *Settings* has been set for International (parameter not visible if North America selected). Set power consumption at 50% speed level. This function is used for storing values needed to tune No Flow Detection.

22-35 Low Speed Power [HP]

Range:		Function:
[illegible]	[illegible]	[illegible]

22-36 High Speed [RPM]

Range:		Function:
[illegible]	[illegible]	[illegible]

22-37 High Speed [Hz]

Range:		Function:
[illegible]	[illegible]	[illegible]

22-38 High Speed Power [kW]

Range:		Function:
[illegible]	[illegible]	[illegible]

22-39 High Speed Power [HP]

Range:		Function:
[illegible]	[illegible]	[illegible]

22-40 Minimum Run Time

Range:		Function:
[illegible]	[illegible]	[illegible]

22-41 Minimum Sleep Time

Range:		Function:
10 s*	[0 - 600 s]	Set the desired minimum time for staying in Sleep Mode. This will override any wake up conditions.

22-42 Wake-up Speed [RPM]

Range:		Function:
[illegible]	[illegible]	[illegible]

8

22-43 Wake-up Speed [Hz]

Range:		Function:
0 Hz*	[par. 4-12 - par. 4-14 Hz]	To be used if par. 0-02 *Motor Speed Unit*, has been set for Hz (parameter not visible if RPM selected). Only to be used if par. 1-00 *Configuration Mode*, is set for Open Loop and speed reference is applied by an external controller controlling the pressure. Set the reference speed at which the Sleep Mode should be cancelled.

22-44 Wake-up Ref./FB Difference

Range:		Function:
10%*	[0-100%]	Only to be used if par. 1-00, *Configuration Mode*, is set for Closed Loop and the integrated PI controller is used for controlling the pressure. Set the pressure drop allowed in percentage of set point for the pressure (Pset) before cancelling the Sleep Mode.

NB!
If used in application where the integrated PI controller is set for inverse control in par. 20-71, *PID, Normal/Inverse Control*, the value set in par. 22-44 will automatically be added.

22-45 Setpoint Boost

Range:		Function:
0 %*	[-100 - 100 %]	Only to be used if par. 1-00 *Configuration Mode*, is set for Closed Loop and the integrated PI controller is used. In systems with e.g. constant pressure control, it is advantageous to increase the system pressure before the motor is stopped. This will extend the time in which the motor is stopped and help to avoid frequent start/stop. Set the desired over pressure/temperature in percentage of set point for the pressure (Pset)/temperature before entering the Sleep Mode. If setting for 5%, the boost pressure will be Pset*1.05. The negative values can be used for e.g. cooling tower control where a negative change is needed.

22-46 Maximum Boost Time

Range:		Function:
60 s*	[0 - 600 s]	Only to be used if par. 1-00 *Configuration Mode* is set for Closed Loop and the integrated PI controller is used for controlling the pressure. Set the maximum time for which boost mode will be allowed. If the set time is exceeded, Sleep Mode will be entered, not waiting for the set boost pressure to be reached.

22-50 End of Curve Function

Option:		Function:
[0] *	Off	End of Curve monitoring not active.
[1]	Warning	A warning is issued in the display [W94].
[2]	Alarm	An alarm is issued and the frequency converter trips. A message [A94] appears in the display.

NB!
Automatic restart will reset the alarm and start the system again.

22-51 End of Curve Delay

Range:		Function:
10 s*	[0 - 600 s]	When an End of Curve condition is detected, a timer is activated. When the time set in this parameter expires, and the End of Curve condition has been steady in the entire period, the function set in par. 22-50 *End of Curve Function* will be activated. If the condition disappears before the timer expires, the timer will be reset.

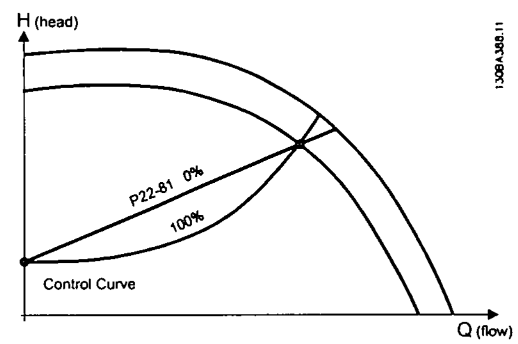
22-80 Flow Compensation

Option:		Function:
[0] *	Disabled	[0] *Disabled*: Set-Point compensation not active.
[1]	Enabled	[1] *Enabled*: Set-Point compensation is active. Enabling this parameter allows Flow Compensated Setpoint operation.

22-81 Square-linear Curve Approximation

Range:		Function:
100 %*	[0 - 100 %]	**Example 1:** Adjustment of this parameter allows the shape of the control curve to be adjusted. 0 = Linear 100% = Ideal shape (theoretical).

NB!
Please note: Not visible when running in cascade.

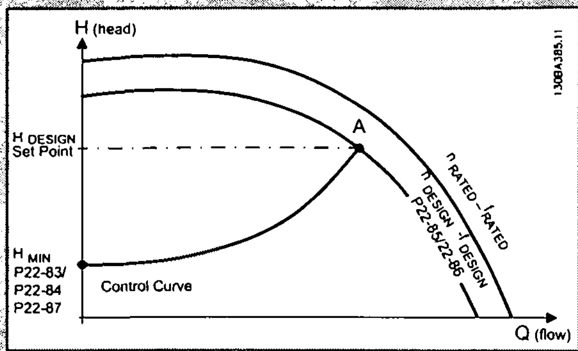


8

22-82 Work Point Calculation

Option:	Function:

Example 1: Speed at System Design Working Point is known:

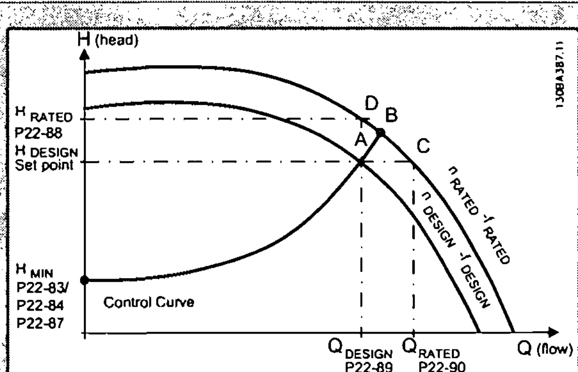


From the data sheet showing characteristics for the specific equipment at different speeds, simply reading across from the H_{DESIGN} point and the Q_{DESIGN} point allows us to find point A, which is the System Design Working Point. The pump characteristics at this point should be identified and the associated speed programmed. Closing the valves and adjusting the speed until H_{MIN} has been achieved allows the speed at the no flow point to be identified.

Adjustment of par. 22-81 *Square-linear Curve Approximation* then allows the shape of the control curve to be adjusted infinitely.

Example 2:

Speed at System Design Working Point is not known: Where the Speed at System Design Working Point is unknown, another reference point on the control curve needs to be determined by means of the data sheet. By looking at the curve for the rated speed and plotting the design pressure (H_{DESIGN}, Point C) the flow at that pressure Q_{RATED} can be determined. Similarly, by plotting the design flow (Q_{DESIGN}, Point D). the pressure H_D at that flow can be determined. Knowing these two points on the pump curve, along with H_{MIN} as described above, allows the frequency converter to calculate the reference point B and thus to plot the control curve which will also include the System design Working Point A.



[0] *	Disabled	*Disabled [0]*: Work Point Calculation not active. To be used if speed at design point is known (see table above).
[1]	Enabled	*Enabled [1]*: Work Point Calculation is active. Enabling this parameter allows the calculation of the unknown System Design Working Point at 50/60 Hz speed, from the input data set in par. 22-83 *Speed at No-Flow [RPM]* par. 22-84 *Speed at No-Flow [Hz]*, par. 22-87 *Pressure at No-Flow Speed*, par. 22-88 *Pressure at Rated Speed*, par. 22-89 Flow *at Design Point* and par. 22-90 *Flow at Rated Speed*.

22-84 Speed at No-Flow [Hz]

Range:	Function:
[illegible]	[illegible]

22-85 Speed at Design Point [RPM]

Range:	Function:
[illegible]	[illegible]

22-86 Speed at Design Point [Hz]

Range:	Function:
[illegible]	[illegible]

8

22-87 Pressure at No-Flow Speed

Range:	Function:
0.000 N/A* [0.000 - par. 22-88 N/A]	Enter the pressure H_{MIN} corresponding to Speed at No Flow in Reference/Feedback Units.

22-88 Pressure at Rated Speed

Range:	Function:
[illegible]	[illegible]

22-83 Speed at No-Flow [RPM]

Range:	Function:
[illegible]	[illegible]

22-90 Flow at Rated Speed

Range:	Function:
[illegible]	Enter the value corresponding to Flow at Rated Speed. This value can be defined using the pump datasheet.

8.2.11. Timed Actions, 23-0*

Use *Timed Actions* for actions needing to be performed on a daily or weekly basis, e.g. different references for working hours / non-working hours. Up to 10 Timed Actions can be programmed in the frequency converter. The Timed Action number is selected from the list when entering parameter group 23-0* from the Local Control Panel. par. 23-00 *ON Time* – par. 23-04 *Occurrence* then refer to the selected Timed Action number. Each Timed Action is divided into an ON time and an OFF time, in which two different actions may be performed.

> **NB!**
> The clock (parameter group 0-7*) must be correctly programmed for Timed Actions to function correctly.

> **NB!**
> When mounting an Analog I/O MCB109 option card, a battery back up of the date and time is included.

23-00 ON Time

Array [10]

Range:		Function:
0 N/A*	[0 - 0 N/A]	Sets the ON time for the Timed Action. **NB!** The frequency converter has no back up of the clock function and the set date/time will reset to default (2000-01-01 00:00) after a power down unless a Real Time Clock module with back up is installed. In par. 0-79 Clock Fault it is possible to program for a Warning in case clock has not been set properly, e.g. after a power down.

23-01 ON Action

Arra [10]

Option:		Function:
		Select the action during ON Time. See par. 13-52 SL *Controller Action* for descriptions of the options.
[0] *	Disabled	
[1]	No action	
[2]	Select set-up 1	
[3]	Select set-up 2	
[4]	Select set-up 3	
[5]	Select set-up 4	
[10]	Select preset ref 0	
[11]	Select preset ref 1	
[12]	Select preset ref 2	
[13]	Select preset ref 3	
[14]	Select preset ref 4	
[15]	Select preset ref 5	
[16]	Select preset ref 6	
[17]	Select preset ref 7	
[18]	Select ramp 1	
[19]	Select ramp 2	
[22]	Run	

[23]	Run reverse
[24]	Stop
[26]	DC Brake
[27]	Coast
[28]	Freeze output
[29]	Start timer 0
[30]	Start timer 1
[31]	Start timer 2
[32]	Set digital out A low
[33]	Set digital out B low
[34]	Set digital out C low
[35]	Set digital out D low
[36]	Set digital out E low
[37]	Set digital out F low
[38]	Set digital out A high
[39]	Set digital out B high
[40]	Set digital out C high
[41]	Set digital out D high
[42]	Set digital out E high
[43]	Set digital out F high
[60]	Reset Counter A
[61]	Reset Counter B
[70]	Start Timer 3
[71]	Start Timer 4
[72]	Start Timer 5
[73]	Start Timer 6
[74]	Start Timer 7

8

23-02 OFF Time

Array [10]

Range:		Function:
0 N/A*	[0 - 0 N/A]	Sets the OFF time for the Timed Action.

NB!

The frequency converter has no back up of the clock function and the set date/time will reset to default (2000-01-01 00:00) after a power down unless a Real Time Clock module with back up is installed. In par. 0-79 *Clock Fault* it is possible to program for a Warning in case clock has not been set properly, e.g. after a power down.

23-03 OFF Action

Array [10]

Option:	Function:
	Select the action during OFF Time. See par. 13-52 *SL Controller Action* for descriptions of the options.
[0] *	Disabled
[1]	No action
[2]	Select set-up 1
[3]	Select set-up 2

[4]	Select set-up 3
[5]	Select set-up 4
[10]	Select preset ref 0
[11]	Select preset ref 1
[12]	Select preset ref 2
[13]	Select preset ref 3
[14]	Select preset ref 4
[15]	Select preset ref 5
[16]	Select preset ref 6
[17]	Select preset ref 7
[18]	Select ramp 1
[19]	Select ramp 2
[22]	Run
[23]	Run reverse
[24]	Stop
[26]	DC Brake
[27]	Coast
[28]	Freeze output
[29]	Start timer 0
[30]	Start timer 1
[31]	Start timer 2
[32]	Set digital out A low
[33]	Set digital out B low
[34]	Set digital out C low
[35]	Set digital out D low
[36]	Set digital out E low
[37]	Set digital out F low
[38]	Set digital out A high
[39]	Set digital out B high
[40]	Set digital out C high
[41]	Set digital out D high
[42]	Set digital out E high
[43]	Set digital out F high
[60]	Reset Counter A
[61]	Reset Counter B
[70]	Start Timer 3
[71]	Start Timer 4
[72]	Start Timer 5
[73]	Start Timer 6
[74]	Start Timer 7

23-04 Occurrence

Array [10]

Option:		Function:
		Select which day(s) the Timed Action applies to. Specify working/non-working days in par. 0-81 Working *Days*, par. 0-82 Additional *Working Days* and par. 0-83 Additional *Non-Working Days*.
[0] *	All days	
[1]	Working days	
[2]	Non-working days	
[3]	Monday	
[4]	Tuesday	
[5]	Wednesday	
[6]	Thursday	
[7]	Friday	
[8]	Saturday	
[9]	Sunday	

8.2.12. Water Application Functions, 29-**

The group contains parameters used for monitoring water / wastewater applications.

29-00 Pipe Fill Enable

Option:		Function:
[0] *	Disabled	Select Enabled to fill pipes at a user specified rate.
[1]	Enabled	Select Enabled to fill pipes with a user specified rate.

29-01 Pipe Fill Speed [RPM]

Range:		Function:
Speed Low Limit*	[Speed Low Limit - Speed High Limit]	Set the filling speed for filling horizontal pipe systems. The speed can be selected in Hz or RPM depending on the choices made in par. 4-11 / par. 4-13 (RPM) or in par. 4-12 / par. 4-14 (Hz).

29-02 Pipe Fill Speed [Hz]

Range:		Function:
Motor Speed Low Limit*	[Speed Low Limit - Speed High Limit]	Set the filling speed for filling horizontal pipe systems. The speed can be selected in Hz or RPM depending on the choices made in par. 4-11 / par. 4-13 (RPM) or in par. 4-12 / par. 4-14 (Hz).

29-03 Pipe Fill Time

Range:		Function:
0 s*	[0 - 3600 s]	Set the specified time for pipe filling of horizontal pipe systems.

29-04 Pipe Fill Rate

Range:		Function:
0.001 units/s*	[0.001 – 999999.999 units/s]	Specifies the filling rate in units/second using the PI controller. Filling rate units are feedback units/second. This function is used for filling-up vertical pipe systems but will be active when the filling-time has expired, no matter what , until the pipe fill-set-point set in par. 29-05 is reached.

29-05 Filled Setpoint

Range:		Function:
0 s*	[0 – 999999,999 s]	Specifies the Filled Set-point at which the Pipe Fill Function will be disabled and the PID controller will take control. This function can be used both for horizontal and vertical pipe systems.

8.3. Parameter Options

8.3.1. Default settings

Changes during operation:
"TRUE" means that the parameter can be changed while the frequency converter is in operation and "FALSE" means that the frequency converter must be stopped before a change can be made.

4-Set-up:
'All set-up': the parameter can be set individually in each of the four set-ups, i. e. one single parameter can have four different data values.
'1 set-up': data value will be the same in all set-ups.

SR:
Size related

N/A:
No default value available.

8

Conversion index:
This number refers to a conversion figure used when writing or reading by means of a frequency converter.

Conv. index	100	67	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6
Conv. factor	1	1/60	1000000	100000	10000	1000	100	10	1	0.1	0.01	0.001	0.0001	0.00001	0.000001

Data type	Description	Type
2	Integer 8	Int8
3	Integer 16	Int16
4	Integer 32	Int32
5	Unsigned 8	Uint8
6	Unsigned 16	Uint16
7	Unsigned 32	Uint32
9	Visible String	VisStr
33	Normalized value 2 bytes	N2
35	Bit sequence of 16 boolean variables	V2
54	Time difference w/o date	TimD

8.3.2. Operation/Display 0-**

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
0-0* Basic Settings							
0-01	Language	[0] English	1 set-up		TRUE	-	Uint8
0-02	Motor Speed Unit	[0] RPM	2 set-ups		FALSE	-	Uint8
0-03	Regional Settings	[0] International	2 set-ups		FALSE	-	Uint8
0-04	Operating State at Power-up	[0] Resume	All set-ups		TRUE	-	Uint8
0-05	Local Mode Unit	[0] As Motor Speed Unit	2 set-ups		FALSE	-	Uint8
0-1* Set-up Operations							
0-10	Active Set-up	[1] Set-up 1	1 set-up		TRUE	-	Uint8
0-11	Programming Set-up	[9] Active Set-up	All set-ups		TRUE	-	Uint8
0-12	This Set-up Linked to	[0] Not linked	All set-ups		FALSE	-	Uint8
0-13	Readout: Linked Set-ups	0 N/A	All set-ups		FALSE	0	Uint16
0-14	Readout: Prog. Set-ups / Channel	0 N/A	All set-ups		TRUE	0	Int32
0-2* LCP Display							
0-20	Display Line 1.1 Small	1601	All set-ups		TRUE	-	Uint16
0-21	Display Line 1.2 Small	1662	All set-ups		TRUE	-	Uint16
0-22	Display Line 1.3 Small	1614	All set-ups		TRUE	-	Uint16
0-23	Display Line 2 Large	1613	All set-ups		TRUE	-	Uint16
0-24	Display Line 3 Large	1652	All set-ups		TRUE	-	Uint16
0-25	My Personal Menu	ExpressionLimit	1 set-up		TRUE	0	Uint16
0-3* LCP Custom Readout							
0-30	Custom Readout Unit	[1] %	All set-ups		TRUE	-	Uint8
0-31	Custom Readout Min Value	ExpressionLimit	All set-ups		TRUE	-2	Int32
0-32	Custom Readout Max Value	100.00 CustomReadoutUnit	All set-ups		TRUE	-2	Int32
0-37	Display Text 1	0 N/A	1 set-up		TRUE	0	VisStr[25]
0-38	Display Text 2	0 N/A	1 set-up		TRUE	0	VisStr[25]
0-39	Display Text 3	0 N/A	1 set-up		TRUE	0	VisStr[25]
0-4* LCP Keypad							
0-40	[Hand on] Key on LCP	[1] Enabled	All set-ups		TRUE	-	Uint8
0-41	[Off] Key on LCP	[1] Enabled	All set-ups		TRUE	-	Uint8
0-42	[Auto on] Key on LCP	[1] Enabled	All set-ups		TRUE	-	Uint8
0-43	[Reset] Key on LCP	[1] Enabled	All set-ups		TRUE	-	Uint8
0-44	[Off/Reset] Key on LCP	[1] Enabled	All set-ups		TRUE	-	Uint8
0-45	[Drive Bypass] Key on LCP	[1] Enabled	All set-ups		TRUE	-	Uint8
0-5* Copy/Save							
0-50	LCP Copy	[0] No copy	All set-ups		FALSE	-	Uint8
0-51	Set-up Copy	[0] No copy	All set-ups		FALSE	-	Uint8
0-6* Password							
0-60	Main Menu Password	100 N/A	1 set-up		TRUE	0	Uint16
0-61	Access to Main Menu w/o Password	[0] Full access	1 set-up		TRUE	-	Uint8
0-65	Personal Menu Password	200 N/A	1 set-up		TRUE	0	Uint16
0-66	Access to Personal Menu w/o Password	[0] Full access	1 set-up		TRUE	-	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
0-7* Clock Settings						
0-70	Date and Time	ExpressionLimit	All set-ups	TRUE	0	TimeOfDay
0-71	Date Format	[0] YYYY-MM-DD	1 set-up	TRUE	-	Uint8
0-72	Time Format	[0] 24 h	1 set-up	TRUE	-	Uint8
0-74	DST/Summertime	[0] Off	1 set-up	TRUE	-	Uint8
0-76	DST/Summertime Start	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
0-77	DST/Summertime End	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
0-79	Clock Fault	null	1 set-up	TRUE	-	Uint8
0-81	Working Days	null	1 set-up	TRUE	-	Uint8
0-82	Additional Working Days	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
0-83	Additional Non-Working Days	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
0-89	Date and Time Readout	0 N/A	All set-ups	TRUE	0	VisStr[25]

8.3.3. Load/Motor 1-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
1-0* General Settings						
1-00	Configuration Mode	null	All set-ups	TRUE	-	Uint8
1-01	Motor Control Principle	null	All set-ups	FALSE	-	Uint8
1-03	Torque Characteristics	[3] Auto Energy Optim. VT	All set-ups	TRUE	-	Uint8
1-1* Motor Selection						
1-10	Motor Construction	[0] Asynchron	All set-ups	FALSE	-	Uint8
1-2* Motor Data						
1-20	Motor Power [kW]	ExpressionLimit	All set-ups	FALSE	1	Uint32
1-21	Motor Power [HP]	ExpressionLimit	All set-ups	FALSE	-2	Uint32
1-22	Motor Voltage	ExpressionLimit	All set-ups	FALSE	0	Uint16
1-23	Motor Frequency	ExpressionLimit	All set-ups	FALSE	0	Uint16
1-24	Motor Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
1-25	Motor Nominal Speed	ExpressionLimit	All set-ups	FALSE	67	Uint16
1-28	Motor Rotation Check	[0] Off	All set-ups	FALSE	-	Uint8
1-29	Automatic Motor Adaptation (AMA)	[0] Off	All set-ups	FALSE	-	Uint8
1-3* Adv. Motor Data						
1-30	Stator Resistance (Rs)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
1-31	Rotor Resistance (Rr)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
1-35	Main Reactance (Xh)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
1-36	Iron Loss Resistance (Rfe)	ExpressionLimit	All set-ups	FALSE	-3	Uint32
1-39	Motor Poles	ExpressionLimit	All set-ups	FALSE	0	Uint8
1-5* Load Indep. Setting						
1-50	Motor Magnetisation at Zero Speed	100 %	All set-ups	TRUE	0	Uint16
1-51	Min Speed Normal Magnetising [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
1-52	Min Speed Normal Magnetising [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
1-6* Load Depen. Setting						
1-60	Low Speed Load Compensation	100 %	All set-ups	TRUE	0	Int16
1-61	High Speed Load Compensation	100 %	All set-ups	TRUE	0	Int16
1-62	Slip Compensation	0 %	All set-ups	TRUE	0	Int16
1-63	Slip Compensation Time Constant	ExpressionLimit	All set-ups	TRUE	-2	Uint16
1-64	Resonance Dampening	100 %	All set-ups	TRUE	0	Uint16
1-65	Resonance Dampening Time Constant	5 ms	All set-ups	TRUE	-3	Uint8
1-7* Start Adjustments						
1-71	Start Delay	0.0 s	All set-ups	TRUE	-1	Uint16
1-73	Flying Start	[0] Disabled	All set-ups	FALSE	-	Uint8
1-74	Start Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
1-75	Start Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
1-76	Start Current	0.00 A	All set-ups	TRUE	-2	Uint32
1-8* Stop Adjustments						
1-80	Function at Stop	[0] Coast	All set-ups	TRUE	-	Uint8
1-81	Min Speed for Function at Stop [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
1-82	Min Speed for Function at Stop [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
1-86	Trip Speed Low [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
1-87	Trip Speed Low [Hz]	0 Hz	All set-ups	TRUE	-1	Uint16
1-9* Motor Temperature						
1-90	Motor Thermal Protection	[4] ETR trip 1	All set-ups	TRUE	-	Uint8
1-91	Motor External Fan	[0] No	All set-ups	TRUE	-	Uint16
1-93	Thermistor Source	[0] None	All set-ups	TRUE	-	Uint8

8.3.4. Brakes 2-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
2-0* DC-Brake						
2-00	DC Hold/Preheat Current	50 %	All set-ups	TRUE	0	Uint8
2-01	DC Brake Current	50 %	All set-ups	TRUE	0	Uint16
2-02	DC Braking Time	10.0 s	All set-ups	TRUE	-1	Uint16
2-03	DC Brake Cut In Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
2-04	DC Brake Cut In Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
2-1* Brake Energy Funct.						
2-10	Brake Function	[0] Off	All set-ups	TRUE	-	Uint8
2-11	Brake Resistor (ohm)	ExpressionLimit	All set-ups	TRUE	0	Uint16
2-12	Brake Power Limit (kW)	ExpressionLimit	All set-ups	TRUE	0	Uint32
2-13	Brake Power Monitoring	[0] Off	All set-ups	TRUE	-	Uint8
2-15	Brake Check	[0] Off	All set-ups	TRUE	-	Uint8
2-16	AC brake Max. Current	100.0 %	All set-ups	TRUE	-1	Uint32
2-17	Over-voltage Control	[2] Enabled	All set-ups	TRUE	-	Uint8

8.3.5. Reference / Ramps 3-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
3-0* Reference Limits						
3-02	Minimum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
3-03	Maximum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
3-04	Reference Function	[0] Sum	All set-ups	TRUE	-	Uint8
3-1* References						
3-10	Preset Reference	0.00 %	All set-ups	TRUE	-2	Int16
3-11	Jog Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
3-13	Reference Site	[0] Linked to Hand / Auto	All set-ups	TRUE	-	Uint8
3-14	Preset Relative Reference	0.00 %	All set-ups	TRUE	-2	Int32
3-15	Reference 1 Source	[1] Analog input 53	All set-ups	TRUE	-	Uint8
3-16	Reference 2 Source	[0] No function	All set-ups	TRUE	-	Uint8
3-17	Reference 3 Source	[0] No function	All set-ups	TRUE	-	Uint8
3-19	Jog Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
3-4* Ramp 1						
3-41	Ramp 1 Ramp Up Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-42	Ramp 1 Ramp Down Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-5* Ramp 2						
3-51	Ramp 2 Ramp Up Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-52	Ramp 2 Ramp Down Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-8* Other Ramps						
3-80	Jog Ramp Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-81	Quick Stop Ramp Time	ExpressionLimit	2 set-ups	TRUE	-2	Uint32
3-84	Initial Ramp Time	0.00 s	All set-ups	TRUE	-2	Uint16
3-85	Check Valve Ramp Time	0.00 s	All set-ups	TRUE	-2	Uint16
3-86	Check Valve Ramp End Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
3-87	Check Valve Ramp End Speed [HZ]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
3-88	Final Ramp Time	0.00 s	All set-ups	TRUE	-2	Uint16
3-9* Digital Pot.Meter						
3-90	Step Size	0.10 %	All set-ups	TRUE	-2	Uint16
3-91	Ramp Time	1.00 s	All set-ups	TRUE	-2	Uint32
3-92	Power Restore	[0] Off	All set-ups	TRUE	-	Uint8
3-93	Maximum Limit	100 %	All set-ups	TRUE	0	Int16
3-94	Minimum Limit	0 %	All set-ups	TRUE	0	Int16
3-95	Ramp Delay	ExpressionLimit	All set-ups	TRUE	-3	TimD

8.3.6. Limits / Warnings 4-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
4-1* Motor Limits						
4-10	Motor Speed Direction	[0] Clockwise	All set-ups	FALSE	-	Uint8
4-11	Motor Speed Low Limit [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
4-12	Motor Speed Low Limit [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
4-13	Motor Speed High Limit [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
4-14	Motor Speed High Limit [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
4-16	Torque Limit Motor Mode	110.0 %	All set-ups	TRUE	-1	Uint16
4-17	Torque Limit Generator Mode	100.0 %	All set-ups	TRUE	-1	Uint16
4-18	Current Limit	ExpressionLimit	All set-ups	TRUE	-1	Uint32
4-19	Max Output Frequency	ExpressionLimit	All set-ups	FALSE	-1	Uint16
4-5* Adj. Warnings						
4-50	Warning Current Low	0.00 A	All set-ups	TRUE	-2	Uint32
4-51	Warning Current High	ImaxVLT (P1637)	All set-ups	TRUE	-2	Uint32
4-52	Warning Speed Low	0 RPM	All set-ups	TRUE	67	Uint16
4-53	Warning Speed High	outputSpeedHighLimit (P413)	All set-ups	TRUE	67	Uint16
4-54	Warning Reference Low	-999999.999 N/A	All set-ups	TRUE	-3	Int32
4-55	Warning Reference High	999999.999 N/A	All set-ups	TRUE	-3	Int32
4-56	Warning Feedback Low	-999999.999 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
4-57	Warning Feedback High	999999.999 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
4-58	Missing Motor Phase Function	[1] On	All set-ups	TRUE	-	Uint8
4-6* Speed Bypass						
4-60	Bypass Speed From [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
4-61	Bypass Speed From [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
4-62	Bypass Speed To [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
4-63	Bypass Speed To [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
4-64	Semi-Auto Bypass Set-up	[0] Off	All set-ups	FALSE	-	Uint8

8.3.7. Digital In/Out 5-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
5-0* Digital I/O mode						
5-00	Digital I/O Mode	[0] PNP - Active at 24V	All set-ups	FALSE	-	Uint8
5-01	Terminal 27 Mode	[0] Input	All set-ups	TRUE	-	Uint8
5-02	Terminal 29 Mode	[0] Input	All set-ups	TRUE	-	Uint8
5-1* Digital Inputs						
5-10	Terminal 18 Digital Input	[8] Start	All set-ups	TRUE	-	Uint8
5-11	Terminal 19 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-12	Terminal 27 Digital Input	null	All set-ups	TRUE	-	Uint8
5-13	Terminal 29 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-14	Terminal 32 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-15	Terminal 33 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-16	Terminal X30/2 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-17	Terminal X30/3 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-18	Terminal X30/4 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-3* Digital Outputs						
5-30	Terminal 27 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
5-31	Terminal 29 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
5-32	Term X30/6 Digi Out (MCB 101)	[0] No operation	All set-ups	TRUE	-	Uint8
5-33	Term X30/7 Digi Out (MCB 101)	[0] No operation	All set-ups	TRUE	-	Uint8
5-4* Relays						
5-40	Function Relay	null	All set-ups	TRUE	-	Uint8
5-41	On Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
5-42	Off Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
5-5* Pulse Input						
5-50	Term. 29 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-51	Term. 29 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-52	Term. 29 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
5-53	Term. 29 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
5-54	Pulse Filter Time Constant #29	100 ms	All set-ups	FALSE	-3	Uint16
5-55	Term. 33 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-56	Term. 33 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-57	Term. 33 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
5-58	Term. 33 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
5-59	Pulse Filter Time Constant #33	100 ms	All set-ups	FALSE	-3	Uint16
5-6* Pulse Output						
5-60	Terminal 27 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-62	Pulse Output Max Freq #27	5000 Hz	All set-ups	TRUE	0	Uint32
5-63	Terminal 29 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-65	Pulse Output Max Freq #29	5000 Hz	All set-ups	TRUE	0	Uint32
5-66	Terminal X30/6 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-68	Pulse Output Max Freq #X30/6	5000 Hz	All set-ups	TRUE	0	Uint32
5-9* Bus Controlled						
5-90	Digital & Relay Bus Control	0 N/A	All set-ups	TRUE	0	Uint32
5-93	Pulse Out #27 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
5-94	Pulse Out #27 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
5-95	Pulse Out #29 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
5-96	Pulse Out #29 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
5-97	Pulse Out #X30/6 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
5-98	Pulse Out #X30/6 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16

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8.3.8. Analog In/Out 6-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
6-0* Analog I/O Mode						
6-00	Live Zero Timeout Time	10 s	All set-ups	TRUE	0	Uint8
6-01	Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	Uint8
6-1* Analog Input 53						
6-10	Terminal 53 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-11	Terminal 53 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
6-12	Terminal 53 Low Current	4.00 mA	All set-ups	TRUE	-5	Int16
6-13	Terminal 53 High Current	20.00 mA	All set-ups	TRUE	-5	Int16
6-14	Terminal 53 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
6-15	Terminal 53 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32
6-16	Terminal 53 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-17	Terminal 53 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-2* Analog Input 54						
6-20	Terminal 54 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-21	Terminal 54 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
6-22	Terminal 54 Low Current	4.00 mA	All set-ups	TRUE	-5	Int16
6-23	Terminal 54 High Current	20.00 mA	All set-ups	TRUE	-5	Int16
6-24	Terminal 54 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
6-25	Terminal 54 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
6-26	Terminal 54 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-27	Terminal 54 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-3* Analog Input X30/11						
6-30	Terminal X30/11 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-31	Terminal X30/11 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
6-34	Term. X30/11 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
6-35	Term. X30/11 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
6-36	Term. X30/11 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-37	Term. X30/11 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-4* Analog Input X30/12						
6-40	Terminal X30/12 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-41	Terminal X30/12 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
6-44	Term. X30/12 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
6-45	Term. X30/12 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
6-46	Term. X30/12 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-47	Term. X30/12 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-5* Analog Output 42						
6-50	Terminal 42 Output	[100] Output freq. 0-100	All set-ups	TRUE	-	Uint8
6-51	Terminal 42 Output Min Scale	0.00 %	All set-ups	TRUE	-2	Int16
6-52	Terminal 42 Output Max Scale	100.00 %	All set-ups	TRUE	-2	Int16
6-53	Terminal 42 Output Bus Control	0.00 %	All set-ups	TRUE	-2	N2
6-54	Terminal 42 Output Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
6-6* Analog Output X30/8						
6-60	Terminal X30/8 Output	[0] No operation	All set-ups	TRUE	-	Uint8
6-61	Terminal X30/8 Min. Scale	0.00 %	All set-ups	TRUE	-2	Int16
6-62	Terminal X30/8 Max. Scale	100.00 %	All set-ups	TRUE	-2	Int16
6-63	Terminal X30/8 Output Bus Control	0.00 %	All set-ups	TRUE	-2	N2
6-64	Terminal X30/8 Output Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16

8.3.9. Comm. and Options 8-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
8-0* General Settings						
8-01	Control Site	null	All set-ups	TRUE	-	Uint8
8-02	Control Source	null	All set-ups	TRUE	-	Uint8
8-03	Control Timeout Time	ExpressionLimit	1 set-up	TRUE	-1	Uint32
8-04	Control Timeout Function	[0] Off	1 set-up	TRUE	-	Uint8
8-05	End-of-Timeout Function	[1] Resume set-up	1 set-up	TRUE	-	Uint8
8-06	Reset Control Timeout	[0] Do not reset	All set-ups	TRUE	-	Uint8
8-07	Diagnosis Trigger	[0] Disable	2 set-ups	TRUE	-	Uint8
8-1* Control Settings						
8-10	Control Profile	[0] FC profile	All set-ups	TRUE	-	Uint8
8-13	Configurable Status Word STW	[1] Profile Default	All set-ups	TRUE	-	Uint8
8-14	Configurable Control Word CTW	[1] Profile default	All set-ups	TRUE	-	Uint8
8-3* FC Port Settings						
8-30	Protocol	null	1 set-up	TRUE	-	Uint8
8-31	Address	ExpressionLimit	1 set-up	TRUE	0	Uint8
8-32	Baud Rate	null	1 set-up	TRUE	-	Uint8
8-33	Parity / Stop Bits	null	1 set-up	TRUE	-	Uint8
8-35	Minimum Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
8-36	Max Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
8-37	Maximum Inter-Char Delay	ExpressionLimit	1 set-up	TRUE	-5	Uint16
8-4* FC MC protocol set						
8-40	Telegram Selection	[1] Standard telegram 1	2 set-ups	TRUE	-	Uint8
8-5* Digital/Bus						
8-50	Coasting Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-52	DC Brake Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-53	Start Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-54	Reversing Select	null	All set-ups	TRUE	-	Uint8
8-55	Set-up Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-56	Preset Reference Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-7* BACnet						
8-70	BACnet Device Instance	1 N/A	1 set-up	TRUE	0	Uint32
8-72	MS/TP Max Masters	127 N/A	1 set-up	TRUE	0	Uint8
8-73	MS/TP Max Info Frames	1 N/A	1 set-up	TRUE	0	Uint16
8-74	"I-Am" Service	[0] Send at power-up	1 set-up	TRUE	-	Uint8
8-75	Initialisation Password	ExpressionLimit	1 set-up	TRUE	0	VisStr[20]
8-8* FC Port Diagnostics						
8-80	Bus Message Count	0 N/A	All set-ups	TRUE	0	Uint32
8-81	Bus Error Count	0 N/A	All set-ups	TRUE	0	Uint32
8-82	Slave Message Rcvd	0 N/A	All set-ups	TRUE	0	Uint32
8-83	Slave Error Count	0 N/A	All set-ups	TRUE	0	Uint32
8-9* Bus Jog / Feedback						
8-90	Bus Jog 1 Speed	100 RPM	All set-ups	TRUE	67	Uint16
8-91	Bus Jog 2 Speed	200 RPM	All set-ups	TRUE	67	Uint16
8-94	Bus Feedback 1	0 N/A	1 set-up	TRUE	0	N2
8-95	Bus Feedback 2	0 N/A	1 set-up	TRUE	0	N2
8-96	Bus Feedback 3	0 N/A	1 set-up	TRUE	0	N2

8.3.10. Profibus 9-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
9-00	Setpoint	0 N/A	All set-ups	TRUE	0	Uint16
9-07	Actual Value	0 N/A	All set-ups	FALSE	0	Uint16
9-15	PCD Write Configuration	ExpressionLimit	2 set-ups	TRUE	-	Uint16
9-16	PCD Read Configuration	ExpressionLimit	2 set-ups	TRUE	-	Uint16
9-18	Node Address	126 N/A	1 set-up	TRUE	0	Uint8
9-22	Telegram Selection	[108] PPO 8	1 set-up	TRUE	-	Uint8
9-23	Parameters for Signals	0	All set-ups	TRUE	-	Uint16
9-27	Parameter Edit	[1] Enabled	2 set-ups	FALSE	-	Uint16
9-28	Process Control	[1] Enable cyclic master	2 set-ups	FALSE	-	Uint8
9-44	Fault Message Counter	0 N/A	All set-ups	TRUE	0	Uint16
9-45	Fault Code	0 N/A	All set-ups	TRUE	0	Uint16
9-47	Fault Number	0 N/A	All set-ups	TRUE	0	Uint16
9-52	Fault Situation Counter	0 N/A	All set-ups	TRUE	0	Uint16
9-53	Profibus Warning Word	0 N/A	All set-ups	TRUE	0	V2
9-63	Actual Baud Rate	[255] No baudrate found	All set-ups	TRUE	-	Uint8
9-64	Device Identification	0 N/A	All set-ups	TRUE	0	Uint16
9-65	Profile Number	0 N/A	All set-ups	TRUE	0	OctStr[2]
9-67	Control Word 1	0 N/A	All set-ups	TRUE	0	V2
9-68	Status Word 1	0 N/A	All set-ups	TRUE	0	V2
9-71	Profibus Save Data Values	[0] Off	All set-ups	TRUE	-	Uint8
9-72	ProfibusDriveReset	[0] No action	1 set-up	FALSE	-	Uint8
9-80	Defined Parameters (1)	0 N/A	All set-ups	FALSE	0	Uint16
9-81	Defined Parameters (2)	0 N/A	All set-ups	FALSE	0	Uint16
9-82	Defined Parameters (3)	0 N/A	All set-ups	FALSE	0	Uint16
9-83	Defined Parameters (4)	0 N/A	All set-ups	FALSE	0	Uint16
9-84	Defined Parameters (5)	0 N/A	All set-ups	FALSE	0	Uint16
9-90	Changed Parameters (1)	0 N/A	All set-ups	FALSE	0	Uint16
9-91	Changed Parameters (2)	0 N/A	All set-ups	FALSE	0	Uint16
9-92	Changed Parameters (3)	0 N/A	All set-ups	FALSE	0	Uint16
9-93	Changed Parameters (4)	0 N/A	All set-ups	FALSE	0	Uint16
9-94	Changed Parameters (5)	0 N/A	All set-ups	FALSE	0	Uint16

8.3.11. CAN Fieldbus 10-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
10-0* Common Settings						
10-00	CAN Protocol	null	2 set-ups	FALSE	-	Uint8
10-01	Baud Rate Select	null	2 set-ups	TRUE	-	Uint8
10-02	MAC ID	ExpressionLimit	2 set-ups	TRUE	0	Uint8
10-05	Readout Transmit Error Counter	0 N/A	All set-ups	TRUE	0	Uint8
10-06	Readout Receive Error Counter	0 N/A	All set-ups	TRUE	0	Uint8
10-07	Readout Bus Off Counter	0 N/A	All set-ups	TRUE	0	Uint8
10-1* DeviceNet						
10-10	Process Data Type Selection	null	All set-ups	TRUE	-	Uint8
10-11	Process Data Config Write	ExpressionLimit	2 set-ups	TRUE	-	Uint16
10-12	Process Data Config Read	ExpressionLimit	2 set-ups	TRUE	-	Uint16
10-13	Warning Parameter	0 N/A	All set-ups	TRUE	0	Uint16
10-14	Net Reference	[0] Off	2 set-ups	TRUE	-	Uint8
10-15	Net Control	[0] Off	2 set-ups	TRUE	-	Uint8
10-2* COS Filters						
10-20	COS Filter 1	0 N/A	All set-ups	FALSE	0	Uint16
10-21	COS Filter 2	0 N/A	All set-ups	FALSE	0	Uint16
10-22	COS Filter 3	0 N/A	All set-ups	FALSE	0	Uint16
10-23	COS Filter 4	0 N/A	All set-ups	FALSE	0	Uint16
10-3* Parameter Access						
10-30	Array Index	0 N/A	2 set-ups	TRUE	0	Uint8
10-31	Store Data Values	[0] Off	All set-ups	TRUE	-	Uint8
10-32	Devicenet Revision	ExpressionLimit	All set-ups	TRUE	0	Uint16
10-33	Store Always	[0] Off	1 set-up	TRUE	-	Uint8
10-34	DeviceNet Product Code	130 N/A	1 set-up	TRUE	0	Uint16
10-39	Devicenet F Parameters	0 N/A	All set-ups	TRUE	0	Uint32

8.3.12. Smart Logic 13-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
13-0* SLC Settings						
13-00	SL Controller Mode	null	2 set-ups	TRUE	-	Uint8
13-01	Start Event	null	2 set-ups	TRUE	-	Uint8
13-02	Stop Event	null	2 set-ups	TRUE	-	Uint8
13-03	Reset SLC	[0] Do not reset SLC	All set-ups	TRUE	-	Uint8
13-1* Comparators						
13-10	Comparator Operand	null	2 set-ups	TRUE	-	Uint8
13-11	Comparator Operator	null	2 set-ups	TRUE	-	Uint8
13-12	Comparator Value	ExpressionLimit	2 set-ups	TRUE	-3	Int32
13-2* Timers						
13-20	SL Controller Timer	ExpressionLimit	1 set-up	TRUE	-3	TimD
13-4* Logic Rules						
13-40	Logic Rule Boolean 1	null	2 set-ups	TRUE	-	Uint8
13-41	Logic Rule Operator 1	null	2 set-ups	TRUE	-	Uint8
13-42	Logic Rule Boolean 2	null	2 set-ups	TRUE	-	Uint8
13-43	Logic Rule Operator 2	null	2 set-ups	TRUE	-	Uint8
13-44	Logic Rule Boolean 3	null	2 set-ups	TRUE	-	Uint8
13-5* States						
13-51	SL Controller Event	null	2 set-ups	TRUE	-	Uint8
13-52	SL Controller Action	null	2 set-ups	TRUE	-	Uint8

8.3.13. Special Functions 14-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
14-0* Inverter Switching						
14-00	Switching Pattern	null	All set-ups	TRUE	-	Uint8
14-01	Switching Frequency	null	All set-ups	TRUE	-	Uint8
14-03	Overmodulation	[1] On	All set-ups	FALSE	-	Uint8
14-04	PWM Random	[0] Off	All set-ups	TRUE	-	Uint8
14-1* Mains On/Off						
14-10	Mains Failure	[0] No function	All set-ups	FALSE	-	Uint8
14-11	Mains Voltage at Mains Fault	ExpressionLimit	All set-ups	TRUE	0	Uint16
14-12	Function at Mains Imbalance	[3] Derate	All set-ups	TRUE	-	Uint8
14-2* Reset Functions						
14-20	Reset Mode	[10] Automatic reset x 10	All set-ups	TRUE	-	Uint8
14-21	Automatic Restart Time	10 s	All set-ups	TRUE	0	Uint16
14-22	Operation Mode	[0] Normal operation	All set-ups	TRUE	-	Uint8
14-23	Typecode Setting	null	2 set-ups	FALSE	-	Uint8
14-25	Trip Delay at Torque Limit	60 s	All set-ups	TRUE	0	Uint8
14-26	Trip Delay at Inverter Fault	ExpressionLimit	All set-ups	TRUE	0	Uint8
14-28	Production Settings	[0] No action	All set-ups	TRUE	-	Uint8
14-29	Service Code	0 N/A	All set-ups	TRUE	0	Int32
14-3* Current Limit Ctrl.						
14-30	Current Lim Ctrl, Proportional Gain	100 %	All set-ups	FALSE	0	Uint16
14-31	Current Lim Ctrl, Integration Time	0.020 s	All set-ups	FALSE	-3	Uint16
14-4* Energy Optimising						
14-40	VT Level	66 %	All set-ups	FALSE	0	Uint8
14-41	AEO Minimum Magnetisation	ExpressionLimit	All set-ups	TRUE	0	Uint8
14-42	Minimum AEO Frequency	10 Hz	All set-ups	TRUE	0	Uint8
14-43	Motor Cosphi	ExpressionLimit	All set-ups	TRUE	-2	Uint16
14-5* Environment						
14-50	RFI Filter	[1] On	1 set-up	FALSE	-	Uint8
14-52	Fan Control	[0] Auto	All set-ups	TRUE	-	Uint8
14-53	Fan Monitor	[1] Warning	All set-ups	TRUE	-	Uint8
14-55	Output Filter	[0] No Filter	1 set-up	FALSE	-	Uint8
14-59	Actual Number of Inverter Units	ExpressionLimit	1 set-up	FALSE	0	Uint8
14-6* Auto Derate						
14-60	Function at Over Temperature	[1] Derate	All set-ups	TRUE	-	Uint8
14-61	Function at Inverter Overload	[1] Derate	All set-ups	TRUE	-	Uint8
14-62	Inv. Overload Derate Current	95 %	All set-ups	TRUE	0	Uint16
14-8* Options						
14-80	Option Supplied by External 24VDC	[0] No	2 set-ups	FALSE	-	Uint8

8.3.14. FC Information 15-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
15-0* Operating Data						
15-00	Operating Hours	0 h	All set-ups	FALSE	74	Uint32
15-01	Running Hours	0 h	All set-ups	FALSE	74	Uint32
15-02	kWh Counter	0 kWh	All set-ups	FALSE	75	Uint32
15-03	Power Up's	0 N/A	All set-ups	FALSE	0	Uint32
15-04	Over Temp's	0 N/A	All set-ups	FALSE	0	Uint16
15-05	Over Volt's	0 N/A	All set-ups	FALSE	0	Uint16
15-06	Reset kWh Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
15-07	Reset Running Hours Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
15-08	Number of Starts	0 N/A	All set-ups	FALSE	0	Uint32
15-1* Data Log Settings						
15-10	Logging Source	0	2 set-ups	TRUE	-	Uint16
15-11	Logging Interval	ExpressionLimit	2 set-ups	TRUE	-3	TimD
15-12	Trigger Event	[0] False	1 set-up	TRUE	-	Uint8
15-13	Logging Mode	[0] Log always	2 set-ups	TRUE	-	Uint8
15-14	Samples Before Trigger	50 N/A	2 set-ups	TRUE	0	Uint8
15-2* Historic Log						
15-20	Historic Log: Event	0 N/A	All set-ups	FALSE	0	Uint8
15-21	Historic Log: Value	0 N/A	All set-ups	FALSE	0	Uint32
15-22	Historic Log: Time	0 ms	All set-ups	FALSE	-3	Uint32
15-23	Historic Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
15-3* Alarm Log						
15-30	Alarm Log: Error Code	0 N/A	All set-ups	FALSE	0	Uint8
15-31	Alarm Log: Value	0 N/A	All set-ups	FALSE	0	Int16
15-32	Alarm Log: Time	0 s	All set-ups	FALSE	0	Uint32
15-33	Alarm Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
15-34	Alarm Log: Setpoint	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
15-35	Alarm Log: Feedback	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
15-36	Alarm Log: Current Demand	0 %	All set-ups	FALSE	0	Uint8
15-37	Alarm Log: Process Ctrl Unit	[0]	All set-ups	FALSE	-	Uint8
15-4* Drive Identification						
15-40	FC Type	0 N/A	All set-ups	FALSE	0	VisStr[6]
15-41	Power Section	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-42	Voltage	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-43	Software Version	0 N/A	All set-ups	FALSE	0	VisStr[5]
15-44	Ordered Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-45	Actual Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-46	Frequency Converter Ordering No	0 N/A	All set-ups	FALSE	0	VisStr[8]
15-47	Power Card Ordering No	0 N/A	All set-ups	FALSE	0	VisStr[8]
15-48	LCP Id No	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-49	SW ID Control Card	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-50	SW ID Power Card	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-51	Frequency Converter Serial Number	0 N/A	All set-ups	FALSE	0	VisStr[10]
15-53	Power Card Serial Number	0 N/A	All set-ups	FALSE	0	VisStr[19]

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
15-6* Option Ident						
15-60	Option Mounted	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-61	Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-62	Option Ordering No	0 N/A	All set-ups	FALSE	0	VisStr[8]
15-63	Option Serial No	0 N/A	All set-ups	FALSE	0	VisStr[18]
15-70	Option in Slot A	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-71	Slot A Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-72	Option in Slot B	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-73	Slot B Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-74	Option in Slot C0	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-75	Slot C0 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-76	Option in Slot C1	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-77	Slot C1 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-9* Parameter Info						
15-92	Defined Parameters	0 N/A	All set-ups	FALSE	0	Uint16
15-93	Modified Parameters	0 N/A	All set-ups	FALSE	0	Uint16
15-98	Drive Identification	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-99	Parameter Metadata	0 N/A	All set-ups	FALSE	0	Uint16

8.3.15. Data Readouts 16-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
16-0* General Status						
16-00	Control Word	0 N/A	All set-ups	TRUE	0	V2
16-01	Reference [Unit]	0.000 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
16-02	Reference [%]	0.0 %	All set-ups	TRUE	-1	Int16
16-03	Status Word	0 N/A	All set-ups	TRUE	0	V2
16-05	Main Actual Value [%]	0.00 %	All set-ups	TRUE	-2	N2
16-09	Custom Readout	0.00 CustomReadoutUnit	All set-ups	TRUE	-2	Int32
16-1* Motor Status						
16-10	Power [kW]	0.00 kW	All set-ups	TRUE	1	Int32
16-11	Power [hp]	0.00 hp	All set-ups	TRUE	-2	Int32
16-12	Motor Voltage	0.0 V	All set-ups	TRUE	-1	Uint16
16-13	Frequency	0.0 Hz	All set-ups	TRUE	-1	Uint16
16-14	Motor Current	0.00 A	All set-ups	TRUE	-2	Int32
16-15	Frequency [%]	0.00 %	All set-ups	TRUE	-2	N2
16-16	Torque [Nm]	0.0 Nm	All set-ups	TRUE	-1	Int32
16-17	Speed [RPM]	0 RPM	All set-ups	TRUE	67	Int32
16-18	Motor Thermal	0 %	All set-ups	TRUE	0	Uint8
16-22	Torque [%]	0 %	All set-ups	TRUE	0	Int16
16-3* Drive Status						
16-30	DC Link Voltage	0 V	All set-ups	TRUE	0	Uint16
16-32	Brake Energy /s	0.000 kW	All set-ups	TRUE	0	Uint32
16-33	Brake Energy /2 min	0.000 kW	All set-ups	TRUE	0	Uint32
16-34	Heatsink Temp.	0 °C	All set-ups	TRUE	100	Uint8
16-35	Inverter Thermal	0 %	All set-ups	TRUE	0	Uint8
16-36	Inv. Nom. Current	ExpressionLimit	All set-ups	TRUE	-2	Uint32
16-37	Inv. Max. Current	ExpressionLimit	All set-ups	TRUE	-2	Uint32
16-38	SL Controller State	0 N/A	All set-ups	TRUE	0	Uint8
16-39	Control Card Temp.	0 °C	All set-ups	TRUE	100	Uint8
16-40	Logging Buffer Full	[0] No	All set-ups	TRUE	-	Uint8
16-5* Ref. & Feedb.						
16-50	External Reference	0.0 N/A	All set-ups	TRUE	-1	Int16
16-52	Feedback [Unit]	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
16-53	Digi Pot Reference	0.00 N/A	All set-ups	TRUE	-2	Int16
16-54	Feedback 1 [Unit]	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
16-55	Feedback 2 [Unit]	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
16-56	Feedback 3 [Unit]	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
16-58	PID Output [%]	0.0 %	All set-ups	TRUE	-1	Int16
16-59	Adjusted Setpoint	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
16-6* Inputs & Outputs						
16-60	Digital Input	0 N/A	All set-ups	TRUE	0	Uint16
16-61	Terminal 53 Switch Setting	[0] Current	All set-ups	TRUE	-	Uint8
16-62	Analog Input 53	0.000 N/A	All set-ups	TRUE	-3	Int32
16-63	Terminal 54 Switch Setting	[0] Current	All set-ups	TRUE	-	Uint8
16-64	Analog Input 54	0.000 N/A	All set-ups	TRUE	-3	Int32
16-65	Analog Output 42 [mA]	0.000 N/A	All set-ups	TRUE	-3	Int16
16-66	Digital Output [bin]	0 N/A	All set-ups	TRUE	0	Int16
16-67	Pulse Input #29 [Hz]	0 N/A	All set-ups	TRUE	0	Int32
16-68	Pulse Input #33 [Hz]	0 N/A	All set-ups	TRUE	0	Int32
16-69	Pulse Output #27 [Hz]	0 N/A	All set-ups	TRUE	0	Int32
16-70	Pulse Output #29 [Hz]	0 N/A	All set-ups	TRUE	0	Int32
16-71	Relay Output [bin]	0 N/A	All set-ups	TRUE	0	Uint16
16-72	Counter A	0 N/A	All set-ups	TRUE	0	Int32
16-73	Counter B	0 N/A	All set-ups	TRUE	0	Int32
16-75	Analog In X30/11	0.000 N/A	All set-ups	TRUE	-3	Int32
16-76	Analog In X30/12	0.000 N/A	All set-ups	TRUE	-3	Int32
16-77	Analog Out X30/8 [mA]	0.000 N/A	All set-ups	TRUE	-3	Int16
16-8* Fieldbus & FC Port						
16-80	Fieldbus CTW 1	0 N/A	All set-ups	TRUE	0	V2
16-82	Fieldbus REF 1	0 N/A	All set-ups	TRUE	0	N2
16-84	Comm. Option STW	0 N/A	All set-ups	TRUE	0	V2
16-85	FC Port CTW 1	0 N/A	All set-ups	TRUE	0	V2
16-86	FC Port REF 1	0 N/A	All set-ups	TRUE	0	N2
16-9* Diagnosis Readouts						
16-90	Alarm Word	0 N/A	All set-ups	TRUE	0	Uint32
16-91	Alarm Word 2	0 N/A	All set-ups	TRUE	0	Uint32
16-92	Warning Word	0 N/A	All set-ups	TRUE	0	Uint32
16-93	Warning Word 2	0 N/A	All set-ups	TRUE	0	Uint32
16-94	Ext. Status Word	0 N/A	All set-ups	TRUE	0	Uint32
16-95	Ext. Status Word 2	0 N/A	All set-ups	TRUE	0	Uint32
16-96	Maintenance Word	0 N/A	All set-ups	TRUE	0	Uint32

8.3.16. Data Readouts 2 18-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
18-0* Maintenance Log						
18-00	Maintenance Log: Item	0 N/A	All set-ups	FALSE	0	Uint8
18-01	Maintenance Log: Action	0 N/A	All set-ups	FALSE	0	Uint8
18-02	Maintenance Log: Time	0 s	All set-ups	FALSE	0	Uint32
18-03	Maintenance Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
18-3* Inputs & Outputs						
18-30	Analog Input X42/1	0.000 N/A	All set-ups	FALSE	-3	Int32
18-31	Analog Input X42/3	0.000 N/A	All set-ups	FALSE	-3	Int32
18-32	Analog Input X42/5	0.000 N/A	All set-ups	FALSE	-3	Int32
18-33	Analog Out X42/7 [V]	0.000 N/A	All set-ups	FALSE	-3	Int16
18-34	Analog Out X42/9 [V]	0.000 N/A	All set-ups	FALSE	-3	Int16
18-35	Analog Out X42/11 [V]	0.000 N/A	All set-ups	FALSE	-3	Int16

8.3.17. FC Closed Loop 20-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
20-0* Feedback						
20-00	Feedback 1 Source	[2] Analog input 54	All set-ups	TRUE	-	Uint8
20-01	Feedback 1 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
20-02	Feedback 1 Source Unit	null	All set-ups	TRUE	-	Uint8
20-03	Feedback 2 Source	[0] No function	All set-ups	TRUE	-	Uint8
20-04	Feedback 2 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
20-05	Feedback 2 Source Unit	null	All set-ups	TRUE	-	Uint8
20-06	Feedback 3 Source	[0] No function	All set-ups	TRUE	-	Uint8
20-07	Feedback 3 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
20-08	Feedback 3 Source Unit	null	All set-ups	TRUE	-	Uint8
20-12	Reference/Feedback Unit	null	All set-ups	TRUE	-	Uint8
20-2* Feedback/Setpoint						
20-20	Feedback Function	[4] Maximum	All set-ups	TRUE	-	Uint8
20-21	Setpoint 1	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
20-22	Setpoint 2	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
20-23	Setpoint 3	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
20-7* PID Autotuning						
20-70	Closed Loop Type	[0] Auto	2 set-ups	TRUE	-	Uint8
20-71	PID Performance	[0] Normal	2 set-ups	TRUE	-	Uint8
20-72	PID Output Change	0.10 N/A	2 set-ups	TRUE	-2	Uint16
20-73	Minimum Feedback Level	-999999.000 ProcessCtrlUnit	2 set-ups	TRUE	-3	Int32
20-74	Maximum Feedback Level	999999.000 ProcessCtrlUnit	2 set-ups	TRUE	-3	Int32
20-79	PID Autotuning	[0] Disabled	All set-ups	TRUE	-	Uint8
20-8* PID Basic Settings						
20-81	PID Normal/ Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
20-82	PID Start Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
20-83	PID Start Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
20-84	On Reference Bandwidth	5 %	All set-ups	TRUE	0	Uint8
20-9* PID Controller						
20-91	PID Anti Windup	[1] On	All set-ups	TRUE	-	Uint8
20-93	PID Proportional Gain	2.00 N/A	All set-ups	TRUE	-2	Uint16
20-94	PID Integral Time	8.00 s	All set-ups	TRUE	-2	Uint32
20-95	PID Differentiation Time	0.00 s	All set-ups	TRUE	-2	Uint16
20-96	PID Diff. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16

8.3.18. Ext. Closed Loop 21-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
21-0* Ext. CL Autotuning						
21-00	Closed Loop Type	[0] Auto	2 set-ups	TRUE	-	Uint8
21-01	PID Performance	[0] Normal	2 set-ups	TRUE	-	Uint8
21-02	PID Output Change	0.10 N/A	2 set-ups	TRUE	-2	Uint16
21-03	Minimum Feedback Level	-999999.000 N/A	2 set-ups	TRUE	-3	Int32
21-04	Maximum Feedback Level	999999.000 N/A	2 set-ups	TRUE	-3	Int32
21-09	PID Auto Tuning	[0] Disabled	All set-ups	TRUE	-	Uint8
21-1* Ext. CL 1 Ref./Fb.						
21-10	Ext. 1 Ref./Feedback Unit	[0]	All set-ups	TRUE	-	Uint8
21-11	Ext. 1 Minimum Reference	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-12	Ext. 1 Maximum Reference	100.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-13	Ext. 1 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
21-14	Ext. 1 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
21-15	Ext. 1 Setpoint	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-17	Ext. 1 Reference [Unit]	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-18	Ext. 1 Feedback [Unit]	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-19	Ext. 1 Output [%]	0 %	All set-ups	TRUE	0	Int32
21-2* Ext. CL 1 PID						
21-20	Ext. 1 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
21-21	Ext. 1 Proportional Gain	0.50 N/A	All set-ups	TRUE	-2	Uint16
21-22	Ext. 1 Integral Time	20.00 s	All set-ups	TRUE	-2	Uint32
21-23	Ext. 1 Differentation Time	0.00 s	All set-ups	TRUE	-2	Uint16
21-24	Ext. 1 Dif. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16
21-3* Ext. CL 2 Ref./Fb.						
21-30	Ext. 2 Ref./Feedback Unit	[0]	All set-ups	TRUE	-	Uint8
21-31	Ext. 2 Minimum Reference	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-32	Ext. 2 Maximum Reference	100.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-33	Ext. 2 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
21-34	Ext. 2 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
21-35	Ext. 2 Setpoint	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-37	Ext. 2 Reference [Unit]	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-38	Ext. 2 Feedback [Unit]	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-39	Ext. 2 Output [%]	0 %	All set-ups	TRUE	0	Int32
21-4* Ext. CL 2 PID						
21-40	Ext. 2 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
21-41	Ext. 2 Proportional Gain	0.50 N/A	All set-ups	TRUE	-2	Uint16
21-42	Ext. 2 Integral Time	20.00 s	All set-ups	TRUE	-2	Uint32
21-43	Ext. 2 Differentation Time	0.00 s	All set-ups	TRUE	-2	Uint16
21-44	Ext. 2 Dif. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
21-5* Ext. CL 3 Ref./Fb.						
21-50	Ext. 3 Ref./Feedback Unit	[0]	All set-ups	TRUE	-	Uint8
21-51	Ext. 3 Minimum Reference	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
21-52	Ext. 3 Maximum Reference	100.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
21-53	Ext. 3 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
21-54	Ext. 3 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
21-55	Ext. 3 Setpoint	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
21-57	Ext. 3 Reference [Unit]	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
21-58	Ext. 3 Feedback [Unit]	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
21-59	Ext. 3 Output [%]	0 %	All set-ups	TRUE	0	Int32
21-6* Ext. CL 3 PID						
21-60	Ext. 3 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
21-61	Ext. 3 Proportional Gain	0.50 N/A	All set-ups	TRUE	-2	Uint16
21-62	Ext. 3 Integral Time	20.00 s	All set-ups	TRUE	-2	Uint32
21-63	Ext. 3 Differentation Time	0.00 s	All set-ups	TRUE	-2	Uint16
21-64	Ext. 3 Dif. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16

8.3.19. Application Functions 22-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
22-0* Miscellaneous						
22-00	External Interlock Delay	0 s	All set-ups	TRUE	0	Uint16
22-2* No-Flow Detection						
22-20	Low Power Auto Set-up	[0] Off	All set-ups	FALSE	-	Uint8
22-21	Low Power Detection	[0] Disabled	All set-ups	TRUE	-	Uint8
22-22	Low Speed Detection	[0] Disabled	All set-ups	TRUE	-	Uint8
22-23	No-Flow Function	[0] Off	All set-ups	TRUE	-	Uint8
22-24	No-Flow Delay	10 s	All set-ups	TRUE	0	Uint16
22-26	Dry Pump Function	[0] Off	All set-ups	TRUE	-	Uint8
22-27	Dry Pump Delay	10 s	All set-ups	TRUE	0	Uint16
22-3* No-Flow Power Tuning						
22-30	No-Flow Power	0.00 kW	All set-ups	TRUE	1	Uint32
22-31	Power Correction Factor	100 %	All set-ups	TRUE	0	Uint16
22-32	Low Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-33	Low Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
22-34	Low Speed Power [kW]	ExpressionLimit	All set-ups	TRUE	1	Uint32
22-35	Low Speed Power [HP]	ExpressionLimit	All set-ups	TRUE	-2	Uint32
22-36	High Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-37	High Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
22-38	High Speed Power [kW]	ExpressionLimit	All set-ups	TRUE	1	Uint32
22-39	High Speed Power [HP]	ExpressionLimit	All set-ups	TRUE	-2	Uint32
22-4* Sleep Mode						
22-40	Minimum Run Time	60 s	All set-ups	TRUE	0	Uint16
22-41	Minimum Sleep Time	30 s	All set-ups	TRUE	0	Uint16
22-42	Wake-up Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-43	Wake-up Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
22-44	Wake-up Ref./FB Difference	10 %	All set-ups	TRUE	0	Int8
22-45	Setpoint Boost	0 %	All set-ups	TRUE	0	Int8
22-46	Maximum Boost Time	60 s	All set-ups	TRUE	0	Uint16
22-5* End of Curve						
22-50	End of Curve Function	[0] Off	All set-ups	TRUE	-	Uint8
22-51	End of Curve Delay	10 s	All set-ups	TRUE	0	Uint16
22-6* Broken Belt Detection						
22-60	Broken Belt Function	[0] Off	All set-ups	TRUE	-	Uint8
22-61	Broken Belt Torque	10 %	All set-ups	TRUE	0	Uint8
22-62	Broken Belt Delay	10 s	All set-ups	TRUE	0	Uint16
22-7* Short Cycle Protection						
22-75	Short Cycle Protection	[0] Disabled	All set-ups	TRUE	-	Uint8
22-76	Interval between Starts	start_to_start_min_on_time (P2277)	All set-ups	TRUE	0	Uint16
22-77	Minimum Run Time	0 s	All set-ups	TRUE	0	Uint16

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
22-8* Flow Compensation						
22-80	Flow Compensation	[0] Disabled	All set-ups	TRUE	-	Uint8
22-81	Square-linear Curve Approximation	100 %	All set-ups	TRUE	0	Uint8
22-82	Work Point Calculation	[0] Disabled	All set-ups	TRUE	-	Uint8
22-83	Speed at No-Flow [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-84	Speed at No-Flow [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
22-85	Speed at Design Point [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-86	Speed at Design Point [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
22-87	Pressure at No-Flow Speed	0.000 N/A	All set-ups	TRUE	-3	Int32
22-88	Pressure at Rated Speed	999999.999 N/A	All set-ups	TRUE	-3	Int32
22-89	Flow at Design Point	0.000 N/A	All set-ups	TRUE	-3	Int32
22-90	Flow at Rated Speed	0.000 N/A	All set-ups	TRUE	-3	Int32

8.3.20. Timed Actions 23-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
23-0* Timed Actions						
23-00	ON Time	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay-WoDate
23-01	ON Action	[0] Disabled	2 set-ups	TRUE	-	Uint8
23-02	OFF Time	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay-WoDate
23-03	OFF Action	[0] Disabled	2 set-ups	TRUE	-	Uint8
23-04	Occurrence	[0] All days	2 set-ups	TRUE	-	Uint8
23-1* Maintenance						
23-10	Maintenance Item	[1] Motor bearings	1 set-up	TRUE	-	Uint8
23-11	Maintenance Action	[1] Lubricate	1 set-up	TRUE	-	Uint8
23-12	Maintenance Time Base	[0] Disabled	1 set-up	TRUE	-	Uint8
23-13	Maintenance Time Interval	1 h	1 set-up	TRUE	74	Uint32
23-14	Maintenance Date and Time	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
23-1* Maintenance Reset						
23-15	Reset Maintenance Word	[0] Do not reset	All set-ups	TRUE	-	Uint8
23-16	Maintenance Text	0 N/A	1 set-up	TRUE	0	VisStr[20]
23-5* Energy Log						
23-50	Energy Log Resolution	[5] Last 24 Hours	2 set-ups	TRUE	-	Uint8
23-51	Period Start	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay
23-53	Energy Log	0 N/A	All set-ups	TRUE	0	Uint32
23-54	Reset Energy Log	[0] Do not reset	All set-ups	TRUE	-	Uint8
23-6* Trending						
23-60	Trend Variable	[0] Power [kW]	2 set-ups	TRUE	-	Uint8
23-61	Continuous Bin Data	0 N/A	All set-ups	TRUE	0	Uint32
23-62	Timed Bin Data	0 N/A	All set-ups	TRUE	0	Uint32
23-63	Timed Period Start	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay
23-64	Timed Period Stop	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay
23-65	Minimum Bin Value	ExpressionLimit	2 set-ups	TRUE	0	Uint8
23-66	Reset Continuous Bin Data	[0] Do not reset	All set-ups	TRUE	-	Uint8
23-67	Reset Timed Bin Data	[0] Do not reset	All set-ups	TRUE	-	Uint8
23-8* Payback Counter						
23-80	Power Reference Factor	100 %	2 set-ups	TRUE	0	Uint8
23-81	Energy Cost	1.00 N/A	2 set-ups	TRUE	-2	Uint32
23-82	Investment	0 N/A	2 set-ups	TRUE	0	Uint32
23-83	Energy Savings	0 kWh	All set-ups	TRUE	75	Int32
23-84	Cost Savings	0 N/A	All set-ups	TRUE	0	Int32

8.3.21. Cascade Controller 25-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
25-0* System Settings						
25-00	Cascade Controller	null	2 set-ups	FALSE	-	Uint8
25-02	Motor Start	[0] Direct on Line	2 set-ups	FALSE	-	Uint8
25-04	Pump Cycling	null	All set-ups	TRUE	-	Uint8
25-05	Fixed Lead Pump	null	2 set-ups	FALSE	-	Uint8
25-06	Number of Pumps	2 N/A	2 set-ups	FALSE	0	Uint8
25-2* Bandwidth Settings						
25-20	Staging Bandwidth	ExpressionLimit	All set-ups	TRUE	0	Uint8
25-21	Override Bandwidth	100 %	All set-ups	TRUE	0	Uint8
25-22	Fixed Speed Bandwidth	casco_staging_bandwidth (P2520)	All set-ups	TRUE	0	Uint8
25-23	SBW Staging Delay	15 s	All set-ups	TRUE	0	Uint16
25-24	SBW Destaging Delay	15 s	All set-ups	TRUE	0	Uint16
25-25	OBW Time	10 s	All set-ups	TRUE	0	Uint16
25-26	Destage At No-Flow	[0] Disabled	All set-ups	TRUE	-	Uint8
25-27	Stage Function	null	All set-ups	TRUE	-	Uint8
25-28	Stage Function Time	15 s	All set-ups	TRUE	0	Uint16
25-29	Destage Function	null	All set-ups	TRUE	-	Uint8
25-30	Destage Function Time	15 s	All set-ups	TRUE	0	Uint16
25-4* Staging Settings						
25-40	Ramp Down Delay	10.0 s	All set-ups	TRUE	-1	Uint16
25-41	Ramp Up Delay	2.0 s	All set-ups	TRUE	-1	Uint16
25-42	Staging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
25-43	Destaging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
25-44	Staging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
25-45	Staging Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
25-46	Destaging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
25-47	Destaging Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
25-5* Alternation Settings						
25-50	Lead Pump Alternation	null	All set-ups	TRUE	-	Uint8
25-51	Alternation Event	[0] External	All set-ups	TRUE	-	Uint8
25-52	Alternation Time Interval	24 h	All set-ups	TRUE	74	Uint16
25-53	Alternation Timer Value	0 N/A	All set-ups	TRUE	0	VisStr[7]
25-54	Alternation Predefined Time	ExpressionLimit	All set-ups	TRUE	0	TimeOfDay-WoDate
25-55	Alternate if Load < 50%	[1] Enabled	All set-ups	TRUE	-	Uint8
25-56	Staging Mode at Alternation	[0] Slow	All set-ups	TRUE	-	Uint8
25-58	Run Next Pump Delay	0.1 s	All set-ups	TRUE	-1	Uint16
25-59	Run on Mains Delay	0.5 s	All set-ups	TRUE	-1	Uint16

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
25-8* Status						
25-80	Cascade Status	0 N/A	All set-ups	TRUE	0	VisStr[25]
25-81	Pump Status	0 N/A	All set-ups	TRUE	0	VisStr[25]
25-82	Lead Pump	0 N/A	All set-ups	TRUE	0	Uint8
25-83	Relay Status	0 N/A	All set-ups	TRUE	0	VisStr[4]
25-84	Pump ON Time	0 h	All set-ups	TRUE	74	Uint32
25-85	Relay ON Time	0 h	All set-ups	TRUE	74	Uint32
25-86	Reset Relay Counters	[0] Do not reset	All set-ups	TRUE	-	Uint8
25-9* Service						
25-90	Pump Interlock	[0] Off	All set-ups	TRUE	-	Uint8
25-91	Manual Alternation	0 N/A	All set-ups	TRUE	0	Uint8

8.3.22. Analog I/O Option MCB 109 26-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
26-0* Analog I/O Mode						
26-00	Terminal X42/1 Mode	[1] Voltage	All set-ups	TRUE	-	Uint8
26-01	Terminal X42/3 Mode	[1] Voltage	All set-ups	TRUE	-	Uint8
26-02	Terminal X42/5 Mode	[1] Voltage	All set-ups	TRUE	-	Uint8
26-1* Analog Input X42/1						
26-10	Terminal X42/1 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
26-11	Terminal X42/1 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
26-14	Term. X42/1 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
26-15	Term. X42/1 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
26-16	Term. X42/1 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
26-17	Term. X42/1 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
26-2* Analog Input X42/3						
26-20	Terminal X42/3 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
26-21	Terminal X42/3 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
26-24	Term. X42/3 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
26-25	Term. X42/3 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
26-26	Term. X42/3 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
26-27	Term. X42/3 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
26-3* Analog Input X42/5						
26-30	Terminal X42/5 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
26-31	Terminal X42/5 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
26-34	Term. X42/5 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
26-35	Term. X42/5 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
26-36	Term. X42/5 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
26-37	Term. X42/5 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
26-4* Analog Out X42/7						
26-40	Terminal X42/7 Output	[0] No operation	All set-ups	TRUE	-	Uint8
26-41	Terminal X42/7 Min. Scale	0.00 %	All set-ups	TRUE	-2	Int16
26-42	Terminal X42/7 Max. Scale	100.00 %	All set-ups	TRUE	-2	Int16
26-43	Terminal X42/7 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
26-44	Terminal X42/7 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
26-5* Analog Out X42/9						
26-50	Terminal X42/9 Output	[0] No operation	All set-ups	TRUE	-	Uint8
26-51	Terminal X42/9 Min. Scale	0.00 %	All set-ups	TRUE	-2	Int16
26-52	Terminal X42/9 Max. Scale	100.00 %	All set-ups	TRUE	-2	Int16
26-53	Terminal X42/9 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
26-54	Terminal X42/9 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
26-6* Analog Out X42/11						
26-60	Terminal X42/11 Output	[0] No operation	All set-ups	TRUE	-	Uint8
26-61	Terminal X42/11 Min. Scale	0.00 %	All set-ups	TRUE	-2	Int16
26-62	Terminal X42/11 Max. Scale	100.00 %	All set-ups	TRUE	-2	Int16
26-63	Terminal X42/11 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
26-64	Terminal X42/11 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16

8.3.23. Cascade CTL Option 27-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
27-0* Control & Status						
27-01	Pump Status	[0] Ready	All set-ups	TRUE	-	Uint8
27-02	Manual Pump Control	[0] No Operation	2 set-ups	TRUE	-	Uint8
27-03	Current Runtime Hours	0 h	All set-ups	TRUE	74	Uint32
27-04	Pump Total Lifetime Hours	0 h	All set-ups	TRUE	74	Uint32
27-1* Configuration						
27-10	Cascade Controller	[0] Disabled	2 set-ups	FALSE	-	Uint8
27-11	Number Of Drives	1 N/A	2 set-ups	FALSE	0	Uint8
27-12	Number Of Pumps	ExpressionLimit	2 set-ups	FALSE	0	Uint8
27-14	Pump Capacity	100 %	2 set-ups	FALSE	0	Uint16
27-16	Runtime Balancing	[0] Balanced Priority 1	2 set-ups	TRUE	-	Uint8
27-17	Motor Starters	[0] Direct Online	2 set-ups	FALSE	-	Uint8
27-18	Spin Time for Unused Pumps	ExpressionLimit	All set-ups	TRUE	0	Uint16
27-19	Reset Current Runtime Hours	[0] Do not reset	All set-ups	TRUE	-	Uint8
27-2* Bandwidth Settings						
27-20	Normal Operating Range	ExpressionLimit	All set-ups	TRUE	0	Uint8
27-21	Override Limit	100 %	All set-ups	TRUE	0	Uint8
27-22	Fixed Speed Only Operating Range	ExpressionLimit	All set-ups	TRUE	0	Uint8
27-23	Staging Delay	15 s	All set-ups	TRUE	0	Uint16
27-24	Destaging Delay	15 s	All set-ups	TRUE	0	Uint16
27-25	Override Hold Time	10 s	All set-ups	TRUE	0	Uint16
27-27	Min Speed Destage Delay	ExpressionLimit	All set-ups	TRUE	0	Uint16
27-3* Staging Speed						
27-31	Stage On Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
27-32	Stage On Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
27-33	Stage Off Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
27-34	Stage Off Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
27-4* Staging Settings						
27-40	Auto Tune Staging Settings	[1] Enabled	All set-ups	TRUE	-	Uint8
27-41	Ramp Down Delay	10.0 s	All set-ups	TRUE	-1	Uint16
27-42	Ramp Up Delay	2.0 s	All set-ups	TRUE	-1	Uint16
27-43	Staging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
27-44	Destaging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
27-45	Staging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
27-46	Staging Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
27-47	Destaging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
27-48	Destaging Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
27-5* Alternate Settings						
27-50	Automatic Alternation	[0] Disabled	All set-ups	FALSE	-	Uint8
27-51	Alternation Event	null	All set-ups	TRUE	-	Uint8
27-52	Alternation Time Interval	0 min	All set-ups	TRUE	70	Uint16
27-53	Alternation Timer Value	0 min	All set-ups	TRUE	70	Uint16
27-54	Alternation At Time of Day	[0] Disabled	All set-ups	TRUE	-	Uint8
27-55	Alternation Predefined Time	ExpressionLimit	All set-ups	TRUE	0	TimeOfDayWoDate
27-56	Alternate Capacity is <	0 %	All set-ups	TRUE	0	Uint8
27-58	Run Next Pump Delay	0.1 s	All set-ups	TRUE	-1	Uint16

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
27-6* Digital Inputs						
27-60	Terminal X66/1 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-61	Terminal X66/3 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-62	Terminal X66/5 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-63	Terminal X66/7 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-64	Terminal X66/9 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-65	Terminal X66/11 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-66	Terminal X66/13 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-7* Connections						
27-70	Relay	[0] Standard Relay	2 set-ups	FALSE	-	Uint8
27-9* Readouts						
27-91	Cascade Reference	0.0 %	All set-ups	TRUE	-1	Int16
27-92	% Of Total Capacity	0 %	All set-ups	TRUE	0	Uint16
27-93	Cascade Option Status	[0] Disabled	All set-ups	TRUE	-	Uint8

8.3.24. Water Application Functions 29-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
29-0* Pipe Fill						
29-00	Pipe Fill Enable	[0] Disabled	2 set-ups	FALSE	-	Uint8
29-01	Pipe Fill Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
29-02	Pipe Fill Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
29-03	Pipe Fill Time	0.00 s	All set-ups	TRUE	-2	Uint32
29-04	Pipe Fill Rate	0.001 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
29-05	Filled Setpoint	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32

8.3.25. Bypass Option 31-**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
31-00	Bypass Mode	[0] Drive	All set-ups	TRUE	-	Uint8
31-01	Bypass Start Time Delay	30 s	All set-ups	TRUE	0	Uint16
31-02	Bypass Trip Time Delay	0 s	All set-ups	TRUE	0	Uint16
31-03	Test Mode Activation	[0] Disabled	All set-ups	TRUE	-	Uint8
31-10	Bypass Status Word	0 N/A	All set-ups	FALSE	0	V2
31-11	Bypass Running Hours	0 h	All set-ups	FALSE	74	Uint32
31-19	Remote Bypass Activation	[0] Disabled	2 set-ups	TRUE	-	Uint8

9

9. Troubleshooting

9.1. Alarms and warnings

A warning or an alarm is signalled by the relevant LED on the front of the frequency converter and indicated by a code on the display.

A warning remains active until its cause is no longer present. Under certain circumstances operation of the motor may still be continued. Warning messages may be critical, but are not necessarily so.

In the event of an alarm, the frequency converter will have tripped. Alarms must be reset to restart operation once their cause has been rectified.

This may be done in four ways:

1. By using the [RESET] control button on the LCP control panel.
2. Via a digital input with the "Reset" function.
3. Via serial communication/optional fieldbus.
4. By resetting automatically using the [Auto Reset] function, which is a default setting for VLT AQUA Drive. see par. 14-20 Reset Mode in **VLT AQUA Drive Programming Guide**

NB!
After a manual reset using the [RESET] button on the LCP, the [AUTO ON] or [HAND ON] button must be pressed to restart the motor.

If an alarm cannot be reset, the reason may be that its cause has not been rectified, or the alarm is trip-locked (see also table on following page).

Alarms that are trip-locked offer additional protection, means that the mains supply must be switched off before the alarm can be reset. After being switched back on, the frequency converter is no longer blocked and may be reset as described above once the cause has been rectified.

Alarms that are not trip-locked can also be reset using the automatic reset function in parameter 14-20 (Warning: automatic wake-up is possible!)

If a warning and alarm is marked against a code in the table on the following page, this means that either a warning occurs before an alarm, or it can be specified whether it is a warning or an alarm that is to be displayed for a given fault.

This is possible, for instance, in parameter 1-90 *Motor Thermal Protection*. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash on the frequency converter. Once the problem has been rectified, only the alarm continues flashing.

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts low	X			
2	Live zero error	(X)	(X)		6-01
3	No motor	(X)			1-80
4	Mains phase loss	(X)	(X)	(X)	14-12
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC over voltage	X	X		
8	DC under voltage	X	X		
9	Inverter overloaded	X	X		
10	Motor ETR over temperature	(X)	(X)		1-90
11	Motor thermistor over temperature	(X)	(X)		1-90
12	Torque limit	X	X		
13	Over Current	X	X	X	
14	Earth fault	X	X	X	
15	Hardware mesh mash		X	X	
16	Short Circuit		X	X	
17	Control word timeout	(X)	(X)		8-04
25	Brake resistor short-circuited	X			
26	Brake resistor power limit	(X)	(X)		2-13
27	Brake chopper short-circuited	X	X		
28	Brake check	(X)	(X)		2-15
29	Power board over temp	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	4-58
31	Motor phase V missing	(X)	(X)	(X)	4-58
32	Motor phase W missing	(X)	(X)	(X)	4-58
33	Inrush fault		X	X	
34	Fieldbus communication fault	X	X		
38	Internal fault		X	X	
47	24 V supply low	X	X	X	
48	1.8 V supply low		X	X	
50	AMA calibration failed		X		
51	AMA check U_{nom} and I_{nom}		X		
52	AMA low I_{nom}		X		
53	AMA motor too big		X		
54	AMA motor too small		X		
55	AMA parameter out of range		X		
56	AMA interrupted by user		X		
57	AMA timeout		X		
58	AMA internal fault	X	X		
59	Current limit	X			
61	Tracking Error	(X)	(X)		4-30
62	Output Frequency at Maximum Limit	X			
64	Voltage Limit	X			
65	Control Board Over-temperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Configuration has Changed		X		
68	Safe Stop Activated		X		
80	Drive Initialised to Default Value		X		

Table 9.1: Alarm/Warning code list

(X) Dependent on parameter

LED indication	
Warning	yellow
Alarm	flashing red
Trip locked	yellow and red

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Alarm Word and Extended Status Word

Bit	Hex	Dec	Alarm Word	Warning Word	Extended Status Word
0	00000001	1	Brake Check	Brake Check	Ramping
1	00000002	2	Pwr. Card Temp	Pwr. Card Temp	AMA Running
2	00000004	4	Earth Fault	Earth Fault	Start CW/CCW
3	00000008	8	Ctrl.Card Temp	Ctrl.Card Temp	Slow Down
4	00000010	16	Ctrl. Word TO	Ctrl. Word TO	Catch Up
5	00000020	32	Over Current	Over Current	Feedback High
6	00000040	64	Torque Limit	Torque Limit	Feedback Low
7	00000080	128	Motor Th Over	Motor Th Over	Output Current High
8	00000100	256	Motor ETR Over	Motor ETR Over	Output Current Low
9	00000200	512	Inverter Overld.	Inverter Overld.	Output Freq High
10	00000400	1024	DC under Volt	DC under Volt	Output Freq Low
11	00000800	2048	DC over Volt	DC over Volt	Brake Check OK
12	00001000	4096	Short Circuit	DC Voltage Low	Braking Max
13	00002000	8192	Inrush Fault	DC Voltage High	Braking
14	00004000	16384	Mains ph. Loss	Mains ph. Loss	Out of Speed Range
15	00008000	32768	AMA Not OK	No Motor	OVC Active
16	00010000	65536	Live Zero Error	Live Zero Error	
17	00020000	131072	Internal Fault	10V Low	
18	00040000	262144	Brake Overload	Brake Overload	
19	00080000	524288	U phase Loss	Brake Resistor	
20	00100000	1048576	V phase Loss	Brake IGBT	
21	00200000	2097152	W phase Loss	Speed Limit	
22	00400000	4194304	Fieldbus Fault	Fieldbus Fault	
23	00800000	8388608	24 V Supply Low	24V Supply Low	
24	01000000	16777216	Mains Failure	Mains Failure	
25	02000000	33554432	1.8V Supply Low	Current Limit	
26	04000000	67108864	Brake Resistor	Low Temp	
27	08000000	134217728	Brake IGBT	Voltage Limit	
28	10000000	268435456	Option Change	Unused	
29	20000000	536870912	Drive Initialised	Unused	
30	40000000	1073741824	Safe Stop	Unused	

Table 9.2: Description of Alarm Word, Warning Word and Extended Status Word

The alarm words, warning words and extended status words can be read out via serial bus or optional fieldbus for diagnosis. See also par. 16-90, 16-92 and 16-94.

9

9.1.1. Fault messages

WARNING 1, 10 Volts low:

The 10 V voltage from terminal 50 on the control card is below 10 V. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Max. 15 mA or minimum 590 Ω.

WARNING/ALARM 2, Live zero error:

The signal on terminal 53 or 54 is less than 50% of the value set in par. 6-10 *Terminal 53 Low Voltage*, par. 6-12 Terminal *53 Low Current*, par. 6-20 *Terminal 54 Low Voltage*, or par. 6-22 Terminal *54 Low Current* respectively.

WARNING/ALARM 3, No motor:

No motor has been connected to the output of the frequency converter.

WARNING/ALARM 4, Mains phase loss:

A phase is missing on the supply side, or the mains voltage imbalance is too high.

This message also appears in case of a fault in the input rectifier on the frequency converter.

Check the supply voltage and supply currents to the frequency converter.

WARNING 5, DC link voltage high:

The intermediate circuit voltage (DC) is higher than the over-voltage limit of the control system. The frequency converter is still active.

WARNING 6, DC link voltage low:

The intermediate circuit voltage (DC) is below the undervoltage limit of the control system. The frequency converter is still active.

WARNING/ALARM 7, DC over voltage:

If the intermediate circuit voltage exceeds the limit, the frequency converter trips after a time.

Possible corrections:

Select Over Voltage Control function in par. 2-17 Over-voltage *Control*

Connect a brake resistor

Extend the ramp time

Activate functions in par. 2-10 Brake *Function*

Increase par. 14-26 Trip *Delay at Inverter Fault*

Selecting OVC function will extend the ramp times.

Alarm/warning limits:

Voltage Range	3 x 200-240 V AC [VDC]	3 x 380-500 V AC [VDC]
Undervoltage	185	373
Voltage warning low	205	410
Voltage warning high (w/o brake - w/brake)	390/405	810/840
Overvoltage	410	855

The voltages stated are the intermediate circuit voltage of the frequency converter with a tolerance of ± 5 %. The corresponding mains voltage is the intermediate circuit voltage (DC-link) divided by 1.35

WARNING/ALARM 8, DC under voltage:
If the intermediate circuit voltage (DC) drops below the "voltage warning low" limit (see table above), the frequency converter checks if 24 V back-up supply is connected.
If no 24 V backup supply is connected, the frequency converter trips after a given time depending on the unit.
To check whether the supply voltage matches the frequency converter, see *3.1 General Specifications*.

WARNING/ALARM 9, Inverter overloaded:
The frequency converter is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection gives a warning at 98% and trips at 100%, while giving an alarm. You cannot reset the frequency converter until the counter is below 90%.
The fault is that the frequency converter is overloaded by more than nominal current for too long.

WARNING/ALARM 10, Motor ETR over temperature:
According to the electronic thermal protection (ETR), the motor is too hot. You can choose if you want the frequency converter to give a warning or an alarm when the counter reaches 100% in par. 1-90 Motor *Thermal Protection*. The fault is that the motor is overloaded by more than nominal current for too long. Check that the motor par. 1-24 *Motor Current* is set correctly.

WARNING/ALARM 11, Motor thermistor over temp:
The thermistor or the thermistor connection is disconnected. You can choose if you want the frequency converter to give a warning or an alarm in par. 1-90 Motor *Thermal Protection*. Check that the thermistor is connected correctly between terminal 53 or 54 (analog voltage input) and terminal 50 (+ 10 Volts supply), or between terminal 18 or 19 (digital input PNP only) and terminal 50. If a KTY sensor is used, check for correct connection between terminal 54 and 55.

WARNING/ALARM 12, Torque limit:
The torque is higher than the value in par. 4-16 Torque *Limit Motor Mode* (in motor operation) or the torque is higher than the value in par. 4-17 Torque *Limit Generator Mode* (in regenerative operation).

WARNING/ALARM 13, Over Current:
The inverter peak current limit (approx. 200% of the rated current) is exceeded. The warning will last approx. 8-12 sec., then the frequency converter trips and issues an alarm. Turn off the frequency converter and check if the motor shaft can be turned and if the motor size matches the frequency converter.

ALARM 14, Earth fault:
There is a discharge from the output phases to earth, either in the cable between the frequency converter and the motor or in the motor itself.
Turn off the frequency converter and remove the earth fault.

ALARM 15, In-complete hardware:
A fitted option is not handled by the present control board (hardware or software).

ALARM 16, Short-circuit:
There is short-circuiting in the motor or on the motor terminals.
Turn off the frequency converter and remove the short-circuit.

WARNING/ALARM 17, Control word timeout:
There is no communication to the frequency converter.
The warning will only be active when par. 8-04 Control *Timeout Function* is NOT set to *OFF*.
If par. 8-04 Control *Timeout Function* is set to *Stop* and *Trip*, a warning appears and the frequency converter ramps down to zero speed, while giving an alarm.
par. 8-03 Control *Timeout Time* could possibly be increased.

WARNING 22, Hoist Mech. Brake:
Report value will show what kind it is.

0 = The torque ref. was not reached before timeout

1 = There was no brake feedback before timeout

WARNING 23, Internal fans:
External fans have failed due to defect hardware or fans not mounted.

WARNING 24, External fan fault:
The fan warning function is an extra protection function that checks if the fan is running / mounted. The fan warning can be disabled in par. 14-53 Fan *Monitor*, [0] Disabled.

WARNING 25, Brake resistor short-circuited:
The brake resistor is monitored during operation. If it short-circuits, the brake function is disconnected and the warning appears. The frequency converter still works, but without the brake function. Turn off the frequency converter and replace the brake resistor (see par. 2-15 Brake *Check*).

ALARM/WARNING 26, Brake resistor power limit:
The power transmitted to the brake resistor is calculated as a percentage, as a mean value over the last 120 s, on the basis of the resistance value of the brake resistor (par. 2-11 Brake *Resistor (ohm)*) and the intermediate circuit voltage. The warning is active when the dissipated braking power is higher than 90%. If *Trip* [2] has been selected in par. 2-13 Brake *Power Monitoring*, the frequency converter cuts out and issues this alarm, when the dissipated braking power is higher than 100%.

WARNING/ALARM 27, Brake chopper fault:
The brake transistor is monitored during operation and if it short-circuits, the brake function disconnects and the warning comes up. The frequency converter is still able to run, but since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.
Turn off the frequency converter and remove the brake resistor.

> Warning: There is a risk of substantial power being transmitted to the brake resistor if the brake transistor is short-circuited.

ALARM/WARNING 28, Brake check failed:
Brake resistor fault: the brake resistor is not connected/working.

WARNING/ALARM 29, Drive over temperature:
If the enclosure isIP00, IP20/Nema1 or IP21/TYPE 1, the cut-out temperature of the heat-sink is 95 °C ±5 °C. The temperature fault cannot be reset, until the temperature of the heatsink is below 70 °C.

The fault could be:

- Ambient temperature too high
- Too long motor cable

ALARM 30, Motor phase U missing:
Motor phase U between the frequency converter and the motor is missing.
Turn off the frequency converter and check motor phase U.

ALARM 31, Motor phase V missing:
Motor phase V between the frequency converter and the motor is missing. Turn off the frequency converter and check motor phase V.

ALARM 32, Motor phase W missing:
Motor phase W between the frequency converter and the motor is missing.
Turn off the frequency converter and check motor phase W.

ALARM 33, Inrush fault:
Too many powerups have occured within a short time period. See the chapter *General Specifications* for the allowed number of power-ups within one minute.

WARNING/ALARM 34, Fieldbus communication fault:
The fieldbus on the communication option card is not working.

WARNING/ALARM 36, Mains failure:
This warning/alarm is only active if the supply voltage to the frequency converter is lost and parameter 14-10 is NOT set to OFF. Possible correction: check the fuses to the frequency converter

WARNING/ALARM 37, Phase Imbalance:
There is a current imbalance between the power units.

ALARM 38, Internal fault:
Contact your local Danfoss supplier.

ALARM 39, Heatsink Sensor:
No feedback from the heatsink sensor.

WARNING 40, Overload of Digital Output Terminal 27
Check the load connected to terminal 27 or remove short-circuit connection. Check parameters 5-00 and 5-01.

WARNING 41, Overload of Digital Output Terminal 29:
Check the load connected to terminal 29 or remove short-circuit connection. Check parameters 5-00 and 5-02.

WARNING 42, Overload of Digital Output On X30/6 :
Check the load connected to X30/6 or remove short-circuit connection. Check parameter 5-32.

WARNING 42, Overload of Digital Output On X30/7 :
Check the load connected to X30/7 or remove short-circuit connection. Check parameter 5-33.

ALARM 46, Pwr. card supply:
The supply on the power card is out of range.

WARNING 47, 24 V supply low:
The external 24 V DC backup power supply may be overloaded, otherwise contact your Danfoss supplier.

ALARM 48, 1.8 V supply low:
Contact your Danfoss supplier.

WARNING 49, Speed limit:
The speed has been limited by range in par. 4-11 *Motor Speed Low Limit [RPM]* and par. 4-13 *Motor Speed High Limit [RPM]*.

ALARM 50, AMA calibration failed:
Contact your Danfoss supplier.

ALARM 51, AMA check Unom and Inom:
The setting of motor voltage, motor current, and motor power is presumably wrong. Check the settings.

ALARM 52, AMA low Inom:
The motor current is too low. Check the settings.

ALARM 53, AMA motor too big:
The motor is too big for the AMA to be carried out.

ALARM 54, AMA motor too small:
The motor is too small for the AMA to be carried out.

ALARM 55, AMA par. out of range:
The par. values found from the motor are outside acceptable range.

ALARM 56, AMA interrupted by user:
The AMA has been interrupted by the user.

ALARM 57, AMA timeout:
Try to start the AMA again a number of times, until the AMA is carried out. Please note that repeated runs may heat the motor to a level where the resistance Rs and Rr are increased. In most cases, however, this is not critical.

WARNING/ALARM 58, AMA internal fault:
Contact your Danfoss supplier.

WARNING 59, Current limit:
The current is higher than the value in par. 4-18 Current *Limit*.

WARNING 60, External Interlock:
External Interlock has been activated. To resume normal operation, apply 24 VDC to the terminal programmed for External Interlock and reset the frequency converter (via Bus, Digital I/O or by pressing [Reset]).

WARNING/ALARM 61, Tracking Error:
Tracking error. Contact your supplier.

WARNING 62, Output Frequency at Maximum Limit:
The output frequency is limited by the value set in par. 4-19 Max *Output Frequency*

WARNING 64, Voltage Limit:
The load and speed combination demands a motor voltage higher than the actual DC link voltage.

WARNING/ALARM/TRIP 65, Control Card Over Temperature:
Control card over temperature: The cut-out temperature of the control card is 80° C.

WARNING 66, Heatsink Temperature Low:
The heat sink temperature is measured as 0° C. This could indicate that the temperature sensor is defective and thus the fan speed is increased to the maximum in case the power part or control card is very hot.
If the temperature is below 15° C the warning will be present.

ALARM 67, Option Configuration has Changed:
One or more options has either been added or removed since the last power-down.

ALARM 68, Safe Stop:
Safe Stop has been activated. To resume normal operation, apply 24 VDC to terminal 37 then send a Reset signal (via Bus, Digital I/O or by pressing [Reset]).

ALARM 69, Pwr. Card Temp:
Power card over temperature.

ALARM 70, Illegal Frequency Converter Configuration:
Actual combination of control board and power board is illegal.

ALARM 90, Feedback Mon.:

ALARM 91, Analogue Input 54 Wrong Settings:
Switch S202 has to be set in position OFF (voltage input), when a KTY sensor is connected to the analogue input terminal 54.

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ALARM 92, NoFlow:

A no load situation has been detected for the system. See parameter group 22-2*.

ALARM 93, Dry Pump:

A no flow situation and high speed indicates that the pump has run dry. See parameter group 22-2*

ALARM 94, End of Curve:

Feed back stays lower than the set point, which may be indicates a leakage in the pipe system. See parameter group 22-5*

ALARM 95, Broken Belt:

Torque is below the torque level set for no load indicating a broken belt. See parameter group 22-6*

ALARM 96, Start Delayed:

Start of the motor has been delayed due to short cycle protection is active. See parameter group 22-7*.

ALARM 250, New Spare Part:

The power or Switch Mode Power Supply has been exchanged. The frequency converter type code must be restored in the EEPROM. Select the correct type code in Par 14-23 according to the label on unit. Remember to select 'Save to EEPROM' to complete.

ALARM 251, New Type Code:

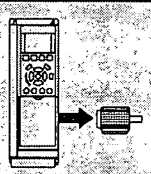
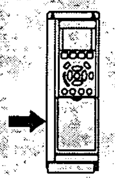
The frequency converter has got a new type code.

10. Specifications

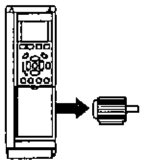
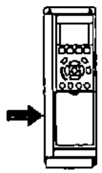
10.1. General Specifications

10.1.1. Mains Supply 1 x 200 - 240 VAC

Mains Supply 1 x 200 - 240 VAC - Normal overload 110% for 1 minute

	P5K	P7K	P15K	P22K
Frequency converter Typical Shaft Output [kW]	P5K 5	P7K 5	P15K	P22K
Typical Shaft Output [HP] at 240 V	7.5	10	20	30
IP 21 / NEMA 1	B1	B2	C1	C2
IP 55 / NEMA 12	B1	B2	C1	C2
IP 66	B1	B2	C1	C2
Output current				
 Continuous (3 x 200-240 V) [A]	24.2	30.8	59.4	88
Intermittent (3 x 200-240 V) [A]	26.6	33.4	65.3	96.8
Continuous kVA (208 V AC) [kVA]	5.00	6.40	12.27	18.30
Max. cable size:				
(mains, motor, brake) [[mm²/ AWG] 2)]	10/7	35/2	50/1/0	95/4/0
Max. input current				
 Continuous (1 x 200-240 V) [A]	46	59	111	172
Intermittent (1 x 200-240 V) [A]	50.6	64.9	122.1	189.2
Max. pre-fuses[1)] [A]	80	100	150	200
Environment				
Estimated power loss at rated max. load [W] [4)]	110	150	300	440
Weight enclosure IP 21 [kg]	23	27	45	65
Weight enclosure IP 55 [kg]	23	27	45	65
Weight enclosure IP 66 [kg]	23	27	45	65
Efficiency [3)]	0.98	0.98	0.98	0.98

10.1.2. Mains Supply 3 x 200 - 240 VAC

Normal overload 110% for 1 minute										
IP 20 / NEMA Chassis		A2	A2	A2	A2	A2	A2	A2	A3	A3
IP 21 / NEMA 1		A2	A2	A2	A2	A2	A2	A2	A3	A3
IP 55 / NEMA 12		A5	A5	A5	A5	A5	A5	A5	A5	A5
IP 66		A5	A5	A5	A5	A5	A5	A5	A5	A5
Mains supply 200 - 240 VAC										
Frequency converter		PK25	PK37	PK55	PK75	P1K1	P1K5	P2K2	P3K0	P3K7
Typical Shaft Output [kW]		0.25	0.37	0.55	0.75	1.1	1.5	2.2	3	3.7
Typical Shaft Output [HP] at 208 V		0.25	0.37	0.55	0.75	1.5	2.0	2.9	4.0	4.9
Output current										
	Continuous (3 x 200-240 V) [A]	1.8	2.4	3.5	4.6	6.6	7.5	10.6	12.5	16.7
	Intermittent (3 x 200-240 V) [A]	1.98	2.64	3.85	5.06	7.26	8.3	11.7	13.8	18.4
	Continuous kVA (208 V AC) [kVA]	0.65	0.86	1.26	1.66	2.38	2.70	3.82	4.50	6.00
	Max. cable size:									
	(mains, motor, brake) [mm²/AWG] 2)	0.2 - 4 mm² / 4 - 10 AWG								
Max. input current										
	Continuous (3 x 200-240 V) [A]	1.6	2.2	3.2	4.1	5.9	6.8	9.5	11.3	15.0
	Intermittent (3 x 200-240 V) [A]	1.7	2.42	3.52	4.51	6.5	7.5	10.5	12.4	16.5
	Max. pre-fuses1) [A]	10	10	10	10	20	20	20	32	32
	Environment									
	Estimated power loss at rated max. load [W] 4)	21	29	42	54	63	82	116	155	185
	Weight enclosure IP20 [kg]	4.9	4.9	4.9	4.9	4.9	4.9	4.9	6.6	6.6
	Weight enclosure IP21 [kg]	5.5	5.5	5.5	5.5	5.5	5.5	5.5	7.5	7.5
	Weight enclosure IP55 [kg]	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
	Weight enclosure IP 66 [kg]	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
	Efficiency 3)	0.94	0.94	0.95	0.95	0.96	0.96	0.96	0.96	0.96

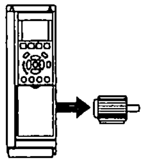
Mains supply 3 x 200 - 240 VAC - Normal overload 110% for 1 minute

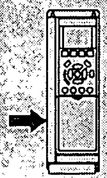
IP 20 / NEMA Chassis (B3+4 and C3+4 may be converted to IP21 using a conversion kit (Please contact Danfoss)	B3	B3	B3	B4	B4	C3	C3	C4	C4
IP 21 / NEMA 1	B1	B1	B1	B2	C1	C1	C1	C2	C2
IP 55 / NEMA 12	B1	B1	B1	B2	C1	C1	C1	C2	C2
IP 66	B1	B1	B1	B2	C1	C1	C1	C2	C2
Frequency converter	P5K5	P7K5	P11K	P15K	P18K	P22K	P30K	P37K	P45K
Typical Shaft Output [kW]	5.5	7.5	11	15	18.5	22	30	37	45
Typical Shaft Output [HP] at 208 V	7.5	10	15	20	25	30	40	50	60
Output current									
Continuous (3 x 200-240 V) [A]	24.2	30.8	46.2	59.4	74.8	88.0	115	143	170
Intermittent (3 x 200-240 V) [A]	26.6	33.9	50.8	65.3	82.3	96.8	127	157	187
Continuous kVA (208 V AC) [kVA]	8.7	11.1	16.6	21.4	26.9	31.7	41.4	51.5	61.2
Max. cable size:									
(mains, motor, brake) [mm² /AWG] 2)		10/7		35/2		50/1/0		95/4/0	120/250 MCM
Max. input current									
Continuous (3 x 200-240 V) [A]	22.0	28.0	42.0	54.0	68.0	80.0	104.0	130.0	154.0
Intermittent (3 x 200-240 V) [A]	24.2	30.8	46.2	59.4	74.8	88.0	114.0	143.0	169.0
Max. pre-fuses1) [A]	63	63	63	80	125	125	160	200	250
Environment:									
Estimated power loss at rated max. load [W] 4)	269	310	447	602	737	845	1140	1353	1636
Weight enclosure IP20 [kg]	12	12	12	23.5	23.5	35	35	50	50
Weight enclosure IP21 [kg]	23	23	23	27	45	45	65	65	65
Weight enclosure IP55 [kg]	23	23	23	27	45	45	65	65	65
Weight enclosure IP 66 [kg]	23	23	23	27	45	45	65	65	65
Efficiency 3)	0.96	0.96	0.96	0.96	0.96	0.97	0.97	0.97	0.97

10.1.3. Mains Supply 1 x 380 - 480 VAC

Mains Supply 1x 380 VAC - Normal overload 110% for 1 minute

Frequency converter	P7K5	P11K	P22K	P37K
Typical Shaft Output [kW]	7.5			
Typical Shaft Output [HP] at 460 V	10	15	30	50
IP 21 / NEMA 1	B1	B2	C1	C2
IP 55 / NEMA 12	B1	B2	C1	C2
IP 66	B1	B2	C1	C2
Output current				
Continuous (3 x 380-440 V) [A]	16	24	44	73
Intermittent (3 x 380-440 V) [A]	17.6	26.4	48.4	80.3
Continuous (3 x 441-480 V) [A]	14.5	21	40	65
Intermittent (3 x 441-480 V) [A]	15.4	23.1	44	71.5
Continuous kVA (400 V AC) [kVA]	11.0	16.6	30.5	50.6
Continuous kVA (460 V AC) [kVA]	11.6	16.7	31.9	51.8
Max. cable size: (mains, motor, brake) [[mm²/ AWG] 2)]	10/7	35/2	50/1/0	120/4/0
Max. input current				
Continuous (1 x 380-440 V) [A]	33	48	94	151
Intermittent (1 x 380-440 V) [A]	36	53	103	166
Continuous (1 x 441-480 V) [A]	30	41	85	135
Intermittent (1 x 441-480 V) [A]	33	46	93	148
Max. pre-fuses 1) [A]	63	80	160	250
Environment				
Estimated power loss at rated max. load [W] 4)	300	440	880	1480
Weight enclosure IP 21 [kg]	23	27	45	65
Weight enclosure IP 55 [kg]	23	27	45	65
Weight enclosure IP 66 [kg]	23	27	45	65
Efficiency 3)	0.96	0.96	0.96	0.96



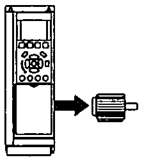
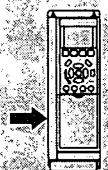


10.1.4. Mains Supply 3 x 380 - 480 VAC

Mains Supply 3 x 380 - 480 VAC - Normal overload 110% for 1 minute

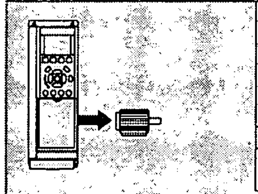
	PK37	PK55	PK75	P1K1	P1K5	P2K2	P3K0	P4K0	P5K5	P7K5
Frequency converter / Typical Shaft Output [kW]	0.37	0.55	0.75	1.1	1.5	2.2	3	4	5.5	7.5
Typical Shaft Output [HP] at 460 V	0.5	0.75	1.0	1.5	2.0	2.9	4.0	5.3	7.5	10
IP 20 / NEMA Chassis	A2	A2	A2	A2	A2	A2	A2	A2	A3	A3
IP 21 / NEMA 1										
IP 55 / NEMA 12	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5
IP 66	A5	A5	A5	A5	A5	A5	A5	A5	AA	A5
Output current										
Continuous (3 x 380-440 V) [A]	1.3	1.8	2.4	3	4.1	5.6	7.2	10	13	16
Intermittent (3 x 380-440 V) [A]	1.43	1.98	2.64	3.3	4.5	6.2	7.9	11	14.3	17.6
Continuous (3 x 441-480 V) [A]	1.2	1.6	2.1	2.7	3.4	4.8	6.3	8.2	11	14.5
Intermittent (3 x 441-480 V) [A]	1.32	1.76	2.31	3.0	3.7	5.3	6.9	9.0	12.1	15.4
Continuous kVA (400 V AC) [kVA]	0.9	1.3	1.7	2.1	2.8	3.9	5.0	6.9	9.0	11.0
Continuous kVA (460 V AC) [kVA]	0.9	1.3	1.7	2.4	2.7	3.8	5.0	6.5	8.8	11.6
Max. cable size: (mains, motor, brake) [[mm²/ AWG] 2)	4/10									
Max. input current										
Continuous (3 x 380-440 V) [A]	1.2	1.6	2.2	2.7	3.7	5.0	6.5	9.0	11.7	14.4
Intermittent (3 x 380-440 V) [A]	1.32	1.76	2.42	3.0	4.1	5.5	7.2	9.9	12.9	15.8
Continuous (3 x 441-480 V) [A]	1.0	1.4	1.9	2.7	3.1	4.3	5.7	7.4	9.9	13.0
Intermittent (3 x 441-480 V) [A]	1.1	1.54	2.09	3.0	3.4	4.7	6.3	8.1	10.9	14.3
Max. pre-fuses 1) [A]	10	10	10	10	10	20	20	20	30	30
Environment										
Estimated power loss at rated max. load [W] 4)	35	42	46	58	62	88	116	124	187	255
Weight enclosure IP20 [kg]	4.7	4.7	4.8	4.8	4.9	4.9	4.9	4.9	6.6	6.6
Weight enclosure IP 21 [kg]										
Weight enclosure IP 55 [kg]	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	14.2	14.2
Weight enclosure IP 66 [kg]	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	14.2	14.2
Efficiency 3)	0.93	0.95	0.96	0.96	0.97	0.97	0.97	0.97	0.97	0.97

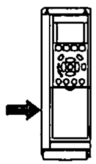
Mains Supply 3 x 380 - 480 VAC - Normal overload 110% for 1 minute

		P11K	P15K	P18K	P22K	P30K	P37K	P45K	P55K	P75K	P90K
Frequency converter Typical Shaft Output [kW]		11	15	18.5	22	30	37	45	55	75	90
Typical Shaft Output [HP] at 460 V		15	20	25	30	40	50	60	75	100	125
IP 20 / NEMA Chassis (B3+4 and C3+4 may be converted to IP21 using a conversion kit (Please contact Danfoss)		B3	B3	B3	B4	B4	B4	C3	C3	C4	C4
IP 21 / NEMA 1		B1	B1	B1	B2	B2	C1	C1	C1	C2	C2
IP 55 / NEMA 12		B1	B1	B1	B2	B2	C1	C1	C1	C2	-
IP 66		B1	B1	B1	B2	B2	C1	C1	C1	C2	-
Output current											
	Continuous (3 x 380-440 V) [A]	24	32	37.5	44	61	73	90	106	147	177
	Intermittent (3 x 380-440 V) [A]	26.4	35.2	41.3	48.4	67.1	80.3	99	117	162	195
	Continuous (3 x 441-480 V) [A]	21	27	34	40	52	65	80	105	130	160
	Intermittent (3 x 441-480 V) [A]	23.1	29.7	37.4	44	61.6	71.5	88	116	143	176
	Continuous kVA (400 V AC) [kVA]	16.6	22.2	26	30.5	42.3	50.6	62.4	73.4	102	123
	Continuous kVA (460 V AC) [kVA]	16.7	21.5	27.1	31.9	41.4	51.8	63.7	83.7	104	128
	Max. cable size: (mains, motor, brake) [[mm²/ AWG] 2)]	10/7			35/2		50/1/0			120/4/0	120/4/0
Max. input current											
	Continuous (3 x 380-440 V) [A]	22	29	34	40	55	66	82	96	133	161
	Intermittent (3 x 380-440 V) [A]	24.2	31.9	37.4	44	60.5	72.6	90.2	106	146	177
	Continuous (3 x 441-480 V) [A]	19	25	31	36	47	59	73	95	118	145
	Intermittent (3 x 441-480 V) [A]	20.9	27.5	34.1	39.6	51.7	64.9	80.3	105	130	160
	Max. pre-fuses 1) [A]	63	63	63	63	80	100	125	160	250	250
	Environment										
	Estimated power loss at rated max. load [W] 4)	278	392	465	525	698	739	843	1083	1384	1474
	Weight enclosure IP20 [kg]	12	12	12	23.5	23.5	23.5	35	35	50	50
	Weight enclosure IP 21 [kg]	23	23	23	27	27	45	45	45	65	65
	Weight enclosure IP 55 [kg]	23	23	23	27	27	45	45	45	65	65
	Weight enclosure IP 66 [kg]	23	23	23	27	27	45	45	45	65	65
	Efficiency 3)	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.99

Normal overload 110% for 1 minute

Frequency converter	P110	P132	P160	P200	P250	P315	P355	P400	P450
Typical Shaft Output [kW]	110	132	160	200	250	315	355	400	450
Typical Shaft Output [HP] at 460V	150	200	250	300	350	450	500	550	600
IP 00	D3	D3	D4	D4	D4	E2	E2	E2	E2
IP 21 / Nema 1	D1	D1	D2	D2	D2	E1	E1	E1	E1
IP 54 / Nema 12	D1	D1	D2	D2	D2	E1	E1	E1	E1
Output current									
Continuous (3 x 380-400 V) [A]	212	260	315	395	480	600	658	745	800
Intermittent (3 x 380-400 V) [A]	233	286	347	435	528	660	724	820	880
Continuous (3 x 401-480V) [A]	190	240	302	361	443	540	590	678	730
Intermittent (3 x 401-480V) [A]	209	264	332	397	487	594	649	746	803
Continuous kVA (400 VAC) [kVA]	147	180	218	274	333	416	456	516	554
Continuous kVA (460 VAC) [kVA]	151	191	241	288	353	430	470	540	582
Max. cable size:									
(mains, motor, brake) [mm²/ AWG] 2)	2x70 2x2/0		2x185 2x350 mcm			4x240 4x500 mcm			
Max. input current									
Continuous (3 x 380-400 V) [A]	204	251	304	381	463	590	647	733	787
Continuous (3 x 401-480V) [A]	183	231	291	348	427	531	580	667	718
Max. pre-fuses1)[A]	300	350	400	500	600	700	900	900	900
Environment									
Estimated power loss at rated max. load [W] 4)	3234	3782	4213	5119	5893	7630	7701	8879	9428
Weight enclosure IP00 [kg]	81.9	90.5	111.8	122.9	137.7	221.4	234.1	236.4	277.3
Weight enclosure IP 21 [kg]	95.5	104.1	125.4	136.3	151.3	263.2	270.0	272.3	313.2
Weight enclosure IP 54 [kg]	95.5	104.1	125.4	136.3	151.3	263.2	270.0	272.3	313.2
Efficiency 3)	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98





1) For type of fuse see section *Fuses*

2) American Wire Gauge

3) Measured using 5 m screened motor cables at rated load and rated frequency

4) The typical power loss is at normal load conditions and expected to be within +/- 15% (tolerance relates to variety in voltage and cable conditions).
Values are based on a typical motor efficiency (eff2/eff3 border line). Lower efficiency motors will also add to the power loss in the frequency converter and vice versa.
If the switching frequency is raised from nominal the power losses may rise significantly.
LCP and typical control card power consumptions are included. Further options and customer load may add up to 30W to the losses. (Though typically only 4W extra for a fully loaded control card, or options for slot A or slot B, each).
Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (+/- 5%).

10.1.5. Mains Supply 3 x 525 - 600 VAC

Normal overload 110% for 1 minute

Size:	PK75	P1K1	P1K5	P2K2	P3K0	P3K7	P4K0	P5K5	P7K5	P11K	P15K	P18K	P22K	P30K	P37K	P45K	P55K	P75K	P90K
Typical Shaft Output [kW]	0.75	1.1	1.5	2.2	3	3.7	4	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
IP 20 / NEMA Chassis	A2	A2	A2	A2	A2	A2	A2	A3	A3	B3	B3	B3	B4	B4	B4	C3	C3	C4	C4
IP 21 / NEMA 1	A2	A2	A2	A2	A2	A2	A2	A3	A3	B1	B1	B1	B2	B2	B2	C1	C1	C2	C2
IP 55 / NEMA 12	A5	A5	A5	A5	A5	A5	A5	A5	A5	B1	B1	B1	B2	B2	B2	C1	C1	C2	C2
IP 66	A5	A5	A5	A5	A5	A5	A5	A5	A5	B1	B1	B1	B2	B2	B2	C1	C1	C2	C2
Output current																			
Continuous (3 x 525-550 V) [A]	1.8	2.6	2.9	4.1	5.2	-	6.4	9.5	11.5	19	23	28	36	43	54	65	87	105	137
Intermittent (3 x 525-550 V) [A]		2.9	3.2	4.5	5.7	-	7.0	10.5	12.7	21	25	31	40	47	59	72	96	116	151
Continuous (3 x 525-600 V) [A]	1.7	2.4	2.7	3.9	4.9	-	6.1	9.0	11.0	18	22	27	34	41	52	62	83	100	131
Intermittent (3 x 525-600 V) [A]		2.6	3.0	4.3	5.4	-	6.7	9.9	12.1	20	24	30	37	45	57	68	91	110	144
Continuous kVA (525 V AC) [kVA]	1.7	2.5	2.8	3.9	5.0	-	6.1	9.0	11.0	18.1	21.9	26.7	34.3	41	51.4	61.9	82.9	100	130.5
Continuous kVA (575 V AC) [kVA]	1.7	2.4	2.7	3.9	4.9	-	6.1	9.0	11.0	17.9	21.9	26.9	33.9	40.8	51.8	61.7	82.7	99.6	130.5
Max. cable size (mains, motor, brake) [AWG] 2) [mm²]						-		24 - 10 AWG 0.2 - 4			6 16			2 35		1 50		3/0 95 5)	
Max. input current																			
Continuous (3 x 525-600 V) [A]	1.7	2.4	2.7	4.1	5.2	-	5.8	8.6	10.4	17.2	20.9	25.4	32.7	39	49	59	78.9	95.3	124.3
Intermittent (3 x 525-600 V) [A]		2.7	3.0	4.5	5.7	-	6.4	9.5	11.5	19	23	28	36	43	54	65	87	105	137
Max. pre-fuses 1) [A]	10	10	10	20	20	-	20	32	32										
Environment:																			
Estimated power loss at rated max. load [W] 4)	35	50	65	92	122	-	145	195	261	225	285	329							
Enclosure IP 20:																			
Weight enclosure IP20 [kg]	6.5	6.5	6.5	6.5	6.5	-	6.5	6.6	6.6	12	12	12	23.5	23.5	23.5	35	35	50	50
Efficiency 4)	0.97	0.97	0.97	0.97	0.97	-	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98

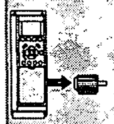
Table 10.1: 5) Motor and mains cable: 300MCM/150mm²

10.1.6. Mains Supply 3 x 525 - 690 VAC

Normal overload 110% for 1 minute

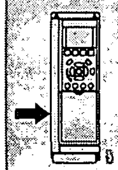
Frequency converter	P45K	P55K	P75K	P90K	P110	P132	P160	P200	P250	P315	P400	P450	P500	P560	P630	P710	P800	P900	P1M0	P1M2
Typical Shaft Output [kW]	45	55	75	90	110	132	160	200	250	315	400	450	500	560	630	710	800	900	1000	1200
Typical Shaft Output [HP] at 575 V	50	60	75	100	125	150	200	250	300	350	400	450	500	600	650	750	950	1050	1150	1350
IP 00	D3	D3	D3	D3	D3	D3	D3	D4	D4	D4	D4	E2	E2	E2	E2	-	-	-	-	-
IP 21 / Nema 1	D1	D1	D1	D1	D1	D1	D1	D2	D2	D2	D2	E1	E1	E1	E1	F1/ F3 6)	F1/ F3 6)	F1/F3 6)	F2/ F4 6)	F2/F4 6)
IP 54 / Nema 12	D1	D1	D1	D1	D1	D1	D1	D2	D2	D2	D2	E1	E1	E1	E1	F1/ F3 6)	F1/ F3 6)	F1/F3 6)	F1/ F3 6)	F1/F3 6)

Output current



Continuous (3 x 550 V) [A]	56	76	90	113	137	162	201	253	303	360	418	470	523	596	630	763	889	988	1108	1317
Intermittent (3 x 550 V) [A]	62	84	99	124	151	178	221	278	333	396	460	517	575	656	693	839	978	1087	1219	1449
Continuous (3 x 690V) [A]	54	73	86	108	131	155	192	242	290	344	400	450	500	570	630	730	850	945	1060	1260
Intermittent (3 x 690 V) [A]	59	80	95	119	144	171	211	266	319	378	440	495	550	627	693	803	935	1040	1166	1386
Continuous kVA (550 VAC) [kVA]	53	72	86	108	131	154	191	241	289	343	398	448	498	568	600	727	847	941	1056	1255
Continuous kVA (575 VAC) [kVA]	54	73	86	108	130	154	191	241	289	343	398	448	498	568	627	727	847	941	1056	1255
Continuous kVA (690 VACr) [kVA]	65	87	103	129	157	185	229	289	347	411	478	538	598	681	753	872	1016	1129	1267	1506
Max. cable size:																				
(Mains) [mm²/ AWG] 2)	2x70 2x2/0							2x185 2x350 mcm				4x240 4x500 mcm				8x240 8x500 mcm			8x240 8x500 mcm	
(Motor) [mm²/ AWG] 2)	2x70 2x2/0							2x185 2x350 mcm				4x240 4x500 mcm				8x150 8x300 mcm			12x150 12x300 mcm	
(Brake) [mm²/ AWG] 2)	2x70 2x2/0							2x185 2x350 mcm				2x185 2x350 mcm				4x185 4x350 mcm			6x185 6x350 mcm	

Max. input current



Continuous (3 x 525 V) [A]	60	77	89	110	130	158	198	299	245	299	355	453	504	574	607	743	866	962	1079	1282
Continuous (3 x 575 V) [A]	58	74	85	106	124	151	189	286	234	286	339	434	482	549	607	711	828	920	1032	1227
Continuous (3 x 690 V) [A]	58	77	87	109	128	155	197	296	240	296	352	434	482	549	607	711	828	920	1032	1227
Max. mains pre-fuses 1) [A]	125	160	200	200	250	315	350	350	400	500	550	700	700	900	900	2000	2000	2000	2000	2000
Environment:																				
Estimated power loss at rated max. load [W] 4)	1458	1717	1913	2262	2662	3114	3612	4292	5156	5821	6149	6449	7249	8727	9673					
Weight enclosure IP00 [kg]	82	82	82	82	82	82	91	112	123	138	151	221	221	236	277	-	-	-	-	-
Weight enclosure IP 21 [kg] 6)	96	96	96	96	96	96	104	125	136	151	165	263	263	272	313	1004	1004	1004	1246	1246
Weight enclosure IP 54 [kg] 6)	96	96	96	96	96	96	104	125	136	151	165	263	263	272	313	1004	1004	1004	1246	1246
Efficiency 3)	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98

1) For type of fuse see section *Fuses*
2) American Wire Gauge
3) Measured using 5 m screened motor cables at rated load and rated frequency
4) The typical power loss is at normal load conditions and expected to be within +/- 15% (tolerance relates to variety in voltage and cable conditions).
Values are based on a typical motor efficiency (eff2/eff3 border line). Lower efficiency motors will also add to the power loss in the frequency converter and vice versa.
If the switching frequency is raised from nominal the power losses may rise significantly.
LCP and typical control card power consumptions are included. Further options and customer load may add up to 30W to the losses. (Though typically only 4W extra for a fully loaded control card, or options for slot A or slot B, each).
Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (+/- 5%).
6) Adding the F-enclosure option cabinet (resulting in the F3 and F4 enclosure sizes) adds 295 kgto the estimated weight.

Protection and Features:

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the frequency converter trips if the temperature reaches 95 °C ± 5°C. An overload temperature cannot be reset until the temperature of the heatsink is below 70 °C ± 5°C (Guideline - these temperatures may vary for different power sizes, enclosures etc.). The frequency converter has an auto derating function to avoid it's heatsink reaching 95 deg C.
- The frequency converter is protected against short-circuits on motor terminals U, V, W.
- If a mains phase is missing, the frequency converter trips or issues a warning (depending on the load).
- Monitoring of the intermediate circuit voltage ensures that the frequency converter trips if the intermediate circuit voltage is too low or too high.
- The frequency converter is protected against earth faults on motor terminals U, V, W.

Mains supply (L1, L2, L3):

Supply voltage	380-480 V ±10%
Supply voltage	525-690 V ±10%
Supply frequency	50/60 Hz
Max. imbalance temporary between mains phases	3.0 % of rated supply voltage
True Power Factor (λ)	≥ 0.9 nominal at rated load
Displacement Power Factor (cosφ) near unity	(> 0.98)
Switching on input supply L1, L2, L3 (power-ups) ≤ enclosure type A	maximum 2 times/min.
Switching on input supply L1, L2, L3 (power-ups) ≥ enclosure type B, C	maximum 1 time/min.
Environment according to EN60664-1	overvoltage category III/pollution degree 2

The unit is suitable for use on a circuit capable of delivering not more than 100.000 RMS symmetrical Amperes, 500/600/690 V maximum.

Motor output (U, V, W):

Output voltage	0 - 100% of supply voltage
Output frequency	0 - 1000 Hz
Switching on output	Unlimited
Ramp times	1 - 3600 sec.

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Torque characteristics:

Starting torque (Constant torque)	maximum 110% for 1 min.*
Starting torque	maximum 135% up to 0.5 sec.*
Overload torque (Constant torque)	maximum 110% for 1 min.*

**Percentage relates to VLT AQUA Drive's nominal torque.*

Cable lengths and cross sections:

Max. motor cable length, screened/armoured	VLT AQUA Drive: 150 m
Max. motor cable length, unscreened/unarmoured	VLT AQUA Drive: 300 m
Max. cross section to motor, mains, load sharing and brake *	
Maximum cross section to control terminals, rigid wire	1.5 mm²/16 AWG (2 x 0.75 mm²)
Maximum cross section to control terminals, flexible cable	1 mm²/18 AWG
Maximum cross section to control terminals, cable with enclosed core	0.5 mm²/20 AWG
Minimum cross section to control terminals	0.25 mm²

** See Mains Supply tables for more information!*

Control card, RS-485 serial communication:

Terminal number	68 (P,TX+, RX+), 69 (N,TX-, RX-)
Terminal number 61	Common for terminals 68 and 69

The RS-485 serial communication circuit is functionally separated from other central circuits and galvanically isolated from the supply voltage (PELV).

Digital inputs:

Programmable digital inputs	4 (6)
Terminal number	18, 19, 27 [1)], 29, 32, 33,
Logic	PNP or NPN
Voltage level	0 - 24 V DC
Voltage level, logic'0' PNP	< 5 V DC
Voltage level, logic'1' PNP	> 10 V DC
Voltage level, logic '0' NPN	> 19 V DC
Voltage level, logic '1' NPN	< 14 V DC
Maximum voltage on input	28 V DC
Input resistance, R_i	approx. 4 kΩ

All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

1) Terminals 27 and 29 can also be programmed as output.

Digital output:

Programmable digital/pulse outputs	2
Terminal number	27, 29 [1)]
Voltage level at digital/frequency output	0 - 24 V
Max. output current (sink or source)	40 mA
Max. load at frequency output	1 kΩ
Max. capacitive load at frequency output	10 nF
Minimum output frequency at frequency output	0 Hz
Maximum output frequency at frequency output	32 kHz
Accuracy of frequency output	Max. error: 0.1 % of full scale
Resolution of frequency outputs	12 bit

1) Terminal 27 and 29 can also be programmed as input.

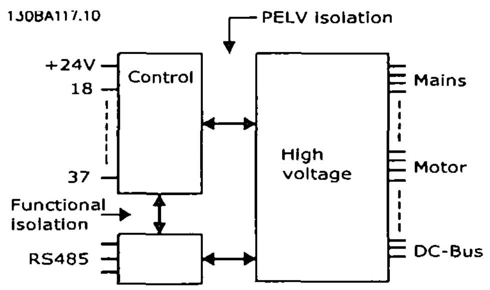
The digital output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

10

Analog inputs:

Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switch S201 and switch S202
Voltage mode	Switch S201/switch S202 = OFF (U)
Voltage level	: 0 to + 10 V (scaleable)
Input resistance, R_i	approx. 10 kΩ
Max. voltage	± 20 V
Current mode	Switch S201/switch S202 = ON (I)
Current level	0/4 to 20 mA (scaleable)
Input resistance, R_i	approx. 200 Ω
Max. current	30 mA
Resolution for analog inputs	10 bit (+ sign)
Accuracy of analog inputs	Max. error 0.5% of full scale
Bandwidth	: 200 Hz

The analog inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.



Analog output:

Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4 - 20 mA
Max. resistor load to common at analog output	500 Ω
Accuracy on analog output	Max. error: 0.8 % of full scale
Resolution on analog output	8 bit

The analog output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control card, 24 V DC output:

Terminal number	12, 13
Max. load	: 200 mA

The 24 V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analog and digital inputs and outputs.

Relay outputs:

Programmable relay outputs	2
Relay 01 Terminal number	1-3 (break), 1-2 (make)
Max. terminal load (AC-1)[1] on 1-3 (NC), 1-2 (NO) (Resistive load)	240 V AC, 2 A
Max. terminal load (AC-15)[1] (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Max. terminal load (DC-1)[1] on 1-2 (NO), 1-3 (NC) (Resistive load)	60 V DC, 1A
Max. terminal load (DC-13)[1] (Inductive load)	24 V DC, 0.1A
Relay 02 Terminal number	4-6 (break), 4-5 (make)
Max. terminal load (AC-1)[1] on 4-5 (NO) (Resistive load)[2][3]	400 V AC, 2 A
Max. terminal load (AC-15)[1] on 4-5 (NO) (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Max. terminal load (DC-1)[1] on 4-5 (NO) (Resistive load)	80 V DC, 2 A
Max. terminal load (DC-13)[1] on 4-5 (NO) (Inductive load)	24 V DC, 0.1A
Max. terminal load (AC-1)[1] on 4-6 (NC) (Resistive load)	240 V AC, 2 A
Max. terminal load (AC-15)[1] on 4-6 (NC) (Inductive load @ cosφ 0.4)	240 V AC, 0.2A
Max. terminal load (DC-1)[1] on 4-6 (NC) (Resistive load)	50 V DC, 2 A
Max. terminal load (DC-13)[1] on 4-6 (NC) (Inductive load)	24 V DC, 0.1 A
Min. terminal load on 1-3 (NC), 1-2 (NO), 4-6 (NC), 4-5 (NO)	24 V DC 10 mA, 24 V AC 20 mA
Environment according to EN 60664-1	overvoltage category III/pollution degree 2

1) IEC 60947 part 4 and 5

The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation (PELV).

2) Overvoltage Category II

3) UL applications 300 V AC 2A

Control card, 10 V DC output:

Terminal number	50
Output voltage	10.5 V ±0.5 V
Max. load	25 mA

The 10 V DC supply is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control characteristics:	
Resolution of output frequency at 0 - 1000 Hz	: +/- 0.003 Hz
System response time (terminals 18, 19, 27, 29, 32, 33)	: ≤ 2 ms
Speed control range (open loop)	1:100 of synchronous speed
Speed accuracy (open loop)	30 - 4000 rpm: Maximum error of ±8 rpm

All control characteristics are based on a 4-pole asynchronous motor

Surroundings:	
Enclosure type A	IP 20/Chassis, IP 21kit/Type 1, IP55/Type12, IP 66
Enclosure type B1/B2	IP 21/Type 1, IP55/Type12, IP 66
Enclosure type B3/B4	IP20/Chassis
Enclosure type C1/C2	IP 21/Type 1, IP55/Type 12, IP66
Enclosure type C3/C4	IP20/Chassis
Enclosure type D1/D2/E1	IP21/Type 1, IP54/Type12
Enclosure type D3/D4/E2	IP00/Chassis
Enclosure kit available ≤ enclosure type A	IP21/TYPE 1/IP 4X top
Vibration test	1.0 g
Max. relative humidity	5% - 95%(IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 721-3-3), uncoated	class 3C2
Aggressive environment (IEC 721-3-3), coated	class 3C3
Test method according to IEC 60068-2-43 H2S (10 days)	
Ambient temperature	Max. 50 °C

Derating for high ambient temperature, see section on special conditions

Minimum ambient temperature during full-scale operation	0 °C
Minimum ambient temperature at reduced performance	- 10 °C
Temperature during storage/transport	-25 - +65/70 °C
Maximum altitude above sea level without derating	1000 m
Maximum altitude above sea level with derating	3000 m

Derating for high altitude, see section on special conditions

EMC standards, Emission	EN 61800-3, EN 61000-6-3/4, EN 55011, IEC 61800-3
EMC standards, Immunity	EN 61800-3, EN 61000-6-1/2, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6

See section on special conditions

Control card performance:	
Scan interval	: 5 ms

Control card, USB serial communication:	
USB standard	1.1 (Full speed)
USB plug	USB type B "device" plug

Connection to PC is carried out via a standard host/device USB cable.
The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.
The USB connection is not galvanically isolated from protection earth. Use only isolated laptop/PC as connection to the USB connector on VLT AQUA Drive or an isolated USB cable/converter.

10.1.7. Efficiency

Efficiency of the frequency converter (η_{VLT})

The load on the frequency converter has little effect on its efficiency. In general, the efficiency is the same at the rated motor frequency $f_{M,N}$, even if the motor supplies 100% of the rated shaft torque or only 75%, i.e. in case of part loads.

This also means that the efficiency of the frequency converter does not change even if other U/f characteristics are chosen.
However, the U/f characteristics influence the efficiency of the motor.

The efficiency declines a little when the switching frequency is set to a value of above 5 kHz. The efficiency will also be slightly reduced if the mains voltage is 480 V, or if the motor cable is longer than 30 m.

Efficiency of the motor (η_{MOTOR})

The efficiency of a motor connected to the frequency converter depends on magnetising level. In general, the efficiency is just as good as with mains operation. The efficiency of the motor depends on the type of motor.

In the range of 75-100% of the rated torque, the efficiency of the motor is practically constant, both when it is controlled by the frequency converter and when it runs directly on mains.

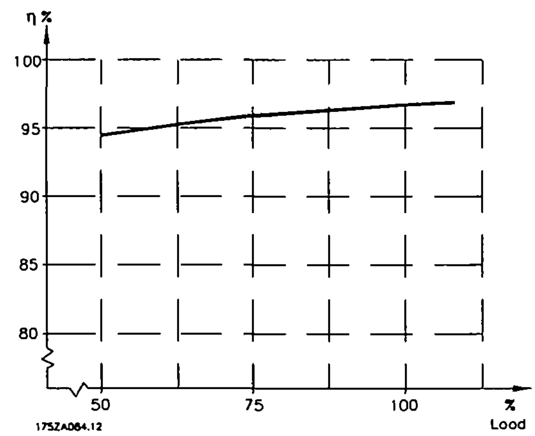
In small motors, the influence from the U/f characteristic on efficiency is marginal. However, in motors from 11 kW and up, the advantages are significant.

In general, the switching frequency does not affect the efficiency of small motors. Motors from 11 kW and up have their efficiency improved (1-2%). This is because the sine shape of the motor current is almost perfect at high switching frequency.

Efficiency of the system (η_{SYSTEM})

To calculate the system efficiency, the efficiency of the frequency converter (η_{VLT}) is multiplied by the efficiency of the motor (η_{MOTOR}):

$\eta_{SYSTEM}) = \eta_{VLT} \times \eta_{MOTOR}$



Based on the graph outlined above, it is possible to calculate the system efficiency at different speeds.

The acoustic noise from the frequency converter comes from three sources:

1. DC intermediate circuit coils.
2. Integral fan.
3. RFI filter choke.

The typical values measured at a distance of 1 m from the unit:

Enclosure	At reduced fan speed (50%) [dBA] ***	Full fan speed [dBA]
A2	51	60
A3	51	60
A5	54	63
B1	61	67
B2	58	70
B3	-	-
B4	-	-
C1	52	62
C2	55	65
C3	-	-
C4	-	-
D1+D3	74	76
D2+D4	73	74
E1/E2 *	73	74
E1/E2 **	82	83

* 315 kW, 380-480 VAC and 355 kW, 525-600 VAC only!
** Remaining E1+E2 power sizes.
*** For D and E sizes, reduced fan speed is at 87%, measured at 200 V.

When a transistor in the inverter bridge switches, the voltage across the motor increases by a du/dt ratio depending on:

- the motor cable (type, cross-section, length screened or unscreened)
- inductance

The natural induction causes an overshoot U_{PEAK} in the motor voltage before it stabilises itself at a level depending on the voltage in the intermediate circuit. The rise time and the peak voltage U_{PEAK} affect the service life of the motor. If the peak voltage is too high, especially motors without phase coil insulation are affected. If the motor cable is short (a few metres), the rise time and peak voltage are lower.
If the motor cable is long (100 m), the rise time and peak voltage are higher.

In motors without phase insulation paper or other insulation reinforcement suitable for operation with voltage supply (such as a frequency converter), fit a du/dt filter or a sine-wave filter on the output of the frequency converter.

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10.2. Special Conditions

10.2.1. Purpose of derating

Derating must be taken into account when using the frequency converter at low air pressure (heights), at low speeds, with long motor cables, cables with a large cross section or at high ambient temperature. The required action is described in this section.

10.2.2. Derating for Ambient Temperature

The average temperature ($T_{AMB, AVG}$) measured over 24 hours must be at least 5 °C lower than the maximum allowed ambient temperature ($T_{AMB,MAX}$).

If the frequency converter is operated at high ambient temperatures, the continuous output current should be decreased.

The derating depends on the switching pattern, which can be set to 60 AVM or SFAVM in parameter 14-00.

A enclosures

60 AVM - Pulse Width Modulation

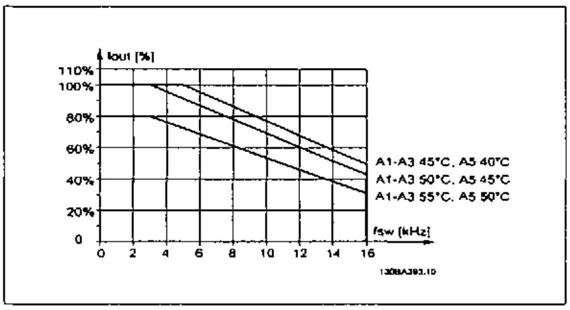

Illustration 10.1: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure A, using 60 AVM

SFAVM - Stator Frequency Asyncron Vector Modulation

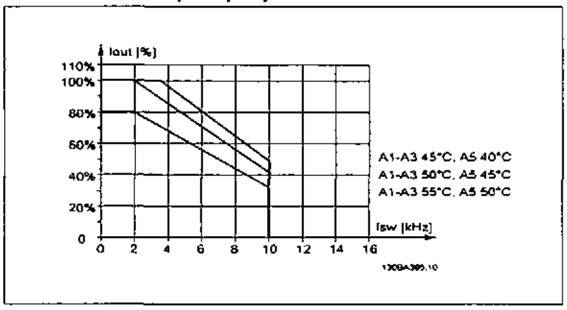

Illustration 10.2: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure A, using SFAVM

In enclosure A, the length of the motor cable has a relatively high impact on the recommended derating. Therefore, the recommended derating for an application with max. 10 m motor cable is also shown.

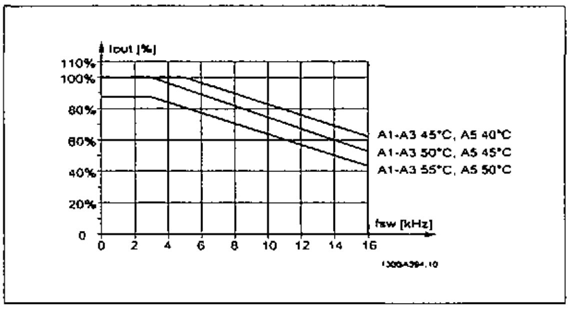

Illustration 10.3: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure A, using 60 AVM and maximum 10 m motor cable

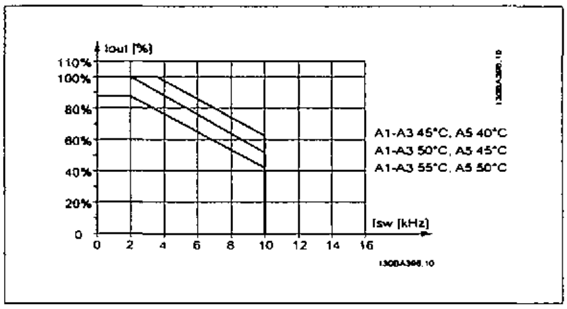

Illustration 10.4: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure A, using SFAVM and maximum 10 m motor cable

B enclosures

60 AVM - Pulse Width Modulation

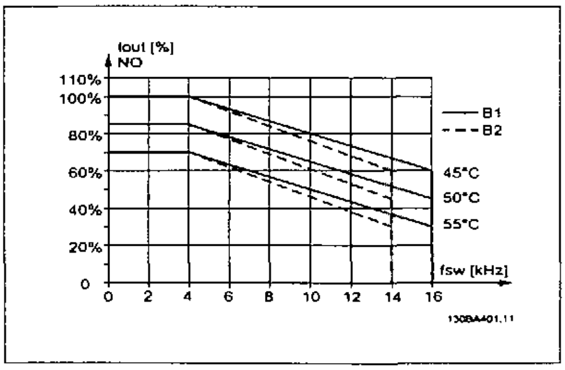

Illustration 10.5: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure B, using 60 AVM in Normal torque mode (110% over torque)

SFAVM - Stator Frequency Asyncron Vector Modulation

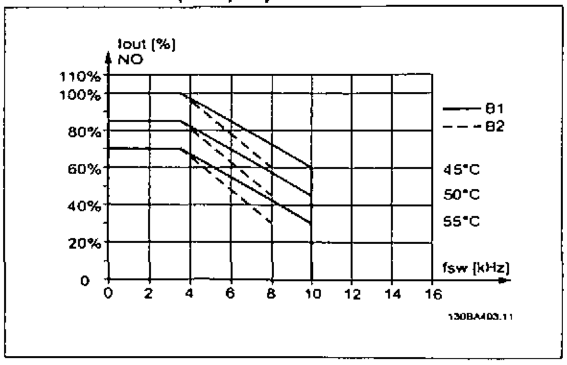

Illustration 10.6: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure B, using SFAVM in Normal torque mode (110% over torque)

C enclosures

Please note: For 90 kW in IP55 and IP66 the max. ambient temperature is 5° C lower.

60 AVM - Pulse Width Modulation

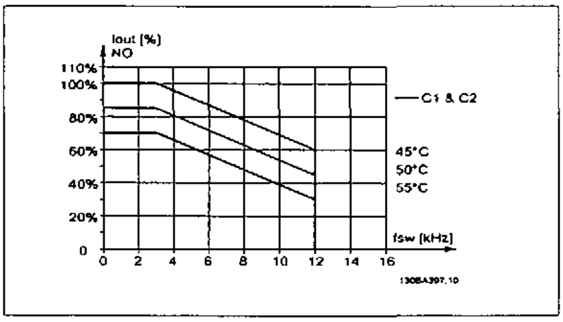

Illustration 10.7: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure C, using 60 AVM in Normal torque mode (110% over torque)

SFAVM - Stator Frequency Asyncron Vector Modulation

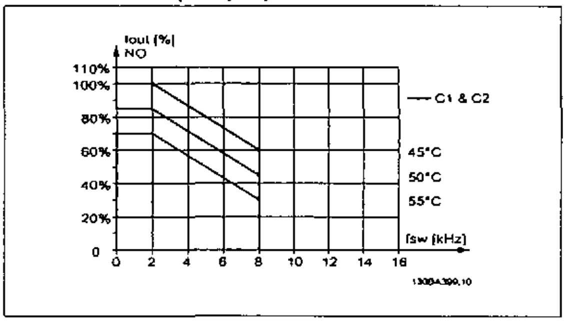

Illustration 10.8: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure C, using SFAVM in Normal torque mode (110% over torque)

D enclosures

60 AVM - Pulse Width Modulation, 380 - 480 V

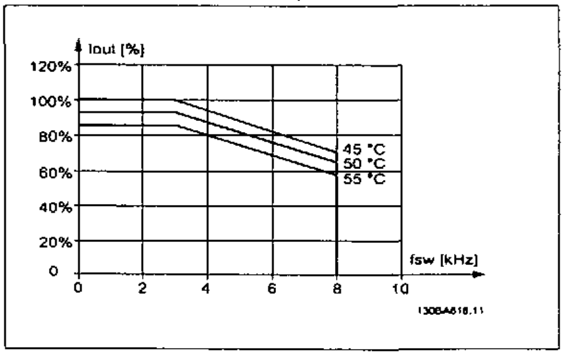

Illustration 10.9: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure D at 480 V, using 60 AVM in Normal torque mode (110% over torque)

SFAVM - Stator Frequency Asyncron Vector Modulation

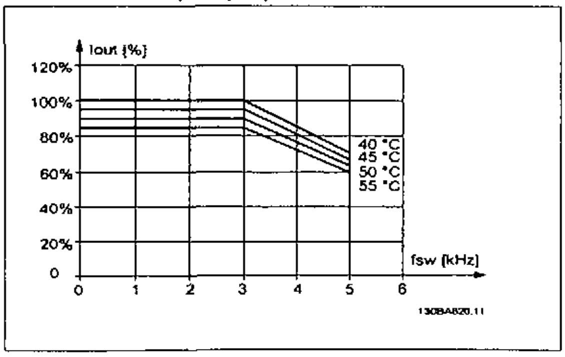

Illustration 10.10: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure D at 480 V, using SFAVM in Normal torque mode (110% over torque)

60 AVM - Pulse Width Modulation, 525 - 600 V (except P315)

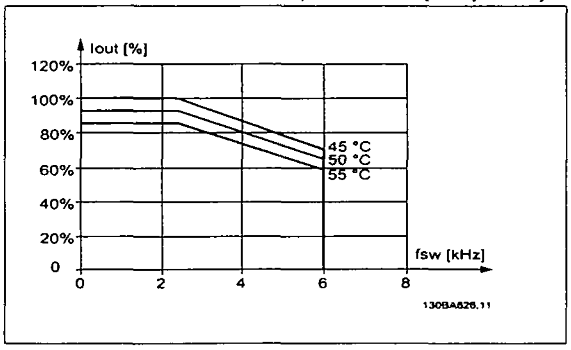

Illustration 10.11: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure D at 600 V, using 60 AVM in Normal torque mode (110% over torque). Note: *not* valid for P315.

SFAVM - Stator Frequency Asyncron Vector Modulation

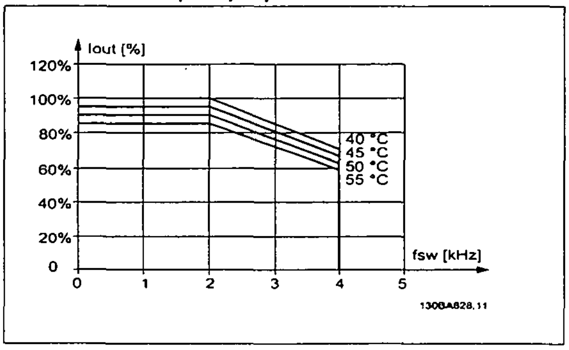

Illustration 10.12: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure D at 600 V, using SFAVM in Normal torque mode (110% over torque). Note: *not* valid for P315.

60 AVM - Pulse Width Modulation, 525 - 600 V, P315

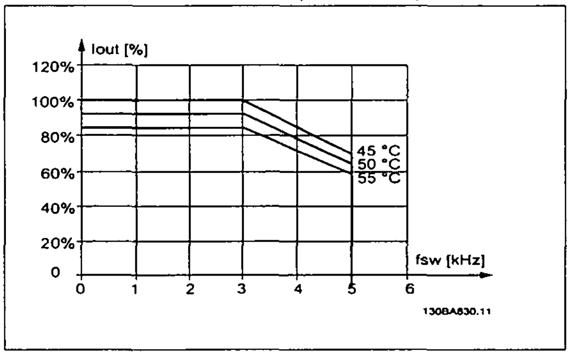

Illustration 10.13: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure D at 600 V, using 60 AVM in Normal torque mode (110% over torque). Note: P315 *only*.

SFAVM - Stator Frequency Asyncron Vector Modulation

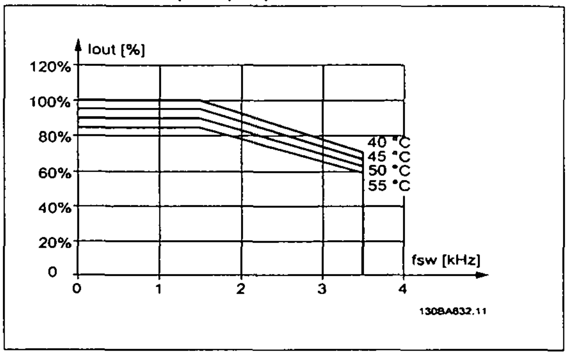

Illustration 10.14: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure D at 600 V, using SFAVM in Normal torque mode (110% over torque). Note: P315 *only*.

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E enclosures

60 AVM - Pulse Width Modulation, 380 - 480 V

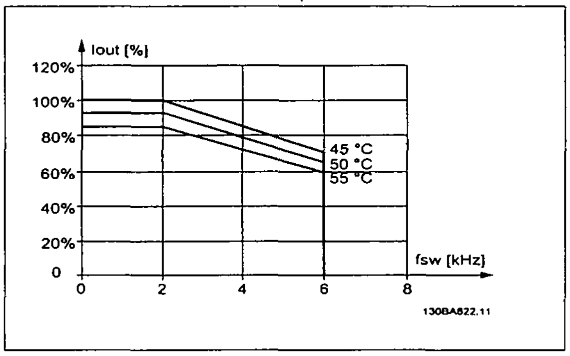

Illustration 10.15: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure E at 480 V, using 60 AVM in Normal torque mode (110% over torque)

SFAVM - Stator Frequency Asyncron Vector Modulation

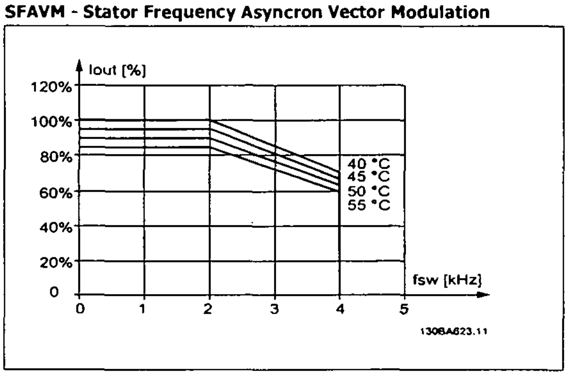

Illustration 10.16: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure E at 480 V, using SFAVM in Normal torque mode (110% over torque)

60 AVM - Pulse Width Modulation, 525 - 600 V

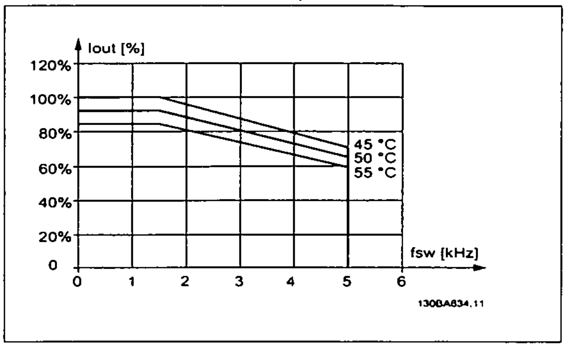

Illustration 10.17: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure E at 600 V, using 60 AVM in Normal torque mode (110% over torque).

SFAVM - Stator Frequency Asyncron Vector Modulation

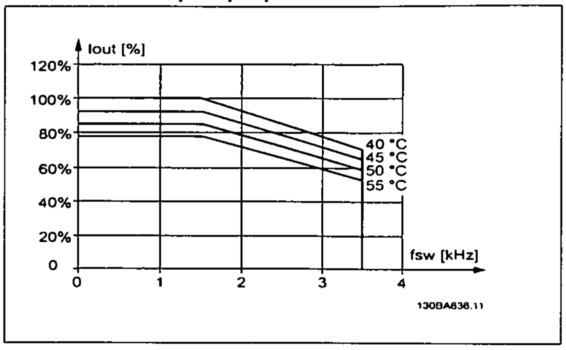

Illustration 10.18: Derating of I_{out} for different $T_{AMB, MAX}$ for enclosure E at 600 V, using SFAVM in Normal torque mode (110% over torque).

10.2.3. Derating for Low Air Pressure

The cooling capability of air is decreased at lower air pressure.

At altitudes higher than 2 km, please contact Danfoss regarding PELV.

Below 1000 m altitude no derating is necessary but above 1000 m the ambient temperature (T_{AMB}) or max. output current (I_{out}) should be derated in accordance with the shown diagram.

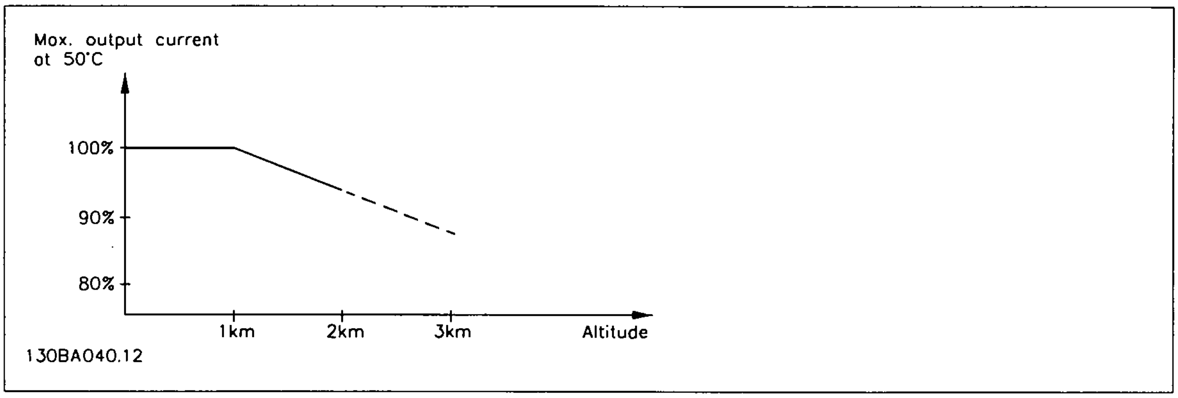

Illustration 10.19: Derating of output current versus altitude at $T_{AMB, MAX}$. By altitudes above 2 km, please contact Danfoss regarding PELV.

An alternative is to lower the ambient temperature at high altitudes and thereby ensure 100% output current at high altitudes.

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10.2.4. Derating for Running at Low Speed

When a motor is connected to a frequency converter, it is necessary to check that the cooling of the motor is adequate.
The level of heating depends on the load on the motor, as well as the operating speed and time.

Constant torque applications (CT mode)

A problem may occur at low RPM values in constant torque applications. In a constant torque application s a motor may over-heat at low speeds due to less cooling air from the motor integral fan.
Therefore, if the motor is to be run continuously at an RPM value lower than half of the rated value, the motor must be supplied with additional air-cooling (or a motor designed for this type of operation may be used).

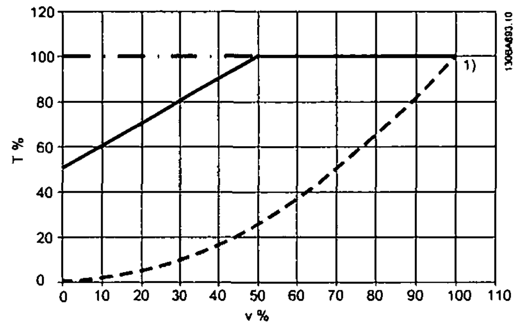
An alternative is to reduce the load level of the motor by choosing a larger motor. However, the design of the frequency converter puts a limit to the motor size.

Variable (Quadratic) torque applications (VT)

In VT applications such as centrifugal pumps and fans, where the torque is proportional to the square of the speed and the power is proportional to the cube of the speed, there is no need for additional cooling or de-rating of the motor.

In the graphs shown below, the typical VT curve is below the maximum torque with de-rating and maximum torque with forced cooling at all speeds.

Maximum Load for a Standard Motor at 40 °C driven by a frequency converter type VLT FCxxx



Legend: – – – –Typical torque at VT load —•—•—Max torque with forced cooling ——Max torque

Note 1) Over-syncronous speed operation will result in the available motor torque decreasing inversely proportional with the increase in speed. This must be considered during the design phase to avoid over-loading of the motor.

10.2.5. Derating for Installing Long Motor Cables or Cables with Larger Cross-Section

The maximum cable length for this frequency converter is 300 m unscreened and 150 m screened cable.

The frequency converter has been designed to work using a motor cable with a rated cross-section. If a cable with a larger cross-section is used, reduce the output current by 5% for every step the cross-section is increased.
(Increased cable cross-section leads to increased capacity to earth, and thus an increased earth leakage current).

10.2.6. Automatic adaptations to ensure performance

The frequency converter constantly checks for critical levels of internal temperature, load current, high voltage on the intermediate circuit and low motor speeds. As a response to a critical level, the frequency converter can adjust the switching frequency and / or change the switching pattern in order to ensure the performance of the frequency converter. The capability to automatically reduce the output current extends the acceptable operating conditions even further.

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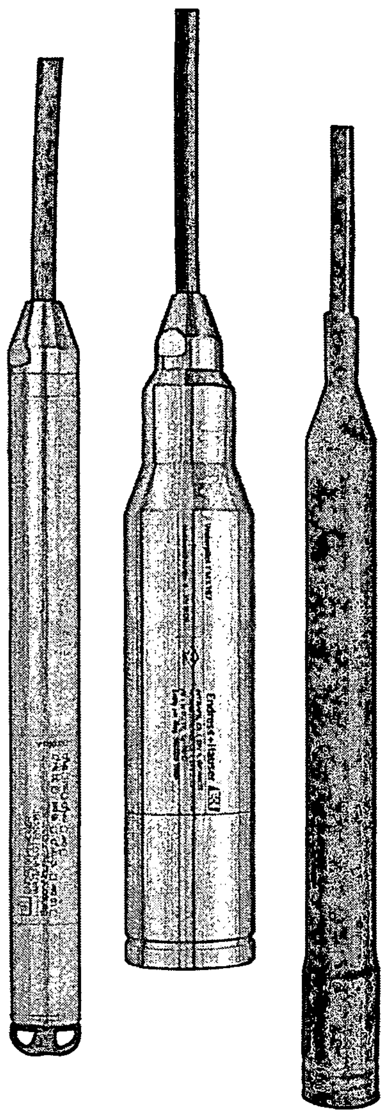
Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Waterpilot FMX167

Hydrostatic Level Measurement
Reliable and rugged level probe with ceramic measuring cell
Compact device for level measurement in fresh water, wastewater and saltwater



Applications

The Waterpilot FMX167 is a pressure sensor for hydrostatic level measurement. Three versions of the FMX167 are available from Endress+Hauser:
- FMX167 with an outer diameter = 0.87 in (22 mm): Version suitable for drinking water applications and for use in standard 1 inch well casings
- FMX167 with an outer diameter = 1.66 in (42 mm): Heavy duty version that is easy to clean due to the flush-mounted diaphragm. Suitable for wastewater, sewage treatment plants, and lift stations
- FMX167 with an outer diameter = 1.15 in (29 mm): Chemical resistant version for use in saltwater

Your benefits

- Ceramic pressure sensor provides high mechanical resistance to overload and aggressive media
- High-precision and long-term stability
- Resistant to climatic changes thanks to potted electronics and dual-filter pressure compensation system
- 4 to 20 mA output signal with integrated overvoltage protection
- Simultaneous level and temperature measurement with optional integrated temperature sensor Pt 100
- Drinking water approval: KTW, NSF, ACS
- Certified to ATEX, FM and CSA
- Complete measuring point solutions through comprehensive accessories

TI351P/24/ae

Endress+Hauser
People for Process Automation

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Function and system design

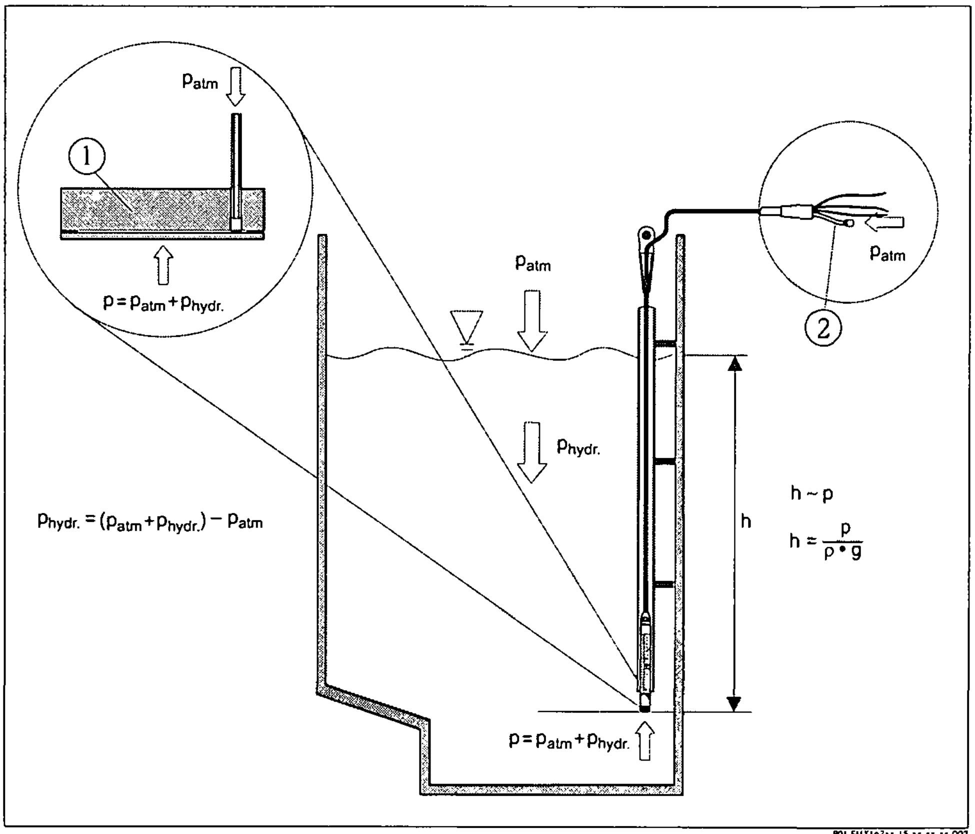
Device selection

Waterpilot FMX167	 P01-FMX167xx-16-xx-xx-xx-002	 P01-FMX167xx-16-xx-xx-xx-003	 P01-FMX167xx-16-xx-xx-xx-004
Field of application	Hydrostatic level measurement in deep wells e.g. drinking water	Hydrostatic level measurement in wastewater	Hydrostatic level measurement in saltwater
Process connection	– Suspension clamp – Extension cable mounting screw with G1 1/2 A or 1-1/2" NPT thread		
Outer diameter	0.87 in (22 mm)	1.66 in (42 mm)	Max. 1.15 in (29 mm)
Seals	– FKM Viton – EPDM[1]	– FKM Viton	– FKM Viton – EPDM
Measuring ranges	– Nine fixed pressure measuring ranges in ftH_2O, psi, bar, and mH_2O, from 0 to 3 ftH_2O to 0 to 600 ftH_2O / 0 to 1.5 psi to 0 to 300 psi (0 to 0.1 bar to 0 to 20 bar / 0 to 1 mH_2O to 0 to 200 mH_2O) – Customer-specific measuring ranges; factory-calibrated		– Seven fixed pressure measuring ranges in ftH_2O, psi, bar, and mH_2O from 0 to 3 ftH_2O to 0 to 150 ftH_2O / 0 to 1.5 psi to 0 to 60 psi (0 to 0.1 bar to 0 to 4 bar / 0 to 1 mH_2O to 0 to 40 mH_2O) – Customer-specific measuring ranges; factory-calibrated
Overload	Up to 580 psi (40 bar)		Up to 362 psi (25 bar)
Process temperature	+14 to +158°F (–10 to +70°C)		+32 to +122°F (0 to +50°C)
Ambient temperature range	+14 to +158°F (–10 to +70°C)		+32 to +122°F (0 to +50°C)
Maximum measured error	±0.2 % of upper range value (URV)		
Supply voltage	10 to 30 V DC		
Output	4 to 20 mA		
Options	– Drinking water approval – Integrated Pt 100 temperature sensor – Integrated Pt 100 temperature sensor and temperature transmitter TMT181 (4 to 20 mA)	– Integrated Pt 100 temperature sensor – Integrated Pt 100 temperature sensor and temperature transmitter TMT181 (4 to 20 mA)	– Integrated Pt 100 temperature sensor – Integrated Pt 100 temperature sensor and temperature transmitter TMT181 (4 to 20 mA)
Specialties	– Integrated overvoltage protection – Large selection of approvals, including ATEX II 2 G, FM and CSA – High-precision, long-term stable and rugged ceramic measuring cell		

1) Recommended for drinking water applications, not suitable for use in hazardous areas

Measuring principle

The ceramic sensor is a dry sensor with the process pressure acting directly on the rugged ceramic diaphragm and deflecting it a maximum of 0.0002" (0.005 mm).
The effects of air pressure on the liquid surface are transferred via a pressure compensation tube through the extension cable to the rear of the ceramic diaphragm and compensated. Pressure-dependent changes in capacitance caused by diaphragm movement are measured at the electrodes of the ceramic carrier. The electronics convert the movement into a pressure-proportional signal which is linear to the medium level.



FMX167 measuring principle

1 Ceramic measuring cell
2 Pressure compensation tube
h Level height
p Total pressure = hydrostatic pressure + atmospheric pressure
ρ Medium density
g Gravitational acceleration
phydr. Hydrostatic pressure
patm Atmospheric pressure

Temperature measurement with optional Pt 100

Endress+Hauser offers an optional 4-wire Pt 100 resistance thermometer for Waterpilot FMX167 to measure level and temperature simultaneously. The Pt 100 belongs to Accuracy Class B to DIN EN 60751.

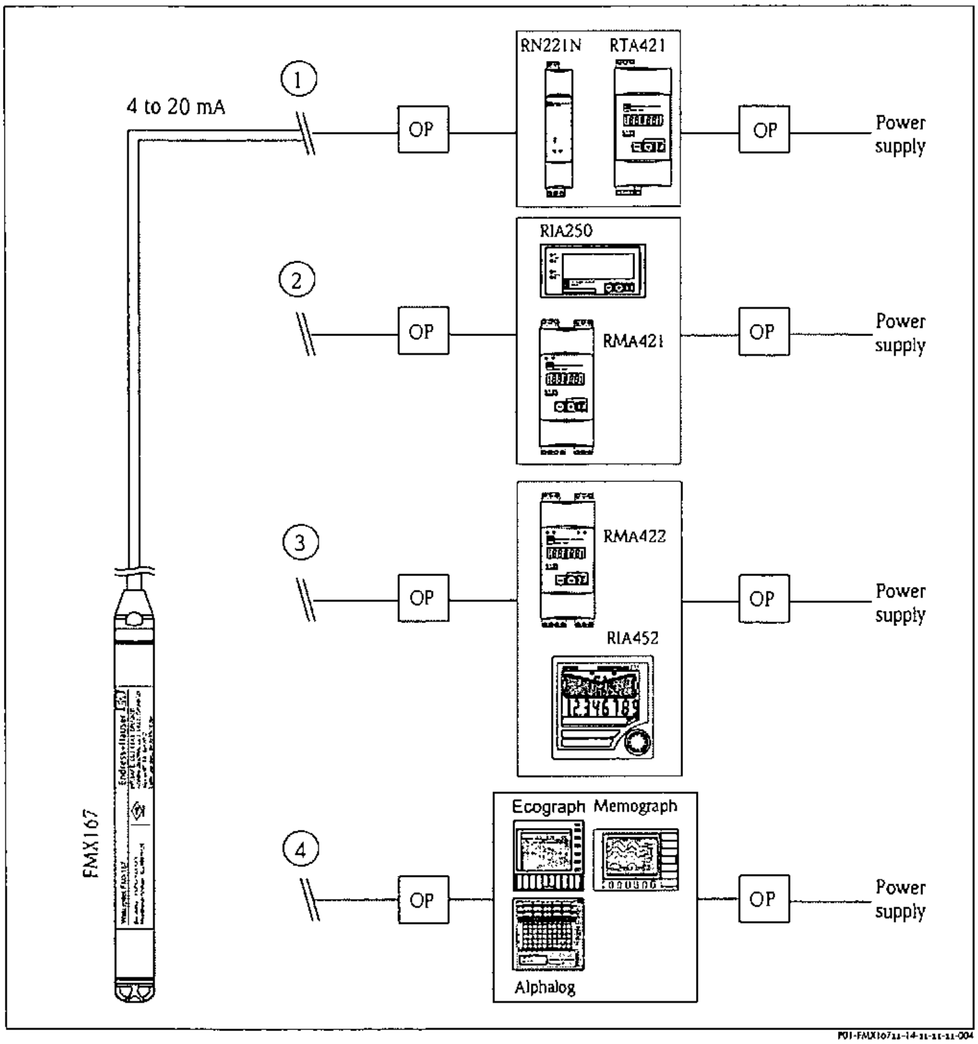
Temperature measurement with optional Pt 100 and temperature transmitter TMT181

To convert the Pt 100 signal to a 4 to 20 mA signal, Endress+Hauser also offers the TMT181 temperature transmitter.

Measuring system

The complete standard measuring system consists of Waterpilot FMX167 and a transmitter power supply unit with supply voltage of 10 to 30 V DC.

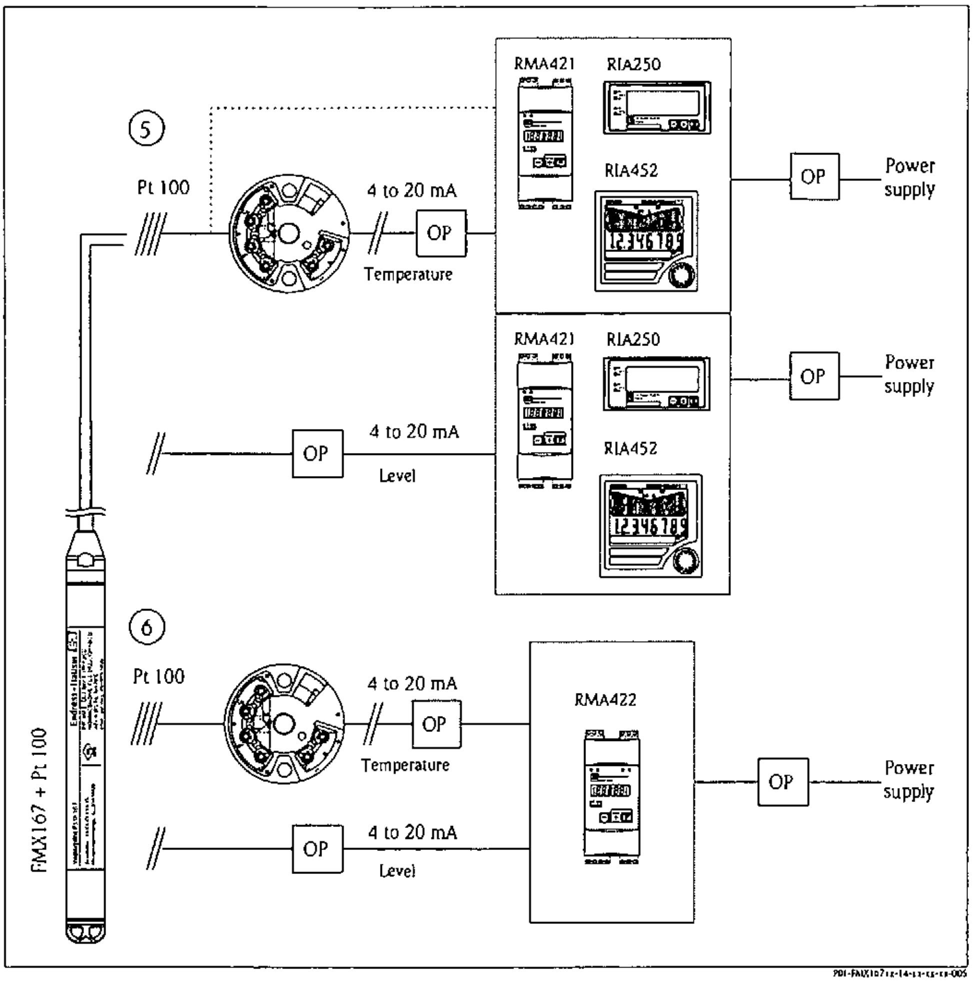
Example for other measuring point solutions with transmitter and possible evaluation units from Endress+Hauser:



Application examples with FMX167

OP   Overvoltage protection e.g. HAW from Endress+Hauser

1. Simple cost-effective measuring point solution: Power supply of Waterpilot in hazardous and non-hazardous areas using RN221N active barrier.
   Power supply and additional control of two consumers, e.g. pumps, via limit switch RTA421 with onsite display.
2. Power supply, onsite display, two switch outputs and a signal adaptation (turn down) are integrated in evaluation devices RMA421 (for mounting on hat rails) and RIA250 (for panel mounting). The evaluation unit RMA421 also has a trend recognition function, e.g. optimizing pump control in stormwater overflow basins. This function detects and evaluates changes in a measurable value within a specific time period.
3. If several pumps are used, pump life can be prolonged by alternate switching. With alternating pump control, the pump which was out of service for the longest period of time is switched on. The evaluation units RIA452 (for panel mounting) and RMA422 (for mounting on Top-hat rails) offer this function as well as several others.
4. State-of-the-art recording technology with monitor recorders from Endress+Hauser, e.g. Ecograph, Memograph or hardcopy recorders such as Alphalog for documenting, monitoring, visualizing and archiving.



Application examples with FMX167 with Pt 100

OP Overvoltage protection e.g. HAW from Endress+Hauser

5. If you want to measure, display and evaluate temperature as well as level, e.g. to monitor temperature in fresh water to detect temperature limits for germ formation, you have the following options:
   The optional temperature transmitter can convert the Pt 100 signal into a 4 to 20 mA signal and transfer it to any customary evaluation unit. Evaluation devices RMA421, RIA250 and RIA452 also offer a direct input for the Pt 100 signal.
6. If you want to detect and evaluate level and temperature with one device, choose the evaluation unit RMA422 with two inputs. It even includes the mathematical operation for linking the input signals.

Input

Measured variable

FMX167 + Pt 100 (optional)

- Hydrostatic pressure of a liquid
- Pt 100: Temperature of a liquid

Temperature transmitter (optional)

- Temperature

Measuring range

- Nine fixed pressure measuring ranges in bar, mH_2O, psi and ftH_2O; → Page 18, "Ordering information" Section
- Customer-specific measuring ranges; factory-calibrated
- Temperature measurement from −10...+70°C (+14...+158°F) (optional with Pt 100)

Input signal

FMX167 + Pt 100 (optional)

- Change in capacitance
- Pt 100: Change in resistance

Temperature transmitter (optional)

- Pt 100 resistance signal, 4-wire

Output

Output signal

FMX167 + Pt 100 (optional)

- FMX167: 4 to 20 mA for hydrostatic pressure measured value, two-wire
- Pt 100: Temperature-dependent resistance of Pt 100

Temperature transmitter (optional)

- 4 to 20 mA for temperature measured value, two-wire

Load

FMX167 + Pt 100 (optional)

$$R_{tot} \le \frac{U_b - 10\ V}{0.0225\ A} - 2 \cdot 0.09 \frac{\Omega}{m} \cdot l - R_{add}$$

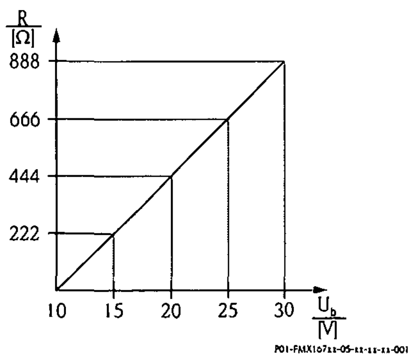
P01-FMX167xx-10-xx-xx-000

Temperature transmitter (optional)

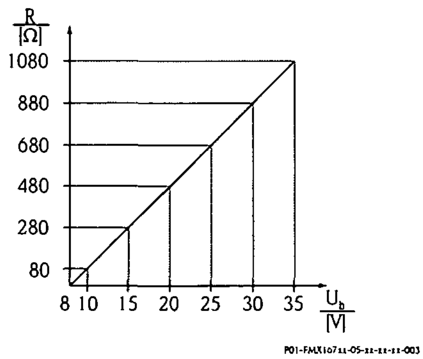
$$R_{tot} \le \frac{U_b - 8\ V}{0.025\ A} - R_{add}$$

P01-FMX167xx-10-xx-xx-001

Rtot = Max. load resistance [Ω]
Radd= Additional resistances such as resistance of evaluating device and/or display instrument, line resistance [Ω]
Ub = Supply voltage [V]
l = Simple length of extension cable [m] (cable resistance per wire ≤ 0.09 /Ωm)



Load chart FMX167 for estimating load resistance. Subtract the additional resistances, e.g. resistance of extension cable, from the calculated value as shown in the equation.



Load chart temperature transmitter for estimating load resistance. Subtract the additional resistances from the calculated value as shown in the equation.

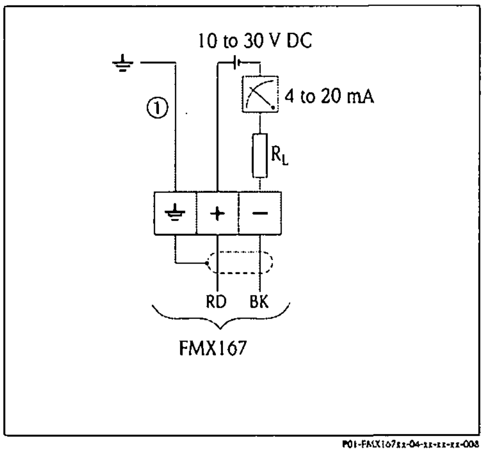
Power supply

Electrical connection

Note!

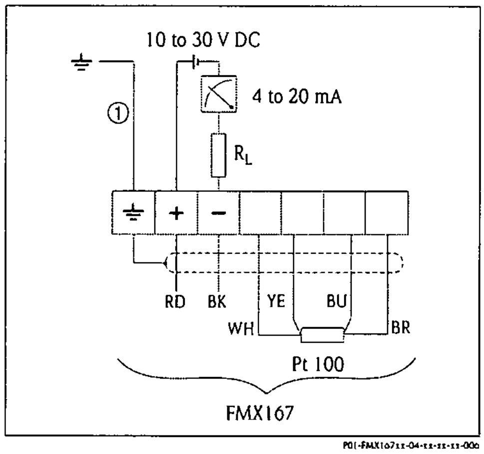
- When using the measuring device in hazardous areas, national standards and regulations as well as the Safety Instructions (XAs) or Installation or Control Drawings (ZDs) have to be observed. → See also Page 20, "Safety Instructions" and "Installation/Control Drawings" Sections.
- Reverse polarity protection is integrated in the Waterpilot FMX167 and in the temperature transmitter TMT181. Changing the polarities has no impact on operation.
- The cable must end in a dry room or in a proper terminal box. For installation outside, use the terminal box NEMA 4X (IP 66/IP 67) with a GORE-TEX® filter from Endress+Hauser. The terminal box can be ordered using the order code of FMX167 (→ see Page 18, "Ordering information" Section) or an accessory (order number: 52006252).

Waterpilot FMX167, standard



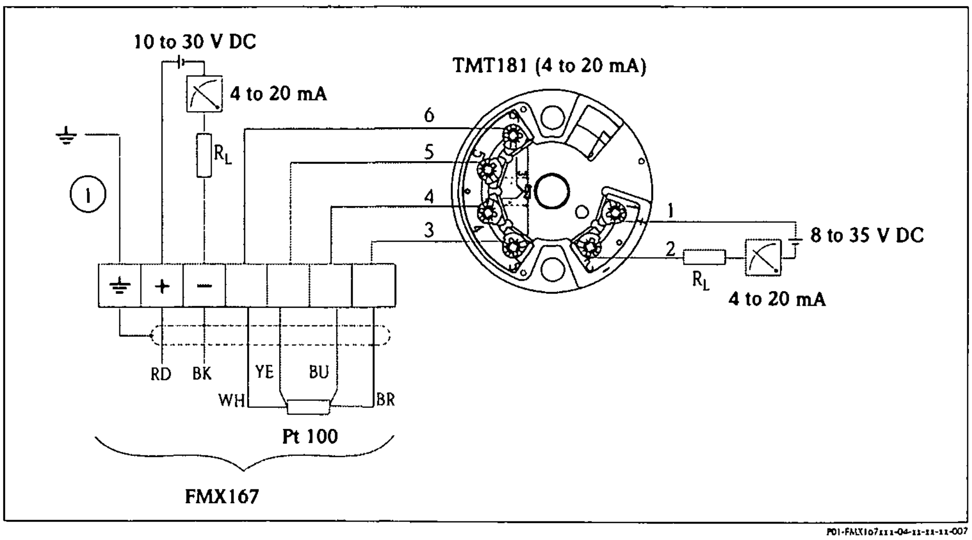
FMX167 electrical connection, versions "7" or "3" for Feature 70 "Additional options" in the order code (→ see Page 18).

Waterpilot FMX167 with Pt 100



FMX167 electrical connection with Pt 100, versions "1" or "4" for Feature 70 "Additional options" in the order code (→ see Page 18).

Waterpilot FMX167 with Pt 100 and TMT181 temperature transmitter (4 to 20 mA)



FMX167 with Pt 100 and TMT181 temperature transmitter (4 to 20 mA), version "5" for Feature 70 in the order code (→ see Page 18).

1 Not for FMX167 with outer diameter = 1.15 in (29 mm)

Wire colors: RD = red, BK = black, WH = white, YE = yellow, BU = blue, BR = brown

Supply voltage	Note! ▪ When using the measuring device in hazardous areas, national standards and regulations as well as the safety instructions (XAs) or Installation or Control Drawings (ZDs) have to be observed. → See also Page 20, "Safety Instructions" and "Installation/Control Drawings" Sections.	
	FMX167 + Pt 100 (optional) ▪ FMX167: 10 to 30 V DC ▪ Pt 100: 10 to 30 V DC	**Temperature transmitter (optional)** ▪ 8 to 35 V DC
Cable specifications	**FMX167 + Pt 100 (optional)** ▪ Commercially available instrument cable ▪ Terminals, terminal housing FMX167: 20 to 14 AWG (0.08 to 2.5 mm^2) ▪ If the Pt 100 signal is directly connected to a display and/or evaluation unit, we recommend the use of a shielded cable.	**Temperature transmitter (optional)** ▪ Commercially available instrument cable ▪ Terminals, terminal housing FMX167: 20 to 14 AWG (0.08 to 2.5 mm^2) ▪ Connection, transmitter: Max. 14 AWG (1.75 mm^2)
Power consumption	**FMX167 + Pt 100 (optional)** ≤ 0.675 W at 30 V DC	**Temperature transmitter (optional)** ≤ 0.875 W at 35 V DC
Current consumption	**FMX167 + Pt 100 (optional)** ▪ Max. current consumption: ≤ 22.5 mA Min. current consumption: ≥ 3.5 mA ▪ Pt 100: ≤ 0.6 mA	**Temperature transmitter (optional)** ▪ Max. current consumption: ≤ 25 mA Min. current consumption: ≥ 3.5 mA ▪ Pt 100 via temperature transmitter: ≤ 0.6 mA
Residual ripple	**FMX167 + Pt 100 (optional)** No effect for 4 to 20 mA signal up to ±5 % residual ripple within permissible range	**Temperature transmitter (optional)** $U_{ss} \geq 5$ V at $U_B \geq 13$ V, $f_{max.} = 1$ kHz

Performance characteristics

	FMX167 + Pt 100 (optional)	Temperature transmitter (optional)
Reference operating conditions	DIN EN 60770 T_U = 77°F (25°C)	Calibration temperature 73°F ± 5 K (23°C ± 5 K)
Maximum measured error	▪ Non-linearity including hysteresis and non-repeatability as per DIN EN 60770: ±0.2% of upper range value (URV) ▪ Pt 100: Max. ±0.7 K (Class B to DIN EN 60751)	▪ ±0.2 K ▪ With Pt 100: Max. ±0.9 K
Long-term stability	±0.1% of upper range value (URV) per year	≤ 0.1 K per year

Influence of medium temperature on the hydrostatic level measurement of FMX167

- Thermal change in zero signal and output span for typical application temperature range +32 to +86°F (0 to +30°C): ±0.4% (±0.5%)* of the upper range limit (URL)
- Thermal change in zero signal and output span for the entire medium temperature range +14 to +158°F (−10 to +70°C): ±1.0% (±1.5%)* of the upper range limit (URL)
- Temperature coefficient (T_K) of zero signal and output span: 0.15%/10 K (0.3%/10 K)* of the upper range limit (URL)

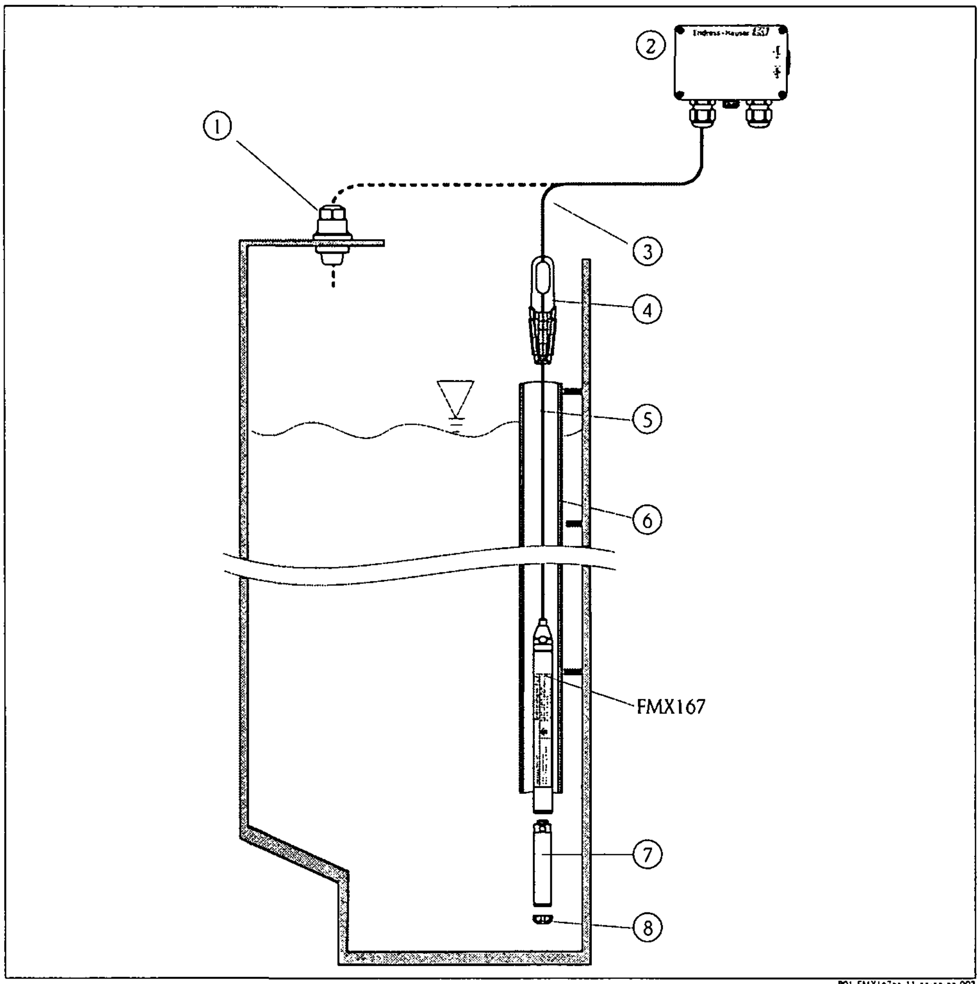
* Specifications for sensors 0.1 bar (1 mH_2O, 1.5 psi, 3 ftH_2O) and 0.6 bar (6 mH_2O, 10 psi, 20 ftH_2O)

	FMX167 + Pt 100 (optional)	Temperature transmitter (optional)
Warm-up period	20 ms	4 s

	FMX167 + Pt 100 (optional)	
Rise time	▪ FMX167: 80 ms ▪ Pt 100: 160 s	
Settling time	▪ FMX167: 150 ms ▪ Pt 100: 300 s	

Installation

Installation instructions



Installation examples, here shown with FMX167 with an outer diameter = 0.87 in (22 mm)

1 Extension cable mounting screw can be ordered via order code or as an accessory, → see Page 14 and 19
2 Terminal housing can be ordered via order code or as an accessory, → see Page 15 and 19
3 Extension cable bending radius > 4.72 in (120 mm)
4 Suspension clamp can be ordered via order code or as an accessory, → see Page 14 and 19
5 Extension cable up to 384 ft (300 m), for max. length → see Page 16, "Extension cable" Section
6 Guide tube for FMX167 with outer diameter = 0.87 in (22 mm) internal diameter > 0.91 in (23 mm)
7 Additional weight can be ordered as an accessory for FMX167 with outer diameter = 0.87 in (22 mm) and 1.15 in (29 mm), → see Page 19
8 Protection cap

Note!

- A sideways movement of the level probe can lead to measuring errors. Therefore, install the probe at a point free from flow and turbulence, or use a guide tube. The internal diameter of the guide tube should be at least 0.04 in (1 mm) bigger than the outer diameter of the selected FMX167.
- The cable must end in a dry room or in a proper terminal box. The terminal box from Endress+Hauser provides optimum humidity and climatic protection and is suitable for outdoor installation.

Environment

	FMX167 + Pt 100 (optional)	Temperature transmitter (optional)
Ambient temperature range	▪ FMX167 with outer diameter = 0.87 in (22 mm) and 1.66 in (42 mm): +14 to +158°F (–10 to +70°C) (= medium temperature) ▪ FMX167 with outer diameter = 1.15 in (29 mm): +32 to +122°F (0 to +50°C) (= medium temperature)	–40 to +185°F (–40 to +85°C)
Storage temperature	–40 to +176°F (–40 to +80°C)	–40 to +212°F (–40 to +100°C)
Degree of protection	▪ NEMA 6P (IP 68), permanently hermetically sealed ▪ Optional terminal box: NEMA 4X (IP 66/IP 67)	▪ IP 00, moisture condensation permissible ▪ When mounted in the optional terminal boxes: NEMA 4X (IP 66/IP67)
Electromagnetic compatibility (EMC)	▪ Interference emission to EN 61326 Class B equipment, interference immunity to EN 61326 Appendix A (Industrial) ▪ Maximum deviation: < 0.5% of span	▪ Interference emission to EN 61326 Class B equipment, interference immunity to EN 61326 Appendix A (Industrial)
Overvoltage protection	Integrated overvoltage protection to EN 61000-4-5 ≤ 1.2kV Install overvoltage protection ≥ 1.2 kV, external if necessary	Install overvoltage protection, external if necessary.

Process

	FMX167 + Pt 100 (optional)	Temperature transmitter (optional)
Medium temperature range	▪ FMX167 with outer diameter = 0.87 in (22 mm) and 1.66 in (42 mm): +14 to +158°F (–10...+70°C) ▪ FMX167 with outer diameter = 1.15 in (29 mm): +32 to +122°F (0 to +50°C)	–40 to +185°C (–40 to +85°C) (= ambient temperature), install temperature transmitter outside medium.

Medium temperature limits

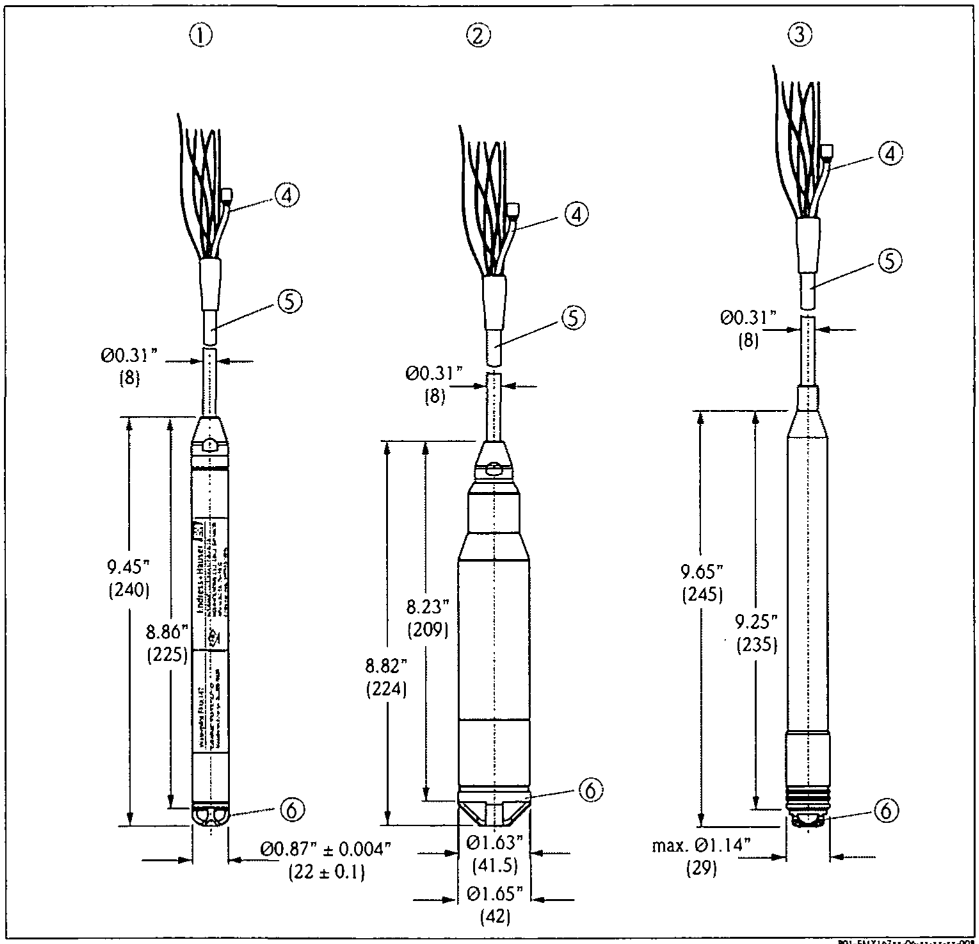
FMX167 + Pt 100 (optional)

- FMX167 with outer diameter = 0.87 in (22 mm) and 1.66 in (42 mm): –4 to +158°F (–20 to +70°C)
- FMX167 with outer diameter = 1.15 in (29 mm): +32 to +122°F (0 to +50°C)

(You may operate the FMX167 in this temperature range. The specification can then be exceeded, e.g. measuring accuracy).

Mechanical construction

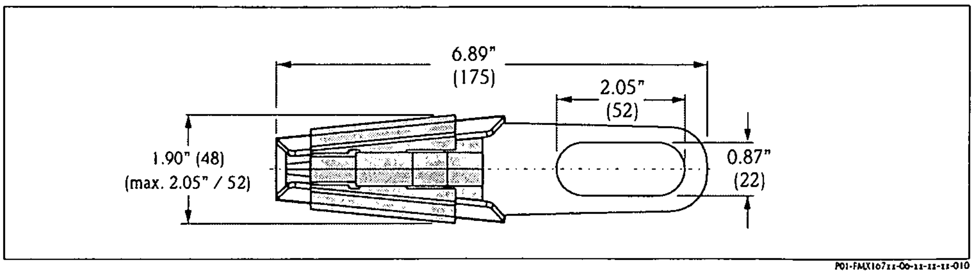
Dimensions of level probe



Versions of FMX167, dimensions in inches (mm)

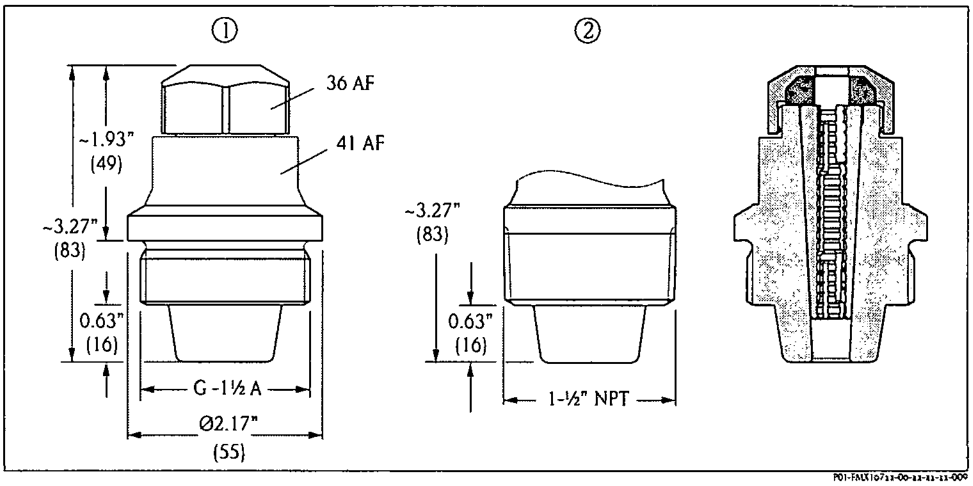
1 FMX167, version "A" or "D" for Feature 30 "Probe tube" in the order code (→ see Page 18)
2 FMX167, version "B" for Feature 30 "Probe tube" in the order code (→ see Page 18)
3 FMX167, version "C" for Feature 30 "Probe tube" in the order code (→ see Page 18)
4 Pressure compensation tube
5 Extension cable
6 Protection cap

Dimensions of suspension clamp



Suspension clamp, version 2 for Feature 20 "Connection" in the order code (→ see Page 18), dimensions in inches (mm)
Order number: 52006151

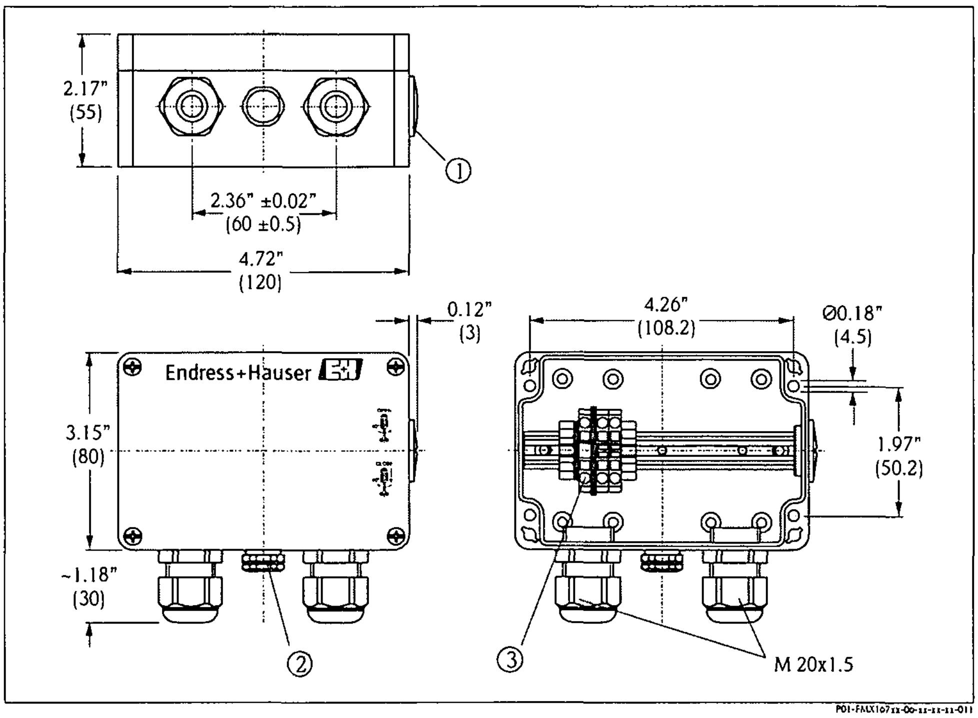
Dimensions of extension cable mounting screws



Extension cable mounting screws, dimensions in inches (mm)
Order number: 52009311

1 Extension cable mounting screw G 1 1/2 A, version "3" for Feature 20 "Connection" in the order code (→ see Page 18)
2 Extension cable mounting screw 1 1/2 NPT, version "4" for Feature 20 "Connection" in the order code (→ see Page 18)

Dimensions of the terminal box NEMA 4X (IP 66/IP 67) with filter

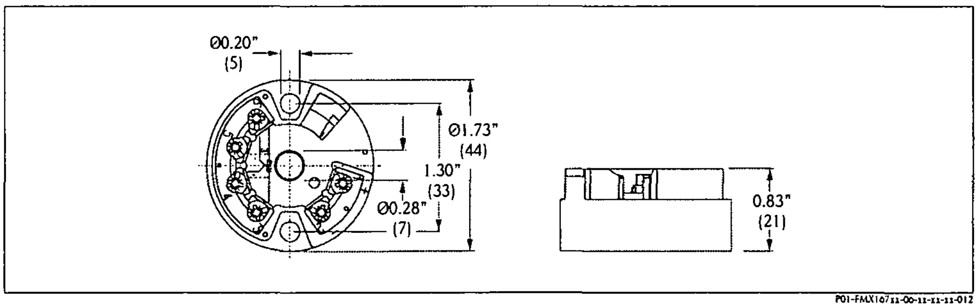


Terminal box, dimensions in inches (mm)
Order number: 52006152

Version "3", "4" or "5" for Feature 70 "Additional options" in the order code (→ see Page 18)

1 Dummy plug M 20 x 1.5
2 GORE-TEX® filter
3 Terminals for 20 to 14 AWG (0.08 to 2.5 mm²)

Dimensions of temperature transmitter TMT181



Temperature transmitter TMT181 (4 to 20 mA), dimensions in inches (mm)

Version "5" for Feature 70 "Additional options" in the order code (→ see Page 18). The temperature transmitter can be used in non-hazardous areas and for EEx nA.

Weight

- Level probe, outer diameter = 0.87 in (22 mm): 0.6 lb (290 g)
- Level probe, outer diameter = 1.66 in (42 mm): 2.5 lb (1150 g)
- Level probe, outer diameter = 1.15 in (29 mm): 0.7 lb (340 g)
- Extension cable LDPE: 0.6 oz/ft (52 g/m)
- Extension cable FEP: 1.3 oz/ft (108 g/m)
- Suspension clamp: 0.4 lb (170 g)
- Extension cable mounting screw G 1 1/2 A: 770 g
- Extension cable mounting screw 1-1/2" NPT: 724 g
- Terminal box: 0.5 lb (235 g)
- Temperature transmitter: 0.1 lb (40 g)
- Additional weight: 0.7 lb (300 g)

Material

Level probe
- Level probe, outer diameter = 0.87 in (22 mm): AISI 316L SS (1.4435)
- Level probe, outer diameter = 1.66 in (42 mm): AISI 316L SS (1.4435)
- Level probe, outer diameter = 1.15 in (29 mm):
  - Level probe: AISI 316L SS (1.4435)
  - Sensor sleeve: PPS (polyphenylene sulfide)
  - Heat-shrink sleeve/cover: Polyolefin

  Metal does not come into contact with the medium.
- Process ceramic: Al_2O_3 aluminum oxide ceramic
- Seal (internal): EPDM or Viton
- Protective cap: PE-HD (high-density polyethylene)
- Extension cable insulation: Either LDPE (low density polyethylene) or FEP (fluorinated ethylene propylene). For more information, see the next Section - "Extension cable"
- Suspension clamp: AISI 316L SS (1.4435) and glass fiber reinforced PA (polyamide)
- Extension cable mounting screw G 1 1/2 A: AISI 304 SS (1.4301)
- Extension cable mounting screw 1-1/2" NPT: AISI 304 SS (1.4301)
- Terminal box: PC (polycarbonate)
- Temperature transmitter: Housing PC (polycarbonate)

Extension cable

Structure of LDPE extension cable
- Slip-resistant extension cable with strain-relief members made of Dynemo; shielded using aluminum-coated film; insulated with low density polyethylene (LDPE), black; copper wires, twisted
- Pressure compensation tube with Teflon filter

Structure of FEP extension cable
- Slip-resistant extension cable; shielded using galvanized steel wire netting; insulated with fluorinated ethylene propylene (FEP), black; copper wires, twisted
- Pressure compensation tube with Teflon filter

Cross-section of LDPE and FEP extension cable
- Total outer diameter: 0.315 inch ± 0.0098 inch (8.0 mm ± 0.25 mm)
- FMX167: 3 x 0.0004 in^2 (0.227 mm^2) + pressure compensation tube with Teflon filter
- FMX167 with Pt 100 (optional): 7 x 0.0004 in^2 (0.227 mm^2) + pressure compensation tube with Teflon filter
- Pressure compensation tube with Teflon filter:
  Outer diameter = 0.098 inch (2.5 mm), internal diameter = 0.059 inch (1.5 mm)

Cable resistance of LDPE and FEP extension cable
- Cable resistance per wire: $\leq 0.09\ \Omega/m$

Cable length of LDPE and FEP extension cable
- Max. free suspended length (mechanical stability under load): 3120 ft (950 m)
- Please also refer to Page 7, "Load" Section.
- When using the measuring device in hazardous areas, national standards and regulations as well as the safety instructions (XAs) or Installation or Control Drawings (ZDs) have to be observed. → See also Page 20, "Safety Instructions" and "Installation/Control Drawings" Sections.

Further technical data of LDPE and FEP extension cable
- Minimum bending radius: 4.72 inch (120 mm)
- Tensile strength: Min. 214 lbf (950 N)
- Cable extraction force: ≥ 100 lbf (450 N)
  (The extension cable could be extracted from the level probe at a tensile force of ≥ 100 lbf / 450 N.)
- Resistance to UV light
- LDPE: Approved for use with drinking water

Terminals

- 3 standard terminals in terminal box
- 4-terminal strip can be ordered as accessory, Order No. 52008938
  Wire cross-section 20 to 14 AWG (0.08 to 2.5 mm^2)

Certificates and approvals

CE approval	By attaching the CE symbol, Endress+Hauser confirms that the instrument fulfills all the requirements of the relevant EC directives.
Ex approval, type of protection	▪ ATEX II 2 G EEx ia IIC T6[1] ▪ ATEX II 3 G EEx nA II T6 ▪ FM: IS, Class I, Division 1, Groups A–D[1] ▪ CSA: IS, Class I, Division 1, Groups A–D[1] 1 Only for Waterpilot FMX167 without Pt 100 Waterpilot FMX167 with outer diameter = 0.87 in (22 mm) is only suitable for use in hazardous areas with the FKM Viton seal. All explosion protection data are contained in separate explosion protection documentation which you can also request. Explosion protection documents are supplied as standard for all devices approved for use in explosion hazardous areas. → See also Page 20, "Safety Instructions" and "Installation/Control Drawings" Sections.
Drinking water approval (for FMX167 with d_O = 0.87 in / 22 mm)	▪ KTW certificate ▪ NSF 61 approval ▪ ACS approval
Marine approval	▪ GL approval ▪ ABS approval
External standards and guidelines	DIN EN 60770 (IEC 60770): Transmitters for use in industrial-control systems Part 1: Methods for performance evaluation DIN 16086: Electrical pressure measuring instruments, pressure sensors, pressure transmitters, pressure measuring instruments, concepts, specifications on data sheets EN 61326 (IEC 61326-1): Electrical equipment for measurement, control and laboratory use – EMC requirements
Registered trademarks	GORE-TEX® Registered trademark of W.L. Gore & Associates, Inc., USA

Ordering information

FMX167

10	Approval
A	Version for non-hazardous area
B	ATEX II 2 G EEx ia IIC T6
C	ATEX II 3 G EEx nA II T6
D	FM IS, Class I, Division 1, Groups A – D
E	CSA IS, Class I, Division 1, Groups A – D
F	CSA General Purpose

20	Connection
1	Probe cable
2	Suspension clamp, AISI 316L SS
3	Cable mounting screw G 1 1/2, AISI 304 SS
4	Cable mounting screw NPT 1-1/2", AISI 304 SS

30	Probe tube:
A	Outer diameter d = 0.87 in (22 mm), AISI 316L SS
B	Outer diameter d = 1.66 in (42 mm), flush mount, AISI 316L SS
C	Outer diameter d = 1.15 in (29 mm), AISI 316L SS with heat-shrink sleeve PPS/polyolefin for saltwater applications
D	Outer diameter d = 0.87 in (22 mm), AISI 316L SS + drinking water approval KTW/NSF/ACS (can only be selected in conjunction with EPDM seal and LDPE probe cable)

40 Measuring range:

	Measuring range		Measuring range	Max. overload	Vacuum resistance
BA	0 to 0.1 bar	MA	0 to 1 mH_2O	5 bar	0 psia (0 bar_{abs})
BB	0 to 0.2 bar	MB	0 to 2 mH_2O	5 bar	0 psia (0 bar_{abs})
BC	0 to 0.4 bar	MC	0 to 4 mH_2O	7 bar	0 psia (0 bar_{abs})
BD	0 to 0.6 bar	MD	0 to 6 mH_2O	10 bar	0 psia (0 bar_{abs})
BE	0 to 1.0 bar	ME	0 to 10 mH_2O	10 bar	0 psia (0 bar_{abs})
BF	0 to 2.0 bar	MF	0 to 20 mH_2O	18 bar	0 psia (0 bar_{abs})
BG	0 to 4.0 bar	MG	0 to 40 mH_2O	25 bar	0 psia (0 bar_{abs})
BH	0 to 10.0 bar	MH	0 to 100 mH_2O	40 bar	0 psia (0 bar_{abs})
BK	0 to 20.0 bar	MK	0 to 200 mH_2O	40 bar	0 psia (0 bar_{abs})
PA	0 to 1.5 psi	FA	0 to 3 ftH_2O	73 psi	0 psia (0 bar_{abs})
PB	0 to 3 psi	FB	0 to 6 ftH_2O	73 psi	0 psia (0 bar_{abs})
PC	0 to 6 psi	FC	0 to 15 ftH_2O	101 psi	0 psia (0 bar_{abs})
PD	0 to 10 psi	FD	0 to 20 ftH_2O	145 psi	0 psia (0 bar_{abs})
PE	0 to 15 psi	FE	0 to 30 ftH_2O	145 psi	0 psia (0 bar_{abs})
PF	0 to 30 psi	FF	0 to 60 ftH_2O	261 psi	0 psia (0 bar_{abs})
PG	0 to 60 psi	FG	0 to 150 ftH_2O	362 psi	0 psia (0 bar_{abs})
PH	0 to 150 psi	FH	0 to 300 ftH_2O	580 psi	0 psia (0 bar_{abs})
PK	0 to 300 psi	FK	0 to 600 ftH_2O	580 psi	0 psia (0 bar_{abs})
VV	Adjusted to customer specifications from 0 to ___ (upper range value) in ___ (unit), upper range value: 1.5 psi (3 ftH_2O, 0.1 bar, 1 mH_2O) to 300 psi (600 ft_2HO, 20 bar, 200 m_2HO)				

50	Sensor seal:
1	FKM Viton
2	EPDM

60	Probe cable (can be shortened):
A	... m, LDPE
B	10 m, LDPE
C	20 m, LDPE
E	30 ft, LDPE
F	60 ft, LDPE
G	... ft, LDPE
I	... m, FEP
K	10 m, FEP
L	20 m, FEP
M	30 ft, FEP
N	60 ft, FEP
P	... ft, FEP

FMX167							Complete order code

→ Ordering information for FMX167 continued on next page.

FMX167 (continued)

70									Additional option:
								7	Basic version
								S	GL/ABS marine certificate
								1	Pt 100, 4-wire
								3	Terminal box NEMA 4X (IP66/67)
								4	Terminal box NEMA 4X (IP66/67) + Pt 100, 4-wire
								5	Pt 100 + temperature transmitter TMT181, 2-wire, 4 to 20 mA = –4 to +176°F (–20 to +80°C)
FMX167									Complete order code

Accessories

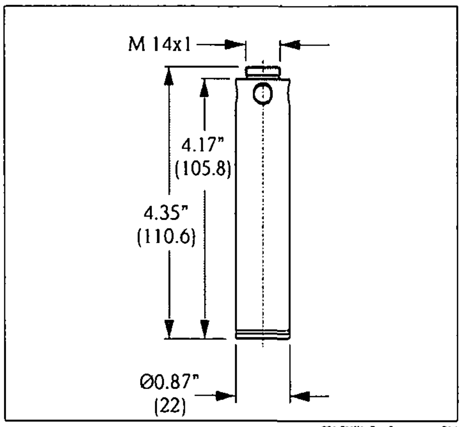
Suspension clamp

- Endress+Hauser offers a suspension clamp for simple FMX167 mounting. → See also Page 14.
- Material: AISI 316L SS (1.4404) and glass fiber reinforced PA (polyamide)
- Order number: 52006151

Terminal box

- Terminal box NEMA 4X (IP 66/IP 67) with GORE-TEX® filter incl. 3 mounted terminals.
  The terminal box is also suitable for installing a temperature transmitter (Order No. 52008794) or for four additional terminals (Order No. 52008938). → See also Page 15.
- Order number: 52006152

Additional weight (for FMX167 with d_O = 0.87 in / 22 mm and d_O = 1.15 in / 29 mm)



- To prevent sideways movement leading to measuring errors or to ensure that the device lowers into a guide tube, Endress+Hauser provides additional weights.
  You can thread several weights together. The weights are then attached directly to the FMX167. For FMX167 with outer diameter = 1.15 in (29 mm), a maximum of 5 weights may be threaded on to the FMX167.
- Material: AISI 316L SS (1.4435)
- Weight: 0.7 lb (300 g)
- Order number: 52006153

Temperature transmitter

- Temperature transmitter, 2-wire, preset for measuring range from –4 to +176°F (–20 to +80°C).
  This setting offers an easily displayable temperature range of 100 K. Note that the Pt 100 resistance thermometer is designed for a temperature range of +14 to +158°F (–10 to +70°C). → See also Page 15.
- Order number: 52008794

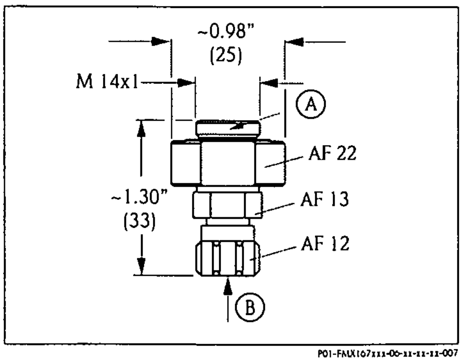
Extension cable mounting assembly

- Endress+Hauser offers extension cable mounting assembly to simplify the installation of the FMX167. The threaded assembly caps the measuring pipe opening. → See also Page 14.
- Material: AISI 304 SS (1.4301)
- Order number for extension cable mounting assembly with G 1 1/2 A thread: 52008264
- Order number for extension cable mounting assembly with 1-1/2" NPT thread: 52009311

Terminals

- Four terminal strip for FMX167 terminal box, suitable for wire cross-section of 20 to 14 AWG (0.08 to 2.5 mm^2)
- Order number: 52008939

Test adapter (for FMX167 with d_O = 0.87 in / 22 mm and d_O = 1.15 in / 29 mm)



Test adapter

A Connection suitable for level probe FMX167
B Connection compressed air hose, internal diameter, quick disconnect 0.157 in (4 mm)

- Endress+Hauser offers a test adapter to simplify the function test of level probes.
- Note the maximum pressure for the compressed air hose and the maximum level probe overload. → See also Page 18.
- The maximum pressure for the supplied quick hose gland is 145 psi (10 bar).
- Adapter material: AISI 304 SS (1.4301)
- Quick hose gland material: Anodized aluminum
- Adapter weight: 0.1 lb (39 g)
- Order number: 52011868

Documentation

Field of Activities
- Pressure Measurement: FA004P/00/en
- Recording Technology: FA014R/09/de
- System Components: FA016K/09/en

Technical Information
- Temperature Head Transmitter iTEMP PCP TMT181: TI070R/24/ae

Operating Instructions
- Waterpilot FMX167: BA231P/00/en

Safety Instructions
- ATEX II 2 G EEx ia IIC T6: XA131P/00/a3
- ATEX II 3 G EEx nA II T6: XA132P/00/a3

Installation/ Control Drawings
- FM IS Class I, Div. 1, Groups A – D: ZD063P/00/en
- CSA IS Class I, Div. 1, Groups A – D: ZD064P/00/en

Drinking water approval
- SD126P/00/a3

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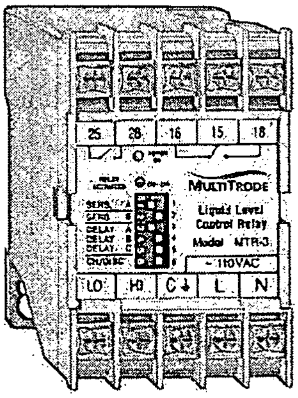
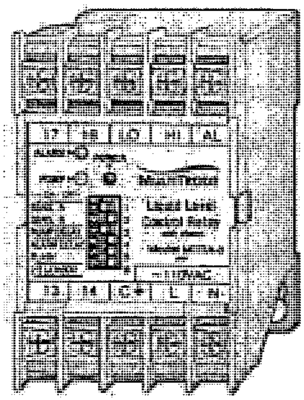
MTR Level Relay





The MTR level relay has proven itself to be simple and extremely reliable in pump stations everywhere. The MTR controls one pump or one alarm. The MTRA controls one pump and one alarm.

- **Safe**
  The extra low sensing voltage ensures maintenance staff and operators are protected at all times.
- **Four sensitivities**
  Allows the relay to operate effectively in a wide range of conductive liquids.
- **Activation delays**
  Each output can have a different time delay to overcome wave action and turbulence.
- **LED indication**
  High intensity LED indicators ensure clear signals. Power On (green). Alarm On (red). Pump On (yellow).
- **Dipswitch programmable**
  All settings are easily selectable from the front panel.
- **Proven reliability**
  The proven design and performance of the relay ensures long-term reliability of the MultiTrode system.
- **I.S application**
  Perfect for I.S application when used with an MTISB.
- **Unique two-sensor operation (MTRA only)**
  Pump and alarm can be controlled using two or three sensors. Two-sensor operation is ideal for budget applications or where space is limited.
- **DIN rail or screw mounting**
- **Low installed cost**

Specifications

Mode of operation:

MTR Mode	Charge/Discharge (Fill or Empty)
MTRA Mode	Discharge ONLY

Probe Inputs:

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

Relay Outputs:

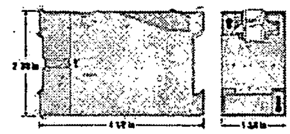
MTR relay output	2 contact sets : 1 N/O & 1 C/O
MTR Output delay	0, 2.5, 5, 10, 20, 40, 80, 160 sec
MTRA relay output	2 relays : both N/O
MTRA Output delay	Pump: 0.5, 10; Alarm: 0.5, 15 sec
Relay contact rating	250 VAC 5A Resistive, 2A Inductive
Relay contact life	10^5 Operations
Terminal size	2 x 13 AWG / 2.5mm^2

Display

LEDs:	Power On	Pump	Alarm
MTR	Green	Red	
MTRA	Green	Yellow	Red

Physical Product:

Dimensions	2.7/8H x 1.3/4W x 4.1/2D (Inches) 72Hx45Wx114D (mm)
Mounting	DIN Rail or 2 x #6 Screws / 2 x M4 Screws
Enclosure	Makrolon (self-extinguishing)



Power Supply:

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

Environmental Range:

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

N1653

US C LISTED 2F27

Available Models & Ordering Information

415VAC	MTR-1	n/a
240VAC	MTR-2	MTRA-2
110VAC	MTR-3	MTRA-3
24VAC	MTR-4	MTRA-4
24VDC	MTR-5	MTRA-5
12VDC	MTR-6	MTRA-6

MULTITRODE www.multitrode.com

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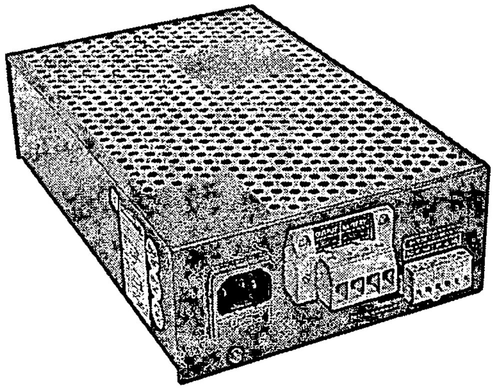
PB251 Series

220-330 WATTS DC UPS

Features

- **Ultra-low noise output**
- **Independent battery charging output**
- **DC output OK & battery OK alarms & LEDs**
- **Battery-LVD and alarm**
- **Over-temperature protection**
- **Battery fuse fail LED**



Specifications

INPUT	
Voltage:	190 to 264 vac, or 190 to 400VDC
Line regulation:	0.2%typical
Current:	1.4A maximum
Inrush current:	10A maximum
Frequency:	45 to 65 Hz
OUTPUT	
Voltage	See table
Current	See table
Load regulation	0.5%typical
Current limit type - load cct	Constant current
Current limit type - batt. cct	Constant current
Short circuit protection	Indefi nite, auto-resetting
Over-voltage protection	17.5 to 20V latching (13.8Vdc output) 31.5 to 39V latching (27.6Vdc output)
Ripple & noise 100 MHz bandwidth	28mVp-p (13.8Vdc output) 55mVp-p (27.6Vdc output)
ENVIRONMENTAL	
Operating temperature	0 to 70^{o}C ambient with derating, 5...90% relative humidity (non-condensing)
Over-temperature protection	Automatic & auto-resetting
Cooling requirement	Natural convection
Efficiency	80% minimum

STANDARDS & APPROVALS	
Safety	Complies with AS/NZS 60950, class 1, NSW Office of Fair Trading Approval N20602
EMC	Emissions comply with AS/NZS CISPR11, Group 1, Class B. Complies with ACA EMC Scheme, Safety & EMC Regulatory Compliance Marked
Isolation i/p-o/p i/p-ground o/p-ground	4242VDC for 1 minute 2121VDC for 1 minute 707VDC for 1 minute
ALARMS & BATTERY FUNCTIONS	
Converter ON/OK alarm	Indicated by voltage-free changeover relay contacts &
green LED	ON=PSU OK
Battery low (& fuse) alarm	10.2 to 12.6V for 12V battery, adjustable 20.4 to 25.2V for 24V battery, adjustable Indicated by voltage-free changeover relay contacts & green LED: ON=BATT OK
Low voltage disconnect	9.6 to 12V for 12V battery, adjustable 19.2 to 24V2 for 4V battery, adjustable
Charger over-load protection	Auto-resetting electronic circuit breaker
Reverse polarity protection	Internal battery fuse
Battery to load voltage drop	0.2 to. 0.25V typical
MECHANICAL	
Case size	264 L x 172 W x 67 H mm
Case size with heatsink	264 L x 186 W x 67 H mm
Rack size	232 D x 19" W x 2RU H
Weight	1.9 kg
Weight with heatsink	2.1 kg
Weight (rack mounted version)	5.5 kg

Selection Table

MODEL NUMBER	**OUTPUT VDC**	**I_{LOAD}**	**I_{BATT}**	**OUTPUT POWER**
PB251-12CM	13.8V	16A	2A	220W
PB251-12CM-H	13.8V	20A	2A	275W
PB251-24CM	27.6V	11A	2A	300W
PB251-24CM-H	27.6V	12A	2A	330W
PB251-12RML	13.8V	20A	4A	275W
PB251-12B	13.8V	20A	4A	275W
PB251-24RML	27.6V	12A	2A	330W

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

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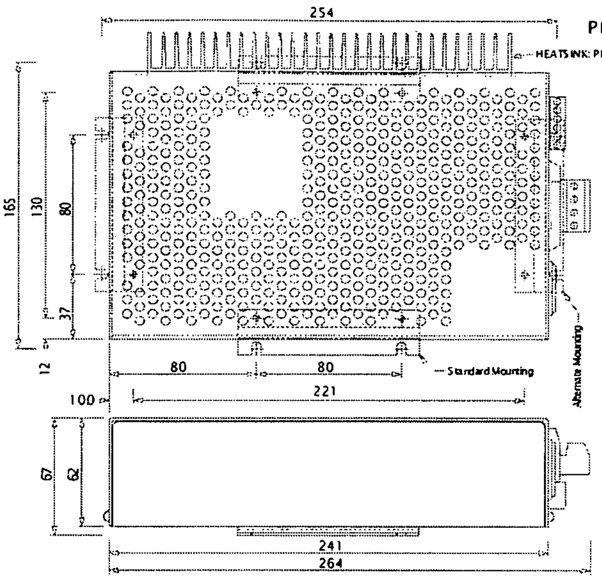
PB251 Series

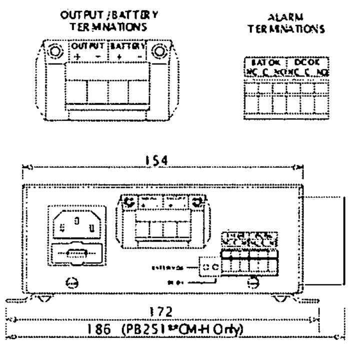
275-330 WATTS DC UPS

Technical Illustrations

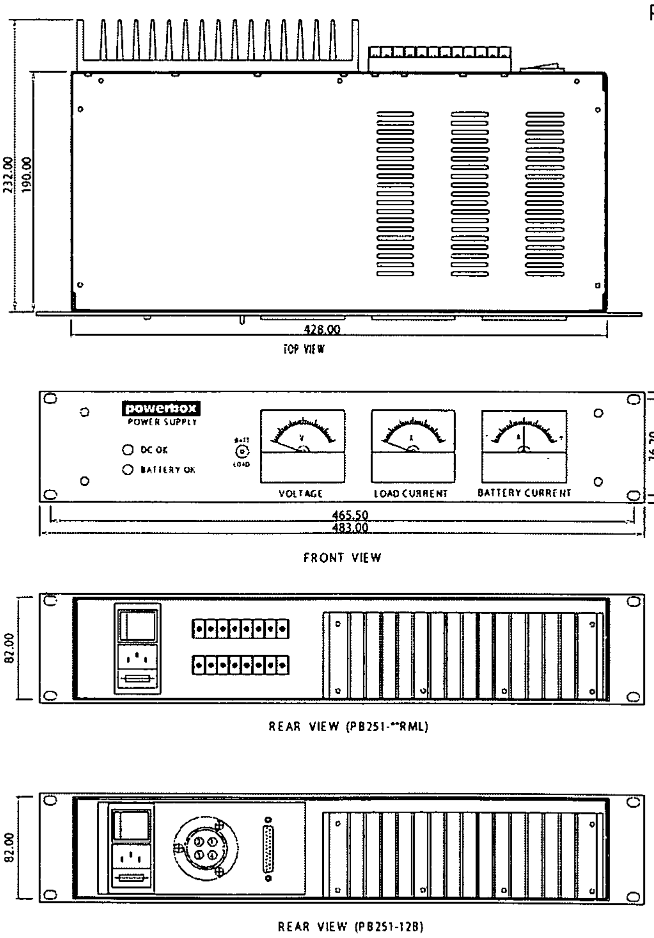
PB251**CM (-H) MECHANICAL OUTLINE



NOTES:
1. Mounting Centres: Suitable for M4 Hardware
   Standard 165x 80mm
   Alternate: 254x 80mm
2. M3 threaded holes on bottom of base.
   Standard 130x 80mm centres
   Alternate: 221x 80mm 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.

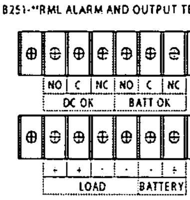


PB251-**RML & -12B MECHANICAL OUTLINE

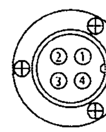


NOTES:
1. 2RU x 19" rack enclosure per IEC 297
2. Mounting slots are suitable for M6 hardware.
3. Input connector is a 10A Class 1 IEC60320 inlet.
4. 2 meter IEC mains cord with Australian plug is supplied with unit.
5. PB251-12B alarm terminal is DB25 female.
6. PB251-12B output and battery connector is Hirose pn. HS28R-4A.
   Mating connector is Hirose pn. HS28P-4A (not supplied).
7. PB251-**RML alarm and output terminals are M3.5 screws suitable for ring or fork lugs up to 8 mm wide.

PB251-**RML ALARM AND OUTPUT TERMINALS



PB251-12B OUTPUT & BATTERY CONNECTOR



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

PB251-12B ALARM CONNECTOR

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

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SECURITY

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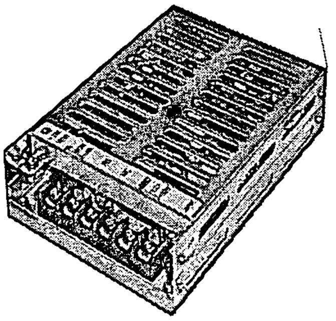
HIGH QUALITY SWITCHING POWER SUPPLIES

DC/DC SWITCHING POWER SUPPLY
DC INPUT 12,24,48, 110
SINGLE OUTPUT
25WATTS

VTA-SCx/VTA-SD SERIES



Dimension: 85W × 135L × 31H

General Description

VT A x S C(D) x

- VT: Series Name
- A: Wattage: A...25W
- x: OutPut Voltage
- S: Single Output
- C(D): DC Input Range C: 12,24,48 / D: 110
- x: Input Voltage

Features

1. Variety of Models
2. Chassis mount type
3. Compact and High Efficiency

DC INPUT: 12V

Input Characteristics	Unit	VTA05SC12	VTA12SC12	VTA15SC15	VTA24SC12	VTA48SC12
Input Voltage	Vdc	DC 12V				
Input Voltage Range	Vdc	DC 9.2V-16V				
Input Current (typ)	A	2.9	2.92	2.87	3.0	2.63
Inrush Current *1	A	Not Specified				
Efficiency (typical) *2	%	72	72	74	73	76
MTBF	H	880'000				
Switching Frequency	kHz	60 Fix.	60 Fix.	60 Fix.	60 Fix.	60 Fix.

DC INPUT: 24V

Input Characteristics	Unit	VTA05SC24	VTA12SC24	VTA15SC24	VTA24SC24	VTA48SC24
Input Voltage	Vdc	DC 24V				
Input Voltage Range	Vdc	DC 19-32V				
Input Current (typ)	A	1.34	1.33	1.36	1.34	1.28
Inrush Current *1	A	Not Specified				
Efficiency (typical) *2	%	75	78	79	78	82
MTBF	H	880'000				
Switching Frequency	kHz	60 Fix.	60 Fix.	60 Fix.	60 Fix.	60 Fix.

DC INPUT: 48V

Input Characteristics	Unit	VTA05SC48	VTA12SC48	VTA15SC48	VTA24SC48	VTA48SC48
Input Voltage	Vdc	DC 48V				
Input Voltage Range	Vdc	DC 38-63V				
Input Current (typ)	A	0.68	0.66	0.65	0.67	0.6
Inrush Current *1	A	Not Specified				
Efficiency (typical) *2	%	78	80	82	82	84
MTBF	H	860'000				
Switching Frequency	kHz	60 Fix.	60 Fix.	60 Fix.	60 Fix.	60 Fix.

DC INPUT: 110V

Input Characteristics	Unit	VTA05SD	VTA12SD	VTA15SD	VTA24SD	VTA48SD
Input Voltage	Vdc	DC 110V				
Input Voltage Range	Vdc	DC 85-140V				
Input Current (typ)	A	0.30	0.29	0.30	0.31	0.28
Inrush Current *1	A	Not Specified				
Efficiency (typical) *2	%	76	78	78	78	78
MTBF	H	790'000				
Switching Frequency	kHz	80 Fix.	80 Fix.	80 Fix.	80 Fix.	80 Fix.

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HIGH QUALITY SWITCHING POWER SUPPLIES

VTA-SC / VTA-SD

Output Characteristic	Unit	Models				
		VTA05SCx / SD	VTA12SCx / SD	VTA15SCx / SD	VTA24SCx / SD	VTA48SCx / SD
Output Voltage	V	5	12	15	24	48
Output Current	A	5.0	2.1	1.7	1.1	0.5
Voltage Adjust Range	V	+/-10% of Rated Output Voltage(at no load within input range)				
Ripple Noise(max) *3	mVpp	100	170	200	290	530
Rise up time	mS	100mS(maximum) at 25℃ and rated input/output				
Hold up time	mS	10mS				
Regulation						
a. Line Regulation (max)	mV	40	96	120	192	384
b. Load Regulation (max)	mV	45	108	135	216	432
c. Temperature Coefficient *4	℃	0.03%/℃				
d. Drift(maximum) *5	mV	40	75	90	135	255
e. Dynamic Load Regulation (typ.) *6	mV	150	360	450	720	1440
f. Recovery Time *6	mS	0.5mS				

Conditions:
*1 at cold start
*2 at rated input/output
*3 measured by a bayonet probe at the output connector at a 0 to 100MHz bandwidth
*4 at 0 to +50℃
*5 for 7hour period after 1hour warm-up at 25℃ and rated input/output
*6 when output current changed between 25% and 75% of rated output current rapidly at rated input

Environmental Specification	
Operating Temperature	0 to +50℃
Operating Humidity	85%RH(non-condensing)
Storage Temperature	-20 to +85°C
Storage Humidity	-
Withstanding Voltage	Primary-Secondary AC1,500Vfor 1minute (Vin=110 2000) Primary-Frame Ground AC1,500V for 1minute (Vin=110 2000) Secondary-Frame Ground AC500V for 1minute
Isolation Resistance	Primary-Secondary-Frame Ground 50MΩ(minimum) by DC500V insulation tester
Vibration	5-10Hz:10mm double amplitude,10-55Hz:19.6m/s2,20minutes' period for 60minutes each along X,Y,Z axes(non-operating)
Shock	294m/s2
Cooling	Convection
Functions	
Over current Protection	Current Limiting with automatic recovery
Over voltage Protection	Output shutdown
Remote Sense	not available
Remote On/Off	not available
Reverse Voltage Protection	by internal fuse
Line Conduction Noise	Not specified
Weight [g] (typical)	380 G
Dimension [mm]	85W × 135L × 31H

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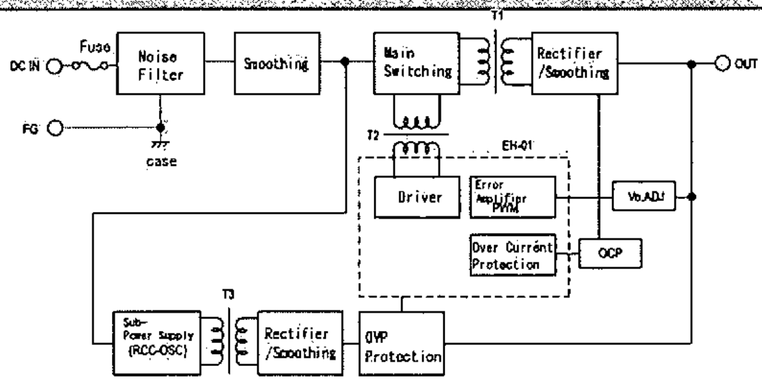
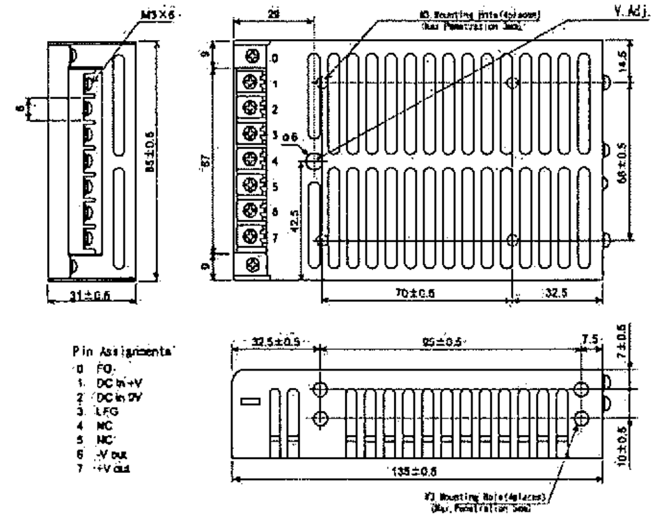
HIGH QUALITY SWITCHING POWER SUPPLIES

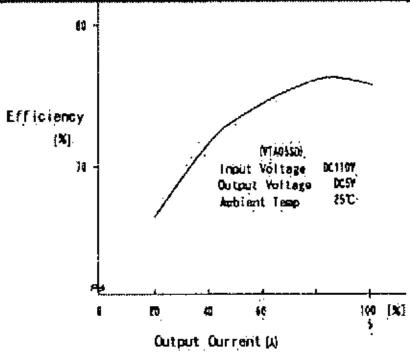
BLOCK DIAGRAM



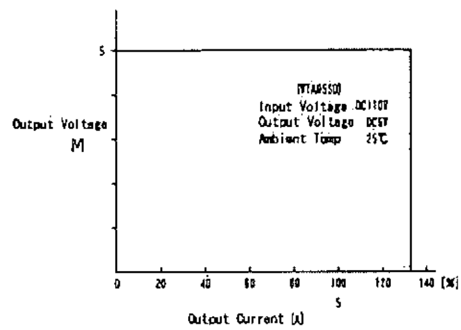
DIMENSION DIAGRAM (mm)



EFFICIENCY CURVE



OCP CURVE



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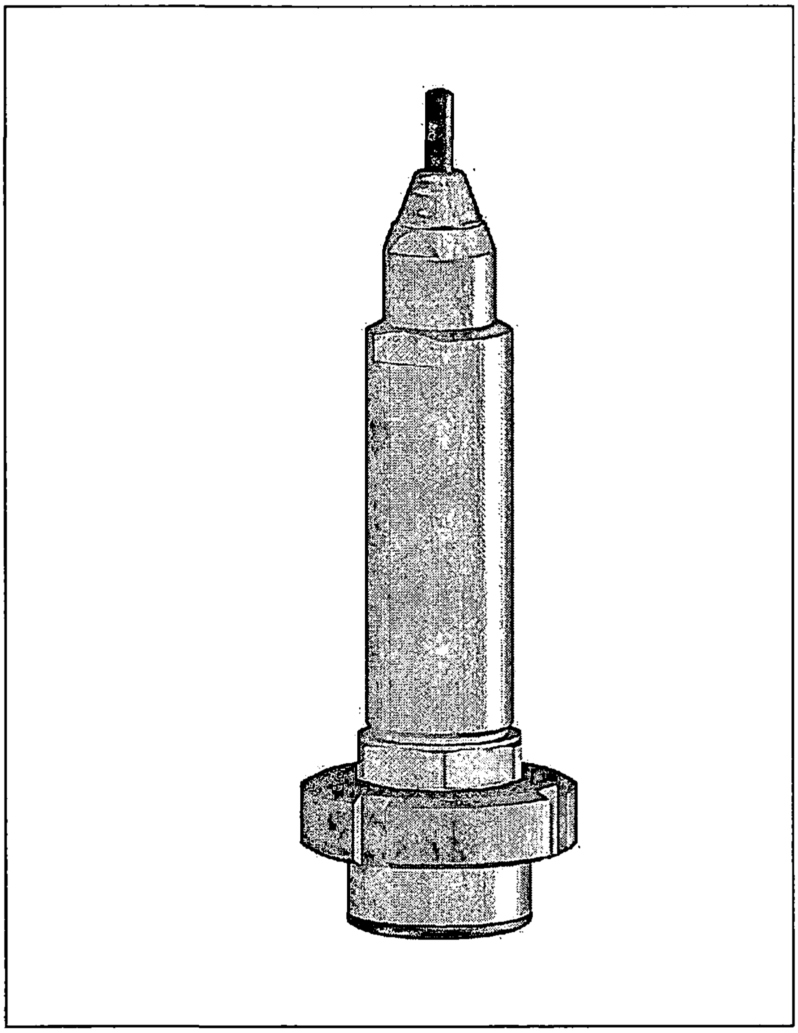
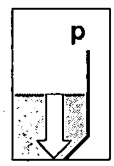
Operating Instructions
VEGABAR 74
4 … 20 mA/HART





Process pressure/
Hydrostatic

Contents

28464-EN-070718

Supplementary documentation

Information:
Depending on the ordered version, supplementary documentation belongs to the scope of delivery. You find this documentation in chapter "*Product description*".

Instructions manuals for accessories and replacement parts

Tip:
To ensure reliable setup and operation of your VEGABAR 74, we offer accessories and replacement parts. The associated documents are:

- Supplementary instructions manual 32036 "*Welded socket and seals*"
- Operating instructions manual 32798 "*Breather housing VEGABOX 02*"
- Operating instructions manual 20591 "*External indicating and adjustment unit VEGADIS 12*"

1 About this document

1.1 Function

This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance and fault rectification. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group

This operating instructions manual is directed to trained personnel. The contents of this manual should be made available to these personnel and put into practice by them.

1.3 Symbolism used

Information, tip, note
This symbol indicates helpful additional information.

Caution: If this warning is ignored, faults or malfunctions can result.
Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.
Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

Ex applications
This symbol indicates special instructions for Ex applications.

• **List**
The dot set in front indicates a list with no implied sequence.

→ **Action**
This arrow indicates a single action.

1 **Sequence**
Numbers set in front indicate successive steps in a procedure.

284 N-070718

2 For your safety

2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the operator.

During work on and with the device the required personal protection equipment must always be worn.

2.2 Appropriate use

VEGABAR 74 is a pressure transmitter for measurement of gauge pressure, absolute pressure and vacuum.

You can find detailed information on the application range in chapter "*Product description*".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

Due to safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

2.3 Warning about misuse

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment.

2.4 General safety instructions

This is a high-tech instrument requiring the strict observance of standard regulations and guidelines. The user must take note of the safety instructions in this operating instructions manual, the country-specific installation standards as well as all prevailing safety regulations and accident prevention rules.

The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for trouble-free operation of the instrument.

During the entire duration of use, the user is obliged to determine the compliance of the required occupational safety measures with the current valid rules and regulations and also take note of new regulations.

2.5 Safety approval markings and safety tips

The safety approval markings and safety tips on the device must be observed.

2.6 CE conformity

VEGABAR 74 is in CE conformity with EMC (89/336/EWG), fulfils NAMUR recommendation NE 21 and is in CE conformity with LVD (73/23/EWG).

Conformity has been judged according to the following standards:

- EMC:
  - Emission EN 61326: 2004 (class B)
  - Susceptibility EN 61326: 2004 including supplement A
- LVD: EN 61010-1: 2001

VEGABAR 74 is not subject to the pressure device guideline.[1]

2.7 Fulfilling NAMUR recommendations

VEGABAR 74 fulfills the following NAMUR recommendations:

- NE 21 (interference resistane and emitted interference)
- NE 43 (signal level for failure information)
- NE 53 (compatibility sensor and indicating/adjustment components)

VEGA instruments are generally upward and downward compatible:

- Sensor software to DTM VEGABAR 74 HART
- DTM VEGABAR 74 for adjustment software PACTware™

The parameter adjustment of the basic sensor functions is independent of the software version. The range of available functions depends on the respective software version of the individual components.

The software version of VEGABAR 74 HART can be read out via PACTware™.

[1] Due to the flush diaphragm, no own pressure compartment is formed.

You can view all software histories on our website www.vega.com. Make use of this advantage and get registered for update information via e-mail.

2.8 Safety instructions for Ex areas

Please note the Ex-specific safety information for installation and operation in Ex areas. These safety instructions are part of the operating instructions manual and come with the Ex-approved instruments.

2.9 Environmental instructions

Protection of the environment is one of our most important duties. That is why we have introduced an environment management system with the goal of continuously improving company environmental protection. The environment management system is certified according to DIN EN ISO 14001.

Please help us fulfil this obligation by observing the environmental instructions in this manual:

- Chapter "*Packaging, transport and storage*"
- Chapter "*Disposal*"

3 Product description

3.1 Configuration

Scope of delivery

The scope of delivery encompasses:

- VEGABAR 74 pressure transmitter
- Documentation
  - this operating instructions manual
  - Test certificate for pressure transmitters
  - Ex-specific "*Safety instructions*" (with Ex-versions)
  - if necessary, further certificates

Components

VEGABAR 74 consists of the following components:

- Process fitting with measuring cell
- Housing with electronics
- Connection cable (direct cable outlet)

The components are available in different versions.

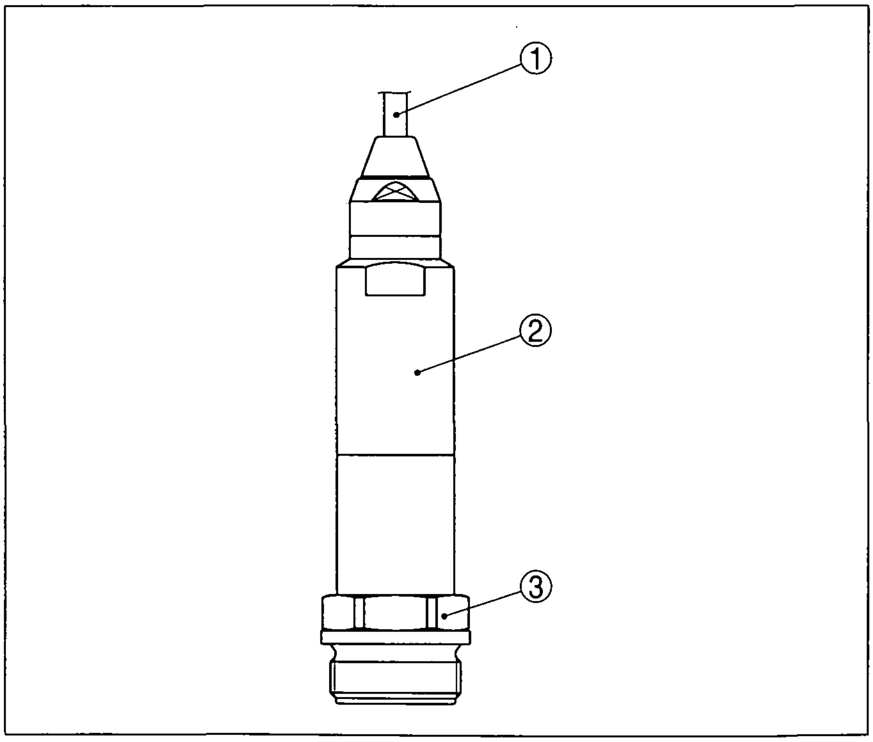


Fig. 1: Example of a VEGABAR 74 with process fitting G1½ A
1 Connection cable
2 Housing with electronics
3 Process fitting with measuring cell

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3.2 Principle of operation

Area of application

VEGABAR 74 is a pressure transmitter for use in the paper, food processing and pharmaceutical industry. Thanks to the high protection class IP 68/IP 69K it is particularly suitable for use in humid environment. Depending on the version, it is used for level, gauge pressure, absolute pressure or vacuum measurements. Measured products are gases, vapours and liquids, also with abrasive contents.

Functional principle

The sensor element is the CERTEC® measuring cell with flush, abrasion resistant ceramic diaphragm. The hydrostatic pressure of the medium or the process pressure causes a capacitance change in the measuring cell via the diaphragm. This change is converted into an appropriate output signal and outputted as measured value.

The CERTEC® measuring cell is also equipped with a temperature sensor. The temperature value can be processed via the signal output.

Supply

Two-wire electronics 4 … 20 mA/HART for power supply and measured value transmission over the same cable.

The supply voltage range can differ depending on the instrument version.

The data for power supply are stated in chapter "*Technical data*" in the "*Supplement*".

3.3 Operation

VEGABAR 74 4 … 20 mA/HART can be adjusted with different adjustment media:

- with external adjustment/indication VEGADIS 12
- an adjustment software according to FDT/DTM standard, e.g. PACTware™ and PC
- with a HART handheld

The kind of adjustment and the adjustment options depend on the selected adjustment component. The entered parameters are generally saved in the respecitive sensor, when adjusting with PACTware™ and PC optionally also in the PC.

3.4 Packaging, transport and storage

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test according to DIN EN 24180.

The packaging of standard instruments consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport

Transport must be carried out under consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

- Storage and transport temperature see "*Supplement - Technical data - Ambient conditions*"
- Relative humidity 20 … 85 %

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4 Mounting

4.1 General instructions

Materials, wetted parts

Make sure that the wetted parts of VEGABAR 74, especially the seal and process fitting, are suitable for the existing process conditions such as pressure, temperature etc. as well as the chemical properties of the medium.

You can find the specifications in chapter "*Technical data*" in the "*Supplement*".

Temperature limits

Higher process temperatures often mean also higher ambient temperatures. Make sure that the upper temperature limits stated in chapter "*Technical data*" for the environment of the electronics housing and connection cable are not exceeded.

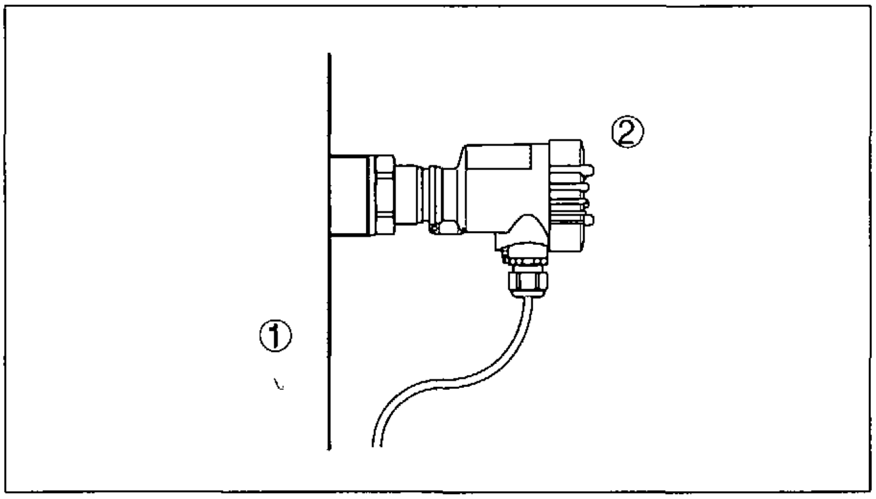

Fig. 2: Temperature ranges
1 Process temperature
2 Ambient temperature

Connection

- The connection cable has a capillary for atmospheric pressure compensation

→ Lead the cable end into a dry space or into a suitable terminal housing.

Information:
VEGA recommends the breather housing VEGABOX 02 or the indication/adjustment VEGADIS 12. Both contain terminals and a ventilation filter for pressure compensation. For mounting outdoors, a suitable protective cover is available.

4.2 Mounting steps

Sealing/Screwing in threaded versions

Seal the thread with teflon, hemp or a similar resistant seal material on the process fitting thread 1½ NPT.

→ Screw VEGABAR 74 into the welded socket. Tighten the hexagon on the process fitting with a suitable wrench. Wrench size, see chapter "*Dimensions*".

Sealing/Screwing in flange versions

Seal the flange connections according to DIN/ANSI with a suitable, resistant seal and mount VEGABAR 74 with suitable screws.

Sealing/Screwing in hygienic fittings

Use the seal suitable for the respective process fitting. You can find the components in the line of VEGA accessories in the supplementary instructions manual "*Welded socket and seals*".

5 Connecting to power supply

5.1 Preparing the connection

Note safety instructions

Always keep in mind the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltage surges are expected, versions with integrated overvoltage arresters should be used or external overvoltage arresters should be installed

Tip:
We recommend the version of VEGABAR 74 with integrated overvoltage arrester or VEGA type ÜSB62-36G.X as external overvoltage arreaster.

Take note of safety instructions for Ex applications

In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units.

Select power supply

Power supply and current signal are carried on the same two-wire cable. The voltage supply range can differ depending on the instrument version.

The data for power supply are stated in chapter "*Technical data*" in the "*Supplement*".

Provide a reliable separation of the supply circuit from the mains circuits according to DIN VDE 0106 part 101.

VEGA power supply units VEGATRENN 149AEx, VEGASTAB 690, VEGADIS 371 as well as all VEGAMETs meet this requirement. When using one of these instruments, protection class III is ensured for VEGABAR 74.

Bear in mind the following factors regarding supply voltage:

- Output voltage of the power supply unit can be lower under nominal load (with a sensor current of 20.5 mA or 22 mA in case of fault message)
- Influence of additional instruments in the circuit (see load values in chapter "*Technical data*")

Selecting connection cable

VEGABAR 74 is connected with standard two-wire cable without screen. An outer cable diameter of 5 … 9 mm ensures the seal effect of the cable gland when connecting via VEGABOX 02 or VEGADIS 12. If electromagnetic interference is expected which is above the test values of EN 61326 for industrial areas, screened cable should be used. For HART multidrop operation we recommend as standard practice the use of screened cable.

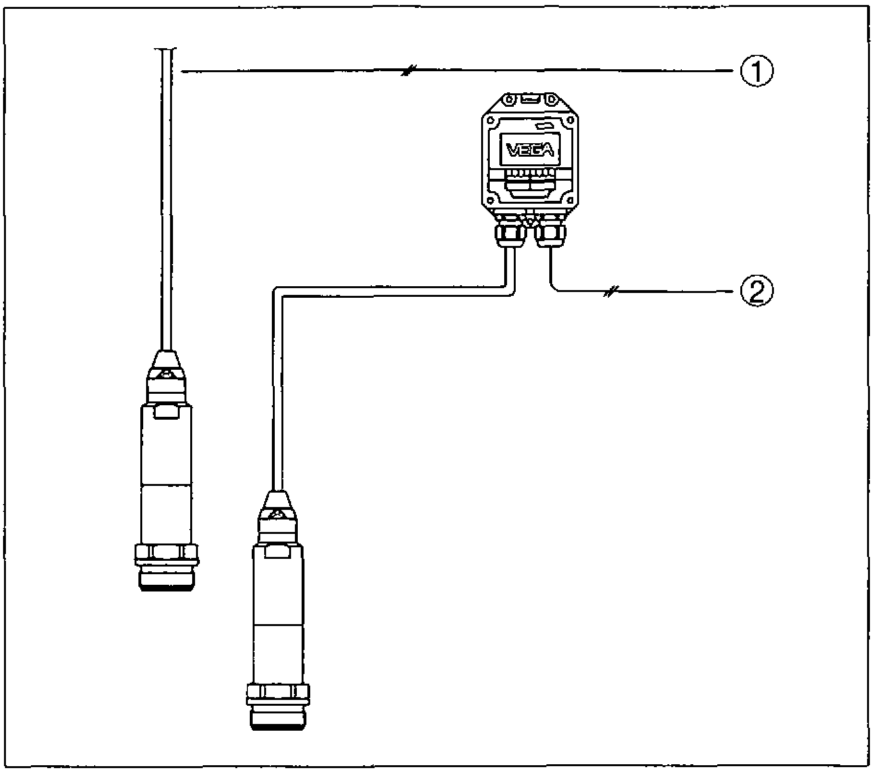

Fig. 3: Connection of VEGABAR 74
1 Direct connection
2 Connection via VEGABOX 02 or VEGADIS 12

Cable screening and grounding

If screened cable is necessary, connect the cable screen on both ends to ground potential. In the VEGABOX 02 or VEGADIS 12, the screen must be connected directly to the internal ground terminal. The ground terminal on the outside of the housing must be connected to the potential equalisation (low impedance).

If potential equalisation currents are expected, the connection on the processing side must be made via a ceramic capacitor (e.g. 1 nF, 1500 V). The low frequency potential equalisation currents are thus suppressed, but the protective effect against high frequency interference signals remains.

Select connection cable for Ex applications

Take note of the corresponding installation regulations for Ex applications. In particular, make sure that no potential equalisation currents flow over the cable screen. In case of grounding on both sides this can be achieved by the use of a capacitor or a separate potential equalisation.

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5.2 Connection procedure

Direct connection

Proceed as follows:

1 Wire the connection cable up to the connection compartment. The bending radius must be at least 25 mm.[2)]

2 Connect the wire ends to the screw terminals according to the wiring plan

Via VEGABOX 01 or VEGADIS 12

Proceed as follows:

1 Snap connection housing onto the carrier rail or screw it to the mounting plate

2 Loosen the cover screws and remove the cover

3 Insert the cable through the cable entry into the connection housing housing

4 Loosen the screws with a screwdriver

5 Insert the wire ends into the open terminals according to the wiring plan

6 Tighten the screws with a screwdriver

7 Check the hold of the wires in the terminals by lightly pulling on them

8 Tighten the compression nut of the cable entry. The seal ring must completely encircle the cable

9 Connect the supply cable according to steps 3 to 8

10 Screw the housing cover back on

The electrical connection is finished.

2) The connection cable is already preconfectioned. After shortening the cable, fasten the type plate with support again to the cable.

5.3 Wiring plan

Direct connection

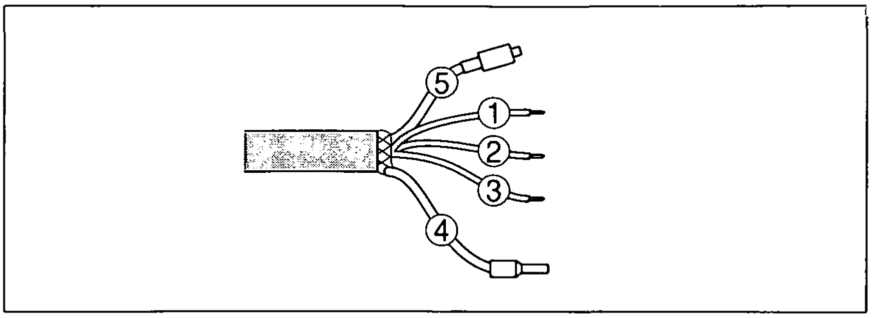

Fig. 4: Wire assignment, connection cable
1 *brown (+): to power supply or to the processing system*
2 *blue (-): to power supply or to the processing system*
3 *yellow: is only required with VEGADIS 12, otherwise connect to minus or with VEGABOX 01 to terminal 3*[3]
4 *Screen*
5 *Breather capillaries with filter element*

Connection via VEGABOX 02

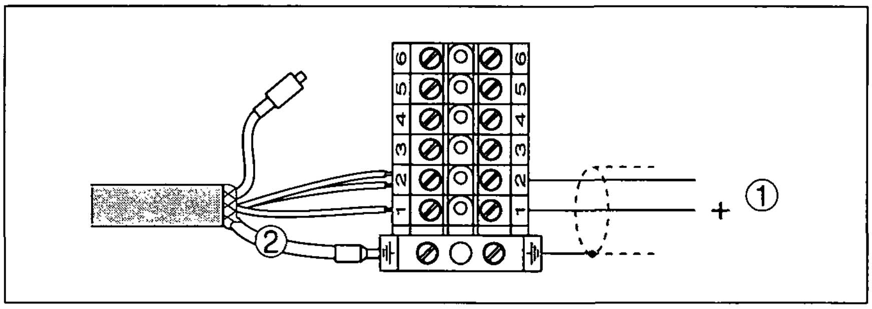

Fig. 5: Terminal assignment VEGABAR 74
1 *To power supply or the processing system*
2 *Screen*[4]

Wire number	Wire colour/Polarity	VEGABAR 74 terminal
1	brown (+)	1
2	blue (-)	2
3	Yellow	2
	Screen	Ground

[3] For customer-specific versions already connected with blue (-) when being shipped.
[4] Connect screen to ground terminal. Connect ground terminal on the outside of the housing as prescribed. The two terminals are galvanically connected.

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Connection via VEGADIS 12

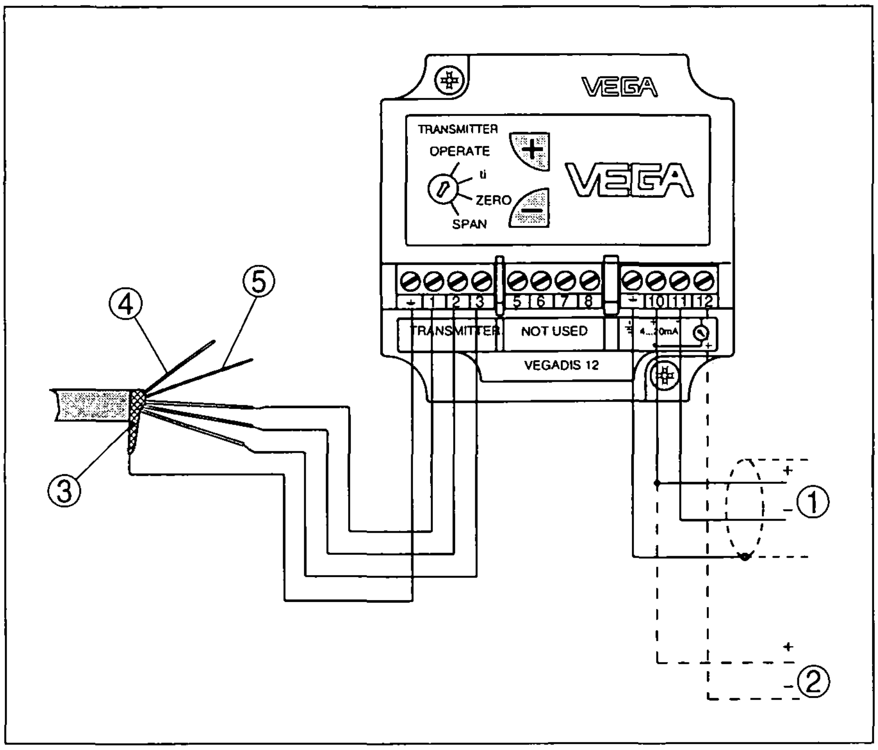

Fig. 6: Terminal assignment, VEGADIS 12

1 To power supply or the processing system
2 Control instrument (4 … 20 mA measurement)
3 Screen[5)]
4 Breather capillaries
5 Suspension cable

Wire number	Wire colour/Polarity	Terminal VEGADIS 12
1	brown (+)	1
2	blue (-)	2
3	Yellow	3

5) Connect screen to ground terminal. Connect ground terminal on the outside of the housing as prescribed. The two terminals are galvanically connected.

6 Set up

6.1 Setup steps without VEGADIS 12

After mounting and electrical connection, VEGABAR 74 is ready for operation.

→ Switch on voltage

The electronics now carries out a self-check for approx. 2 seconds. Then VEGABAR 74 delivers a current of 4 … 20 mA according to the actual level.

6.2 Setup steps with VEGADIS 12

Adjustment volume

- zero - measuring range begin
- span - measuring range end
- ti - Integration time

Adjustment system

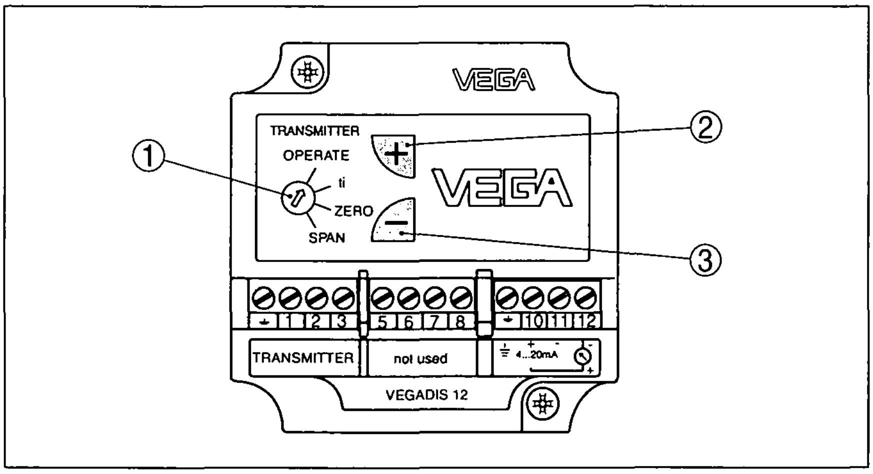

Fig. 7: Adjustment elements of VEGADIS 12
1 *Rotary switch: choose the requested function*
2 *[+] key, change value (rising)*
3 *[-] key, change value (falling)*

- With the rotary switch the requested function is selected
- With the *[+]* and *[-]* keys, the signal current or the integration time are adjusted
- Finally the rotary switch is set to position "*OPERATE*"

The set values are transmitted to the EEPROM memory and remain there even in case of voltage loss.

Adjustment steps, adjustment

Proceed as follows for adjustment with VEGADIS 12:

1 Open housing cover
2 Connect hand multimeter to terminals 10 and 12
3 Meas. range begin: Set rotary switch to "*zero*"

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4 Empty the vessel or reduce process pressure
5 Set a current of 4 mA with the *[+]* and *[-]* keys
6 Meas. range end: Set rotary switch to "*span*"
7 Fill the vessel or increase process pressure
8 Set a current of 20 mA with the *[+]* and *[-]* keys
9 Operation: Set rotary switch to "*OPERATE*"
10 Close housing cover

The adjustment data are effective, the output current 4 ... 20 mA corresponds to the actual level.

Adjustment steps, integration time

Proceed as follows for the adjustment of the integration time with VEGADIS 12:

1 Open housing cover
2 Set rotary switch to "*ti*"
3 By pushing the *[-]* key 10-times, make sure that the integration time is set to 0 sec.
4 For every 1 sec. requested integration time, push the *[+]* key once.
5 The integration time is the time required by the output current signal to reach 90 % of the actual height after a sudden level change.
6 Set rotary switch to "*OPERATE*"
7 Close housing cover

Adjustment steps, scaling

The display outputs the current 4 ... 20 mA as bar graph and digital value.

With 4 mA no segment of the bar graph appears, with 20 mA all segments appear. This assignment is fix.

You can scale the digital value to any value between -9999 ... +9999 via the adjustment module.

Proceed as follows for scaling the indication of VEGADIS 12:

1 Open housing cover
2 Initial value: Set rotary switch to "*zero*"
3 Set the requested value, e.g. 0 with the *[+]* and *[-]* keys
4 Final value: Set the rotary switch to "*span*"
5 Set the requested value, e.g. 1000 with the *[+]* and *[-]* keys
6 Decimal point: Set the rotary switch to "*point*"
7 With the *[+]* and *[-]* keys you can adjust the requested value, e.g. 8888 (no decimal point)

8 Set rotary switch to "*OPERATE*"

9 Close housing cover

The adjustment data are effective, the output current 4 ... 20 mA corresponds to the actual level.

7 Setup with PACTware™

7.1 Connect the PC with VEGACONNECT 3

Connecting the PC to the signal cable

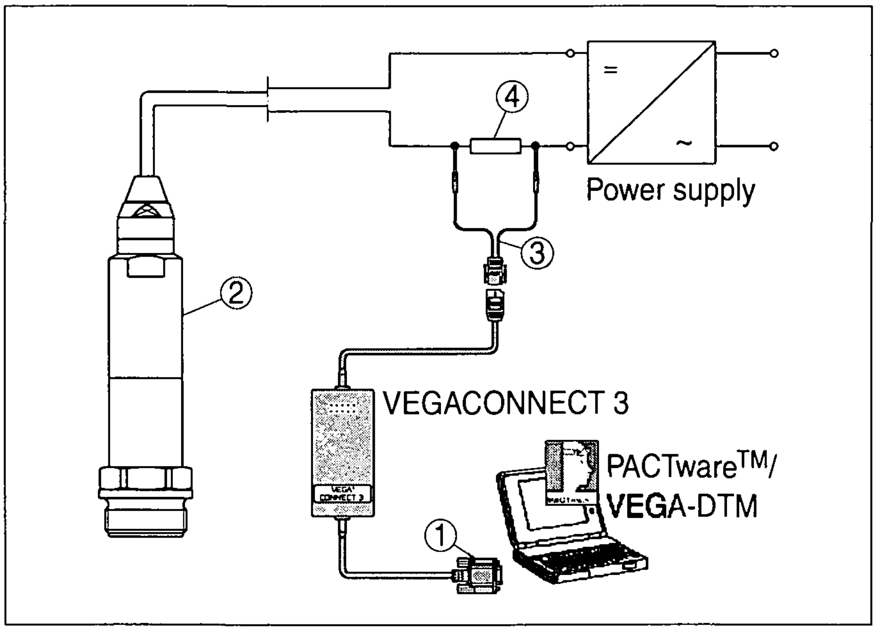

Fig. 8: Connecting the PC to the signal cable
1 *RS232 connection (with VEGACONNECT 3) or USB connection (with VEGACONNECT 4)*
2 *VEGABAR 74*
3 *HART adapter cable*
4 *HART resistance 250 Ohm (optional depending on the processing)*

Necessary components:

- VEGABAR 74
- PC with PACTware™ and suitable VEGA DTM
- VEGACONNECT 3 or 4 with HART adapter cable (art. no. 2.25397)
- HART resistance approx. 250 Ohm
- Power supply unit

Note:
With power supply units with integrated HART resistance (internal resistance approx. 250 Ohm), an additional external resistance is not necessary (e.g. VEGATRENN 149A, VEGADIS 371, VEGAMET 381/624/625, VEGASCAN 693). In such cases, VEGACONNECT 3 can be connected parallel to the 4 … 20 mA cable.

7.2 Connect the PC with VEGACONNECT 4

Connection via HART

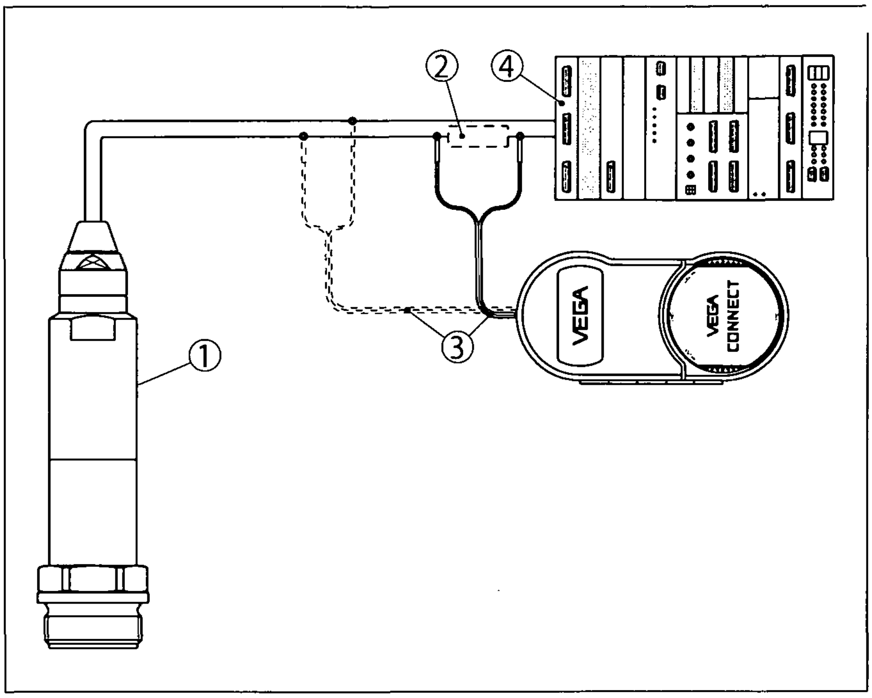

Fig. 9: Connecting the PC via HART to the signal cable
1 VEGABAR 74
2 HART resistance 250 Ohm (optional depending on the processing)
3 Connection cable with 2 mm pins and terminals
4 Processing system/PLC/Voltage supply

Necessary components:

- VEGABAR 74
- PC with PACTware™ and suitable VEGA DTM
- VEGACONNECT 4
- HART resistance 250 Ohm (optional depending on the processing)
- Power supply unit or processing system

Note:
With power supply units with integrated HART resistance (internal resistance approx. 250 Ohm), an additional external resistance is not necessary. This applies, e.g. to the VEGA instruments VEGATRENN 149A, VEGADIS 371, VEGAMET 381). Also usual Ex separators are most of the time equipped with a sufficient current limitation resistor. In such cases, VEGACONNECT 4 can be connected parallel to the 4 … 20 mA cable.

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7.3 Parameter adjustment with PACTware™

Further setup steps are described in the operating instructions manual "*DTM Collection/PACTware™*" attached to each CD and which can also be downloaded from our homepage. A detailed description is available in the online help of PACTware™ and the VEGA DTMs.

Note:
Keep in mind that for setup of VEGABAR 74, DTM-Collection in the actual version must be used.

All currently available VEGA DTMs are provided in the DTM Collection on CD and can be obtained from the responsible VEGA agency for a token fee. This CD includes also the up-to-date PACTware™ version. The basic version of this DTM Collection incl. PACTware™ is also available as a free-of-charge download from the Internet.

Go via www.vega.com and "*Downloads*" to the item "*Software*".

7.4 Parameter adjustment with AMS™ and PDM

For VEGA sensors, instrument descriptions for the adjustment programs AMS™ and PDM are available as DD or EDD. The instrument descriptions are already implemented in the current versions of AMS™ and PDM. For older versions of AMS™ and PDM, a free-of-charge download is available via Internet.

Go via www.vega.com and "*Downloads*" to the item "*Software*".

7.5 Saving the parameter adjustment data

It is recommended to document or save the parameter adjustment data. They are hence available for multiple use or service purposes.

The VEGA DTM Collection and PACTware™ in the licensed, professional version provide suitable tools for systematic project documentation and storage.

8 Maintenance and fault rectification

8.1 Maintenance

When used as directed in normal operation, VEGABAR 74 is completely maintenance free.

8.2 Fault clearance

Reaction in case of failures

The operator of the system is responsible for taken suitable measures to remove interferences.

Causes of malfunction

VEGABAR 74 offers maximum reliability. Nevertheless faults can occur during operation. These may be caused by the following, e.g.:

- Sensor
- Process
- Supply
- Signal processing

Fault rectification

The first measures to be taken are to check the output signals as well as to evaluate the error messages via the indicating and adjustment module. The procedure is described below. Further comprehensive diagnostics can be carried out on a PC with the software PACTware™ and the suitable DTM. In many cases, the causes can be determined in this way and faults can be rectified.

24 hour service hotline

However, if these measures are not successful, call the VEGA service hotline in urgent cases under the phone no. **+49 1805 858550**.

The hotline is available to you 7 days a week round-the-clock. Since we offer this service world-wide, the support is only available in the English language. The service is free of charge, only the standard telephone costs will be charged.

Checking the 4 … 20 mA signal

Connect a handheld multimeter in the suitable measuring range according to the wiring plan.

? 4 … 20 mA signal not stable

- Level fluctuations
  → Adjust integration time via PACTware™
- no atmospheric pressure compensation
  → Check the capillaries and cut them clean

→ Check the pressure compensation in the housing and clean the filter element, if necessary

? 4 … 20 mA signal missing

- Wrong connection to power supply

→ Check connection according to chapter "*Connection steps*" and if necessary, correct according to chapter "*Wiring plan*"

- No voltage supply

→ Check cables for breaks; repair if necessary

- supply voltage too low or load resistance too high

→ Check, adapt if necessary

? Current signal 3.6 mA; 22 mA

- electronics module or measuring cell defective

→ Exchange instrument or return instrument for repair

In Ex applications, the regulations for the wiring of intrinsically safe circuits must be observed.

Reaction after fault rectification

Depending on the failure reason and measures taken, the steps described in chapter "*Set up*" must be carried out again, if necessary.

8.3 Instrument repair

If a repair is necessary, please proceed as follows:

You can download a return form (23 KB) from the Internet on our homepage www.vega.com under: "*Downloads - Forms and certificates - Repair form*".

By doing this you help us carry out the repair quickly and without having to call back for needed information.

- Print and fill out one form per instrument
- Clean the instrument and pack it damage-proof
- Attach the completed form and, if need be, also a safety data sheet outside on the packaging
- Please ask the agency serving you for the address of your return shipment. You can find the respective agency on our website www.vega.com under: "*Company - VEGA worldwide*"

9 Dismounting

9.1 Dismounting steps

Warning:
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel, high temperatures, corrosive or toxic products etc.

Take note of chapters "*Mounting*" and "*Connecting to power supply*" and carry out the listed steps in reverse order.

9.2 Disposal

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the electronics to be easily separable.

WEEE directive 2002/96/EG
This instrument is not subject to the WEEE directive 2002/96/EG and the respective national laws (in Germany, e.g. ElektroG). Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

Correct disposal avoids negative effects to persons and environment and ensures recycling of useful raw materials.

Materials: see chapter "*Technical data*"

If you cannot dispose of the instrument properly, please contact us about disposal methods or return.

10 Supplement

10.1 Technical data

General data

Manufacturer	VEGA Grieshaber KG, D-77761 Schiltach
Type name	VEGABAR 74
Parameter, pressure	Gauge pressure, absolute pressure, vacuum
Measuring principle	Ceramic-capacitive, dry measuring cell
Communication interface	None

Materials and weights

Material 316L corresponds to 1.4404 or 1.4435

Materials, wetted parts	
– Process fitting	316L
– Diaphragm	sapphire ceramic® (99.9 % oxide ceramic)
– Seal	FKM (e.g. Viton), Kalrez 6375, EPDM, Chemraz 535
– Seal process fitting thread G½ A, G1½ A	Klingersil C-4400
Materials, non-wetted parts	
– Housing	316L
– Ground terminal	316Ti/316L
– Connection cable	PUR, FEP, PE
– type label support on cable	PE-HART
Weight	0.8 … 8 kg (1.8 … 17.6 lbs), depending on process fitting

Output variable

Output signal	4 … 20 mA/HART
Failure signal	22 mA (3.6 mA), adjustable
Max. output current	22.5 mA
Damping (63 % of the input variable)	0 … 10 s, adjustable
Step response or adjustment time	70 ms (ti: 0 s, 0 … 63 %)
Fulfilled NAMUR recommendations	NE 43

Additional output parameter - temperature

Processing is made via HART-Multidrop

Range	-50 … +150 °C (-58 … +302 °F)
Resolution	1 °C (1.8 °F)
Accuracy	
– in the range of 0 … +100°C (+32 … +212 °F)	±3 K
– in the range of -50 … 0 °C (-58 … +32 °F) and +100 … +150 °C (+212 … +302 °F)	typ. ±4 K

Input variable

Adjustment

Zero adjustable	-20 … +95 % of the nominal measuring range
Span adjustable	3.3 … +120 % of the nominal measuring range
Recommended max. turn down	10:1

Nominal measuring ranges and overload resistance

Nominal range	Overload, max. pressure[6)]	Overload, min. pressure
Gauge pressure		
0 … 0.1 bar/0 … 10 kPa	15 bar/1500 kPa	-0.2 bar/-20 kPa
0 … 0.2 bar/0 … 20 kPa	20 bar/2000 kPa	-0.4 bar/-40 kPa
0 … 0.4 bar/0 … 40 kPa	30 bar/3000 kPa	-0.8 bar/-80 kPa
0 … 1 bar/0 … 100 kPa	35 bar/3500 kPa	-1 bar/-100 kPa
0 … 2.5 bar/0 … 250 kPa	50 bar/5000 kPa	-1 bar/-100 kPa
0 … 5 bar/0 … 500 kPa	65 bar/6500 kPa	-1 bar/-100 kPa
0 … 10 bar/0 … 1000 kPa	90 bar/9000 kPa	-1 bar/-100 kPa
0 … 25 bar/0 … 2500 kPa	130 bar/13000 kPa	-1 bar/-100 kPa
0 … 60 bar/0 … 6000 kPa	200 bar/20000 kPa	-1 bar/-100 kPa
-1 … 0 bar/-100 … 0 kPa	35 bar/3500 kPa	-1 bar/-100 kPa
-1 … 1.5 bar/-100 … 150 kPa	50 bar/5000 kPa	-1 bar/-100 kPa
-1 … 5 bar/-100 … 500 kPa	65 bar/6500 kPa	-1 bar/-100 kPa
-1 … 10 bar/-100 … 1000 kPa	90 bar/9000 kPa	-1 bar/-100 kPa
-1 … 25 bar/-100 … 2500 kPa	130 bar/13000 kPa	-1 bar/-100 kPa
-1 … 60 bar/-100 … 6000 kPa	300 bar/30000 kPa	-1 bar/-100 kPa
-0.05 … 0.05 bar/-5 … 5 kPa	15 bar/1500 kPa	-0.2 bar/-20 kPa
-0.1 … 0.1 bar/-10 … 10 kPa	20 bar/2000 kPa	-0.4 bar/-40 kPa

6) Limited to 200 bar according to the pressure device directive.

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Nominal range	Overload, max. pressure6)	Overload, min. pressure
-0.2 … 0.2 bar/-20 … 20 kPa	30 bar/3000 kPa	-0.8 bar/-80 kPa
-0.5 … 0.5 bar/-50 … 50 kPa	35 bar/3500 kPa	-1 bar/-100 kPa
Absolute pressure		
0 … 0.1 bar/0 … 10 kPa	15 bar/1500 kPa	
0 … 1 bar/0 … 100 kPa	35 bar/3500 kPa	
0 … 2.5 bar/0 … 250 kPa	50 bar/5000 kPa	
0 … 5 bar/0 … 500 kPa	65 bar/6500 kPa	
0 … 10 bar/0 … 1000 kPa	90 bar/9000 kPa	
0 … 25 bar/0 … 2500 kPa	130 bar/13000 kPa	
0 … 60 bar/0 … 6000 kPa	200 bar/20000 kPa	

Reference conditions and influencing variables (similar to DIN EN 60770-1)

Reference conditions according to DIN EN 61298-1

- Temperature: +15 … +25 °C (+59 … +77 °F)
- Relative humidity: 45 … 75 %
- Air pressure: 860 … 1060 mbar/86 … 106 kPa (12.5 … 15.4 psi)

Determination of characteristics: Limit point adjustment according to IEC 61298-2

Characteristics: linear

Reference installation position: upright, diaphragm points downward

Influence of the installation position: <0.2 mbar/20 Pa (0.003 psi)

Deviation determined according to the limit point method according to IEC 60770[7]

Applies to **digital** HART interface as well as to **analogue** current output 4 … 20 mA. Specifications refer to the set span. Turn down (TD) = nominal measuring range/set span.

Deviation

- Turn down 1:1 up to 5:1: <0.075 %
- Turn down up to 10:1: <0.015 % x TD

Deviation with absolutely flush process fittings EV, FT

- Turn down 1:1 up to 5:1: <0.05 %
- Turn down up to 10:1: <0.01 % x TD

7) Incl. non-linearity, hysteresis and non-repeatability.

Deviation with absolute pressure measuring range 0.1 bar

- Turn down 1:1 up to 5:1 <0.25 % x TD
- Turn down up to 10:1 <0.05 % x TD

Influence of the product or ambient temperature

Applies to **digital** HART interface as well as to **analogue** current output 4 … 20 mA. Specifications refer to the set span. Turn down (TD) = nominal measuring range/set span.

Average temperature coefficient of the zero signal

In the compensated temperature range of 0 … +100 °C (+212 °F), reference temperature 20 °C (68 °F):

Average temperature coefficient of the zero signal

- Turn down 1:1 <0.05 %/10 K
- Turn down 1:1 up to 5:1 <0.1 %/10 K
- Turn down up to 10:1 <0.15 %/10 K

Outside the compensated temperature range:

Average temperature coefficient of the zero signal

- Turn down 1:1 typ. <0.05 %/10 K

Thermal change of the current output

Applies also to the **analogue** 4 … 20 mA current output and refers to the set span.

Thermal change, current output <0.15 % at -40 … +80 °C (-40 … +176 °F)

Long-term stability (similar to DIN 16086, DINV 19259-1 and IEC 60770-1)

Applies to **digital** HART interface as well as to **analogue** current output 4 … 20 mA. Specifications refer to the set span. Turn down (TD) = nominal measuring range/set span.

Long-term drift of the zero signal <(0.1 % x TD)/1 year

Total deviation (similar to DIN 16086)

The total deviation (max. practical deviation) is the sum of basic accuracy and long-term stability:

$F_{total} = F_{perf} + F_{stab}$

$F_{perf} = \sqrt{((F_T)^2 + (F_{KI})^2)}$

With

- F_{total}: Total deviation
- F_{perf}: Basic accuracy
- F_{stab}: Long-term drift

- F_T: Temperature coefficient (influence of medium or ambient temperature)
- F_{Kl}: Deviation

Ambient conditions

Ambient, storage and transport temperature	
– Connection cable PE	-40 … +60 °C (-40 … +140 °F)
– Connection cable PUR, FEP	-40 … +85 °C (-40 … +185 °F)

Process conditions

The specifications of the pressure stage are used as an overview. The specifications on the type plate are applicable.

Pressure stage, process fitting	
– Thread 316L	PN 60
– Thread Alu	PN 25
– Hygienic fittings 316L	PN 10, PN 16, PN 25, PN 40
– Flange 316L, flange with extension 316L	PN 40 or 150 lbs, 300 lbs
Product temperature depending on the measuring cell seal	
– FKM (e.g. Viton)	-20 … +100 °C (-4 … +212 °F)
– EPDM	-40 … +100 °C (-40 … +212 °F), 1 h: 140 °C/ 284 °F cleaning temperature
– Kalrez 6375 (FFKM)	-10 … +100 °C (+14 … +212 °F)
– Chemraz 535	-30 … +100 °C (-22 … +212 °F)
Vibration resistance	mechanical vibrations with 4 g and 5 … 100 Hz[8)]
Shock resistance	Acceleration 100 g/6 ms[9)]

Electromechanical data

Connection cable	
– Configuration	four wires, one suspension cable, one breather capillary, screen braiding, metal foil, mantle
– Wire cross-section	0.5 mm² (AWG no. 20)
– wire resistance	<0.036 Ohm/m (0.011 Ohm/ft)
– Standard length	6 m (19.685 ft)
– max. length with VEGADIS 12	200 m (656.168 ft)

8) Tested according to the regulations of German Lloyd, GL directive 2.
9) Tested according to EN 60068-2-27.

– Min. bending radius at 25 °C/77 °F	25 mm (0.985 in)
– Diameter	approx. 8 mm (0.315 in)
– Colour - standard PE	Black
– Colour - standard PUR	Blue
– Colour - Ex-version	Blue

Voltage supply

Supply voltage	
– Non-Ex instrument	12 … 36 V DC
– EEx ia instrument	12 … 29 V DC
Permissible residual ripple	
– <100 Hz	U_{ss} <1 V
– 100 Hz … 10 kHz	U_{ss} <10 mV
Load	see diagram

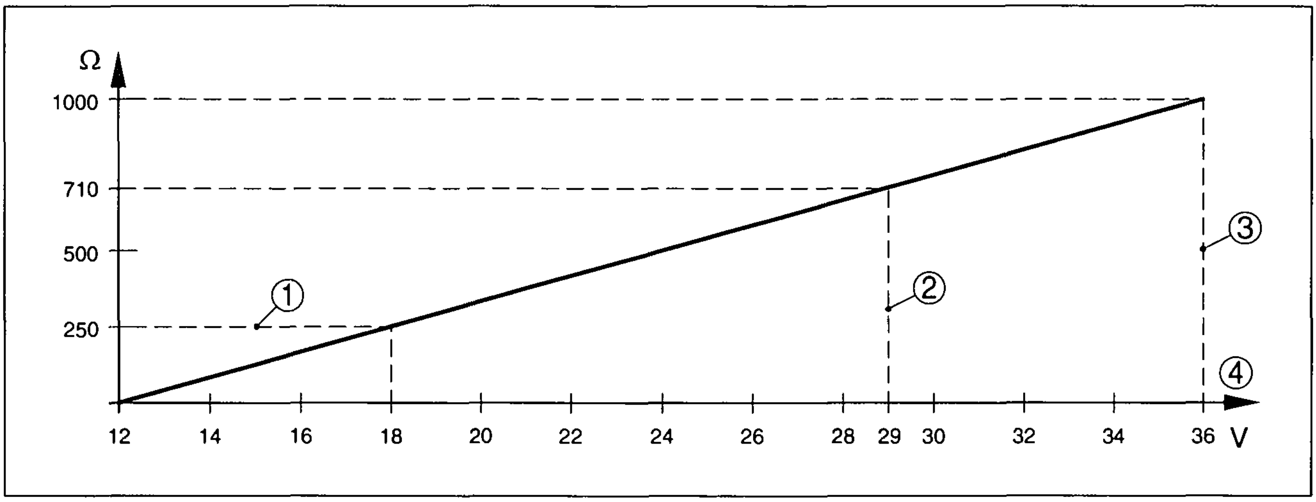

Fig. 10: Voltage diagram VEGABAR 74
1 HART load
2 Voltage limit Ex instrument
3 Voltage limit non-Ex instrument
4 Voltage supply

Load in conjunction with VEGADIS 12	see diagram

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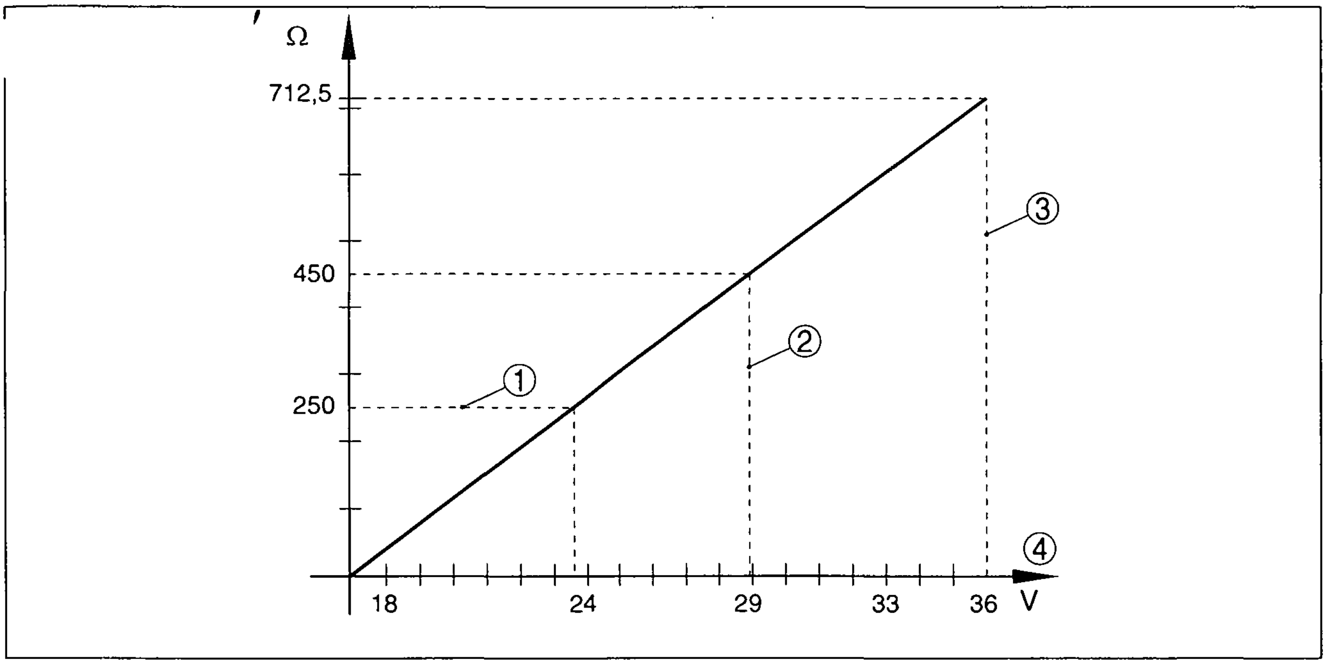

Fig. 11: Voltage diagram VEGABAR 74 with VEGADIS 12
1 HART load
2 Voltage limit Ex instrument
3 Voltage limit non-Ex instrument
4 Voltage supply

Integrated overvoltage protection

Nominal leakage current (8/20 µs)	10 kA
Min. response time	<25 ns

Electrical protective measures

Protection	IP 68 (25 bar)/IP 69K
Overvoltage category	III
Protection class	III

Approvals[10)]

ATEX ia	ATEX II 1G EEx ia IIC T6; ATEX II 2G EEx ia IIC T6
Ship approvals	GL, LRS, ABS, CCS, RINA, DNV
Others	WHG

10) Deviating data in Ex applications: see separate safety instructions.

10.2 Dimensions

VEGABAR 74 - threaded fitting

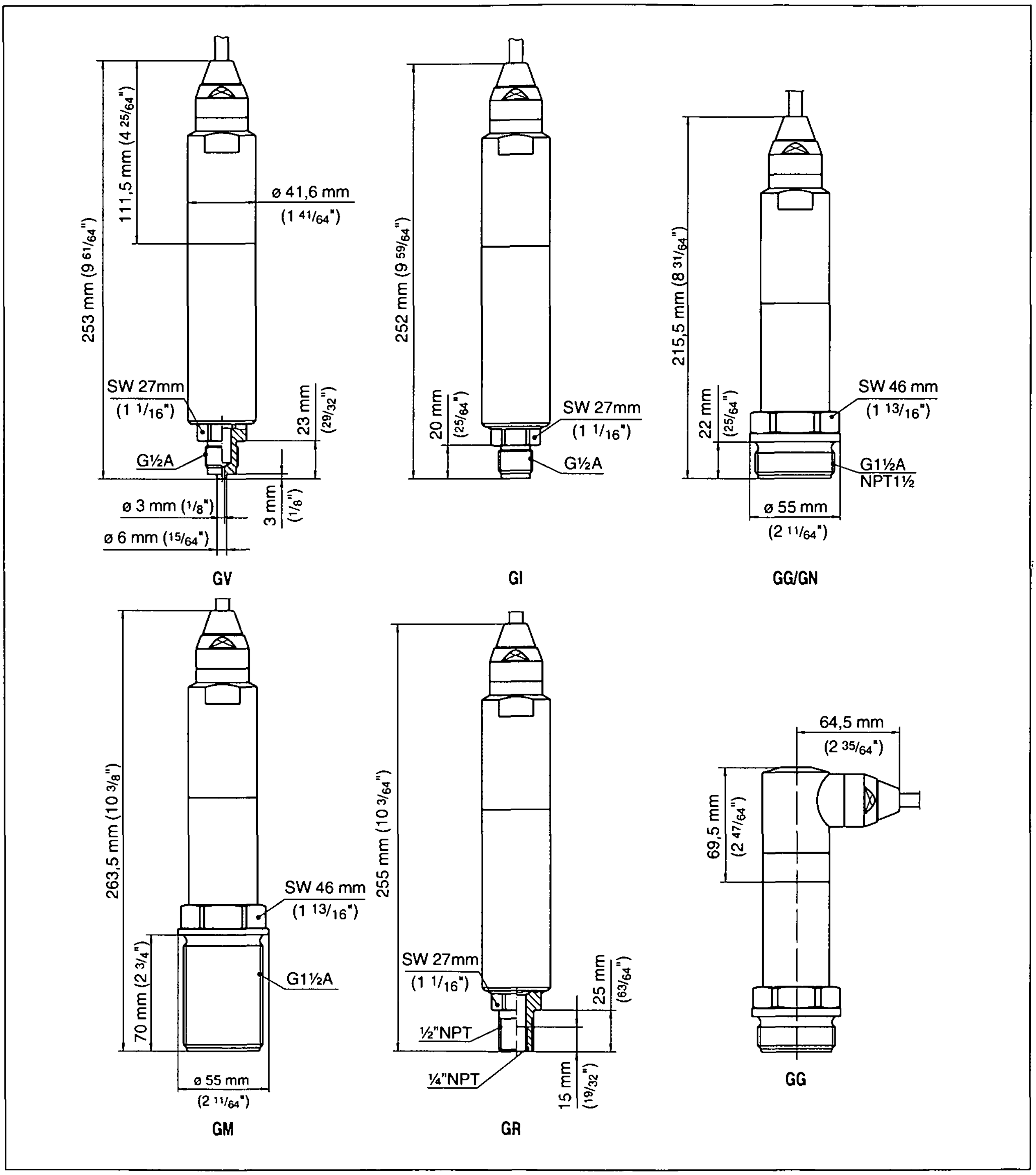

Fig. 12: VEGABAR 74 threaded fitting: GV = G½ A manometer connection EN 837, GI = G½ A inner G¼ A, GG = G1½ A, GN = 1½ NPT, GM = G1½ A 70 mm, GR = ½ NPT inner ¼ NPT

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VEGABAR 74 - hygienic fitting 1

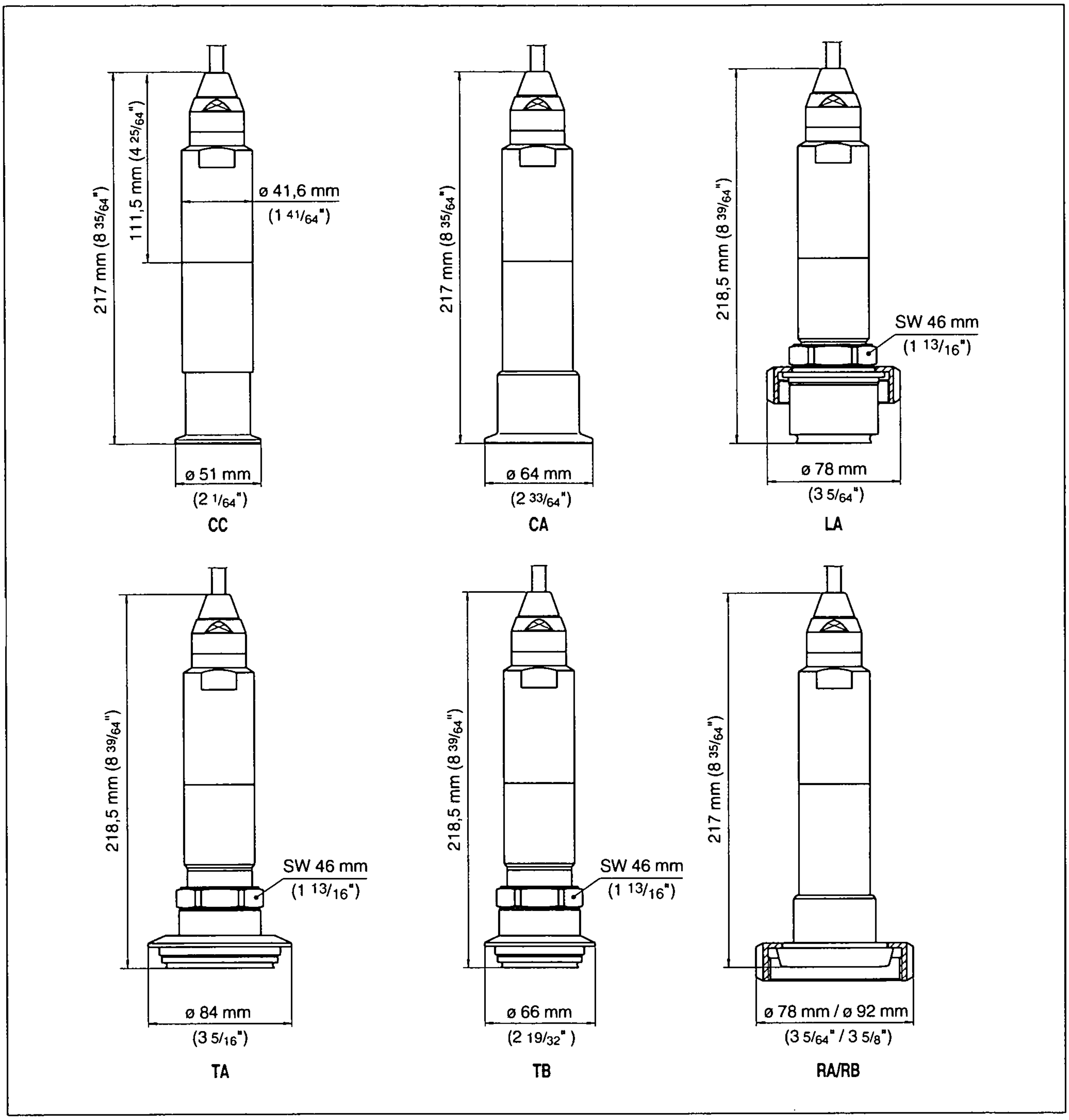

Fig. 13: VEGABAR 74 hygienic fitting: CC = Tri-Clamp 1½", CA = Tri-Clamp 2", LA = hygienic fitting with compression nut F40, TA = Tuchenhagen Varivent DN 32, TB = Tuchenhagen Varivent DN 25, RA/RB = bolting DN 40/DN 50 according to DIN 11851

VEGABAR 74 - hygienic fitting 2

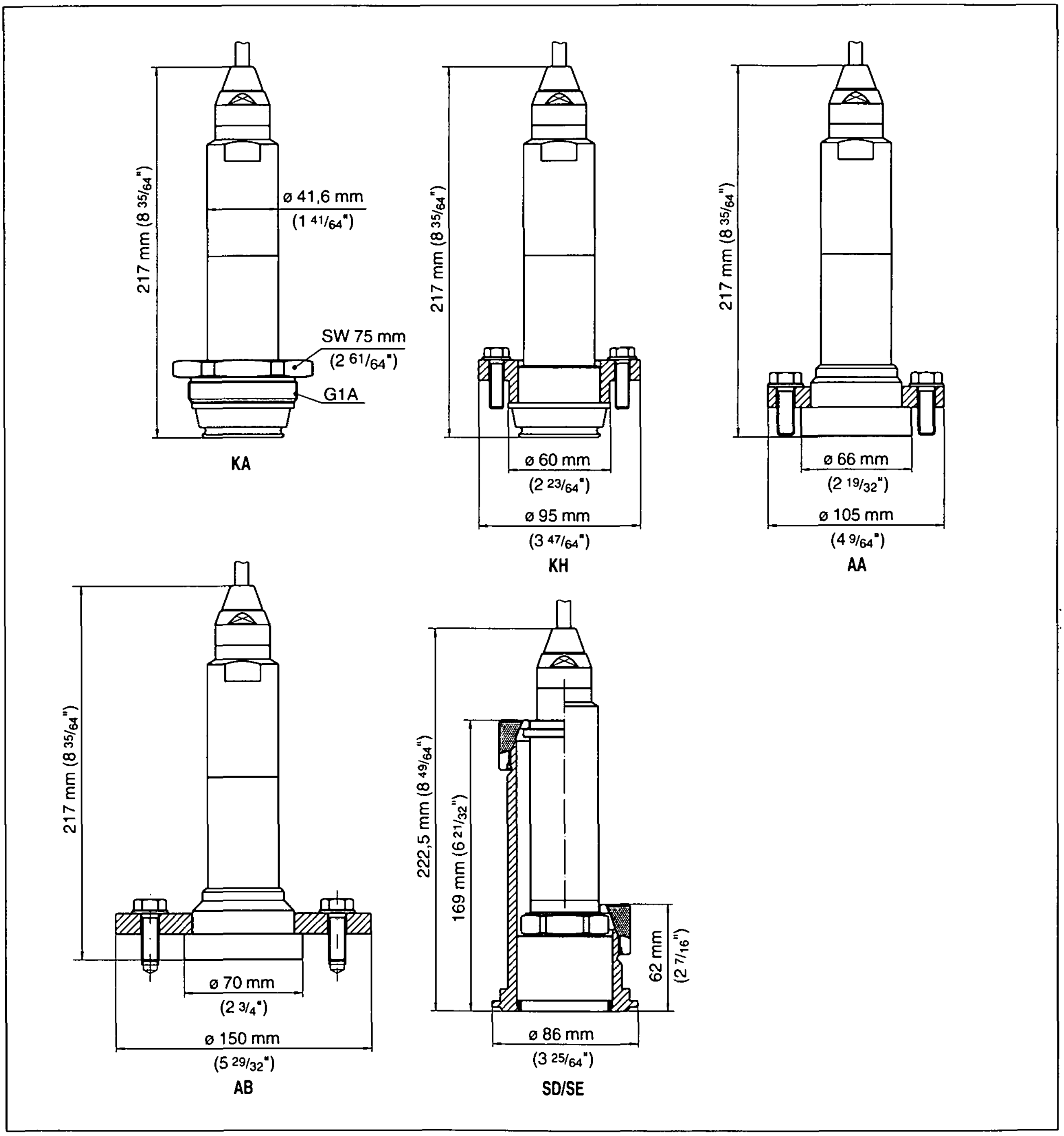

Fig. 14: VEGABAR 74 KA/KH = cone DN 40, AA = DRD, SD/SE = Anderson 3" long/short fitting

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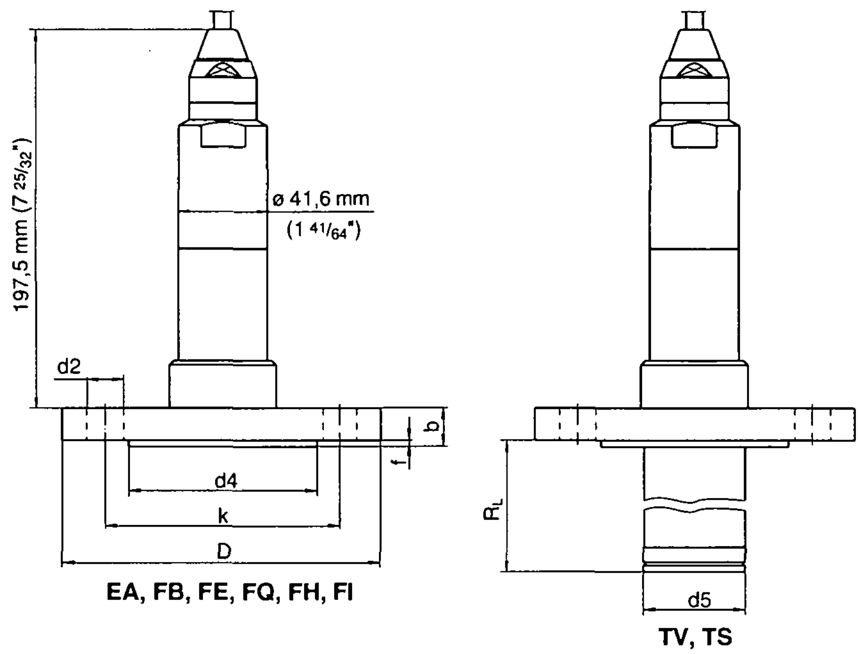
VEGABAR 74 - flange connection



①	DN	PN	D	b	k	d2	d4	f	RL	d5
EA	40	40	5 29/32"	45/64"	4 21/64"	4xø 45/64"	3 15/32"	1/8"	-	-
FB	50	40	6 1/2"	25/32"	4 59/64"	4xø 45/64"	4 1/64"	1/8"	-	-
FE	80	40	7 7/8"	15/16"	6 19/64"	8xø 45/64"	5 7/16"	1/8"	-	-
②	"	lbs	D	b	k	d2	d4	f	RL	d5
FQ	1 ½"	150	5"	11/16"	3 14/16"	4xø 5/8"	2 7/8"	1/8"	-	-
FH	2"	150	6"	3/4"	4 3/4"	4xø 5/8"	3 5/8"	1/8"	-	-
FI	3"	150	7 1/2"	3/4"	6	4xø 5/8"	6	1/8"	-	-
③	DN	PN	D	b	k	d2	d4	f	RL	d5
TV	50	40	6 1/2"	25/32"	4 59/64"	4xø 45/64"	4 1/64"	1/8"	④	1 1/2"
TS	80	40	7 7/8"	15/16"	6 19/64"	8xø 45/64"	5 7/16"	1/8"		1 1/2"

Fig. 15: VEGABAR 74 - flange connection
1 *Flange connection according to DIN 2501*
2 *Flange fitting according to ANSI B16.5*
3 *Flange with extension*
4 *Order-specific*

VEGABAR 74 - threaded fitting for paper industry

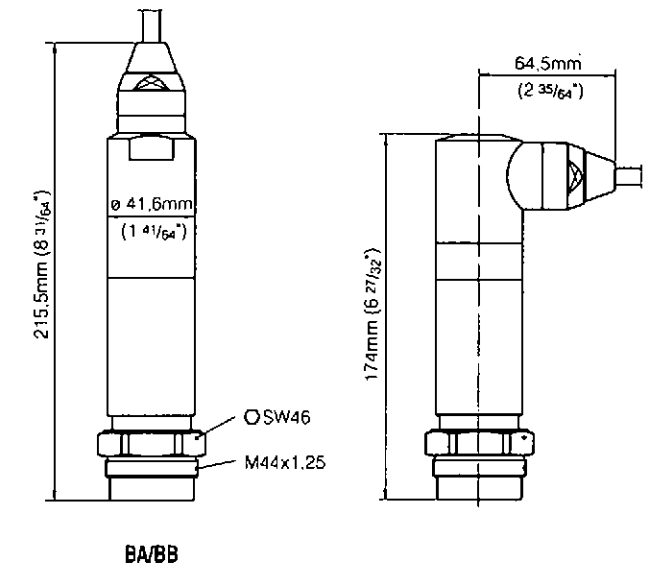


Fig. 16: VEGABAR 74 - connection for paper industry: BA/BB = M44x1.25

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VEGABAR 74 - extension fitting for paper industry

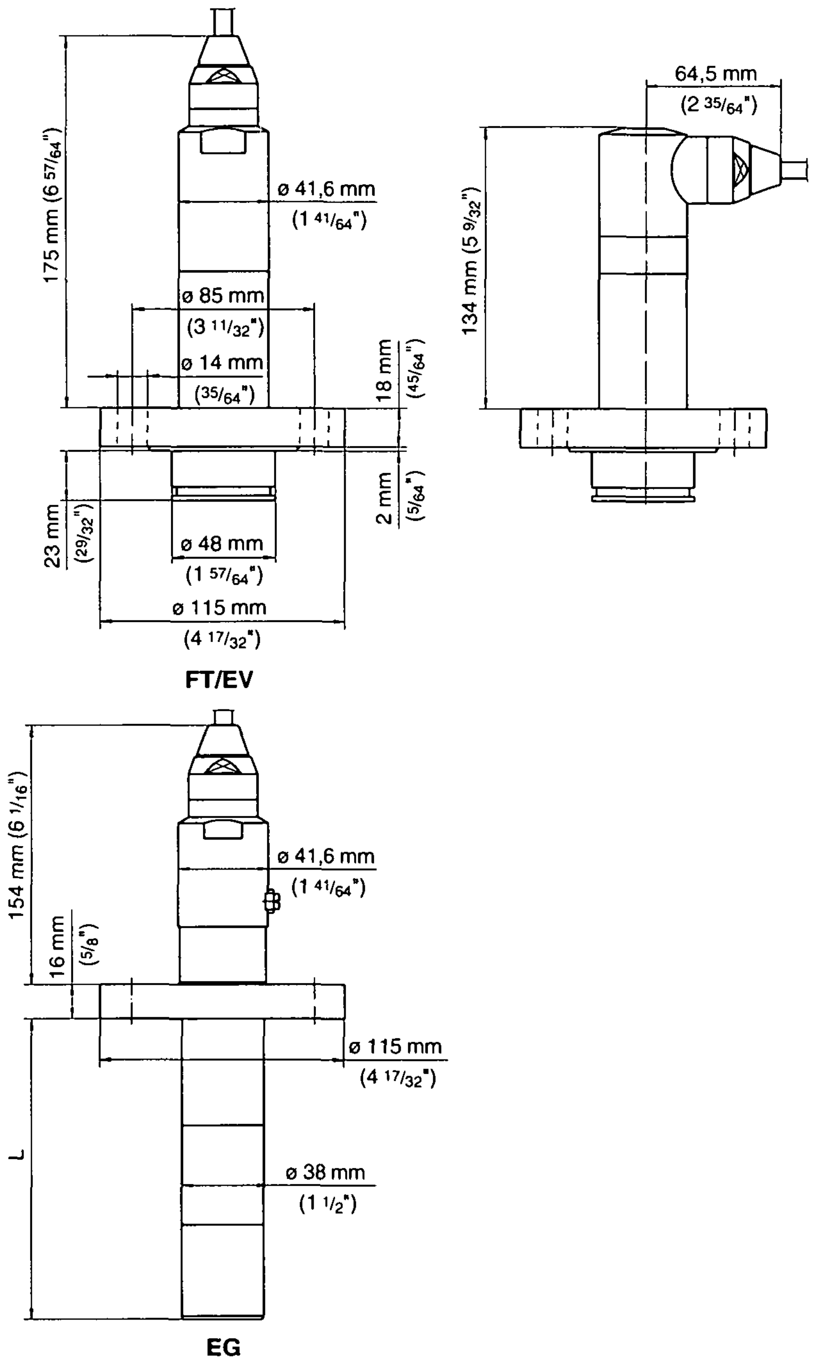

Fig. 17: VEGABAR 74 - extension fitting for paper industry: EV/FT = absolutely flush for pulper (EV 2-times flattened), EG = extension for ball valve fitting (L = order-specific)

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ISO 9001 VEGA Q

All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and processing systems correspond to the information available at the time of printing.

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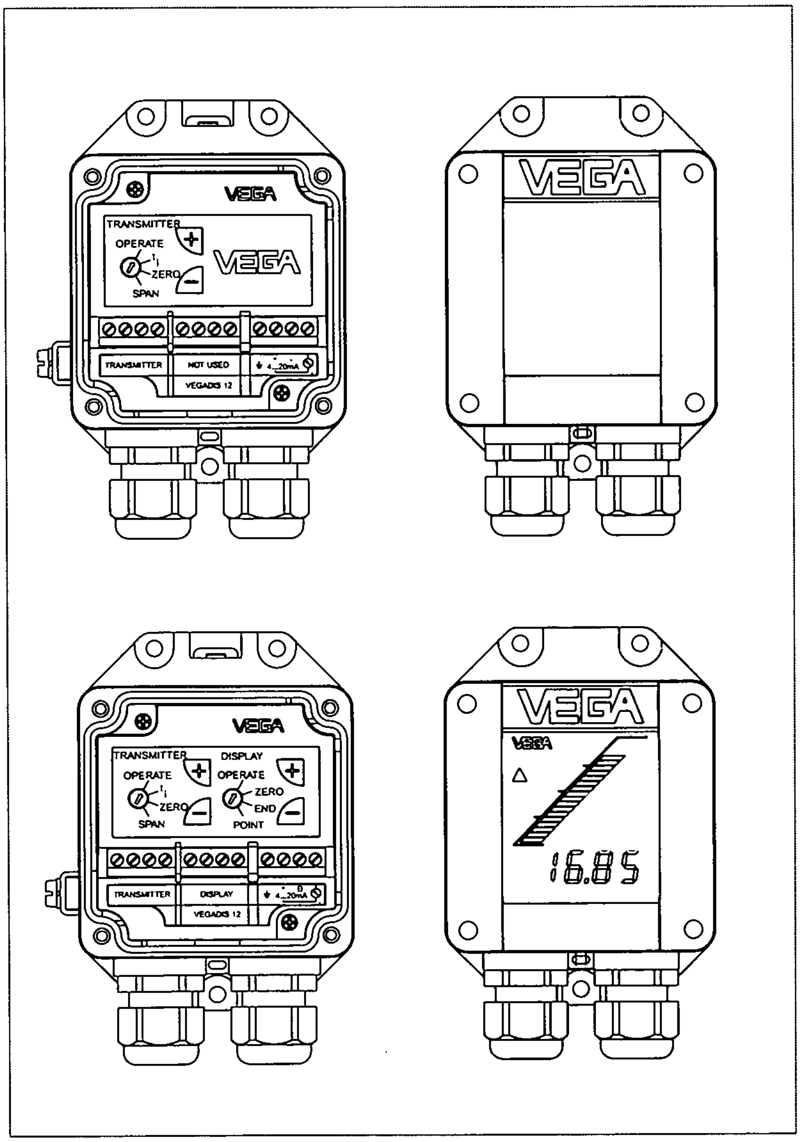
Operating Instructions

VEGADIS 12



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Safety information

Please read this manual carefully, and also take note of country-specific installation standards (e.g. the VDE regulations in Germany) as well as all prevailing safety regulations and accident prevention rules.

For safety and warranty reasons, any internal work on the instruments, apart from that involved in normal installation and electrical connection, must be carried out by qualified VEGA personnel.

Note Ex area

Please note the approval documents (yellow binder), and especially the included safety data sheet.

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Contents

1 Product description

1.1 Function and configuration

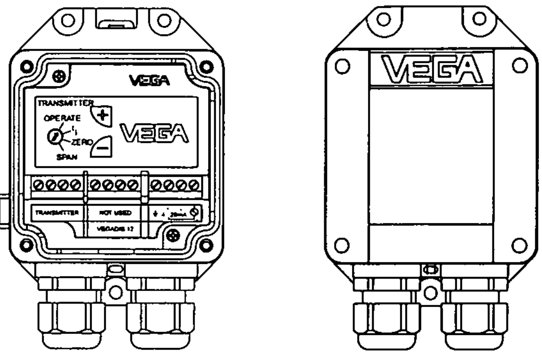
VEGADIS 12 is an external connection housing with integrated adjustment elements. It is connected via the VEGA special cable with breather capillaries or a three-wire standard cable to the hydrostatic pressure transmitter VEGAWELL 72 - 4 … 20 mA/HART®, VEGABAR 74 or VEGABAR 75. VEGADIS 12 is connected to the supply and signal circuit of the pressure transmitter and does not require a separate external energy source.

VEGADIS 12 has the following functions:
- adjustment of zero, span and ti
- atmospheric pressure compensation for the pressure transmitter
- measured value display (optional).

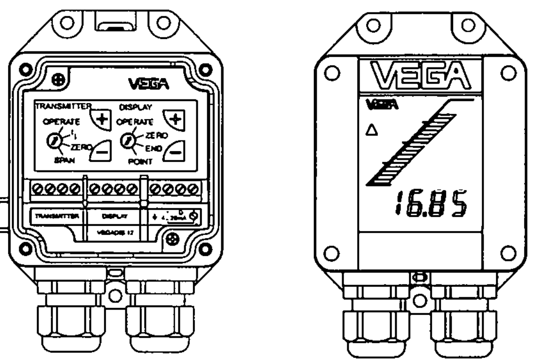
As a standard feature, VEGADIS 12 is equipped with an adjustment module for the pressure transmitter. The optional display is located in the housing cover and is equipped with a bar graph and a digital display indication. In this version, additional adjustment elements for indication scaling are integrated.

1.2 Types and versions

VEGADIS 12 without display



VEGADIS 12 with display



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1.3 Technical data

Standard data

Materials and weight

Housing	high-resistance plastic PBT (Polyester)
Ground terminal	stainless steel 1.4305
Display window	Lexan
Breather facility	PTFE filter element [1]
Weight	approx. 0.5 kg

Adjustment and indicating elements

Adjustment elements	2 keys, 1 rotary switch
Adjustment elements with display	2 x 2 keys, 2 x 1 rotary switch
Display (option)	LC multifunctional display with - bar graph (20 segments) - digital value (4 digits) - tendency indicator for rising or falling values

Connection

Cable entry	M20 x 1.5 (for cable ø 5 … 9 mm)
Screw terminals	for wire cross-section up to 2.5 mm²

Adjustment circuit

Connection to	VEGAWELL 72 - 4 … 20 mA/HART®, VEGABAR 74 or VEGABAR 75
connection cable	VEGA special cable with breather capillaries or 3-wire standard cable
Cable length	max. 200 m

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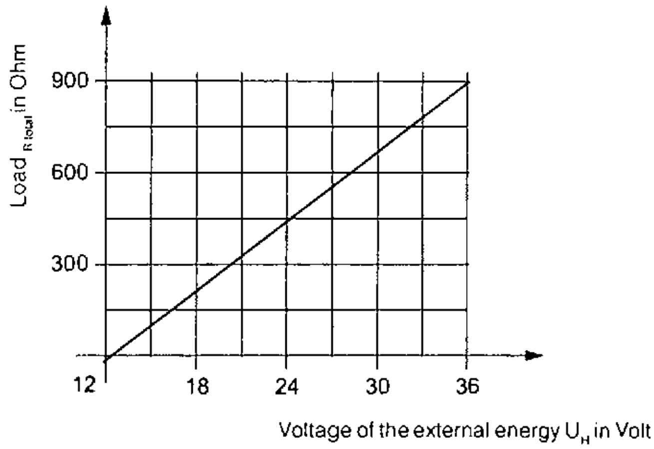
[1] air permeable and humidity blocking

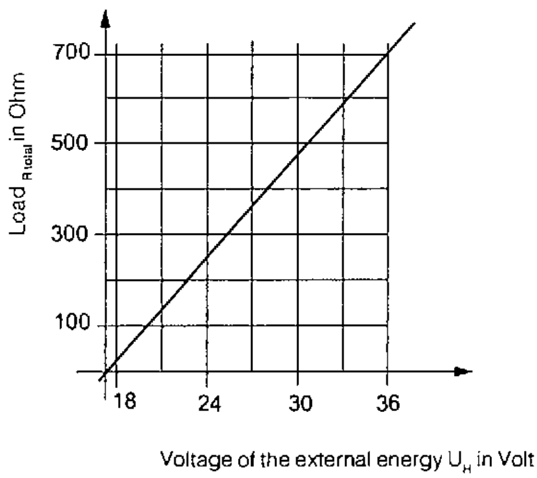
Supply and signal circuit (analogue transmission, 4 ... 20 mA)

Supply voltage via pressure transmitter in conjunction with VEGADIS 12	
- without display	12 ... 36 V DC
- with display	17 ... 36 V DC
Max. input current	150 mA
Range of the current signal	3.5 ... 22 mA
Max. permissible load	depending on the supply voltage (see load diagrams)

Load diagram without display



Load diagram with display



Protective measures

Housing	IP 65 [1]
Protection class	III
Overvoltage category	III

Ambient conditions

Ambient temperature	
- VEGADIS 12	-40°C ... +85°C
- VEGADIS 12 with display	-20°C ... +70°C
Storage and transport temperature	-40°C ... +85°C

[1] Maintaining the housing protection IP 65 requires the use of a seal in the cable entry fitting to the cable. If the supplied seal does not fit, the customer has to provide a suitable one.

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1.4 Approvals

If a pressure transmitter or the external housing is used in hazardous areas, approved versions should be used.

The respective official documents (test reports, test certificates and conformity certificates) must be noted for these applications. These are supplied with the respective instrument.

General approvals

VEGADIS 12	CENELEC EEx ia IIC

CE conformity CE

The external housings VEGADIS 12 or VEGADIS 12 Ex meet the protective regulations of EMC (89/336/EWG) and NSR (73/23/EWG). The conformity has been judged acc. to the following standards:

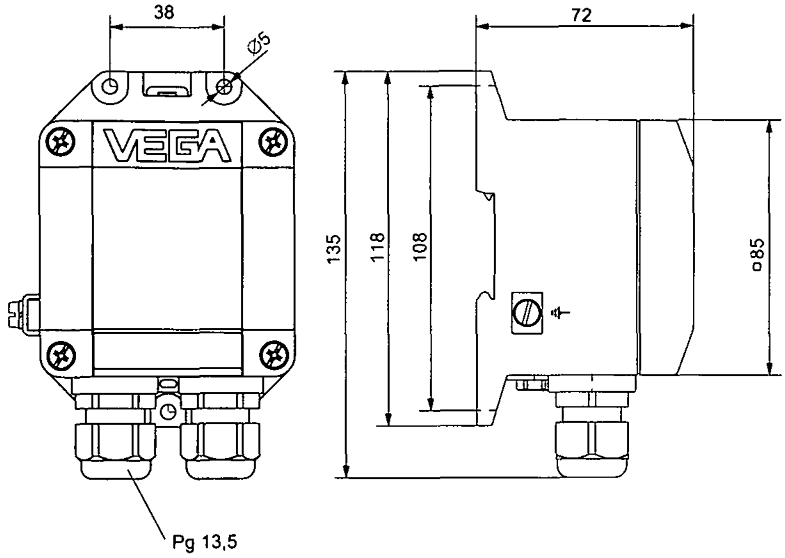
EMC	Emission	EN 50 081
	Susceptibility	EN 50 082
NSR		EN 61 010

NAMUR regulations

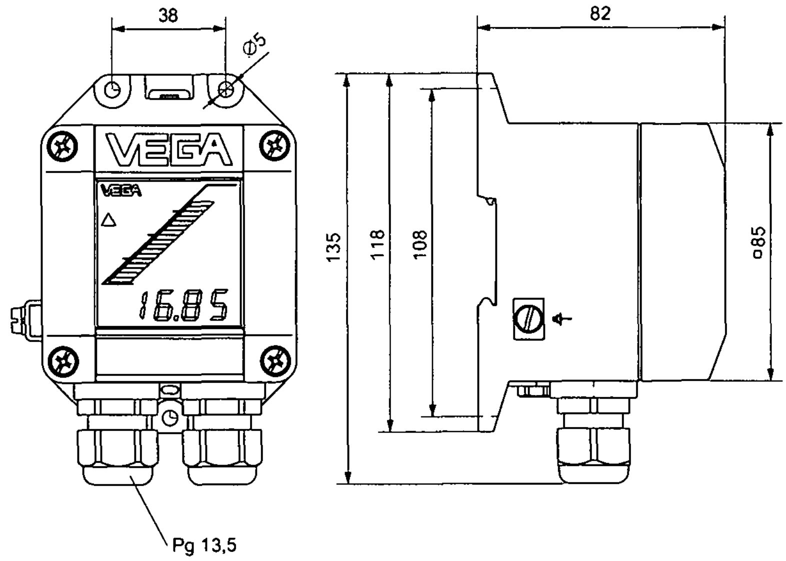
Full compliance with NAMUR regulations NE21, May 1993.

1.5 Dimensions

without display



with display



2 Mounting

VEGADIS 12 can be mounted in the following ways:
- on carrier rail 35 x 7.5 acc. to EN 50 022
- on mounting sheet or to the wall.

In case of vertical wall mounting, the cable entry must point downwards to avoid moisture ingress.

If VEGADIS 12 is additionally used for atmospheric pressure compensation for the pressure transmitter, the following must be noted:
- there must be the same atmospheric pressure on the breather facility as on the vessel
- the breather facility must not be clogged or dirty.

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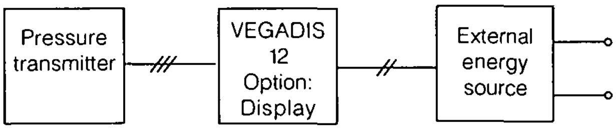
3 Electrical connection

3.1 Connection instructions

VEGADIS 12 is connected to the supply and signal circuit of the pressure transmitter and does not require a separate external energy source.

Block diagram



The electronics in the pressure transmitter is designed in two-wire technology and requires a supply voltage of 12 ... 36 V DC, with display 17 ... 36 V DC. Supply voltage and current signal are led via the same two-wire connection cable to the connection terminals. The third cable between pressure transmitter and VEGADIS 12 is used for transmission of the adjustment data.

The external energy is provided via a separate power supply unit:
- power supply unit, e.g. VEGASTAB 690
- processing unit with integrated DC current source (e.g. active DCS input)

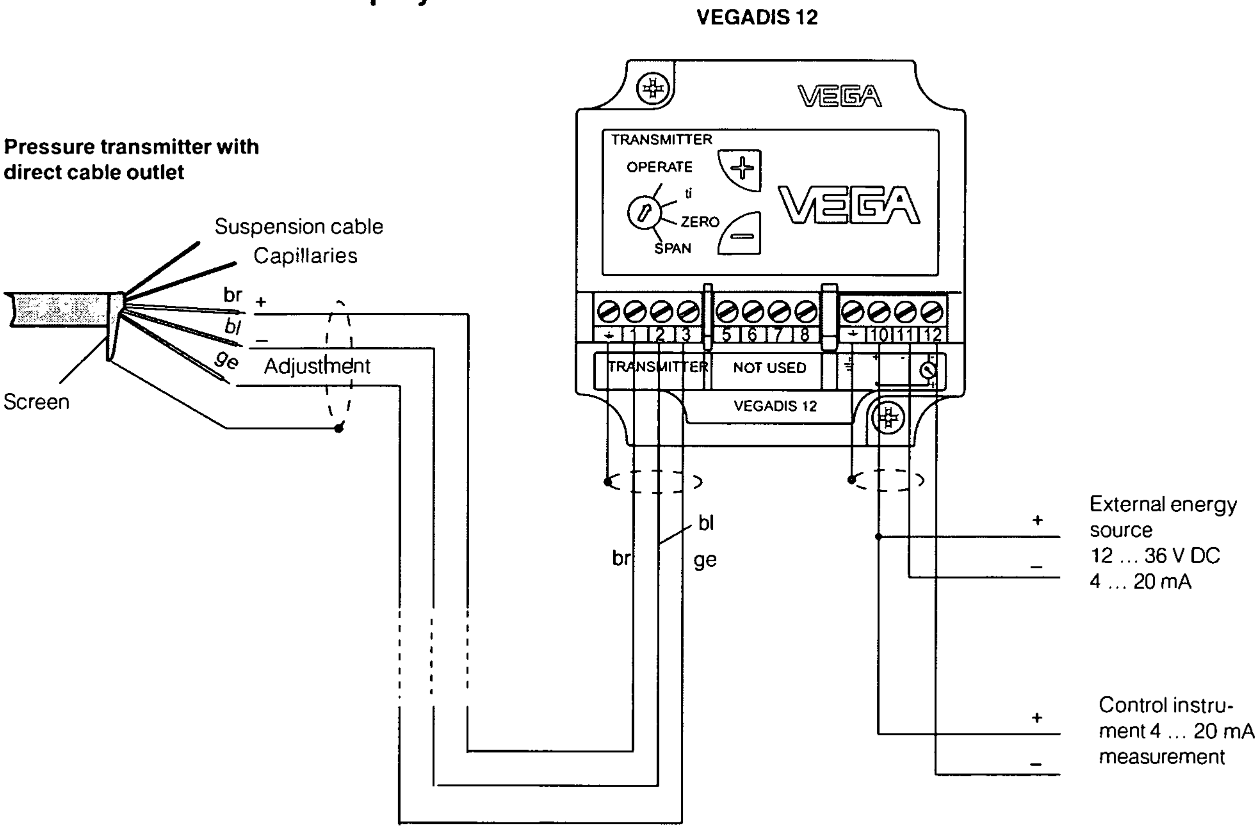
Make sure that the external energy source is reliably separated from the mains circuits acc. to DIN VDE 0106, part 101. The above mentioned VEGA instruments meet this requirement and protection class III is therefore ensured.

The external energy source must deliver a terminal voltage of at least 12 V or 17 V to the transmitter. The actual terminal voltage on the transmitter depends on the following factors:
- output voltage U_H of the external energy source under nominal load.
- load resistances of the instruments in the current circuit.

For electrical connection in general, the following points should be given attention:
- The connection must be made according to the national installation standards (e.g. in Germany acc. to the VDE regulations).
- To avoid damage of the electronics, the terminal voltage must not exceed 36 V.
- The connection elements have built-in protection against polarity reversal.
- The wiring between pressure transmitter and VEGADIS 12 or between VEGADIS 12 and the power supply can be made with standard three or two-wire cable.
- If strong electromagnetic interferences are expected, screened cable is recommended. The screening must be made on both ends. For use in Ex areas, the installation regulations must be noted.
- If overvoltages are expected, we recommend the installation of VEGA overvoltage arresters.
- A seal fitting the cable must be used in the cable entry.

3.2 Wiring plan

VEGADIS 12 without display



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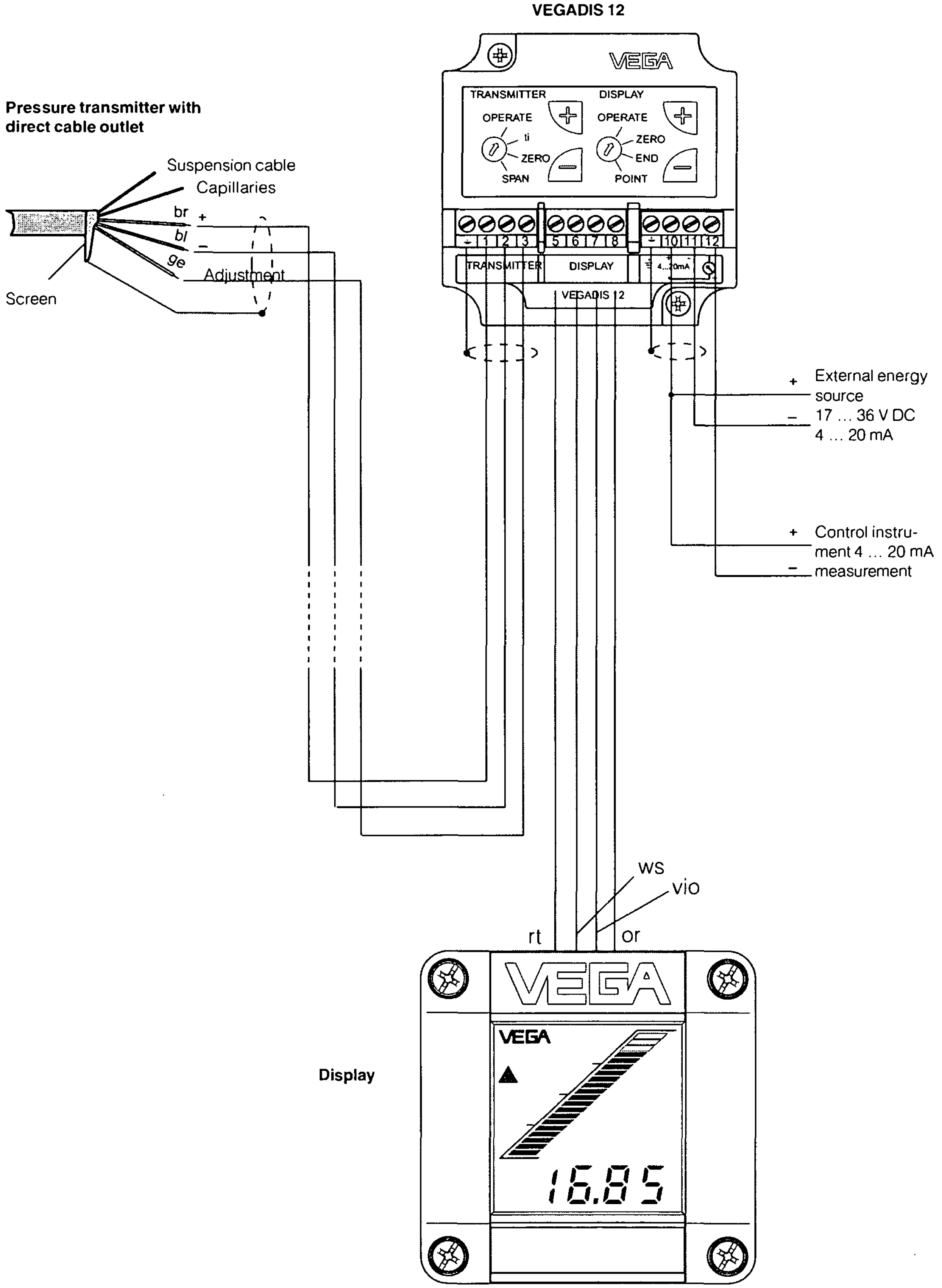
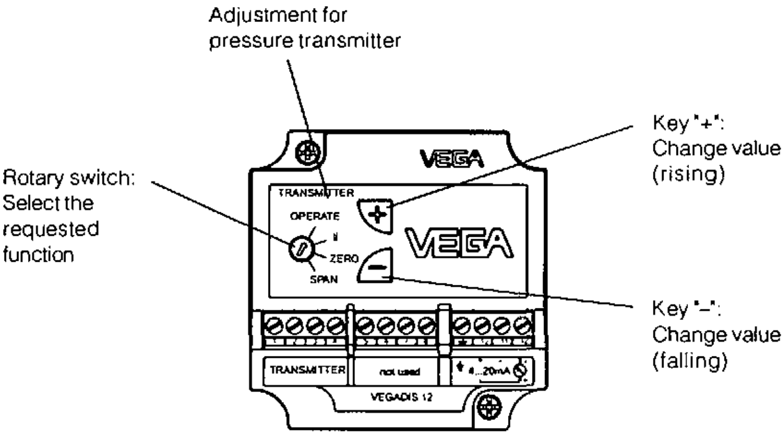
VEGADIS 12 with display



4 Setup

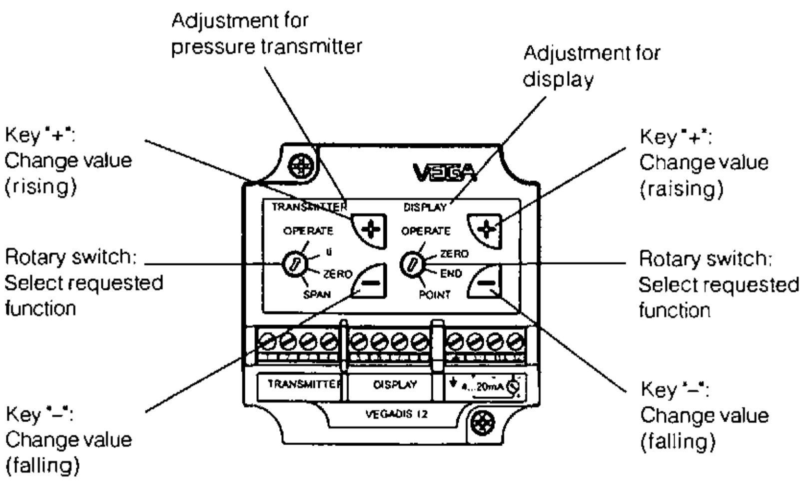
4.1 Adjustment elements

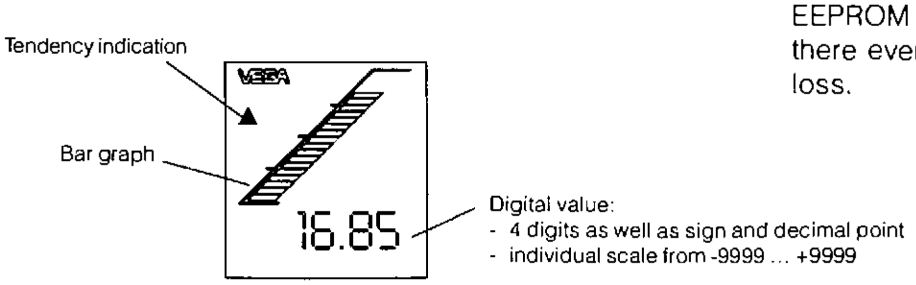


Adjustment system (transmitter)

- Choose the requested function with the rotary switch.
- With the "+" and "–" keys you modify the signal current to the requested values or set the suitable integration time.
- Set the rotary switch to position "OPERATE". The set values are transferred to the EEPROM memory and remain there even in case of voltage loss.

4.2 Adjustment and indicating elements (version with display)





Adjustment system (transmitter)

(see section 4.1)

Adjustment system (display)

- With the rotary switch you choose the requested function.
- With the "+" and "–" keys you change the display indication to the requested values or set the suitable decimal point.
- Then set the rotary switch to position "OPERATE". The set values are transferred to the EEPROM memory and remain there even in case of voltage loss.

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4.3 Adjustment of the transmitter

Adjustment

To adjust the beginning of the measuring range and end value of the measuring range, connect an ammeter to terminals 10 and 12. The measured value is identical to the output current.

1 Adjust zero
(vessel empty)

- Set the rotary switch to zero.
- Set a current of 4 mA by pushing the "+" and "–" key.

2 Adjust span
(max. vessel level)

- Set the rotary switch to span.
- Set a current of 20 mA by pushing the "+" and "–" key.

Adjustment range of the measuring range final value:
3.3 % ... 120 % of nominal range

Adjustment instructions:

- A modification of the beginning of the measuring range does not influence the adjusted span.
- It is also possible to adjust currents for partial fillings, e.g. 8 mA for 25 % and 16 mA for 75 %. The electronics then calculates automatically the current values for 0 % and 100 % (only possible with a delta ≥ 3 %).
- The current value first changes in steps of 6 µA steps, then after approx. 10 sec. of pressing, in steps of about 300 µA.
- If the current values react to the key pressing with a time delay, this can have two reasons:
  - the last adjustment was carried out with a level considerably deviating from the actual level.

Integration time

An integration time t_i of 0 ... 10 sec can be set for damping level fluctuations.

Procedure:

- Set rotary switch to t_i.
- By pushing the "-" key 10 times, make sure that the integration time is set to 0 sec.
- For every 1 sec requested integration time, push the "+" key once.

The integration time is the time required by the current output signal to reach 90 % of the actual level after a sudden level change.

4.4 Scaling of the indication

The display provides the current values 4 ... 20 mA as bar graph and as digital value.

Bar graph
At 4 mA no segment of the bar graph appears, at 20 mA all segments appear. This assignment is fixed.

Digital value
The digital value can be scaled individually between -9999 ... +9999 via the adjustment module.

1 Adjust zero

- Set the rotary switch to zero.
- Set the requested value, e.g. 0 by pushing the "+" and "–" key.

2 Adjust end

- Set the rotary switch to end.
- Set the requested value, e.g. 1000 by pushing the "+" and "–" key.

3 Adjust the decimal point (point)

- Set the rotary switch to point.
- Set the requested values, e.g. 8888 (no decimal point) by pushing the "+" and "–" key.

5 Diagnostics

5.1 Maintenance

VEGADIS 12 is maintenance-free.

5.2 Failure rectification

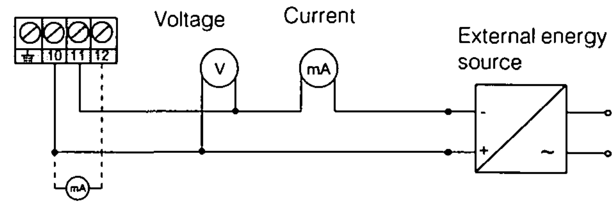
In case of an instrument failure, please check the following:
- the atmospheric pressure compensation
- the electrical connections and components.

Check atmospheric pressure compensation

First of all open the housing cover. The indicated measured value must not change. However, if the indicated value changes nevertheless, the compensation of the atmospheric pressure is not ensured. Please therefore check:
- the breather facility on the housing
- the capillaries in the special cable.

Note:
There must be always the same atmospheric pressure on the breather facility as on the open vessel.

Check electrical components



Instruction for Ex applications
Deviating from the previous assignment, the terminals 10 and 12 are here used for brief connection to a certified, active, floating (max. value: 470 mW) or to an individual passive, floating measuring instrument. For connection, the regulations for wiring of intrinsically safe circuits (measuring instrument, supply and signal circuit) must be noted.

Voltage

- Check the terminal voltage on VEGADIS 12 (must be at least 12 V DC or 17 V DC with display).

Current

Current value	Condition
3.8 … 20.5 mA	standard range for output current
0 mA	signal cable interrupted
< 3.6 mA	electronics or pressure sensor element defective
22 mA	electronics or pressure sensor element defective

20 591-EN-030728

20591-EN-030728

Notes

VEGA

VEGA Grieshaber KG
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77761 Schiltach
Germany
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ISO 9001

All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and processing systems correspond to the latest information at the time of printing.

Technical data subject to alterations

20 591-EN-030728

2. Test Results

2.0 TEST RESULTS

SSM089

FIXED SPEED SEWAGE PUMP STATION

SWITCHBOARD CHANGEOVER COMMISSIONING PLAN

Site ID and Name	YOUNGS RD. SP126
Commissioning Date	6-9-08

In Attendance

Name	Role During Commissioning	Company
MARK DE RUYTER	ELECT SUPERVISOR	TPR
GLEN LERUETTO	ELECTRICAL	″
WADE HOWARD	ELECTRICAL	″
PAUL FRAMPTON	MECH / TRUCK DRIVER	″

1 INTRODUCTION

This document is the standard testing procedure for a switchboard change over at a sewage pumping station. The procedure ensures that for a two pump sewage pump station, at least one pump will be operational at all times. The basic cut-over procedure is as follows:

1. Install temporary pumping system (pump controller and generator).
2. Disconnect sewage Pump #2 from existing switchboard and connect to temporary pumping system.

PUMP #1 IS NOW RUNNING THE STATION FROM EXISTING SWITCHBOARD

3. Fully commission Pump #2 on the temporary pumping system.

PUMP #2 IS NOW RUNNING THE STATION FROM TEMPORARY PUMPING SYSTEM

4. Disconnect Pump #1, consumer mains, on site generator and all field instrumentation from the existing switchboard.
5. Install new switchboard and connect to consumer mains.
6. Connect Pump #1 to the new switchboard and test in "emergency pumping" mode (via the "Emergency Start" switch).

PUMP #2 IS STILL RUNNING THE STATION FROM THE TEMPORARY PUMPING SYSTEM AND PUMP #1 CAN BE RUN UNDER "EMERGENCY PUMPING" MODE FROM NEW SWITCHBOARD.

7. Connect all field instrumentation.
8. Fully commission Pump #1 on the new switchboard to operate in "Local" and "Remote" modes.

PUMP #1 IS NOW RUNNING THE STATION FROM NEW SWITCHBOARD

9. Connect Pump #2 to the new switchboard and fully commission on the new switchboard to operate in all modes.
10. Complete the Site Acceptance Test (SAT) including all pump, RTU and SCADA testing.

NOTE: This testing procedure will only be acceptable on sites that do NOT need two pumps to run during the cut over procedure.

(Confirm the current running conditions of the existing switchboard before commencing).

For sites that require two pumps to run simultaneously under dry weather conditions during the proposed cut over period, a site-specific cut over procedure must be developed to incorporate adequate flow control measures (ie tankers or temporary pumps).

2 PRE - CHANGE OVER WORKS CHECKLIST

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

2.1 SWITCHBOARD FACTORY ACCEPTANCE TEST

Contractor Task	Completed
FAT has been completed as per BW FAT Document and all defects that were identified have been rectified.	/ /

2.2 CONCRETE SLAB EXTENSION

Contractor Task	Result
Confirm the concrete slab extension is complete including all necessary conduits.	OK ☐

2.3 SUPPLY AUTHORITY

Contractor Task	Outcome
The relevant supply authority has been organised to install the metering into the New Switchboard. CA TS	Company ______ Booked for / / @ ______ (time) Ref # ______

2.4 NEW RADIO ANTENNA MAST LOCATION

Contractor Task	Result
Check the location of the antenna mast and ensure that the new position will not be directly below electrical transmission lines. POINT TOWARDS ENERGEX POLE	Location OK ☐ Antenna dir. ______

2.5 DISCHARGE MAINS PRESSURE TRANSDUCER

Contractor Task	Completed
Install delivery pressure transducer on the discharge rising main. Transducer is calibrated to the specified range (as per spec). Calibration sheet to be supplied with AS BUILT drawings. 0kPA to ______kPA	Installed OK ☐ Range___(m) to___(m)

2.6 TEMPORARY GENERATOR SIZE

Contractor Task	Completed
Note the kW of each pump.	Pump #1 9 kW Pump #2 9 kW
Determine the type of generator and size of pump starter required	Genset Size ______ kVA Date Booked / / Delivery Date / / Delivery Time ______

Electrical Contactor's Supervisor

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

Signature: ....

3 CHANGE OVER WORKS

The following sequence of works that must be carried out in order. One pump must be operational at all times. After each phase has been completed, the commissioning manager will record the results and instruct the commissioning team to commence work on the next phase.

3.1 STEP 1 - INSTALL TEMPORARY PUMPING SYSTEM

3.1.1 Register with Control Room

Contractor Task	Outcome
Call the Brisbane Water Control Room Operator (CRO) and inform him that you are on site. Record the CRO's Name and Officer Code and record the time of the call. Advise CRO that you are performing a switchboard changeover and that you will initially be taking one pump off line. Give the operator a contact name and number and ask that he contact you if any level alarm is activated on site.	Name: M. PE Ruttle CRO: ______ Time: 6.15 am

3.1.2 Existing Switchboard Parameters

Contractor Task		Outcome
Ensure that the station is fully functional (pump can run)		OK ☑
Record the direction of the installed antenna for later reference. Point to		Antenna dir. Eventer Pole
Record the kWhr meter serial numbers.		#
Record 3 phase motor currents	Pump #1	U 16.8 V. 16.8 W. 16.8
	Pump #2	U 16.8 V. 16 W. 16.8
Record pump rotation **Mains Supply**		C'wise (RWB) Anti C'wise
	Pump #1	☑ ☐
	Pump #2	☐ ☑

3.1.3 Prepare and Install Temporary Pump Controller and Generator

Contractor Task	Outcome
Position generator in an appropriate location. Locate away from the work site to reduce noise.	OK ☑
Position fire extinguisher and oil spill bund as per risk analysis.	OK ☑
Connect the temporary pump controller to the generator and test connection (ie point to point to confirm correct connection)	OK ☑
Install Multitrode level sensors and set the Start and Stop levels to be equivalent to the current Start and Stop levels of the existing switchboard parameters.	OK ☑
Install the backup audible and visual alarm system (powered by separate battery). Test electrodes back to temporary pump controller to confirm operation.	OK ☑
Ensure that the generator fuel will be sufficient to enable the generator to run loaded for 12 hours. (This may require extra fuel – arrange if required).	OK ☑
Start the generator and measure the 3 phase volts and record the phase rotation.	C'wise (RWB) Anti C'wise ☑ ☐

Electrical Contactor's Supervisor	BW Commissioning Manager
Name: M. PE Ruyth Date: 6-9-08	Name:...... .... Date: ....
Signature:	Signature: ....

3.2 STEP 2 - CONNECT PUMP #2 TO TEMPORARY PUMPING SYSTEM

Contractor Task	Outcome
On the existing switchboard, Isolate sewage pump (Pump #2) as per BW Isolation Tag and Lock Out procedure. (Unplug from Decontactor).	OK ☑
Disconnect Pump #2 from the existing switchboard and remove the power and control cables from the switchboard.	OK ☑
Connect Pump #2 power and control cables to the **temporary pump controller**.	OK ☑
Electrically test Pump #2 to temporary pump controller connections.	OK ☑
Switch the existing switchboard to "Local" and stop Pump #1.	OK ☑
Manual Test of Temporary Pumping System: (Confirm Pump Direction) Manually start the submersible pump and closely monitor wet well level to confirm that the level is dropping. When confirmed, stop pump.	OK ☑
Auto Test of Temporary Pumping System: (Confirm Pump Cycle) Allow the temporary pumping system to complete one full start and stop cycle automatically to confirm complete system is functioning correctly. **This is a HOLD point. Do not proceed until the temporary pump is confirmed to be controlling the wet well level.**	OK ☑ TIME:__________

3.3 STEP 3 - DISCONNECT EXISTING SWITCHBOARD AND REMOVE

3.3.1 Contact Control Room

Contractor Task	Outcome
Call the Control Room Operator (CRO) and advise that you are going to remove power to the switchboard and that he will lose communication with the site. Record the CRO's office code and the time of the call.	Name: __________ CRO: __________ Time: __________

3.3.2 Disconnect Pump #1 and Remove Existing Switchboard

Contractor Task	Outcome
On the existing switchboard, Isolate sewage pump (Pump #1) as per BW Isolation Tag and Lock Out procedure. (Unplug from Decontactor).	OK ☑
Disconnect Pump #1 from the existing switchboard and remove the power and control cables from the switchboard and place near the temporary system so as to enable a quick changeover for Pump #2 if required.	OK ☑
Isolate main incomer at the switchboard. Ensure all secondary sources of power (ie on site Generator) are also isolated. Confirm there is no load.	OK ☑
Remove primary 3-phase fuses from power pole. Lock fuses in lockout box as per BW Isolation and Lock Out procedure.	OK ☑
Disconnect mains cable from the switchboard.	OK ☑
Disconnect all other control and communication cables and remove	OK ☑
Remove the existing switchboard away from job site.	OK ☑

Electrical Contactor's Supervisor

Name:...... .... Date: 6-9-8

Signature: ....

BW Commissioning Manager

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

Signature: ....

3.4 STEP 4 - INSTALL NEW SWITCHBOARD

3.4.1 Install new switchboard (For Sites with Option F Only)

Contractor Task	Outcome
Install and connect the required (new or existing) mains and earth as per the contract.	New ☑ Existing ☐
Record the cable insulation resistance of the 3 phases	A 200 + Megohm B 200 + Megohm. C 200 + Megohm
Record earth resistance	0.02 ohms
Point to point phase continuity	R to L1 OK☑ W to L2 OK☑ B to L3 OK☑

3.4.2 Install Supply Authority Metering

Task	Outcome
Install ~~the direct connected kWhr~~ Meter C.T. METERING.	OK ☑

3.4.3 Energise New Switchboard

Contractor Task	Outcome
Retrieve mains 3-phase pole fuses from lock out box as per BW Isolation and Lock Out procedure.	OK ☑
Ensure new switchboard main incomer is turned "Off".	OK ☑
Install the 3-phase ~~pole fuses~~. Pillar	OK ☑
Turn on mains switch	OK ☐
Check 3 phase voltages	AB ________V BC ________V CA ________V
Check phase rotation and ensure it is the same as determined earlier.	OK ☐
Check MEN connection.	OK ☐

Electrical Contactor's Supervisor

Name:...... .... Date: 6-9-08

Signature: ....

BW Commissioning Manager

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

Signature: ....

3.5 STEP 5 - CONNECT PUMP #1 TO NEW SWITCHBOARD

Contractor Task	Outcome
At the beginning of this procedure, Pump #2 is operating under the control of the temporary switchboard running from the Generator.	OK ☑
Isolate submersible Pump #1 and Pump #2 at the **new switchboard**, as per BW Isolation and Lock Out procedure.	OK ☑
Via the MERACHAL plug in sockets provided on the switchboard reconnect the power and control cables for Pump #1 (the pump that is **not** connected to the generator set) If VFD connection is direct connect.	OK ☑
Before beginning the next step ensure that the well level is between 'Start' and 'Stop' level and Pump #2 is not running. **Isolate Pump #2 to prevent it from running during the next test**	OK ☑
De-isolate this now connected Pump #1. Check the rotation by bumping the pump On / Off via the local "Emergency Start" switch.	OK ☑
Check the 3 phase motor current and compare with original readings. **PUMP #1 Can now be run in an emergency under the control of the new switchboard.** **When checking is complete - Isolate Pump #1**	A 16.8 Amps B 16.8 Amps C 16.8 Amps
De-isolate Pump #2 so that the station is again under the control of the temporary switchboard.	OK ☑

3.6 STEP 6 - CONNECT FIELD INSTRUMENTATION TO NEW SWITCHBOARD

3.6.1 Field Devices

Contractor Task	Outcome	
Install and connect the hydrostatic level probe to the transmitter	OK ☑	0 to ___ Mtrs
Connect the delivery pressure probe to the transmitter	OK ☑	0 to ___ Mtrs
Install and connect the Multitrode LR3 wet well high level relay Probe	OK ☑	at 4.4 Mtrs
Install and connect the Multitrode SIR surcharge imminent level relay Probe	OK ☑	at 2.05 Mtrs
Connect the moisture in oil sensor for each pump (sites with option A only) N/A	OK ☐	N/A ☑
Connect the moisture in stator for each pump (sites with option B1 only) N/A	OK ☐	N/A ☑
Connect the motor bearing temperature for each pump (sites with option B2 only) N/A	OK ☐	N/A ☑
Connect the reflux valve micro switch for each pump (sites with option C only) N/A	OK ☐	N/A ☑
Connect the upstream manhole surcharge imminent probe (sites with option D only) N/A	OK ☐	N/A ☑
Connect the Multitrode LR2 sump pump start/ stop probes (sites with option E only)	OK ☐	N/A ☐
Connect the Multitrode LR4 sump pump high/trip probes (sites with option E only)	OK ☑	N/A ☐
Connect the sump pump (sites with option E only)	OK ☐	N/A ☑
Connect the generator IO cables (sites with option F only)	OK ☐	N/A ☑
Connect the thermistors for each pump (sites with option I only)	OK ☐	N/A ☑

Electrical Contactor's Supervisor	BW Commissioning Manager
Name:...... .... Date: 6-9-08	Name:...... .... Date: ....
Signature:	Signature: ....

3.6.2 Install Generator Mains (For Sites with Permanent Generators)

Contractor Task	Outcome
Record insulation resistance of the 3-phases	A _______Megohm B_______ Megohm. C_______ Megohm
Record earth resistance	_________ohms
Point to point phase continuity	R to L1 OK☐ W to L2 OK☐ B to L3 OK☐

3.6.3 Radio Antenna Installation

BW Programmer Task	Outcome
Install new mast with Antenna, orientate antenna to the position determined in section 3.1.2 connect coaxial cable plugs.	OK ☐

BRIS WATER

3.6.4 Telemetry and SCADA Communications Checks

BW Programmer Task	Outcome
Brisbane Water programmer must complete the following procedures ***From the SSM086 Standard Fixed Speed Sewage Pumping Station (S.A.T.)*** ***Section 1: Setup and Pre-Commissioning Checks***	OK ☐

3.7 STEP 7 - COMMISSIONING PUMP #1

BW Programmer & Contractor Task	Outcome
Before doing the next step ensure that the well level is between 'Start' and 'Stop' level and Pump #2 is not running. **Isolate Pump #2 to prevent it from running during the next test.**	OK ☑
At this stage the Brisbane Water Programmer must complete the following procedures ***From the SSM086 Standard Fixed Speed Sewage Pumping Station (S.A.T.)*** ***Section2 : On Site Commissioning Procedure (Pump #1 Only)***	OK ☑
Once Pump #1 has been commissioned, leave the new switchboard in control of the site operating under "Remote" control.	OK ☑

Electrical Contactor's Supervisor

Name:...... .... Date: 6-7-8

Signature: ....

BW Commissioning Manager

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

Signature: ....

3.8 STEP 8 - CONNECT PUMP #2 AND COMMISSION

3.8.1 Connect Pump #2 to New Switchboard

Contractor Task	Outcome
At the beginning of this procedure, Pump #1 is operating under the control of the new switchboard running from the supply authority.	OK ☑
Shut down the generator and disconnect Pump #2 from the temporary switchboard	OK ☑
Ensure Pump #2 circuit breaker at the new switchboard is still isolated and locked out as per BW Isolation and Lock Out procedure.	OK ☑
Via the MERACHAL plug in sockets provided on the switchboard, connect the power and control cables for Pump #2.	OK ☑
De-isolate this now connected submersible pump. Check the rotation of this submersible pump by bumping the pump On / Off via the local "Emergency Start" switch.	OK ☑
Check the 3-phase motor current and compare with original results. **PUMP #2 Can now be run in an emergency under the control of the new switchboard.**	A 16.8 Amps B 16.8 Amps C 16.8 Amps

3.8.2 Commissioning of Pump #2

BW Programmer & Contractor Task	Outcome
Before beginning the next step ensure that the well level is between "Start and Stop" level and Pump #1 is not running. (Station under the control of the new board) **Isolate Pump #1 to prevent it from running during the next test.**	OK ☑
Brisbane Water Programmer must complete the following procedures ***From the SSM086 Standard Fixed Speed Sewage Pumping Station (S.A.T.)*** ***Section2: On Site Commissioning Procedure – (Pump #2 Only)***	OK ☑
Once Pump #2 has been commissioned, de-isolate Pump #1 and leave that new switchboard in control of the site operating under remote control with both pumps able to run	OK ☑

3.9 SUGGESTIONS FOR IMPROVEMENT

Suggestion	Recommended By

Electrical Contactor's Supervisor

Name:...... .... Date: 6-9-08

Signature: [signature]

BW Commissioning Manager

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

Signature: ....

3.10 STEP 9 - COMPLETE TESTING

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

BW Programmer & Contractor Task	Outcome
Once pump 2 has been commissioned Complete any remaining procedures in Section 2 ***from the SSM086 Standard Fixed Speed Sewage Pumping Station (S.A.T.)***	OK ☐
Check operation of SIR for 20 sec. with probe to prove probe operation and operation of 2 pumps	OK ☐
Check operation LR3 with probe to prove RTU and probe	OK ☐
Seal conduits with denso and grout under switchboard.	OK ☑
Check Energex Phase Fail Input.	OK ☑
Confirm automatic control of pumps.	OK ☐
Check Parameter 203 of Soft Starter is a positive value	OK ☐
Confirm correct operation of all door locks.	OK ☑
Confirm Operation & Maintenance Manual left on site.	OK ☐

3.10.2 SCADA Testing

BW Programmer & Contractor Task	Outcome
The Brisbane Water Programmer must complete the following procedures with the assistance from the Commissioning Engineer and SCADA Commissioning Engineer in the Control Room. ***From the SSM086 Standard Fixed Speed Sewage Pumping Station (S.A.T.)*** *Section3* : SCADA Commissioning Procedure	OK ☐

3.10.3 Preliminary Work Completion by Electrical Contractors

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

3.10.4 Register Control Room

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

John To CALL Control Room

BW Commissioning Manager

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

Signature: ....

4 POST CHANGE OVER CHECKLIST

4.1 DELIVERABLES FROM RTU PROGRAMMER

BW Programmer	Date Completed
Within 7 days of the change over the following must be completed and signed off by the BW Programmer0 Complete <u>Section 4: Post Commissioning</u> ***from the SSM086 Standard Fixed Speed Sewage Pumping Station (S.A.T.)***	/ /
The BW Programmer will ensure that the Control Room Acceptance (CRA) form is signed by the Manager of the Control Room Officers. The form is to be handed to the Contracts Manager (CM).	/ /

4.2 DELIVERABLES FROM ELECTRICAL CONTRACTOR

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

4.3 DELIVERABLES FROM COMMISSIONING MANAGER

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

BW Commissioning Manager

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

Signature: ....

J. & P. RICHARDSON INDUSTRIES PTY. LTD.
A.B.N. 23 001 952 325 Lic. No. 756
ELECTRICAL CONTRACTORS and ENGINEERS
TELEPHONE: 3271 2911 (All hours) 114 CAMPBELL AVENUE - WACOL, BRISBANE Q 4076

DOCKET No. R 6815

CUSTOMER: BCC
ADDRESS: Youngs Rd.

DAY: SAT
DATE: 6/9/08
EMP. No. 291

JOB NUMBER					
N	H	O	M	S	I
2	5	2	0	0	

WORK START TIME
NORMAL

RISK MANAGEMENT HAS BEEN CARRIED OUT IN ACCORDANCE WITH: RISK ASSESS ☑ SAFETY PLAN ☐

I have carried out the work listed & I confirm it complies with Good Work Practices, Our Quality Goals & to Customer's Satisfaction.

H P h m

TEST BEFORE TOUCHING

Disconnected old mains to old s/board + removed cable. Disconnected pumps + levels. Installed new s/board + mains cables + terminated. Connected pumps + new levels + new pressure transmitter. Tested + found working ok.

+ travel

REPORT PROMPTLY ANY CONDITION LIABLE TO CAUSE AN ACCIDENT
REMEMBER
YOU ARE RESPONSIBLE FOR YOUR SAFETY

TIME CLOCK
0, 6m, 12m, 18m, 24m, 30m, 36m, 42m, 48m, 54m
10 UNITS PER HR.

Customer's Authorisation for live work:

Customer's Signature

Employee Signature:

ENT BY:

					HRS. MIN.	UNITS
WORK	W	0600 To 1900	(1900 To 1930)	To	13 : —	130
TRAVEL	T	To	To	To	:	

SERVICE CALL -	APP BY -	ENDORSEE -
CALL OUT -	COST SECTION -	SERVICE FOLLOW UP / CA / SS

DRIVER FATIGUE MANAGEMENT

UNIT No.		Over 12 Tonne GVM		
Driving Time		Driving Time		Total Hours
Start	Finish	Start	Finish	

CERTIFICATE OF TESTING & SAFETY

I certify that the electrical work listed has been tested in accordance with the prescribed procedure and that such work complies in every respect with the requirements of the Electrical Safety Regulation 2002. The electrical equipment listed to the extent that it is affected by the above electrical work, is electrically safe.

Certificate of Competency No: 57774

Signature of Electrical Worker:

Form No. F1024/4 May 08

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J. & P. RICHARDSON INDUSTRIES PTY. LTD.

A.C.N. 001 952 325

114 CAMPBELL AVENUE, WACOL, BRISBANE, QLD. 4076

Telephone: (07) 3271 2911 - All Hours

Facsimile: (07) 3271 3623

ELECTRICAL CONTRACTORS & ENGINEERS

INDUSTRIAL - COMMERCIAL - MINING

ELECTRICAL INSTALLATION AND MAINTENANCE

24 HOUR BREAKDOWN SERVICE

POWER RETICULATION

SWITCHBOARD DESIGN AND MANUFACTURE

ELECTRICAL ENGINEERING, PROCESS SOFTWARE AND DESIGN SERVICES

SHEETMETAL FABRICATION

MUNICIPAL PUMPING INSTALLATIONS

HIGH VOLTAGE INSTALLATIONS

CERTIFICATE OF COMPLIANCE

CONTRACT NUMBER BW.70103-06/07
ORDER No: 70103-001
JPR JOB No: C25200
CONTROL PANEL FOR SP126
DRAWINGS 486/5/7-0039-000,-001,-002,-003,-006,-007,-008,-009,-010,-011,-012,-014,-015,-016,-017,-018,-019,-020,-022,-023,-024 AMEND. B

J&P Richardson Industries Pty. Ltd. certify that the above listed control panel has been tested in accordance with the job specification and the as built drawings on the date recorded on the quality assurance documentation for this control panel.

Yours faithfully,
J & P RICHARDSON INDUSTRIES PTY LTD

D.WEDLEY
ASSISTANT SWITCHBOARD MANAGER

GOLD COAST PH: (07) 5591 6340 SUNSHINE COAST PH: (07) 5476 5133 TOOWOOMBA PH: (07) 4659 9900

"A Family owned company providing Electrical Services since 1958."

FORM F 1025

C.A !

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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: BRISBANE WATER.	**Job No:** C25200
Item: SEWAGE P/S SB SP126	**Drawing No:** EC7-C25200/A0, A1, A2, A3

TASK	PRODUCT DETAIL	INSPECTED BY	DATE	PASS / FAIL	CORRECTIVE ACTION REQUEST OR COMMENTS
Design	Documents	DW	15/2	P	
Drafting	Documents	DW	15/2	P	
Sheetmetal	Switchboard	[signature]	3/3	P	
(Refer F1018 for details)	Doors	[signature]	4/3	P	
	Cell/Panels	[signature]	29-2	P	
Painting					
Process	Powder ~~Wet~~				
Min DFT (40 STD)					
Cure Test					
Colour Exterior	MIST GREEN	[signature]	05/03/08	PASS	
Colour Internal	MIST GREEN				
Colour Panels	WHITE				
Cubicle Erection		[signature]	7-3-08	PASS	
Electrical Fitout	M. LAWLEY	[signature]			
(In accordance with drawings)					
Inspection & Test		EEnsor	21/4/08	Pass	
(Refer to F1019)					
Packing					MTN

Comments:

ANTENNA - 1 off REQUIRED ON SIDE WALL + OPTIONAL ON BACK (LEFT END)

All Reqs are done! Aswant Wgh 05/03/08

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

Form No. F1018/2

J. & P. RICHARDSON INDUSTRIES PTY. LTD.
114 Campbell Avenue, WACOL QLD 4076
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E-mail: jpr@jpr.com.au

SWITCHBOARD / SHEETMETAL INSPECTION CHECKLIST

CLIENT: BRISBANE WATER **JOB NO:** S25200

PRODUCT DESCRIPTION: SEWAGE P/S SB SP126

DRAWING & SCHEDULE NUMBERS: E07 C25200 A0 – A3

CONSTRUCTION	QUALITY: GOOD	QUALITY: POOR	COMPLIANCE WITH DRAWINGS: YES	COMPLIANCE WITH DRAWINGS: NO	REMARKS OR ACTION
1. Folds			✓		
2. Welds			✓		
3. Edges / File			✓		
4. Gauge			✓		
5. Material			✓		
6. Ventilation Openings / Filter Bracket			✓		
7. Equipment Mounting Arrangement			✓		
8. Doors Stiffened			✓		
9. Escutcheons and Lexan Covers			✓		
10. Cable Saddles			✓		
11. Grinding			✓		
12. Door Stays Fitted			✓		
13. Earth Studs			✓		
14. Rubber Retainer			N/A		
15. Drawing Holder			✓		
16. Hat Sections			✓		
17. Locking Bars Fitted			✓		
18. External Crevice Welded and Ground			✓		
19. Legend Cards			✓		
20. General Conditions Satisfactory			✓		
21. Cabinet Clean			✓		
22. Job Name and Number Marked			✓		

INSPECTED BY: JBL **DATE:** 4 – 3 – 08

AFFIX STATUS HERE		
	Yellow	Awaiting Inspection
	Green	Inspected/Tested Passed
	Red	Inspected/Tested Awaiting Rectification

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J. & P. RICHARDSON INDUSTRIES PTY LTD
114 Campbell Avenue, WACOL QLD 4076
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SWITCHBOARD ELECTRICAL INSPECTION & TEST REPORT
INDIVIDUAL DRIVES

Customer Name:	Brisbane Water					
Project:	Youngs Road Sewage Pump Station					
JPR Job No:	C 25200		**Item:**	RTU Section		
Constructed by:	M Lawley		**Tested by:**	E Ensor	**Date:** 21/4/08	
Item check list:	*To comply with Drawings, Documents & Specification*					
Main Functional Unit/s:	Qty		Size		Fuses/O/L	
Fuse Fittings	Qty	✓	Size	✓	Fuse Size	✓
Circuit Breakers	Qty		Size		O/L	
Neutral	Reqd		Size		ID	
Earthing	Checked	✓	Size	✓		
C.T.s	Qty		Rating		Function	
Torroid	Qty		Rating		Function	
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	
Transformer/DC Supply	Qty	✓	Rating	✓	Voltage	✓
ATT	Qty		Rating		Function	
VFD	Qty		Rating		Function	
Soft Starter	Qty		Rating		Function	
Terminals	Qty	✓	Size	✓	ID	✓
Engraving	Qty	✓	Size	✓	ID	✓
Cabling	Type	✓	Size	✓	ID	✓
Busbars	Type		Size		ID	
Escutcheons / Shrouds	Type	✓	Material	✓	IP rating	✓
Earth Leakage Unit	Qty		Size		Function	
Remote I/O Unit	Qty		Size		Function	
General Check List:						
IP Sealing	Rating	✓				
Door Latches	Qty	✓	Type	✓	Operation	✓
Ventilation	Required		Type		Operation	
Circuit Schedule	Required		Fitted		Checked	
Terminal Tightness	Power		Control	✓	Result	✓
Polarity Check	R - R		W - W		B - B	
Continuity Check	R - R		W - W		B - B	N - N
Partially Checked Circuits - Point to Point						
Comments:						

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SWITCHBOARD ELECTRICAL INSPECTION & TEST REPORT
INDIVIDUAL DRIVES

Customer Name:	Brisbane Water		
Project:	Youngs Road Sewage Pump Station SP126		
JPR Job No:	C25200	Item:	Common Control
Constructed by:	M Lawley	Tested by: E Ensor	Date: 21/4/08

Item Check list:	To comply with Drawings, Documents & Specification					
Main Functional Unit/s:	Qty		Size		Fuses/O/L	
Fuse Fittings	Qty	✓	Size	✓	Fuse Size	✓
Circuit Breakers	Qty		Size		O/L	
Neutral	Reqd		Size		ID	
Earthing	Checked	✓	Size	✓		
C.T.s	Qty		Rating		Function	
Torroid	Qty		Rating		Function	
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	✓
Transformer/DC Supply	Qty	✓	Rating	✓	Voltage	✓
ATT	Qty		Rating		Function	
VFD	Qty		Rating		Function	
Soft Starter	Qty		Rating		Function	
Terminals	Qty	✓	Size	✓	ID	✓
Engraving	Qty	✓	Size	✓	ID	✓
Cabling	Type	✓	Size	✓	ID	✓
Busbars	Type		Size		ID	
Escutcheons / Shrouds	Type	✓	Material	✓	IP rating	✓
Earth Leakage Unit	Qty		Size		Function	
Remote I/O Unit	Qty		Size		Function	
General Check List:						
IP Sealing	Rating	✓				
Door Latches	Qty	✓	Type	✓	Operation	✓
Ventilation	Required		Type		Operation	
Circuit Schedule	Required		Fitted		Checked	
Terminal Tightness	Power		Control	✓	Result	✓
Polarity Check	R - R		W - W		B - B	
Continuity Check	R - R		W - W		B - B	N - N
Partially Checked Circuits - Point to Point						

Comments:

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SWITCHBOARD ELECTRICAL INSPECTION & TEST REPORT
INDIVIDUAL DRIVES

Customer Name:	Brisbane Water				
Project:	Youngs Road Sewage Pump Station SP126				
JPR Job No:	C25200	Item:	Pump No1		
Constructed by:	M Lowley	Tested by:	E Ensor	Date: 21/4/08	
Item check list:	To comply with Drawings, Documents & Specification				
Main Functional Unit/s:	Qty	✓	Size	✓	Fuses/O/L	
Fuse Fittings	Qty		Size		Fuse Size	
Circuit Breakers	Qty	✓	Size	✓	O/L	
Neutral	Reqd	✓	Size	✓	ID	✓
Earthing	Checked	✓	Size	✓		
C.T.s	Qty		Rating		Function	
Torroid	Qty		Rating		Function	
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	
Transformer/DC Supply	Qty		Rating		Voltage	
ATT	Qty		Rating		Function	
VFD	Qty	✓	Rating	✓	Function	✓
Soft Starter	Qty		Rating		Function	
Terminals	Qty	✓	Size	✓	ID	✓
Engraving	Qty	✓	Size	✓	ID	✓
Cabling	Type	✓	Size	✓	ID	✓
Busbars	Type		Size		ID	
Escutcheons / Shrouds	Type	✓	Material	✓	IP rating	✓
Earth Leakage Unit	Qty		Size		Function	
Remote I/O Unit	Qty		Size		Function	
General Check List:						
IP Sealing	Rating	✓				
Door Latches	Qty	✓	Type	✓	Operation	✓
Ventilation	Required		Type		Operation	
Circuit Schedule	Required		Fitted		Checked	
Terminal Tightness	Power	✓	Control	✓	Result	✓
Polarity Check	R - R	✓	W - W	✓	B - B	✓
Continuity Check	R - R	✓	W - W	✓	B - B	✓ N - N ✓
Partially Checked Circuits - Point to Point						
Comments:						

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SWITCHBOARD ELECTRICAL INSPECTION & TEST REPORT
INDIVIDUAL DRIVES

Customer Name: Brisbane Water			
Project: Youngs Road Sewage Pump Station			
JPR Job No: C7572.00	**Item:** Pump No2		
Constructed by: M Lawley	**Tested by:** E Ensor		**Date:** 21/4/08

Item check list:	*To comply with Drawings, Documents & Specification*					
Main Functional Unit/s:	Qty	✓	Size	✓	Fuses/O/L	
Fuse Fittings	Qty		Size		Fuse Size	
Circuit Breakers	Qty	✓	Size	✓	O/L	
Neutral	Reqd	✓	Size	✓	ID	✓
Earthing	Checked	✓	Size	✓		
C.T.s	Qty		Rating		Function	
Torroid	Qty		Rating		Function	
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	
Transformer/DC Supply	Qty		Rating		Voltage	
ATT	Qty		Rating		Function	
VFD	Qty	✓	Rating	✓	Function	✓
Soft Starter	Qty		Rating		Function	
Terminals	Qty	✓	Size	✓	ID	✓
Engraving	Qty	✓	Size	✓	ID	✓
Cabling	Type	✓	Size	✓	ID	✓
Busbars	Type		Size		ID	
Escutcheons / Shrouds	Type	✓	Material	✓	IP rating	✓
Earth Leakage Unit	Qty		Size		Function	
Remote I/O Unit	Qty		Size		Function	
General Check List:						
IP Sealing	Rating	✓				
Door Latches	Qty	✓	Type	✓	Operation	✓
Ventilation	Required		Type		Operation	
Circuit Schedule	Required		Fitted		Checked	
Terminal Tightness	Power	✓	Control	✓	Result	✓
Polarity Check	R - R	✓	W - W	✓	B - B	✓
Continuity Check	R - R	✓	W - W	✓	B - B	✓ N - N ✓
Partially Checked Circuits - Point to Point						
Comments:						

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SWITCHBOARD ELECTRICAL INSPECTION & TEST REPORT

Customer Name: Brisbane Water			
Project: Youngs Road Sewage Pump Station			
JPR Job No: C25200	Item: SP 126		
Constructed by: M Lawley	Tested by: E Ensor		Date: 21/4/08

Item Check List	(To Comply with Drawings, Documents & Specification)							
Main Functional Unit/s	Qty	✓	Size	✓	Fuses/O/L			
Fuse Fittings	Qty	✓	Size	✓	Fuse Size	✓		
Circuit Breakers	Qty	✓	Size	✓	O/L			
Neutral	Reqd	✓	Size	✓	ID	✓		
Earthing	Checked	✓	Size	✓				
C.T.s	Qty		Rating					
Meters	Qty		Rating					
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	✓	Material	✓	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	Required		Fitted		Checked			
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	✓

Comments:

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SWITCHBOARD CONTINUITY & INSULATION TEST REPORT

Customer Name:	Brisbane Water		
Project:	Youngs Road Sewage Pump Station		
JPR Job No:	C 25200	Switchboard:	SP 126
Constructed by:	M Lawley	Tested by: E Ensor	Date: 9/4/08

CONTINUITY TEST

From	To	Red	White	Blue	Neutral

Sketch:

INSULATION TESTS TO SECTION 8 OF AS3439.1

Designation	1000 V Test (MΩ)	2.5 kV Test (1min)	1000 V Test (MΩ)
Red to Earth	500		
White to Earth	500		
Blue to Earth	500		
Neutral to Earth			
Red to White	500		
Red to Blue	500		
White to Blue	500		

Comments:

Form No. F1019/8
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SWITCHBOARD ELECTRICAL INSPECTION & TEST REPORT
INDIVIDUAL DRIVES

Customer Name: Brisbane Water			
Project: Youngs Road Sewage Pump Station			
JPR Job No: C25200	Item: Generator / DB Sections		
Constructed by: M Lawley	Tested by: E Ensor		Date: 21/4/08

Item check list:	To comply with Drawings, Documents & Specification					
Main Functional Unit/s:	Qty	✓	Size	✓	Fuses/O/L	
Fuse Fittings	Qty		Size		Fuse Size	
Circuit Breakers	Qty	✓	Size	✓	O/L	
Neutral	Reqd	✓	Size	✓	ID	✓
Earthing	Checked	✓	Size	✓		
C.T.s	Qty		Rating		Function	
Torroid	Qty		Rating		Function	
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	
Transformer/DC Supply	Qty		Rating		Voltage	
ATT	Qty		Rating		Function	
VFD	Qty		Rating		Function	
Soft Starter	Qty		Rating		Function	
Terminals	Qty		Size		ID	
Engraving	Qty	✓	Size	✓	ID	✓
Cabling	Type	✓	Size	✓	ID	✓
Busbars	Type	✓	Size	✓	ID	✓
Escutcheons / Shrouds	Type	✓	Material	✓	IP rating	✓
Earth Leakage Unit	Qty		Size		Function	
Remote I/O Unit	Qty		Size		Function	
General Check List:						
IP Sealing	Rating	✓				
Door Latches	Qty	✓	Type	✓	Operation	✓
Ventilation	Required		Type		Operation	
Circuit Schedule	Required		Fitted		Checked	
Terminal Tightness	Power	✓	Control	✓	Result	✓
Polarity Check	R - R	✓	W - W	✓	B - B	✓
Continuity Check	R - R	✓	W - W	✓	B - B	✓ N - N
Partially Checked Circuits - Point to Point						

Comments:

Form No. F1019/8
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SWITCHBOARD ELECTRICAL INSPECTION & TEST REPORT
EARTH LEAKAGE TEST

Customer Name: Brisbane Water			
JPR Job No: C25200	Item: Youngs Rd.	SP 126	
Constructed by: M Lawley	Tested by: B Encor	Date: 17/4/08	
Test Unit	Megger RCDT330	–	Other

Circuit Breaker	Phase	Rated Current (mA)		Trip Current (mA)		Trip Time (mS)	Comments
	R	30		21		53.1	
Q11	W	30		21		51.4	
	B	30		21		50.2	
Q12		30		23		28.7	
Q13		30		25		29.7	
Q19		30		23		27.7	
Q21		30		25		28.6	

Comments:-

JOB SAFETY ANALYSIS

LIVE LOW VOLTAGE WORK

TESTING SWITCHBOARDS AND CONTROL PANELS WITHIN OUR MANUFACTURING PREMISES

APPROVED BY: Eric McCulloch (WHSO)

LOCATION: WACOL WORKSHOP DATE: 18/4/08

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.

FILE: EMC0381/BL 03/01/03 PAGE 1 OF :

JOB SAFETY ANALYSIS

LIVE LOW VOLTAGE WORK

TESTING SWITCHBOARDS AND CONTROL PANELS WITHIN OUR MANUFACTURING PREMISES

APPROVED BY: Eric McCulloch (WHSO)

LOCATION: WACOL WORKSHOP DATE: 17/4/08

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. E.C...	2.	3.	4.	5.

FILE: EMC0381/BL　　03/01/03　　PAGE 1 O

JOB SAFETY ANALYSIS

LIVE LOW VOLTAGE WORK

TESTING SWITCHBOARDS AND CONTROL PANELS WITHIN OUR MANUFACTURING PREMISES

APPROVED BY: Eric McCulloch (WHSO)

LOCATION: WACOL WORKSHOP　　DATE: 21.1.4.08

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.

3. Electrical Drawings

3.0 ELECTRICAL DRAWINGS

BRISBANE WATER

SP126 YOUNGS ROAD SEWAGE PUMPING STATION

SITE COVER SHEET

ELECTRICAL DRAWINGS INDEX

DWG N°.	TITLE	SHEET	REVISIONS				
486/5/7-0039-000	SITE COVER SHEET	00	P1	O	A	B	C
486/5/7-0039-001	POWER DISTRIBUTION SCHEMATIC DIAGRAM	01	P1	O	A	B	C
486/5/7-0039-002	PUMP 01 SCHEMATIC DIAGRAM	02	P1	O	A	B	C
486/5/7-0039-003	PUMP 02 SCHEMATIC DIAGRAM	03	P1	O	A	B	C
486/5/7-0039-004	*RESERVED (SUMP PUMP)*	04					
486/5/7-0039-005	*RESERVED (GENERATOR CONTROL)*	05					
486/5/7-0039-006	COMMON CONTROLS SCHEMATIC DIAGRAM	06	P1	O	A	B	C
486/5/7-0039-007	COMMON RTU I/O SCHEMATIC DIAGRAM	07	P1	O	A	B	C
486/5/7-0039-008	RTU POWER DISTRIBUTION SCHEMATIC DIAGRAM	08	P1	O	A	B	C
486/5/7-0039-009	RTU DIGITAL INPUTS TERMINATION DIAGRAM	09	P1	O	A	B	C
486/5/7-0039-010	RTU DIGITAL INPUTS TERMINATION DIAGRAM	10	P1	O	A	B	C
486/5/7-0039-011	RTU DIGITAL OUTPUTS TERMINATION DIAGRAM	11	P1	O	A	B	C
486/5/7-0039-012	RTU ANALOGS & MISCELLANEOUS TERMINATION DIAGRAM	12	P1	O	A	B	C
486/5/7-0039-013	*RESERVED (COMMON CONTROLS TERMINATION DIAGRAM)*	13					
486/5/7-0039-014	EQUIPMENT LIST	14	P1	O	A	B	C
486/5/7-0039-015	CABLE SCHEDULE	15	P1	O	A	B	C
486/5/7-0039-016	SWITCHBOARD LABEL SCHEDULE	16	P1	O	A	B	C
486/5/7-0039-017	SWITCHBOARD CONSTRUCTION DETAILS	17	P1	O	A	B	C
486/5/7-0039-018	SWITCHBOARD CONSTRUCTION DETAILS	18	P1	O	A	B	C
486/5/7-0039-019	LEVEL PROBES AND PRESSURE TRANSMITTER INSTALLATION DETAILS	19	P1	O	A	B	C
486/5/7-0039-020	CATHODIC PROTECTION UNIT - CONSTRUCTION AND WIRING DETAILS	20	P1	O	A	B	C
486/5/7-0039-021	*RESERVED (FIELD DISCONNECTION BOX)*	21					
486/5/7-0039-022	SWITCHBOARD GENERAL ARRANGEMENT - ELEVATIONS - SINGLE SIDED	22	P1	O	A	B	C
486/5/7-0039-023	SWITCHBOARD GENERAL ARRANGEMENT - SECTIONS - SINGLE SIDED	23	P1	O	A	B	C
486/5/7-0039-024	SLAB & CONDUIT DETAILS	24	P1	O	A	B	C

STANDARD VARIABLES

DESCRIPTION	VALUES
CT METERING ISOLATOR	250A SLB 250 3P
NORMAL SUPPLY MAIN SWITCH	160A XS400SE/250
GENERATOR SUPPLY MAIN SWITCH	160A XS400SE/250
PUMP1 CIRCUIT BREAKER	100A S125GJ/100
PUMP2 CIRCUIT BREAKER	100A S125GJ/100
DRY WELL SUMP PUMP CIRCUIT BREAKER	NOT APPLICABLE
PUMP VSD SIZE	FC202P30K
PUMP RATING	22kW 40A
PUMP LINE CONTACTOR	CA7-85
SUMP PUMP RATING	NOT APPLICABLE
SUMP PUMP CONTACTOR & TOL	NOT APPLICABLE
WET WELL LEVEL TRANSMITTER	FM167-A2BMD1A3 6m
EMERGENCY STORAGE WELL LEVEL TRANSMITTER	NOT APPLICABLE
DELIVERY PRESSURE TRANSMITTER	BR74XXGG1FHA2X 50m
WET WELL ULTRASONIC LEVEL SENSOR	NOT APPLICABLE
FLOWMETER RANGE	100l/s
RADIO	DR900-06A02-D0
EMERGENCY PUMPING TIME	360sec
No of SINGLE POINT PROBES	3
INCOMING MAINS SUPPLY CABLE	$50mm^2$
MAIN EARTHING CABLE	$16mm^2$
INCOMING GENERATOR SUPPLY CABLE	NOT APPLICABLE
PUMP MOTOR SUPPLY CABLE	$16mm^2$

STANDARD DESIGN OPTIONS

OPTION	DESCRIPTION	FITTED
~~A~~	~~INDIVIDUAL PUMP MOISTURE IN OIL (MIO) SENSOR AND FAULT RELAY~~	~~YES~~ NO
~~B~~	~~INDIVIDUAL PUMP MOTOR AUX PROTECTION SENSORS AND FAULT RELAYS~~	~~YES~~ NO
~~C~~	~~INDIVIDUAL PUMP REFLUX VALVE MICROSWITCH~~	~~YES~~ NO
~~D~~	~~STATION MANHOLE SURCHARGE IMMINENT~~	~~YES~~ NO
~~E~~	~~STATION DRY WELL SUMP PUMP AND LEVEL INDICATION SENSORS AND RELAYS~~	~~YES~~ NO
~~F~~	~~STATION PERMANENT GENERATOR - ATS AND CONTROL CONNECTIONS~~	~~YES~~ NO
~~G~~	~~STATION EMERGENCY STORAGE LEVEL SENSOR~~	~~YES~~ NO
H	STATION DELIVERY FLOWMETER	YES ~~NO~~
~~I~~	~~BACKUP COMMUNICATION OPTIONS~~	~~YES~~ NO
J	PUMP CONNECTION (Via Intergrated Disconnect Cubicle)	YES ~~NO~~
K	CATHODIC PROTECTION	YES ~~NO~~
L	MOTOR THERMISTORS (Via Intergrated Disconnect Cubicle)	YES ~~NO~~
~~M~~	~~ODOUR CONTROL~~	~~YES~~ NO
N	CURRENT TRANSFORMER (CT) METERING	YES ~~NO~~
~~O~~	~~PUMPS ELECTRICAL INTERLOCK~~	~~YES~~ NO
P	WET WELL WASHER (Solenoid not Installed)	YES ~~NO~~
Q	FLOWMETER PIT SUMP PUMP AND LEVEL PROBE	YES ~~NO~~
R	TELEMETRY RADIO	YES ~~NO~~
~~S~~	~~WET WELL ULTRASONIC LEVEL SENSOR~~	~~YES~~ NO
T	SINGLE SIDED SWITCHBOARD	YES ~~NO~~
U	DELIVERY PRESSURE TRANSMITTER	YES ~~NO~~
~~V~~	~~CHEMICAL DOSING~~	~~YES~~ NO

Sheet 00

AS BUILT

ELECTRICAL AS BUILT CERTIFICATION

REV	
C	COMPANY J&P RICHARDSON CONTRACTOR LICENCE No. 756 CERTIFIED BY M. DERUYTER DATE: 6/9/2008

No	DATE	AMENDMENT	DRN.	APD.
A	11.07	RE-ISSUED FOR TENDER	P.H.	A.W.
C	12.08	AS BUILT	P.H.	A.W.
B	01.08	ISSUED FOR CONSTRUCTION	P.H.	A.W.

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Original signed by R.JANFADA 5192 21.06.07
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Orig Signed by F.FORNASIER 27.06.07
PRINCIPAL DESIGN MANAGER DATE
Original Signed by P.SHERRIFF 28.06.07
CLIENT DELEGATE DATE

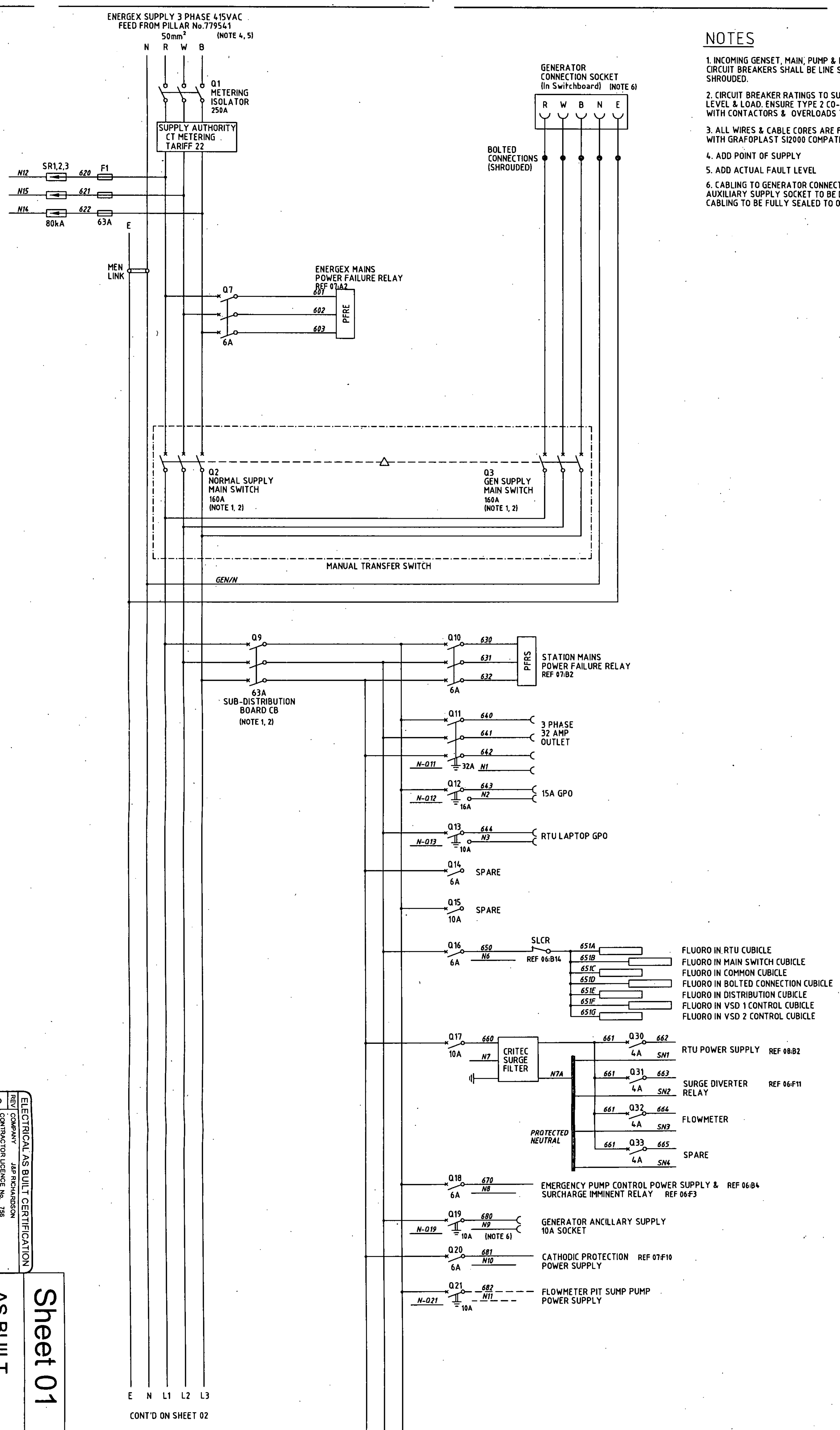
BRISBANE WATER

SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION

TITLE
SITE COVER SHEET

SHEET No. 0
BRISBANE WATER DRAWING No. 486/5/7-0039-000
AMEND. C

STB TEMPLATE SP-3P-VSD-RTU Ver12



CONT'D ON SHEET 02

NOTES

1. INCOMING GENSET, MAIN, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD. ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
4. ADD POINT OF SUPPLY
5. ADD ACTUAL FAULT LEVEL
6. CABLING TO GENERATOR CONNECTION SOCKET AND AUXILIARY SUPPLY SOCKET TO BE DOUBLE INSULATED. CABLING TO BE FULLY SEALED TO OTHER COMPARTMENTS

No	DATE	AMENDMENT	DRN.	APD.
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Original Signed by P.SHERRIFF 28.06.07
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BRISBANE WATER

SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION

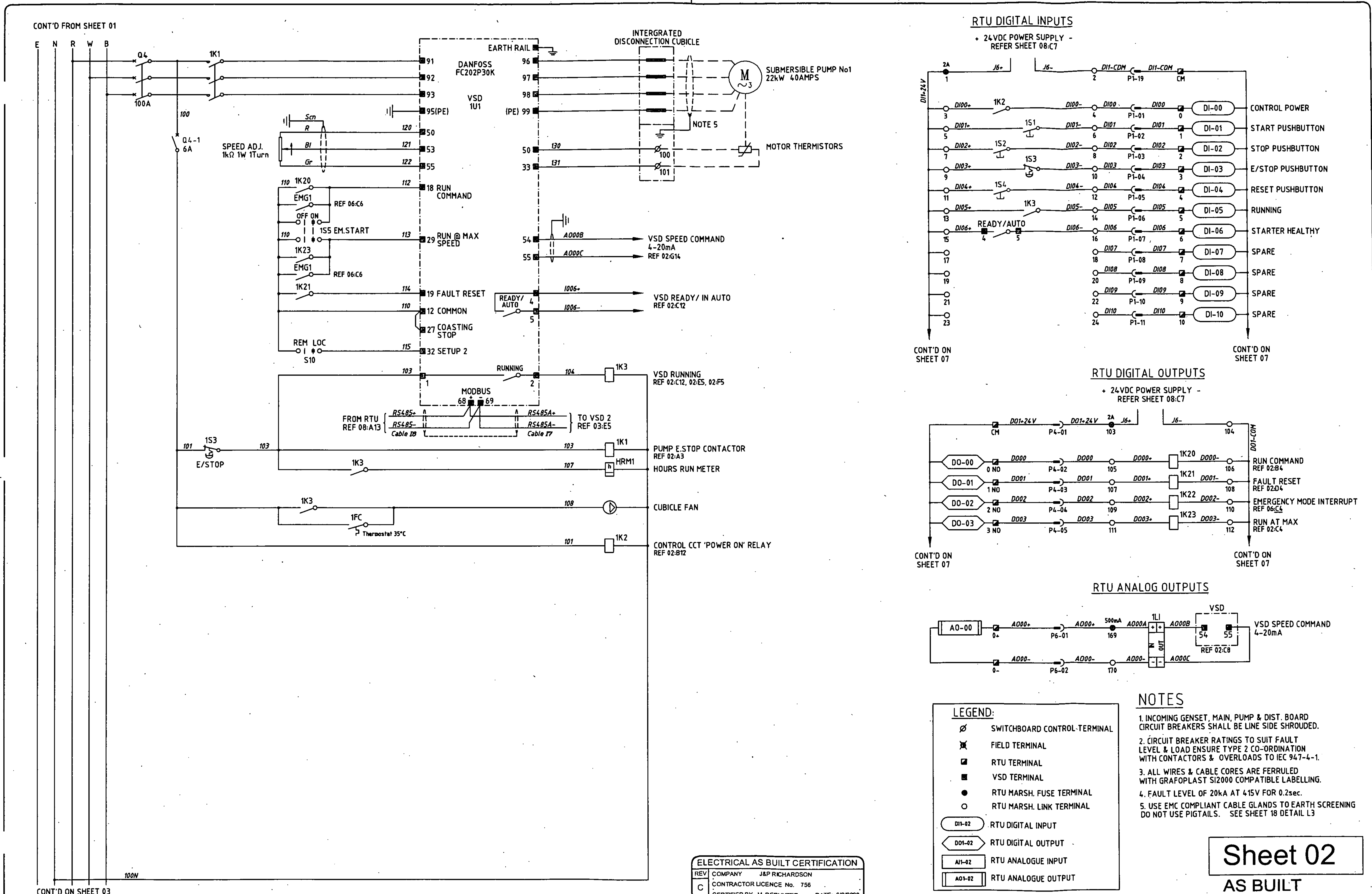
ELECTRICAL AS BUILT CERTIFICATION
REV C
COMPANY J&P RICHARDSON
CONTRACTOR LICENCE No. 756
CERTIFIED BY M. DERUYTER DATE: 6/9/2008

TITLE
POWER DISTRIBUTION
SCHEMATIC DIAGRAM

Sheet 01

AS BUILT

SHEET No. 1
BRISBANE WATER DRAWING No.
486/5/7-0039-001
AMEND. C



ELECTRICAL AS BUILT CERTIFICATION
REV C — COMPANY J&P RICHARDSON; CONTRACTOR LICENCE No. 756; CERTIFIED BY M. DERUYTER DATE: 6/9/2008

No	DATE	AMENDMENT	DRN.	APD.
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Orig Signed by F.FORNASIER 27.08.07 — PRINCIPAL DESIGN MANAGER — DATE
Original Signed by P.SHERRIFF 28.08.07 — CLIENT DELEGATE — DATE

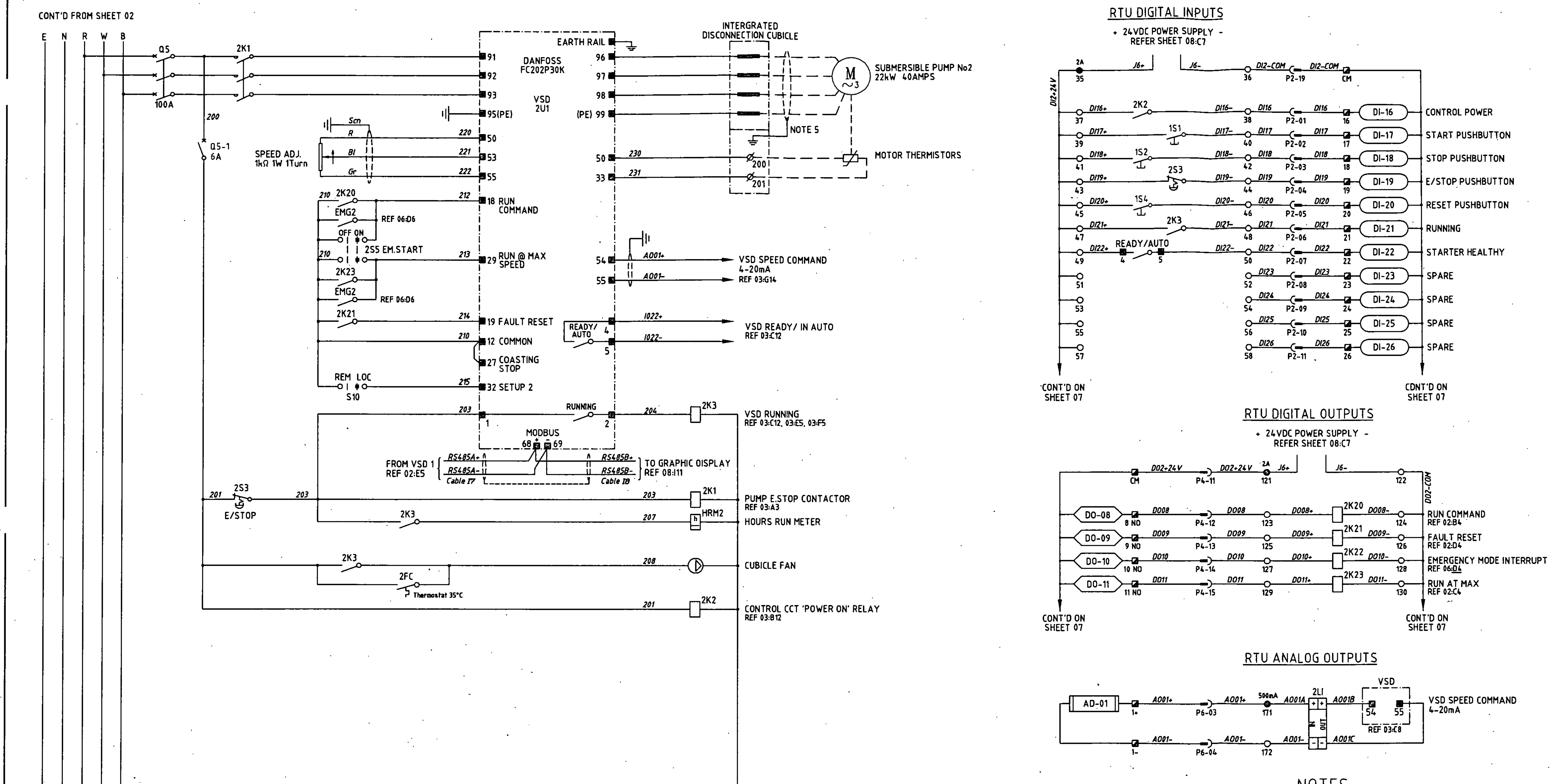
BRISBANE WATER

SITE: SP126 YOUNGS ROAD SEWAGE PUMP STATION

TITLE: PUMP No1 SCHEMATIC DIAGRAM

SHEET No. 2 — BRISBANE WATER DRAWING No. 486/5/7-0039-002 — AMEND. C

STD TEMPLATE SP-3P-VSD-RTU Ver12



LEGEND:

- SWITCHBOARD CONTROL TERMINAL
- FIELD TERMINAL
- RTU TERMINAL
- VSD TERMINAL
- RTU MARSH. FUSE TERMINAL
- RTU MARSH. LINK TERMINAL
- DI1-02 RTU DIGITAL INPUT
- DO1-02 RTU DIGITAL OUTPUT
- AI1-02 RTU ANALOGUE INPUT
- AO1-02 RTU ANALOGUE OUTPUT

NOTES

1. INCOMING GENSET, MAIN, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
4. FAULT LEVEL OF 20kA AT 415V FOR 0.2sec.
5. USE EMC COMPLIANT CABLE GLANDS TO EARTH SCREENING DO NOT USE PIGTAILS. SEE SHEET 18 DETAIL L3

Sheet 03

AS BUILT

ELECTRICAL AS BUILT CERTIFICATION
REV C COMPANY J&P RICHARDSON
CONTRACTOR LICENCE No. 756
CERTIFIED BY M.DERUYTER DATE: 6/9/2008

No	DATE	AMENDMENT	DRN.	APD.
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CLIENT DELEGATE DATE

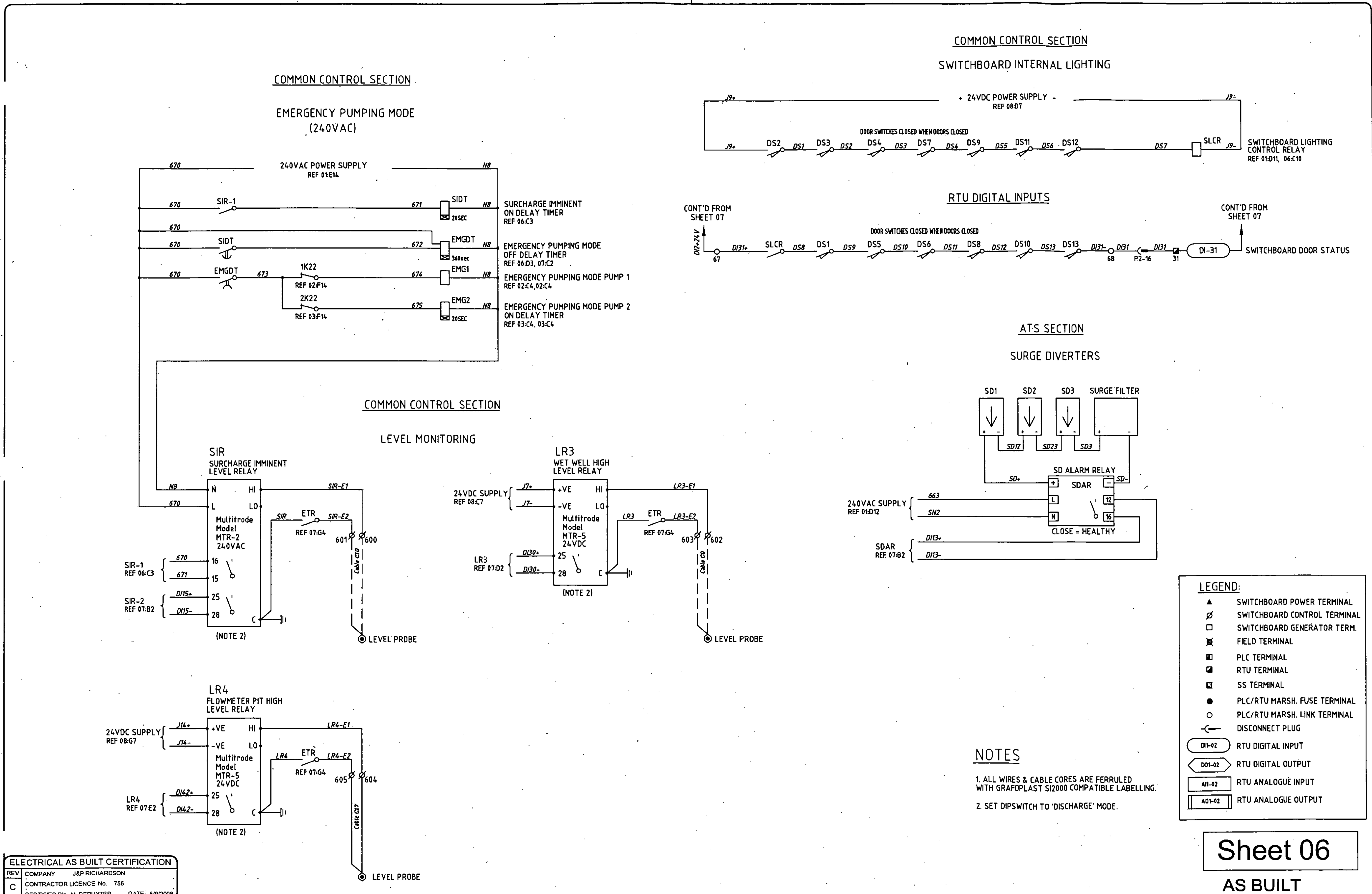
BRISBANE WATER

SITE SP126 YOUNGS ROAD SEWAGE PUMP STATION

TITLE PUMP No2 SCHEMATIC DIAGRAM

SHEET No. 3
BRISBANE WATER DRAWING No. 486/5/7-0039-003
AMEND. C

STD TEMPLATE SP-3P-VSD-RTU Ver12



ELECTRICAL AS BUILT CERTIFICATION
REV C — COMPANY J&P RICHARDSON — CONTRACTOR LICENCE No. 756 — CERTIFIED BY M. DERUYTER — DATE: 6/9/2008

No	DATE	AMENDMENT	DRN.	APD.
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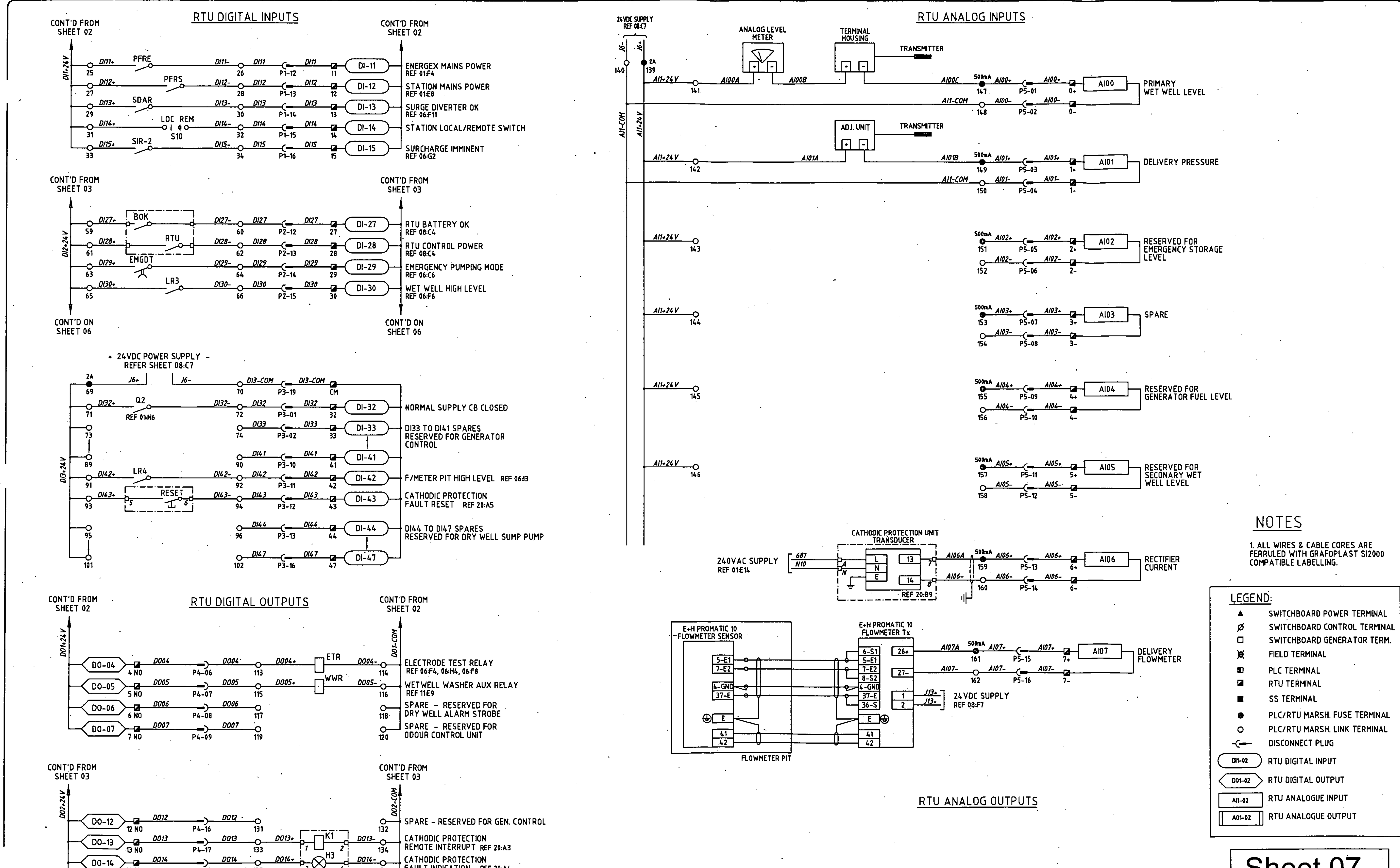
BRISBANE WATER

SITE: SP126 YOUNGS ROAD SEWAGE PUMP STATION

TITLE: COMMON CONTROLS SCHEMATIC DIAGRAM

SHEET No. 6 — BRISBANE WATER DRAWING No. 486/5/7-0039-006 — AMEND. C



Sheet 07

AS BUILT

ELECTRICAL AS BUILT CERTIFICATION

REV		
C	COMPANY J&P RICHARDSON	
	CONTRACTOR LICENCE No. 756	
	CERTIFIED BY M. DERUYTER	DATE: 6/9/2008

No	DATE	AMENDMENT	DRN.	APD.
A	11.07	RE-ISSUED FOR TENDER	P.H.	A.W.
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Original signed by R.JANFADA 5192 21.06.07
DESIGN CHECK R.P.E.Q. No. DATE

Orig Signed by F.FORNASIER 27.06.07
PRINCIPAL DESIGN MANAGER DATE
Original Signed by P.SHERRIFF 28.06.07
CLIENT DELEGATE DATE

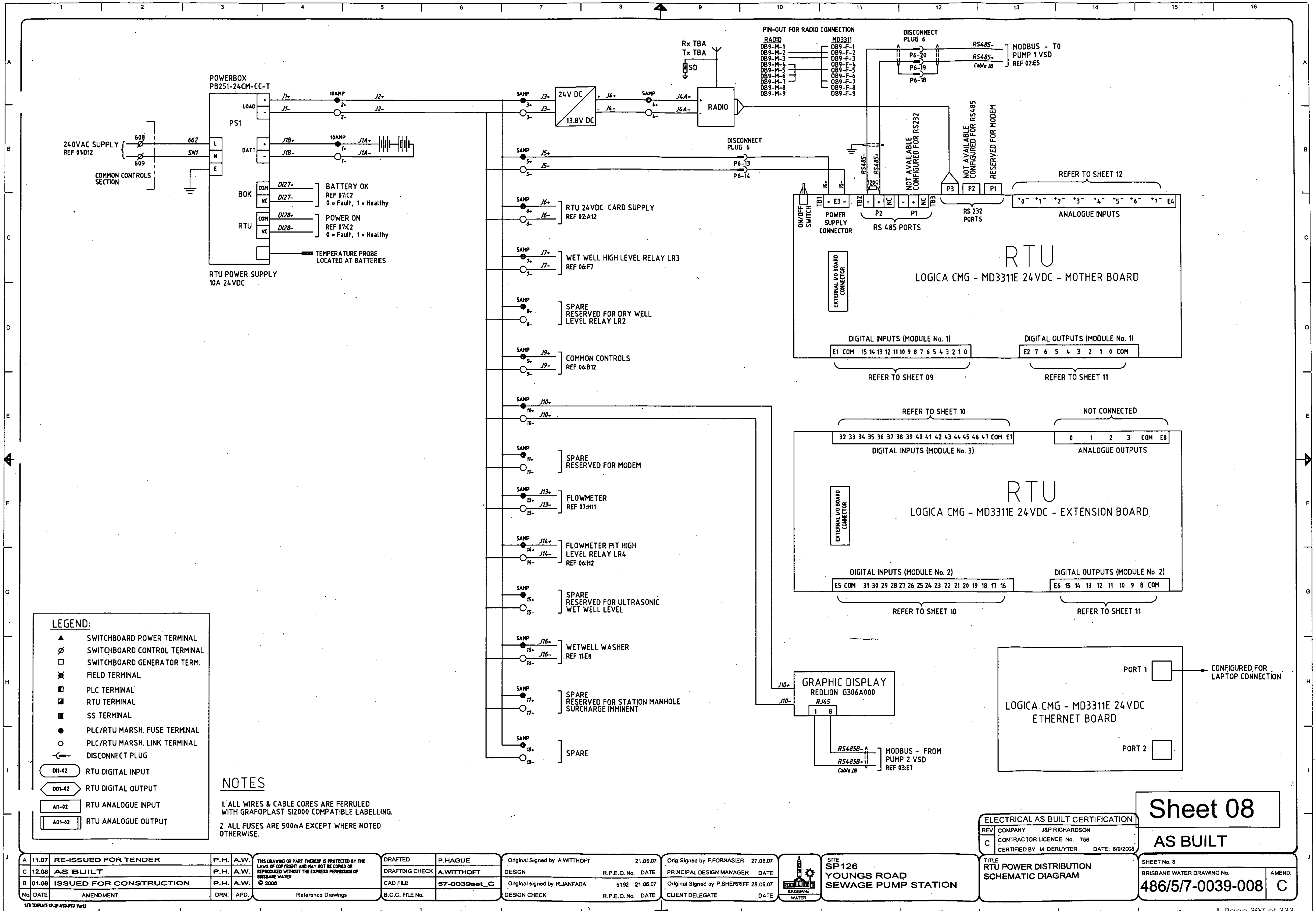
BRISBANE WATER

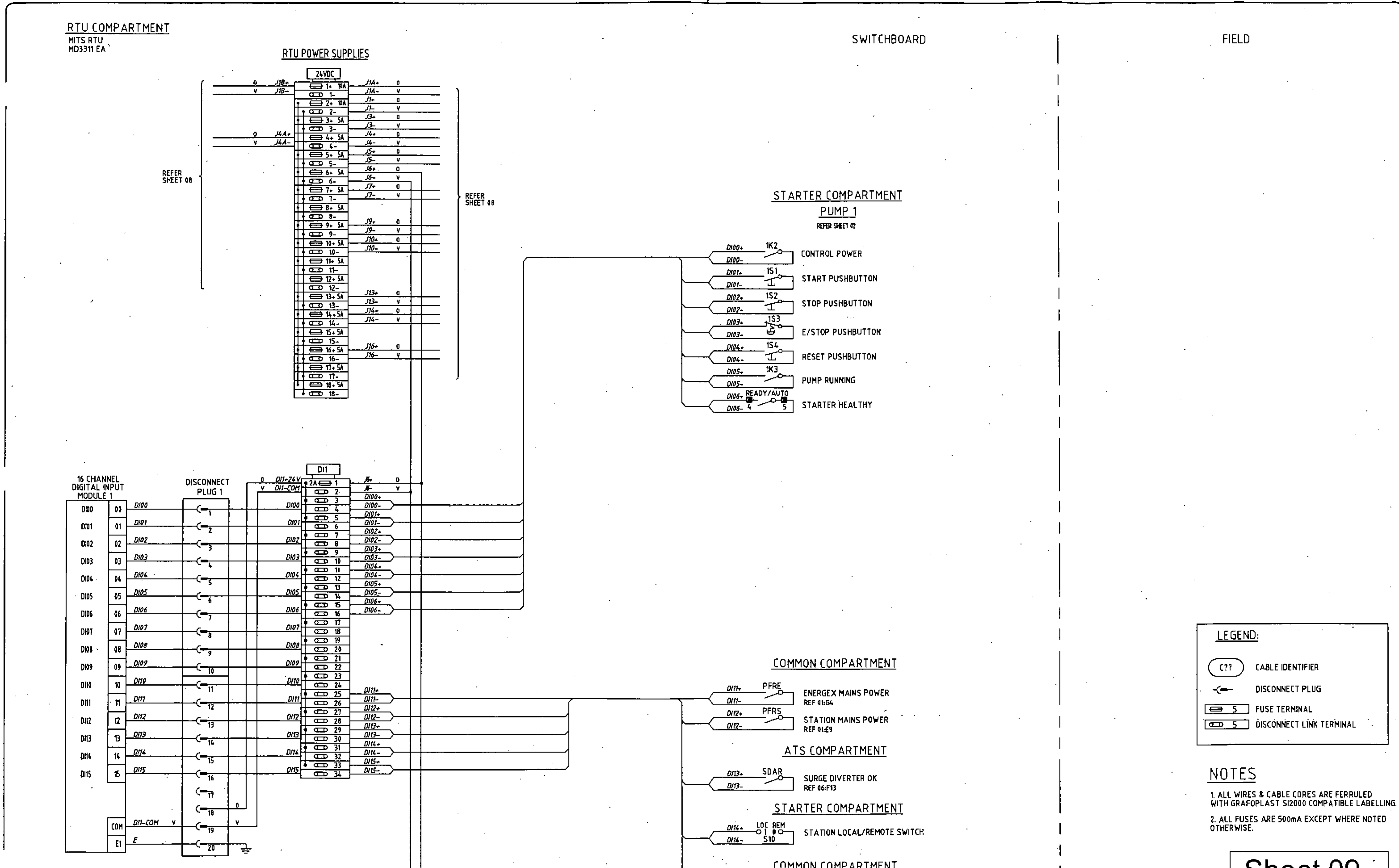
SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION

TITLE
COMMON RTU I/O
SCHEMATIC DIAGRAM

SHEET No. 7
BRISBANE WATER DRAWING No. 486/5/7-0039-007
AMEND. C

STD TEMPLATE SP-3P-VSD-RTU Ver12


POWERBOX
PB251-24CM-CC-T
PS1
240VAC SUPPLY
REF 01:D12
COMMON CONTROLS SECTION
BATTERY OK
REF 07:C2
0 = Fault, 1 = Healthy
POWER ON
REF 07:C2
0 = Fault, 1 = Healthy
TEMPERATURE PROBE LOCATED AT BATTERIES
RTU POWER SUPPLY
10A 24VDC
24V DC
13.8V DC
RADIO
Rx TBA
Tx TBA
PIN-OUT FOR RADIO CONNECTION
DISCONNECT PLUG 6
MODBUS - TO PUMP 1 VSD
REF 02:E5
RTU 24VDC CARD SUPPLY
REF 02:A12
WET WELL HIGH LEVEL RELAY LR3
REF 06:F7
SPARE
RESERVED FOR DRY WELL LEVEL RELAY LR2
COMMON CONTROLS
REF 06:B12
SPARE
RESERVED FOR MODEM
FLOWMETER
REF 07:H11
FLOWMETER PIT HIGH LEVEL RELAY LR4
REF 06:H2
SPARE
RESERVED FOR ULTRASONIC WET WELL LEVEL
WETWELL WASHER
REF 11:E8
SPARE
RESERVED FOR STATION MANHOLE SURCHARGE IMMINENT
SPARE
NOT AVAILABLE CONFIGURED FOR RS232
NOT AVAILABLE CONFIGURED FOR RS485
RESERVED FOR MODEM
REFER TO SHEET 12
POWER SUPPLY CONNECTOR
RS 485 PORTS
RS 232 PORTS
ANALOGUE INPUTS
RTU
LOGICA CMG - MD3311E 24VDC - MOTHER BOARD
EXTERNAL I/O BOARD CONNECTOR
DIGITAL INPUTS (MODULE No. 1)
DIGITAL OUTPUTS (MODULE No. 1)
REFER TO SHEET 09
REFER TO SHEET 11
REFER TO SHEET 10
NOT CONNECTED
DIGITAL INPUTS (MODULE No. 3)
ANALOGUE OUTPUTS
RTU
LOGICA CMG - MD3311E 24VDC - EXTENSION BOARD
DIGITAL INPUTS (MODULE No. 2)
DIGITAL OUTPUTS (MODULE No. 2)
REFER TO SHEET 10
REFER TO SHEET 11
GRAPHIC DISPLAY
REDLION G306A000
MODBUS - FROM PUMP 2 VSD
REF 03:E7
LOGICA CMG - MD3311E 24VDC
ETHERNET BOARD
PORT 1
PORT 2
CONFIGURED FOR LAPTOP CONNECTION
LEGEND:
SWITCHBOARD POWER TERMINAL
SWITCHBOARD CONTROL TERMINAL
SWITCHBOARD GENERATOR TERM.
FIELD TERMINAL
PLC TERMINAL
RTU TERMINAL
SS TERMINAL
PLC/RTU MARSH. FUSE TERMINAL
PLC/RTU MARSH. LINK TERMINAL
DISCONNECT PLUG
RTU DIGITAL INPUT
RTU DIGITAL OUTPUT
RTU ANALOGUE INPUT
RTU ANALOGUE OUTPUT
NOTES
1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
2. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.
Sheet 08
AS BUILT
ELECTRICAL AS BUILT CERTIFICATION
COMPANY J&P RICHARDSON
CONTRACTOR LICENCE No. 756
CERTIFIED BY M. DERUYTER DATE: 6/9/2008
A 11.07 RE-ISSUED FOR TENDER P.H. A.W.
C 12.08 AS BUILT P.H. A.W.
B 01.08 ISSUED FOR CONSTRUCTION P.H. A.W.
DRAFTED P.HAGUE
DRAFTING CHECK A.WITTHOFT
CAD FILE 57-0039set_C
SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION
TITLE
RTU POWER DISTRIBUTION SCHEMATIC DIAGRAM
SHEET No. 8
BRISBANE WATER DRAWING No.
486/5/7-0039-008
AMEND. C



NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
2. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

Sheet 09

AS BUILT

ELECTRICAL AS BUILT CERTIFICATION

REV	
C	COMPANY J&P RICHARDSON CONTRACTOR LICENCE No. 756 CERTIFIED BY M. DERUYTER DATE: 6/9/2008

No	DATE	AMENDMENT	DRN.	APD.
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Orig Signed by F.FORNASER 27.06.07 — PRINCIPAL DESIGN MANAGER DATE
Original Signed by P.SHERRIFF 28.08.07 — CLIENT DELEGATE DATE

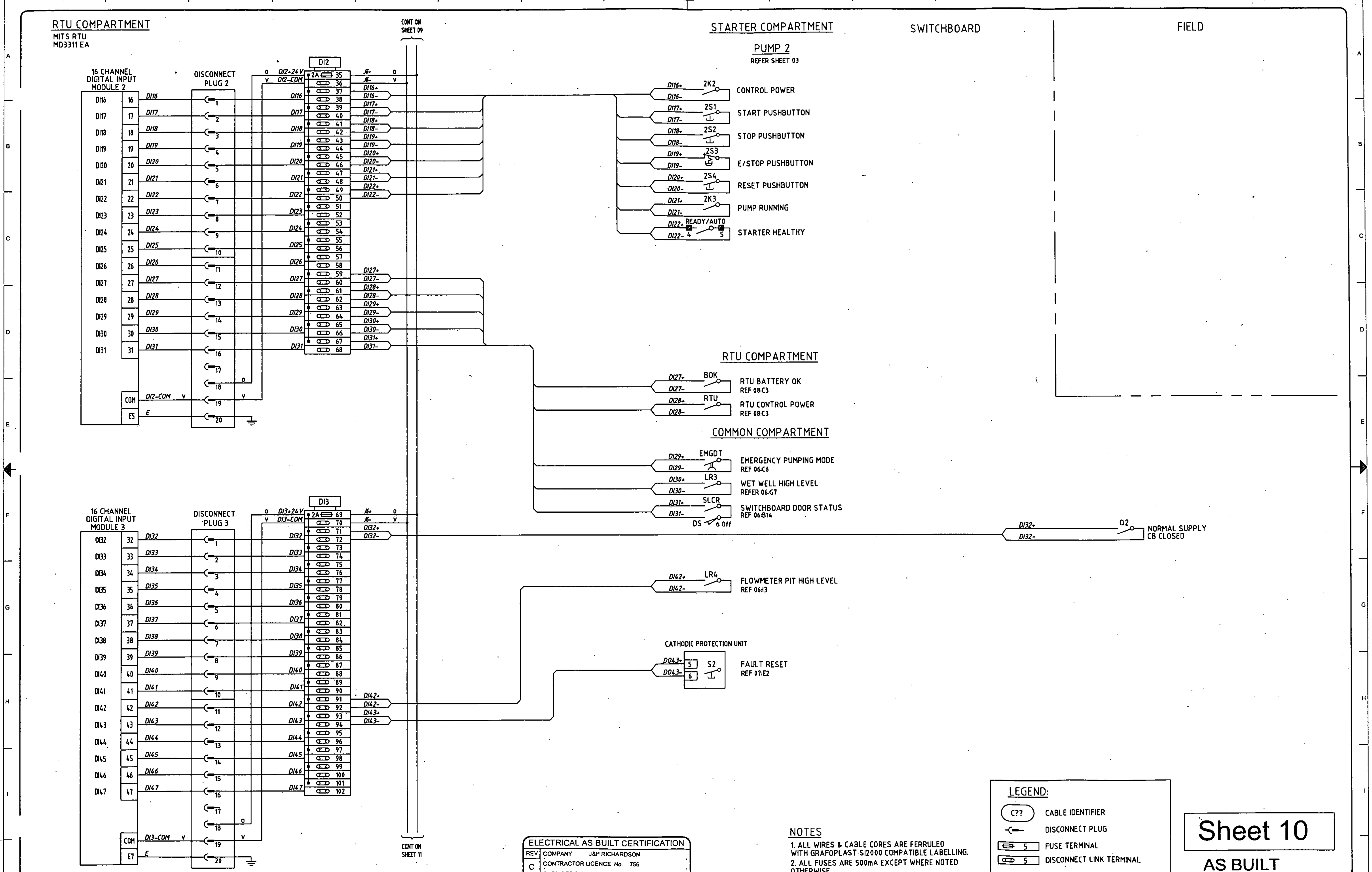
BRISBANE WATER

SITE SP126 YOUNGS ROAD SEWAGE PUMP STATION

TITLE RTU DIGITAL INPUTS TERMINATION DIAGRAM

SHEET No. 9

BRISBANE WATER DRAWING No. 486/5/7-0039-009 AMEND. C



NOTES
1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
2. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

ELECTRICAL AS BUILT CERTIFICATION
REV C — COMPANY J&P RICHARDSON — CONTRACTOR LICENCE No. 756 — CERTIFIED BY M. DERUYTER — DATE: 6/9/2008

Sheet 10

AS BUILT

REV	DATE	AMENDMENT	DRN.	APD.
A	11.07	RE-ISSUED FOR TENDER	P.H.	A.W.
C	12.08	AS BUILT	P.H.	A.W.
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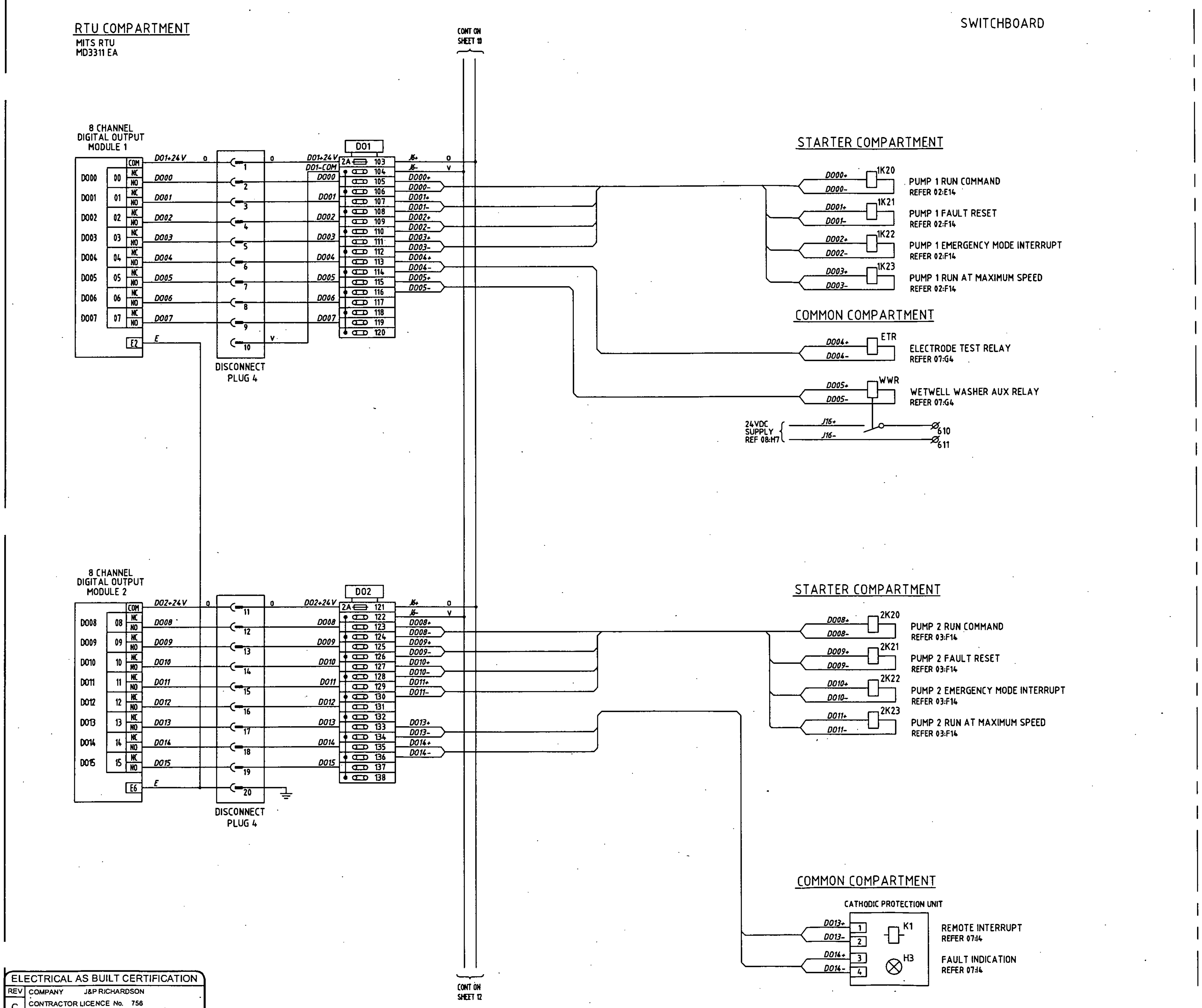
BRISBANE WATER

SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION

TITLE
RTU DIGITAL INPUTS TERMINATION DIAGRAM

SHEET No. 10
BRISBANE WATER DRAWING No. 486/5/7-0039-010
AMEND. C

STB TEMPLATE SP-3P-VSD-RTU Ver1.2



LEGEND:

- (C??) CABLE IDENTIFIER
- DISCONNECT PLUG
- SWITCHBOARD CONTROL TERMINAL
- FUSE TERMINAL
- DISCONNECT LINK TERMINAL

NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
2. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

Sheet 11

AS BUILT

ELECTRICAL AS BUILT CERTIFICATION
REV C — COMPANY J&P RICHARDSON — CONTRACTOR LICENCE No. 756 — CERTIFIED BY M.DERUYTER — DATE: 6/9/2008

No	DATE	AMENDMENT	DRN.	APD.
A	11.07	RE-ISSUED FOR TENDER	P.H.	A.W.
C	12.08	AS BUILT	P.H.	A.W.
B	01.08	ISSUED FOR CONSTRUCTION	P.H.	A.W.

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Reference Drawings

DRAFTED	P.HAGUE
DRAFTING CHECK	A.WITTHOFT
CAD FILE	57-0039set_C
B.C.C. FILE No.	

Original Signed by A.WITTHOFT 21.06.07 — DESIGN — R.P.E.Q. No. DATE
Original signed by R.JANFADA 5192 21.06.07 — DESIGN CHECK — R.P.E.Q. No. DATE
Orig Signed by F.FORNASIER 27.06.07 — PRINCIPAL DESIGN MANAGER — DATE
Original Signed by P.SHERRIFF 28.06.07 — CLIENT DELEGATE — DATE

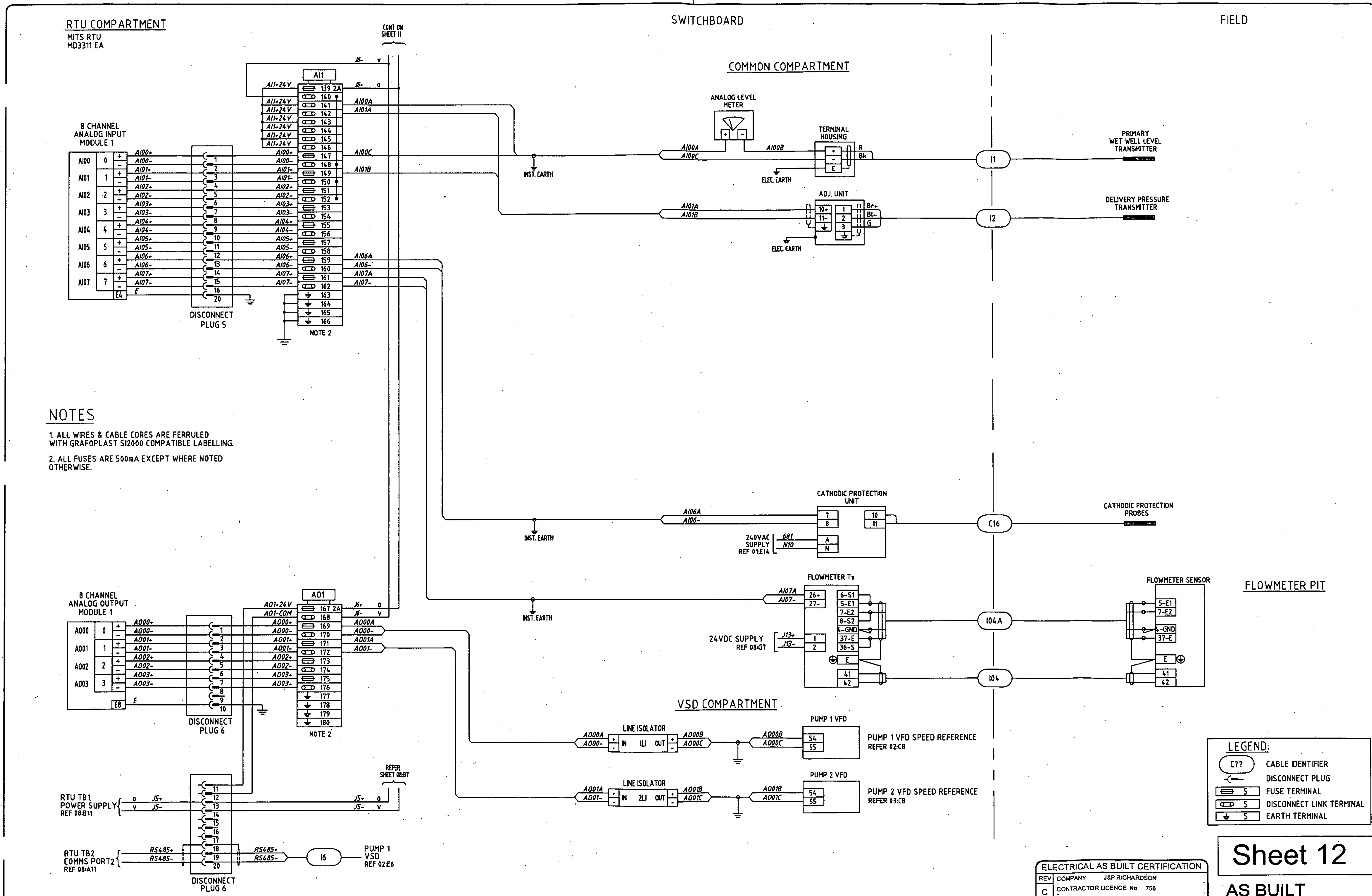
BRISBANE WATER

SITE: SP126 YOUNGS ROAD SEWAGE PUMP STATION

TITLE: RTU DIGITAL OUTPUTS TERMINATION DIAGRAM

SHEET No. 11 — BRISBANE WATER DRAWING No. 486/5/7-0039-011 — AMEND. C

STR TEMPLATE SP-3P-P53-RTU Ver12



NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
2. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

Sheet 12

AS BUILT

ELECTRICAL AS BUILT CERTIFICATION

REV	
C	COMPANY J&P RICHARDSON; CONTRACTOR LICENCE No. 756; CERTIFIED BY M. DERUYTER DATE: 6/9/2008

No	DATE	AMENDMENT	DRN.	APD.
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Original Signed by P.SHERRIFF 28.06.07 — CLIENT DELEGATE — DATE

BRISBANE WATER

SITE: SP126 YOUNGS ROAD SEWAGE PUMP STATION

TITLE: RTU ANALOGS & MISCELLANEOUS TERMINATION DIAGRAM

SHEET No. 12

BRISBANE WATER DRAWING No. 486/5/7-0039-012 — AMEND. C

STD TEMPLATE SP-3P-VSD-RTU Ver12

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	OPT	REMARKS
1	1	Q1 METERING ISOLATOR	SOCOMEC	SLB 250 3P	N	
2	1	Q2 NORMAL SUPPLY MAIN SWITCH	TERASAKI	XS400SE/250	-	Set @ 160A + N/O AUX
3	1	Q3 GENERATOR SUPPLY MAIN SWITCH	TERASAKI	XS400SE/250	-	Set @ 160A
4	1	Q4 PUMP1 CIRCUIT BREAKER	TERASAKI	S125GJ/100	-	Set @ 100A
5	1	Q5 PUMP2 CIRCUIT BREAKER	TERASAKI	S125GJ/100	-	Set @ 100A
6					E	
7	1	Q7 ENERGEX PHASE FAILURE CIRCUIT BREAKER	TERASAKI	DTCB15306C	-	
8					F	
9	1	Q9 SUB-DISTRIBUTION BOARD CIRCUIT BREAKER	TERASAKI	S125NJ/63	-	
10	1	Q10 STATION MAINS PHASE FAILURE CIRCUIT BREAKER	TERASAKI	DTCB6306C	-	
11	1	Q11 3 PHASE OUTLET CIRCUIT BREAKER	TERASAKI	DTCB6332C	-	PLUS DSRCM-32-30-3PN
12	1	Q12 15A GPO CIRCUIT BREAKER	TERASAKI	DSRCBH-16-30A	-	
13	1	Q13 RTU LAPTOP GPO CIRCUIT BREAKER	TERASAKI	DSRCBH-10-30A	-	
14	1	Q14 SPARE	TERASAKI	DTCB6106C	E	
15	1	Q15 SPARE	TERASAKI	DTCB6110C	E	
16	1	Q16 SW/BD INTERNAL LIGHTING CIRCUIT BREAKER	TERASAKI	DTCB6106C		
17	1	Q17 SURGE FILTER CIRCUIT BREAKER	TERASAKI	DTCB6110C	-	
18	1	Q18 EM PUMP CNTRL & SURCHARGE IMMINENT CB	TERASAKI	DTCB6106C	-	
19	1	Q19 GENERATOR AUXILLARY SUPPLY CIRCUIT BREAKER	TERASAKI	DSRCBH-10-30A	-	
20	1	Q20 CATHODIC PROTECTION POWER SUPPLY	TERASAKI	DTCB6106C	K	
21	1	Q21 FLOWMETER PIT SUMP PUMP POWER SUPPLY	TERASAKI	DSRCBH-10-30A	Q	
22					M	
23					V	
24		NOT USED				
25		NOT USED				
26	1	Q30 RTU POWER SUPPLY CIRCUIT BREAKER	TERASAKI	DTCB4104C	-	
27	1	Q31 SURGE DIVERTERS RELAY CIRCUIT BREAKER	TERASAKI	DTCB4104C	-	
28	1	Q32 FLOWMETER CIRCUIT BREAKER	TERASAKI	DTCB4104C	H	
29	1	Q33 SPARE	TERASAKI	DTCB4104C	-	
30		NOT USED				
31	1	Q4-1 PUMP1 CONTROL CIRCUIT BREAKER	TERASAKI	DTCB6106C	-	
32	1	Q5-1 PUMP2 CONTROL CIRCUIT BREAKER	TERASAKI	DTCB6106C	-	
33					E	
34		NOT USED				
35					F	
36	1	DISTRIBUTION BOARD CHASSIS	TERASAKI	CD-2-24/18-3U	-	
37	3	F1 - SURGE DIVERTER CIRCUIT FUSES	NHP	63AMP 63MS	-	FUSES & HOLDERS
38	3	SURGE DIVERTER	CRITEC	TDS-150-2S-277	-	
39	1	SURGE DIVERTER ALARM RELAY - SDAR	CRITEC	DAR-275V	-	
40	1	RTU SURGE REDUCTION FILTER	CRITEC	TDF-10A-240V	-	
41	1	ENERGEX MAINS PHASE FAILURE RELAY - PFRE	CROMPTON INSTRUMENTS	252-PSGW	-	
42		NOT USED				
43	1	STATION MAINS PHASE FAILURE RELAY - PFRS	CROMPTON INSTRUMENTS	252-PSGW	-	
44		NOT USED				
45	1	MAIN NEUTRAL LINK	D&L ELEC.	DLAH12	-	INSULATED
46	1	MAIN EARTH LINK	D&L ELEC.	DLAHE12	-	
47	1	DIST. BD NEUTRAL LINK	D&L ELEC.	2DLA24	-	INSULATED
48	1	DIST. BD EARTH LINK	D&L ELEC.	2DLAE24	-	
49						
50	1	INSTRUMENT EARTH LINK	D&L ELEC.	DLBE12	-	INSULATED
51	1	RTU FILTERED SUPPLY NEUTRAL LINK	CLIPSAL	L7	-	INSULATED
52	1	3 PHASE SWITCHED OUTLET	CLIPSAL	56C532	-	USE ENCLOSURE AS SHROUD
53	1	1 PHASE OUTLET 15A	CLIPSAL	15/15+90B (SHROUD)	-	
54	1	RTU LAPTOP GPO	CLIPSAL	15+449A+449AP	-	
55	1	1 PHASE OUTLET - GENERATOR AUX POWER	CLIPSAL	56S0310	M	IP56
56	1	3 PHASE N&E APPLIANCE INLET - GENERATOR POWER	MENNEKES	MEN368	M	c/w PROTECTIVE CAP 40788
57	1	3 PHASE N&E CONNECTOR - GENERATOR POWER	MENNEKES	MEN1454	M	
58	13	SW/BD DOOR MICRO SWITCHES	CAMSCO	SM202	-	13 OFF N/O
59	7	SW/BD 8W INTERNAL FLURO LIGHTS	THORN	880108	-	
60	2	PUMP VARIABLE SPEED DRIVES	DANFOSS	Model No: FC202P30KT4E21H1xGCxxxSxxxxAxBPCxxxxDx		
61	2	REMOTE KEYPAD MOUNTING KIT	DANFOSS	130B1107	-	
62	2	SPEED POTENTIOMETERS 1kΩ 1W 1 Turn	NHP	D7P-POT3		c/w 1kΩ 1W 1 Turn POT.
63	2	PUMP E/STOP CONTACTOR - K1	SPRECHER & SCHUH	CA7-85		
64	2	PUMP CONTROL CCT POWER ON RELAY - K2	IDEC	RH2B-UL-240VAC	-	

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	OPT	REMARKS
65	2	VSD RUNNING RELAY - K3	IDEC	RH4B-UL-240VAC	-	
66						
67		NOT USED				
68					E	
69					A	
70					B	
71					B	
72		NOT USED				
73		NOT USED				
74	2	PUMP RUN COMMAND RELAY - K20	IDEC	RH2B-UL-24VDC	-	
75	2	PUMP FAULT RESET RELAY - K21	IDEC	RH2B-UL-24VDC	-	
76	2	PUMP EMERGENCY MODE INTERRUPT RELAY - K22	IDEC	RH2B-UL-24VDC	-	
77	2	PUMP 'RUN AT MAX' RELAY - K23	IDEC	RH2B-UL-24VDC	-	
78	2	PUMP START PUSHBUTTON - S1	SPRECHER & SCHUH	D7P-F3-PX10	-	
79	2	PUMP STOP PUSHBUTTON - S2	SPRECHER & SCHUH	D7P-F4-PX10	-	
80	2	PUMP EM/STOP PUSHBUTTON - S3	SPRECHER & SCHUH	D7P-MT34-PX02S	-	c/w 60mm E/Stop Ring - Label
81	2	PUMP RESET PUSHBUTTON - S4	SPRECHER & SCHUH	D7P-F6-PX10	-	
82	2	PUMP HOUR RUN METER	NATIONAL	TH639	-	
83		NOT USED				
84					E	
85					E	
86					E	
87					E	
88					E	
89					E	
90					E	
91	1	LR3- WET WELL HIGH LEVEL RELAY	MULTITRODE	MTR-5	-	24VDC
92	1	LR4- FLOWMETER PIT HIGH LEVEL RELAY	MULTITRODE	MTR-5	Q	24VDC
93					D	
94	1	SIR - SURCHARGE IMMINENT LEVEL RELAY	MULTITRODE	MTR-2	-	240VAC
95	3	SINGLE POINT PROBES	MULTITRODE	0.2/2-'x' (2 core)	-	'x' = CABLE LENGTH TO SUIT
96	1	EMERGENCY PUMPING MODE RELAY PUMP1 - EMG1	IDEC	RH2B-UL-24VDC	-	
97	1	SURCHARGE IMMINENT DELAY TIMER - SIDT	SPRECHER & SCHUH	RZ7-FSA 3E - U23	-	ON DELAY 0.05-60sec
98	1	EMERGENCY PUMPING MODE TIMER - EMGDT	SPRECHER & SCHUH	RZ7-FSB 4U - U23	-	OFF DELAY 0.05-60hr
99	1	EMERGENCY PUMPING MODE TIMER PUMP2- EMG2	SPRECHER & SCHUH	RZ7-FSA 4U - U23	-	ON DELAY 0.05-60hr
100	2	EMERGENCY PUMPING MODE SWITCH - S5	SPRECHER & SCHUH	D7P-LSM2S-PX20	-	ENGRAVE 'OFF ON'
101					F	
102					F	
103					F	
104					F	
105					F	
106					F	
107					F	
108					F	
109					F	
110					F	
111					F	
112					F	
113					F	
114		NOT USED				
115	1	GRAPHIC DISPLAY	REDLION	G306C000	-	
116		NOT USED				
117	1	SW/BD LIGHTING CONTROL RELAY - SLCR	IDEC	RH2B-UL-24VDC	-	
118	1	STATION LOCAL/REMOTE SWITCH - S10	KRAUS & NAIMER	CA011	-	ENGRAVE 'LOCAL REMOTE'
119	1	ELECTRODES TEST RELAY - ETR	IDEC	RH4B-UL-24VDC	-	
120	1	WETWELL WASHER AUX RELAY - WWR	IDEC	RH2B-UL-24VDC	P	
121	1	WET WELL LEVEL INDICATOR	CROMPTON INSTRUMENTS	244-01KG-HG-IP-SR 4-20mA	-	0-100% ADJ RED POINTER
122		NOT USED				
123	2	VSD CUBICLE VENT FAN	RITTEL	3326.607	-	360M3/Hr
124	2	CUBICLE FAN THERMOSTAT	NHP	FZK01100	-	10 - +60°C
125		NOT USED				
126		NOT USED				
127					S	
128					S	

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	OPT	REMARKS
129	1	CATHODIC PROTECTION UNIT	DRAWING No	SHEET 20	K	
130	1	ANODE - FREE ISSUE			K	Installed by BW
131		NOT USED				
132	1	FLOWMETER - FREE ISSUE	ENDRES+HAUSER	PROMATIC 10	H	RANGE = 100l/s
133	1	WET WELL LEVEL TRANSMITTER	ENDRUSS + HAUSER	FMI67-A2BMD1A3	-	RANGE = 6m
134	1	WET WELL LEVEL TRANSMITTER TERMINAL HOUSING	ENDRUSS + HAUSER	(Part of Item 133)	-	
135					G	
136					G	
137	1	DELIVERY PRESSURE TRANSMITTER	VEGA VEGABAR74	BR74XXGG1FHA2X	U	RANGE = 50m
138	1	DELIVERY PRESSURE ADJUSTMENT UNIT	VEGA VEGA DIS12	VEGADIS12XBAX	U	
139	1	RTU POWER SUPPLY 24VDC	POWERBOX	PB251-24CM-CC-T	-	
140	1	RADIO 24V/13.8VDC CONVERTER	POWERBOX	VTA12SC24	R	
141					I	
142	2	BATTERIES	YUASA	UXH50-12	-	
143	1	RADIO	TRIO	DR900-06A02-D0	R	
144	1	ANTENNA	TRIO	YAGI ANT BAL	R	15 ELEMENT 13dB ALUM
145	1	RADIO COAX SURGE PROTECTION UNIT	POLYPHASER CORPORATION	IS-50NX-C2	R	
146	1	TELEMETRY UNIT	LOGICA CMG	MD3311EAL/271D-0-7	-	
147					I	
148					I	
149	6	DISCONNECT PLUGS	PHOENIX CONTACT	MSTB 2,5/20-ST-5,08	-	
150	6	DISCONNECT TERMINAL BLOCKS	PHOENIX CONTACT	UMSTBVK2,5/20-G-5.08	-	
151	6	CABLE HOUSING	PHOENIX CONTACT	KGS-MSTB2,5/20	-	
152		NOT USED				
153	2	SIGNAL ISOLATORS - 2 WIRE INPUT LOOP POWERED	MOORE INDUSTRIES	ECT/4-20mA/4-20mA	-	
154		NOT USED				
155	1	CODING PINS	PHOENIX CONTACT	CP-MSTB + CR-MSTB	-	
156	1	ANTENNA MAST	SWBD BUILDER	SHEET 22	R	LENGTH = 6MTRS
157	1	COAX CABLE (INTERNAL)	R.F. INDUSTRIES	RG58	R	
158	1	COAX CABLE (EXTERNAL)	R.F. INDUSTRIES	RG213	R	
159	1	COAX PLUG	R.F. INDUSTRIES	SMA	R	
160	1	COAX PLUG	R.F. INDUSTRIES	N08 (MALE)	R	
161	1	COAX PLUG	R.F. INDUSTRIES	N07 (MALE)	R	
162	1	U CLAMPS	R.F. INDUSTRIES	UNV	R	
163		NOT USED				
164		SWITCHBOARD TERMINALS				
164.1	Lot	FUSED TERMINALS with LED 24V INDICATION	PHOENIX CONTACT	UT4-HESI LED24 (5x20)	-	
164.2	Lot	FUSE CARTRIDGES	PHOENIX CONTACT	M205	-	RATINGS AS REQUIRED
164.3	Lot	DISCONNECT TERMINALS	PHOENIX CONTACT	UT4-MT P/P	-	
164.4	4	EARTH TERMINALS	PHOENIX CONTACT	UT4-MTD-PE/S	-	
164.5	8	GROUP MARKER CARRIER	PHOENIX CONTACT	UBE	-	
164.6	2	TEST PLUG ADAPTOR	PHOENIX CONTACT	PS-6	-	
164.7	1	SCREW DRIVER	PHOENIX CONTACT	SZS 0.6 x 3.5	-	
164.8	Lot	PLUG-IN BRIDGE	PHOENIX CONTACT	FBS	-	AS REQUIRED
164.9						
165	2	CORROSION INHIBITOR	CORTEC	VPCI-110 OR 111	-	FROM AP CONTROLS
166	Lot	WET WELL CONDUIT SEALING BUNGS	RUBBER	TO SUIT CONDUITS	-	Detail 'W'
167		NOT USED				
168	1	ENERGEX PADLOCK - 45mm brass pin tumbler	H.A. REED LOCKSMITHS	KEY No 325	-	c/w 2 KEYS
169		NOT USED				
170	Lot	S/STEEL FITTINGS AS DETAILED FOR PRESSURE TX	FITTINGS	STAINLESS STEEL	U	Sheet 19
171	1	EARTH ROD CONNECTION BOX	NESCO	ERB1	-	
172	1	LINE TAP - BONDING TO EARTHING ROD	CLIPSAL	BP26	-	
173	1	EARTHING ROD	COPPER ROD	13mm Diameter	-	
174	1	IP67 JUNCTION BOX - FOR F/METER SUMP PUMP	-	To Suit Installation	Q	
175		NOT USED				
176		NOT USED				

ELECTRICAL AS BUILT CERTIFICATION
REV C
COMPANY J&P RICHARDSON
CONTRACTOR LICENCE No. 756
CERTIFIED BY M. DERUYTER DATE: 6/9/2008

Sheet 14

AS BUILT

No	DATE	AMENDMENT	DRN.	APD.
A	11.07	RE-ISSUED FOR TENDER	P.H.	A.W.
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PRINCIPAL DESIGN MANAGER DATE
Original Signed by P.SHERRIFF 28.06.07
CLIENT DELEGATE DATE

BRISBANE WATER

SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION

TITLE
EQUIPMENT LIST

SHEET No. 14
BRISBANE WATER DRAWING No. 486/5/7-0039-014
AMEND. C

STD TEMPLATE SP-SP-VSD-RTU Ver1.2

CABLE No.	STATUS (Note 2)	SIZE	CORES	TYPE	LENGTH (m)	FROM	TO	CABLE FUNCTION	NOTES
P01	EXISTING	50mm^2	4C+E	PVC/CU/PVC		ENERGEX Supply Pillar	Switchboard	Incoming Mains Supply	
P02	EXISTING	16mm^2	1C	Building Wire		Switchboard	Earth stake	Main Earth	
P03		-							Reserved - Generator Supply
P04		-							Reserved 240VAC gen supply
P05		-							Reserved Pump 1
P06		-							Reserved Pump 1
P07	EXISTING	16mm^2	3C+E+2pilots	Screened Flexible (Submersible)		Switchboard	Pump No1	Pump 1 Motor Feed +Thermistors	
P08		-							Reserved Pump 2
P09		-							Reserved Pump 2
P10	EXISTING	16mm^2	3C+E+2pilots	Screened Flexible (Submersible)		Switchboard	Pump No2	Pump 2 Motor Feed +Thermistors	
P11		-							Reserved Dry Well Sump Pump
P11A		-							Reserved Dry Well Sump Pump
P12		-							Reserved Pump Well Lighting
P13		-							Reserved Pump Well Vent Fan
P14	NEW	2.5mm^2	2C+E	PVC/CU/PVC		Switchboard	F/Meter Pit Sump Pump Junction Box (IP67)	F/Meter Pit Sump Pump Motor	
P14A	NEW	2.5mm^2	2C+E	Vendor		F/Meter Pit Sump Pump Junction Box (IP67)	F/Meter Pit Sump Pump	F/Meter Pit Sump Pump Motor	
P15		-							Reserved Odour Control Unit
P16		-							Reserved Chemical Dosing Unit
C01		-							Reserved Pump 1 MIO probe
C02		-							Reserved Pump 1 MIS probe
C03		-							Reserved Pump 1 B.Temp RTD
C04		-							Reserved Pump 1 relux l/s
C05		-							Reserved Pump 2 MIO probe
C06		-							Reserved Pump 2 MIS probe
C07		-							Reserved Pump 2 B.Temp RTD
C08		-							Reserved Pump 2 relux l/s
C09	NEW		2C	Vendor- 0.20130FSP	25mtrs	Switchboard	Wet Well High Level Probe	Wet Well Level Signal (LR3)	
		-							Reserved Remote LR3 Terminals
C10	NEW		2C	Vendor- 0.20130FSP	25mtrs	Switchboard	Surcharge Imminent Probe	Surcharge Imminent Signal (SIR)	
		-							Reserved Remote SIR Terminals
C11		-							Reserved Dry Well Trip Level
C12		-							Reserved Dry Well Alarm Level
C13A		-							Reserved Sump Pump level
C13B		-							Reserved Sump Pump level
C14									
C15		-							Reserved Generator controls
C16	NEW	1.5mm^2	2C	PVC/PVC		Switchboard	Cathodic Protection Anode	Anode	
C17	NEW		2C	Vendor- 0.20130FSP	30mtrs	Switchboard	Flowmeter Pit High Level Probe	Flowmeter Pit High Level Signal (LR4)	
C18		-							Reserved Pump 1 Lockout
C19		-							Reserved Pump 2 Lockout
C20		-							Reserved Dry Well Alarm Strobe
C21		-							Reserved Odour Control Unit
C22		-							Reserved Manhole Surcharge
I01	NEW			Vendor	25mtrs	Switchboard	Wet Well Hydroscopic Level Sensor	Primary Wet Well Level	
		-							Reserved Remote Mount TX
I02	NEW			Vendor	25mtrs	Switchboard	Delivery Pressure Transmitter	Delivery Pressure	
I03		-							Reserved Em.storage level
I04	NEW			Vendor	50mtrs	Switchboard	Delivery Flowmeter	Flowmeter Sensor Power Supply	
I04A	NEW			Vendor	50mtrs	Switchboard	Delivery Flowmeter	Flowmeter Signals	
									Reserved Ultrasonic Level
									Reserved Ultrasonic Level
I06	NEW	0.75mm^2	1Pr	Dekoron		Switchboard - RTU	Switchboard - Pump 1 Soft Starter	RS485 Comms	Overall Screened Twisted Pair
I07	NEW	0.75mm^2	1Pr	Dekoron		Switchboard - Pump 1 Soft Starter	Switchboard - Pump 2 Soft Starter	RS485 Comms	Overall Screened Twisted Pair
I08	NEW	0.75mm^2	1Pr	Dekoron		Switchboard - Pump 2 Soft Starter	Switchboard - Graphic Display	RS485 Comms	Overall Screened Twisted Pair
I09		-							Reserved Chemical Dosing Unit
X01	NEW			Vendor		Switchboard - Radio	Aerial Coax Surge Protector	Radio Communications	
X02	NEW			Vendor		Aerial Coax Surge Protector	Aerial	Radio Communications	

NOTE:

1. THE CONTRACTOR IS RESPONSIBLE IN DETERMINING THE ACTUAL CABLE LENGTHS REQUIRED ON SITE.
2. USE EXISTING CABLES IF SIZE & CONDITION IS ADEQUATE FOR NEW LOADS & FUNCTIONS. OTHERWISE SUPPLY & INSTALL NEW CABLES. TYPE & SIZE AS PER THIS SCHEDULE.

Sheet 15

ELECTRICAL AS BUILT CERTIFICATION

REV	
C	COMPANY J&P RICHARDSON CONTRACTOR LICENCE No. 756 CERTIFIED BY M. DERUYTER DATE: 6/9/2008

AS BUILT

No	DATE	AMENDMENT	DRN.	APD.
A	11.07	RE-ISSUED FOR TENDER	P.H.	A.W.
C	12.08	AS BUILT	P.H.	A.W.
B	01.08	ISSUED FOR CONSTRUCTION	P.H.	A.W.

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Reference Drawings

DRAFTED	P.HAGUE
DRAFTING CHECK	A.WITTHOFT
CAD FILE	57-0039set_C
B.C.C. FILE No.	-

Original Signed by A.WITTHOFT 21.06.07
DESIGN - R.P.E.Q. No. DATE
Original signed by R.JANFADA 5192 21.06.07
DESIGN CHECK R.P.E.Q. No. DATE

Orig Signed by F.FORNASIER 27.06.07
PRINCIPAL DESIGN MANAGER DATE
Original Signed by P.SHERRIFF 26.06.07
CLIENT DELEGATE DATE

BRISBANE WATER

SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION

TITLE
CABLE SCHEDULE

SHEET No. 15
BRISBANE WATER DRAWING No. 486/5/7-0039-015
AMEND. C

STD TEMPLATE SP-3P-VSD-ETS Ver12

ITEM #	OPT.	DESCRIPTION	LABEL 1	LABELS 2 & 3 (IF NECESSARY)	TEXT HEIGHT	MATERIAL / COLOUR
01	N	METERING ISOLATOR	CT METERING ISOLATOR ONLY 250A		10mm 4mm	ABS PLASTIC B/W
02		ENERGEX SUPPLY	NORMAL SUPPLY MAIN SWITCH 160A		10mm 4mm	ABS PLASTIC B/W
03		GENERATOR SUPPLY	GENERATOR SUPPLY MAIN SWITCH 160A		10mm 4mm	ABS PLASTIC B/W
04/05		PUMP CIRCUIT BREAKER	PUMP No1 100A	PUMP No2 100A	6mm 4mm	ABS PLASTIC W/B
07		PHASE FAILURE CIRCUIT BREAKER	ENERGEX PHASE FAILURE CB Q7	FED FROM LINE SIDE OF MAIN SWITCH	4mm 4mm	ABS PLASTIC W/B - R/W
08						
09		SUB-DISTRIBUTION BOARD CB	SUB-DISTRIBUTION BOARD 63A		6mm 4mm	ABS PLASTIC W/B
10		PHASE FAILURE CIRCUIT BREAKER	STATION PHASE FAILURE CB Q10		4mm 4mm	ABS PLASTIC W/B
11		3 PHASE OUTLET CIRCUIT BREAKER	3Ø OUTLET Q11		4mm 4mm	ABS PLASTIC W/B
12		1 PHASE OUTLET CIRCUIT BREAKER	1Ø GPO Q12		4mm 4mm	ABS PLASTIC W/B
13		RTU LAPTOP CIRCUIT BREAKER	RTU LAPTOP GPO Q13		4mm 4mm	ABS PLASTIC W/B
16		SWITCHBOARD LIGHTING CIRCUIT BREAKER	SWITCHBOARD LIGHTING Q16		4mm 4mm	ABS PLASTIC W/B
17		RTU SURGE FILTER CIRCUIT BREAKER	RTU SURGE FILTER Q17		4mm 4mm	ABS PLASTIC W/B
18		EM PUMP CONTROL & SIR CIRCUIT BREAKER	EM PUMPING CCT & SIR Q18		4mm 4mm	ABS PLASTIC W/B
19		GENERATOR ANCILLARY SUPPLY CB	GENERATOR ANCILLARY SUPPLY Q19		4mm 4mm	ABS PLASTIC W/B
20	K	CATHODIC PROTECTION POWER SUPPLY CB	CATHODIC PROTECTION Q20		4mm 4mm	ABS PLASTIC W/B
21	Q	FLOWMETER PIT SUMP PUMP POWER SUPPLY CB	F/METER PIT SUMP PUMP Q21		4mm 4mm	ABS PLASTIC W/B
26		RTU POWER SUPPLY CIRCUIT BREAKER	RTU POWER SUPPLY Q30		4mm 4mm	ABS PLASTIC W/B
27		SURGE DIVERTER RELAY CIRCUIT BREAKER	SURGE DIVERTER RELAY Q31		4mm 4mm	ABS PLASTIC W/B
28	H	FLOWMETER CIRCUIT BREAKER	FLOWMETER Q32		4mm 4mm	ABS PLASTIC W/B
29		SPARE CIRCUIT BREAKER	SPARE Q33		4mm 4mm	ABS PLASTIC W/B
31/32		PUMP CONTROL CIRCUIT BREAKER	PUMP No1 Q4-1	PUMP No2 Q5-1	4mm 4mm	ABS PLASTIC W/B
37		SURGE DIVERTER FUSES	SURGE DIVERTER FUSES 63A	FED FROM LINE SIDE OF MAIN SWITCH	4mm 4mm	ABS PLASTIC W/B - R/W
38		SURGE DIVERTERS	LIGHTNING ARRESTORS	FED FROM LINE SIDE OF MAIN SWITCH	4mm 4mm	ABS PLASTIC W/B - R/W
39		SURGE DIVERTER ALARM RELAY	SDAR		4mm 4mm	ABS PLASTIC W/B
40		RTU SURGE REDUCTION FILTER	RTU SURGE REDUCTION FILTER		4mm 4mm	ABS PLASTIC W/B
41		PHASE FAILURE RELAY	ENERGEX MAINS POWER FAIL - PFRE	FED FROM LINE SIDE OF MAIN SWITCH	4mm 4mm	ABS PLASTIC W/B - R/W
43		PHASE FAILURE RELAY	STATION MAINS POWER FAIL - PFRS		4mm 4mm	ABS PLASTIC W/B
45		MAIN NEUTRAL LINK	MAIN NEUTRAL		4mm	ABS PLASTIC W/B
46		MAIN EARTH LINK	MAIN EARTH		4mm	ABS PLASTIC W/B
47		SUB-BOARD NEUTRAL LINK	NEUTRAL		4mm	ABS PLASTIC W/B
48		SUB-BOARD EARTH LINK	EARTH		4mm	ABS PLASTIC W/B
49		SURGE DIVERTER EARTH LINK	EARTH		4mm	ABS PLASTIC W/B
50		INSTRUMENT EARTH LINK	INSTRUMENT EARTH		4mm	ABS PLASTIC W/B
51		RTU FILTERED SUPPLY NEUTRAL LINK	FILTERED SUPPLY NEUTRAL		4mm 4mm	ABS PLASTIC W/B
54		LAPTOP GPO	LAPTOP GPO		4mm	ABS PLASTIC W/B
55	M	GENERATOR 240VAC CONNECTION SOCKET	GENERATOR AUX SUPPLY		4mm 4mm	ABS PLASTIC W/B
56	M	GENERATOR POWER CONNECTION SOCKET	GENERATOR CONNECTION		6mm 6mm	ABS PLASTIC W/B
60		PUMP VARIABLE SPEED DRIVE	PUMP No1 1U1	PUMP No2 2U1	6mm 4mm	ABS PLASTIC W/B
61		PUMP VSD KEYPAD	PUMP No1	PUMP No2	6mm	ABS PLASTIC W/B
62		PUMP MANUAL SPEED CONTROL	VSD SPEED	VSD SPEED	6mm	ABS PLASTIC W/B
63		E/STOP CONTACTOR	1K1	2K1	4mm	ABS PLASTIC W/B
64		PUMP CONTROL CCT POWER ON RELAY	1K2	2K2	4mm	ABS PLASTIC W/B
65		VSD RUNNING RELAY	1K3	2K3	4mm	ABS PLASTIC W/B
66		PUMP INTERLOCKING RELAY	1K4	2K4	4mm	ABS PLASTIC W/B
67						

ITEM #	OPT.	DESCRIPTION	LABEL 1	LABELS 2 & 3 (IF NECESSARY)	TEXT HEIGHT	MATERIAL / COLOUR
74		PUMP RUN COMMAND RELAY	1K20	2K20	4mm	ABS PLASTIC W/B
75		PUMP FAULT RESET RELAY	1K21	2K21	4mm	ABS PLASTIC W/B
76		PUMP EMERGENCY MODE INTERRUPT RELAY	1K22	2K22	4mm	ABS PLASTIC W/B
77		PUMP 'RUN AT MAX' RELAY	1K23	2K23	4mm	ABS PLASTIC W/B
78		PUMP START PUSHBUTTON	START	START	4mm	ABS PLASTIC W/B
79		PUMP STOP PUSHBUTTON	STOP	STOP	4mm	ABS PLASTIC W/B
80		PUMP EM.STOP PUSHBUTTON	EMERGENCY STOP	EMERGENCY STOP	4mm	ABS PLASTIC Y/B
81		PUMP RESET PUSHBUTTON	FAULT RESET	FAULT RESET	4mm	ABS PLASTIC W/B
82						
91		WET WELL HIGH LEVEL RELAY	WET WELL HIGH LEVEL - LR3		4mm 4mm	ABS PLASTIC W/B
92	Q	FLOWMETER PIT LEVEL RELAY	FLOWMETER PIT HIGH LEVEL - LR4		4mm 4mm	ABS PLASTIC W/B
94		SURCHARGE IMMINENT LEVEL RELAY	WET WELL SURCHARGE IMMINENT - SIR		4mm 4mm	ABS PLASTIC W/B
96		EMERGENCY PUMPING MODE PUMP 1 RELAY	EMG1		4mm	ABS PLASTIC W/B
97		SURCHARGE IMMINENT ON DELAY TIMER	SIDT		4mm	ABS PLASTIC W/B
98		EMERGENCY PUMPING MODE OFF DELAY TIMER	EMGDT		4mm	ABS PLASTIC W/B
99		EMERGENCY PUMPING MODE PUMP 2 TIMER	EMG2		4mm	ABS PLASTIC W/B
100		EMERGENCY PUMPING MODE START SWITCH	EMERGENCY PUMPING MODE	EMERGENCY PUMPING MODE	4mm 4mm	ABS PLASTIC W/B
117		SWITCHBOARD LIGHTING CONTROL RELAY	SLCR		4mm	ABS PLASTIC W/B
118		STATION LOCAL/REMOTE SELECTOR SWITCH	STATION CONTROL MODE		4mm	ABS PLASTIC W/B
119		ELECTRODES TEST RELAY	ETR		4mm	ABS PLASTIC W/B
120	P	WETWELL WASHER AUX RELAY	WWR		4mm	ABS PLASTIC W/B
121		WET WELL LEVEL INDICATOR	WET WELL LEVEL		4mm	ABS PLASTIC W/B
129	K	CATHODIC PROTECTION UNIT	CATHODIC PROTECTION UNIT		4mm	ABS PLASTIC W/B
132	H	DELIVERY FLOWMETER TRANSMITTER	DELIVERY FLOWMETER		4mm	ABS PLASTIC W/B
133		WET WELL LEVEL ADJ. UNIT	PRIMARY WET WELL LEVEL	PRIMARY WET WELL LEVEL	4mm	ABS PLASTIC W/B
137	U	DELIVERY PRESSURE ADJ. UNIT	DELIVERY PRESSURE		4mm	ABS PLASTIC W/B
139		RTU 240VAC/24VDC POWER SUPPLY	RTU 24VDC POWER SUPPLY		4mm 4mm	ABS PLASTIC W/B
140	R	RADIO 24V/13.8VDC CONVERTER	24/12 VDC CONVERTER - RADIO		4mm 4mm	ABS PLASTIC W/B
143	R	RADIO	RADIO		4mm	ABS PLASTIC W/B
145	R	RADIO COAX SURGE PROTECTION	RADIO SURGE PROTECTION		4mm	ABS PLASTIC W/B
146		TELEMETRY UNIT	RTU		4mm	ABS PLASTIC W/B

ITEM #	OPT.	DESCRIPTION	LABEL 1	LABELS 2 & 3 (IF NECESSARY)	TEXT HEIGHT	MATERIAL / COLOUR
149		RTU DISCONNECT PLUG	PLUG No??		4mm	ABS PLASTIC W/B
150		RTU DISCONNECT TERMINAL BLOCKS	PLUG No??		4mm	ABS PLASTIC W/B
153		SIGNAL ISOLATOR	1U	2U	4mm	ABS PLASTIC W/B
		TERMINAL HEADER	RTU POWER SUPPLIES		4mm 4mm	ABS PLASTIC W/B
		TERMINAL HEADER	DIGITAL INPUTS DI1	DIGITAL INPUTS DI2	4mm 4mm	ABS PLASTIC W/B
		TERMINAL HEADER	DIGITAL INPUTS DI3		4mm 4mm	ABS PLASTIC W/B
		TERMINAL HEADER	DIGITAL OUTPUTS DO1	DIGITAL OUTPUTS DO2	4mm 4mm	ABS PLASTIC W/B
		TERMINAL HEADER	ANALOG INPUTS AI1		4mm 4mm	ABS PLASTIC W/B
		HEADER LABEL (Above Circuit Breakers)	NON FILTERED SUPPLY		6mm 6mm	ABS PLASTIC W/B
		HEADER LABEL (Above Circuit Breakers)	FILTERED SUPPLY		6mm 6mm	ABS PLASTIC W/B
		HEADER LABEL (Incomer Section)	MEN BEHIND		6mm	ABS PLASTIC W/B
	M	GENERATOR INTERFACE TERMINALS	GENERATOR INTERFACE		4mm 4mm	ABS PLASTIC W/B
	J	PUMP CONNECTIONS	PUMP No1	PUMP No2	6mm	ABS PLASTIC W/B
	F2	GENERATOR BOLTED CONNECTIONS	BUSBAR LIVE WHEN SWITCHBOARD ENERGISED FROM GENERATOR		4mm 4mm	ABS PLASTIC R/W
		GLAND PLATE LABEL (????? Section)	SPARE CONDUITS BELOW FOR FUTURE INSTALLS		6mm 6mm	ABS PLASTIC W/B
		PUMP INFORMATION LABEL Label size to be approximately 150x50	SP126 YOUNGS ROAD PUMPS ZONE ?? IMPELLER ??? kW ??		6mm	ABS PLASTIC W/B

EXTERNAL LABEL LIST

LABEL	TEXT	TEXT HEIGHT	PAINT FILL LETTERING	SIZE	QTY	OPT
A	SP126	20mm	Black	100x35	1	
B	RTU	10mm	Black	54x20	1	
C	PUMP CONTROL	10mm	Black	120x20	2	
D	WARNING THIS SITE IS MONITORED BY NETWORK CONTROL PLEASE INFORM THE OPERATOR BEFORE ISOLATING PUMPS OR STATION	8mm	Black	254x100	2	
E	PLEASE CHECK THAT THE STATION IS IN REMOTE MODE BEFORE LEAVING SITE	8mm	Black	210x60	1	
F	COMMON CONTROL	10mm	Black	120x20	1	
G	METERING ISOLATOR	10mm	Black	120x20	1	N
H	METERING CT's	10mm	Black	100x20	1	N
I	MAIN SWITCHES	10mm	Black	120x20	1	
J	DISTRIBUTION BOARD	10mm	Black	150x20	1	
L	GENERATOR CONNECTIONS	10mm	Black	180x20	1	F
M	PUMP ? VSD	10mm	Black	80x20	2	
N	GENERATOR INLET	10mm	Black	120x20	1	F
O	BATTERIES	10mm	Black	80x20	1	
P	SUPPLY AUTHORITY METERING	10mm	Black	200x20	1	
Q	DANGER 415V	10mm	Black	100x20	4	
R	DANGER - 2 SOURSES OF SUPPLY	10mm	Red	220x20	1	
S	PUMP CONNECTIONS	10mm	Black	150x20	1	

EXTERNAL LABELS 1mm THICK 316 GRADE STAINLESS STEEL FIXED WITH M3 316 STAINLESS STEEL METAL THREADS.

DETAIL Q

ELECTRICAL AS BUILT CERTIFICATION
REV C | COMPANY J&P RICHARDSON | CONTRACTOR LICENCE No. 756 | CERTIFIED BY M. DERUYTER | DATE: 6/9/2008

Sheet 16

AS BUILT

No	DATE	AMENDMENT	DRN.	APD.
A	11.07	RE-ISSUED FOR TENDER	P.H.	A.W.
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Reference Drawings

DRAFTED: P.HAGUE
DRAFTING CHECK: A.WITTHOFT
CAD FILE: 57-0039set_C
B.C.C. FILE No.

DESIGN: Original Signed by A.WITTHOFT — R.P.E.Q. No. — DATE 21.06.07
DESIGN CHECK: Original signed by R.JANFADA — R.P.E.Q. No. 5192 — DATE 21.06.07

PRINCIPAL DESIGN MANAGER: Orig Signed by F.FORNASIER — DATE 27.06.07
CLIENT DELEGATE: Original Signed by P.SHERRIFF — DATE 28.06.07

BRISBANE WATER

SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION

TITLE
SWITCHBOARD
LABEL SCHEDULE

SHEET No. 16
BRISBANE WATER DRAWING No. 486/5/7-0039-016
AMEND. C

CONSTRUCTION

Cubicle construction 3mm Marine grade Aluminium (5251).
Plinth construction 160x60 channel 6061 T6 Grade Aluminium.
Folded, "Pulse MIG" & "TIG welded with all visible seams and joints fully welded, free from splatter and ground smooth where needed.
External doors and covers fitted with Emka 1011-207 self grip seal.
"D" Handles fitted where indicated on the drawings.
M6 Earth studs fixed to the interior of all doors and hinged escutcheons and on adjacent cubicle interior surfaces.
Door stiffeners, door stays, cable straps, and document holders etc fitted where shown on the drawings.
Door stiffeners to be S/Steel and of sufficient strength to prevent being deformed when subjected to reasonable loads. Minimum 3mm S/Steel.
Lift-off covers and mounting panels fixed with M8 studs & chrome acorn nuts.
Gland plates manufactured from 6mm Bakelite, unless otherwise shown.
Inspection/Access plates manufactured from 3mm aluminium.
Gland/Inspection/Access plate openings reinforced with 25x10mm flat aluminium bar. (Detail F)
Cable glands to be fitted with compression side installed within cubicle. (Detail G)
Gland/Inspection/Access plates to be fitted with seals attached to cubicle.
Gland/Inspection/Access plate fixings at 100mm.
Gland/Inspection/Access plates to maintain a 50mm clearance from section dividers.
Gland/Inspection/Access plates are NOT to be split.
Provide Shrouding to all live parts to IP20 where required.
Hinges (external) Selectrix HIB650ss-316. Stainless Steel.
Star washers fitted under all hinge screws.
Hinged escutcheons fixed with Emka 1/4 turn 1000-U142

Locks Doors 1-4, 6-13

Dirak Swing Handle 207-9294. Stainless Steel
Selectrix 1107-U123 3pt cam
Lockwood 71 Barel Lock
Emka 1049-U3 roller rod
Key Codes RC496A, RC496AB, RC496ABC refer to each door for clarification.

Locks Doors 5

Selectrix Swing Handle 1107-SS02-316. Stainless Steel
Selectrix 1107-U123 3pt cam
Emka 1049-U3 roller rod
ENERGEX padlock 45mm brass pin tumbler. Key No325. c/w 2 keys.

OPERATING PARAMETERS

Standard	AS 3439.1
Current & Frequency	AC 50Hz
Rated Operational Voltage Ue	415 VAC
Rated Insulation Voltage Ui	660 V
Rated Auxiliary Voltage	240 VAC / 24 VDC
Rated Current (Main Bus)	300 AMPS
Short Circuit Current Isc	20 kA
Duration of Isc	.2 sec
Degree of Protection	IP 55 to AS 1939
Measure of Protection by barriers and enclosures	
Service Conditions	Outdoors
Mass	Not exceeding 2000kg
Forms of Segregation	Form 1
Earthing System	TN-S

PAINTING

Aluminium Surface Preparation.
Finish smooth all exposed welds, clean, descale, and degrease all surfaces.
Surfaces pretreatment in accordance with AS 1580 & AS 3715 using Novox LF acid etch cleaner, Novacoat 12 conversion coating, & clean water rinses
Apply DULUX ALPHATECH 3000 powder coat to manufacturer's recommendations.
CUBICLE & EXTERNAL COMPONENTS :- DULUX Mist Green (36648) matt finish.
INTERIOR ITEMS (mounting panels, escutcheons, etc.) :- DULUX Bright White (32166)
Minimum Dry Film Thickness all surfaces 50 microns.

WIRING

All wiring to be PVC V90 HT 0.6/1Kv Grade with tinned conductor.
Control and instrumentation wiring has flexible copper conductors, and is colour coded as detailed below, 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.
Use proprietary bridging links when required to common up terminals.
Not more than two wires shall be connected to any terminal.
Not more than one wire shall be connected on one side of any tunnel type terminal.
Where multiple connections are required on tunnel terminals, proprietary terminal link bars shall be used.
Power wiring to be minimum 2.5sqmm stranded copper conductors, phase colour coded as detailed below.
Control wiring to be minimum 1.0sqmm flexible copper conductors, colour coded as detailed below.
Low level control signals to be minimum 0.5sqmm flexible copper conductors. colour coded as detailed below.
4-20mA analog signals (internal & external) wired in shielded pair minimum size 0.5sqmm, and earthed at one end only. (Switchboard end for external signals)
All 240VAC wiring in the RTU or PLC sections shall be double insulated and all terminals shall be shouded and labelled- ' Danger 240VAC'
Earth cables minimum 2.5sqmm flexible.
Doors and hinged escutcheons bonded with flexible tinned copper braiding.
Ensure a minimum clearance of 100mm is maintained between cable ducting and gland plates.
Wire numbering will be equal to Grafoplast SI2000 system.
Wire numbers are readable left to right,bottom to top as shown.

2111 2111

Refer to sheet 17 for coding details for RTU disconnection plugs.
Coding pins must be fitted to both the disconnect plug and terminal block.

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	Grey	1.0sqmm
RTU & PLC Wiring	Grey	0.5sqmm
Electrode Wiring	Salmon	1.0sqmm
Intrinsically safe wiring	Light Blue	1.5sqmm
Earth	Green/Yellow	2.5sqmm (min)
Door & Escutcheon Earth Bonds	Green/Yellow	4 sqmm

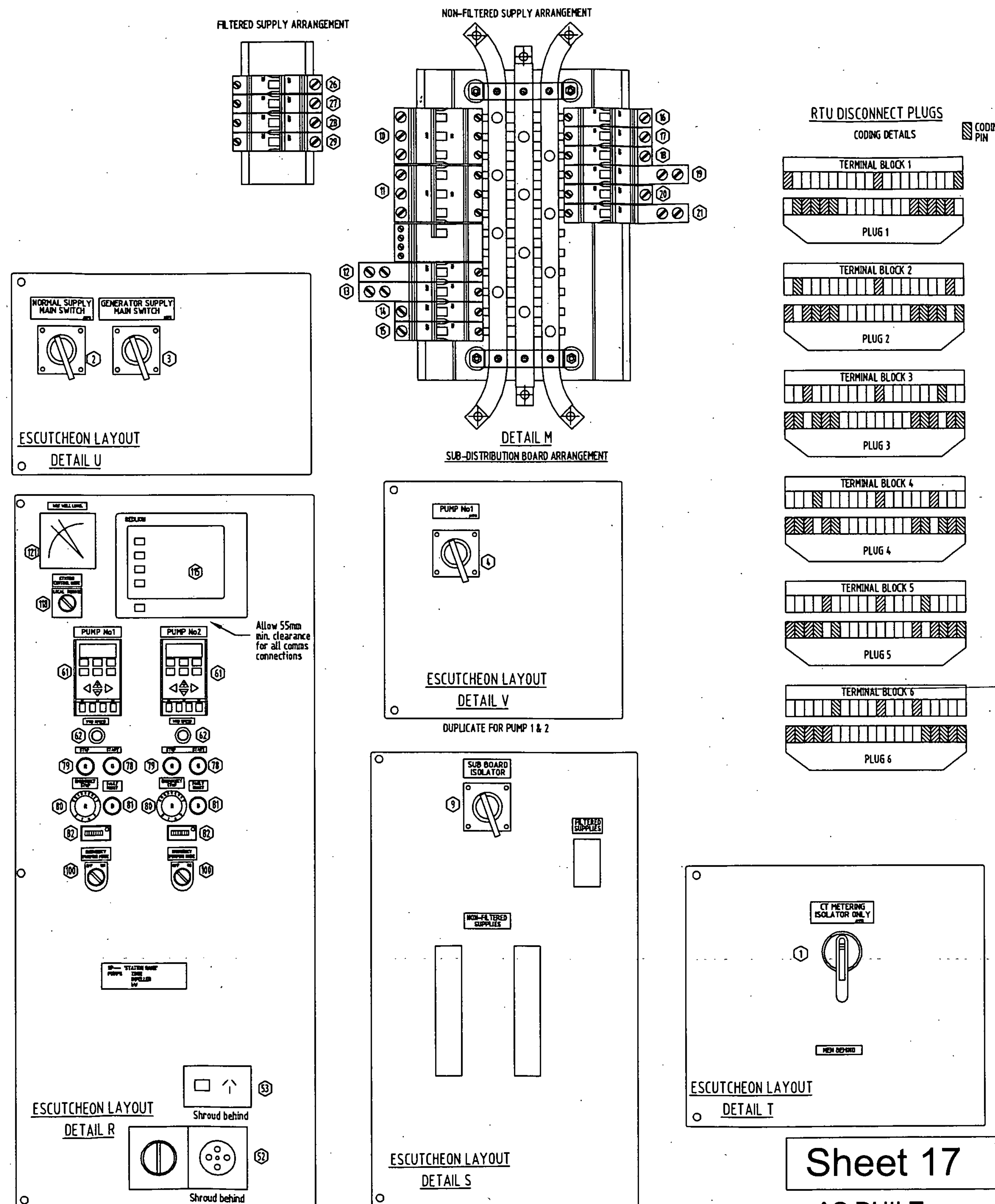
LABELS

Internal labels W/B engraved ABS PLASTIC to label schedule.
Warning labels R/W engraved ABS PLASTIC to label schedule.
E/Stop labels Y/B engraved ABS PLASTIC to label schedule.

First letter = Background colour, Second letter = Lettering colour.

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

Internal labels secured by M3 chrome plated metal threads.
CB's to be identified with individual labels as per label schedule
Labels obstructed by switchboard wiring are relocated to adjacent duct lid.
Labels secured by M3 nylon threads.
The duct lid is secured by a single cable tie at one corner.
External labels secured by M3 316 stainless steel metal threads.
Remove all sharp edges and burrs from all internal and external labels.



Sheet 17

AS BUILT

ELECTRICAL AS BUILT CERTIFICATION

REV	
C	COMPANY J&P RICHARDSON CONTRACTOR LICENCE No. 756 CERTIFIED BY M. DERUYTER DATE: 6/9/2008

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Original signed by R.JANFADA 5192 21.06.07
DESIGN CHECK R.P.E.Q. No. DATE

Orig Signed by F.FORNASIER 27.06.07
PRINCIPAL DESIGN MANAGER DATE
Original Signed by P.SHERRIFF 28.06.07
CLIENT DELEGATE DATE

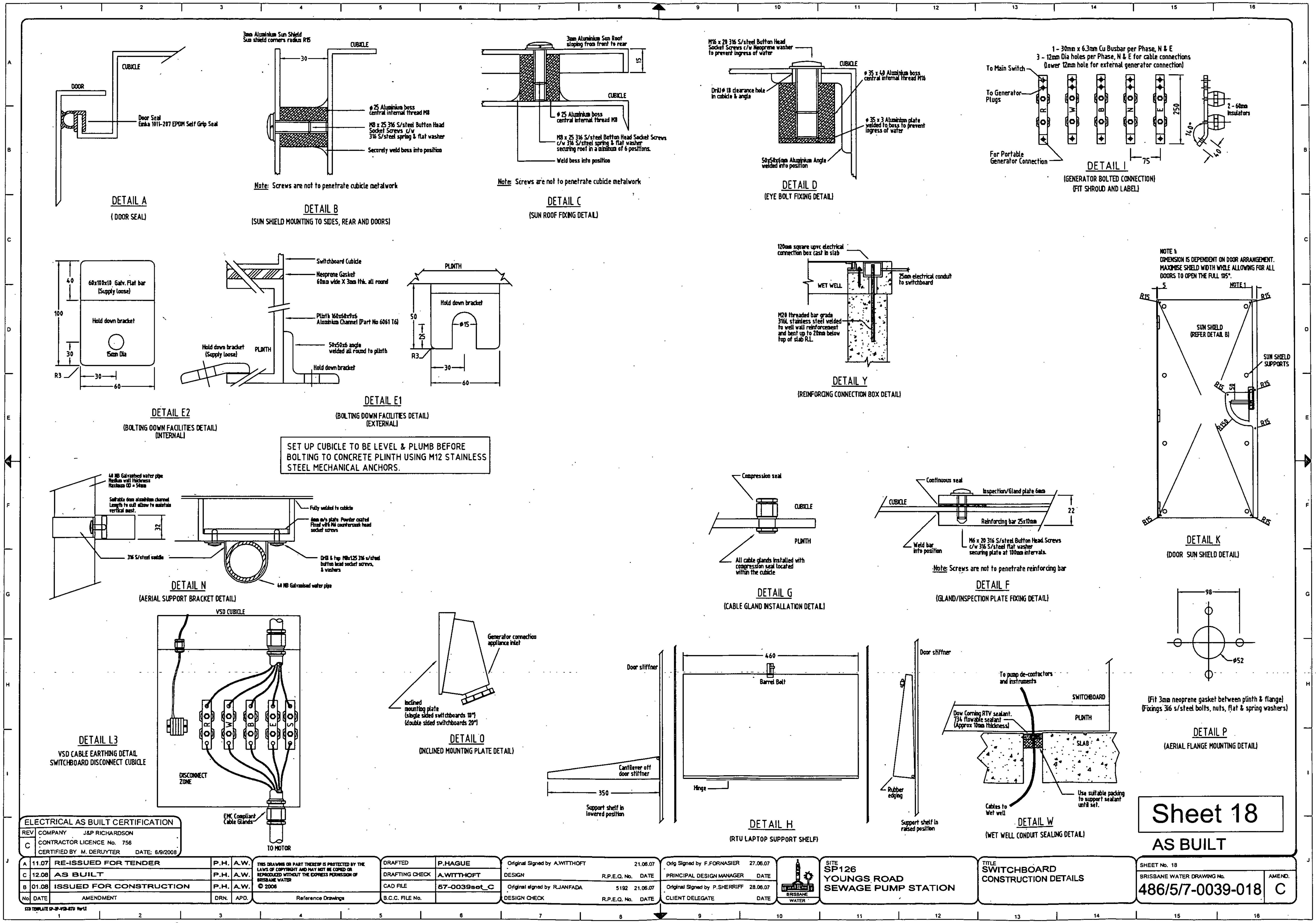
BRISBANE WATER

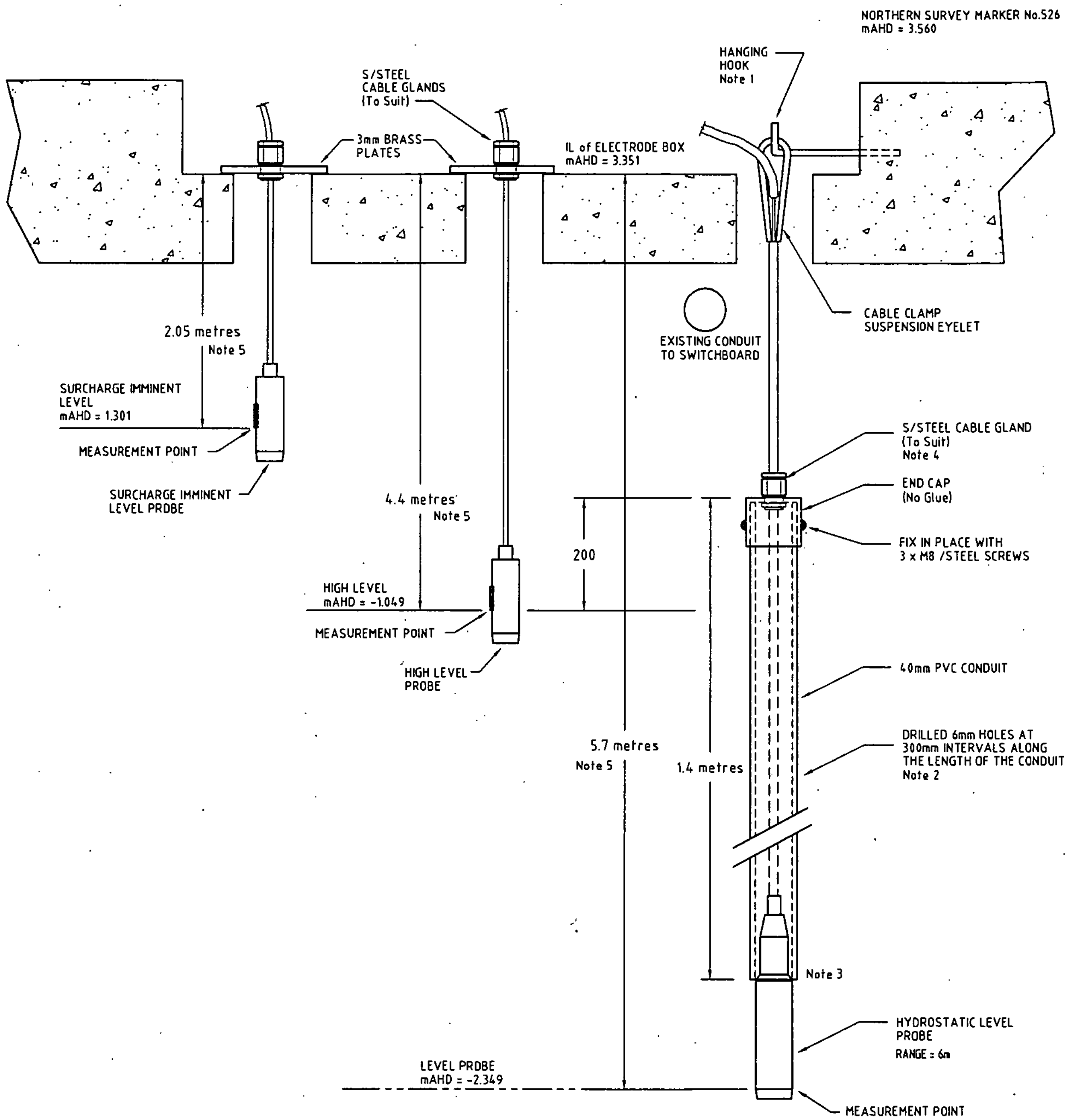
SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION

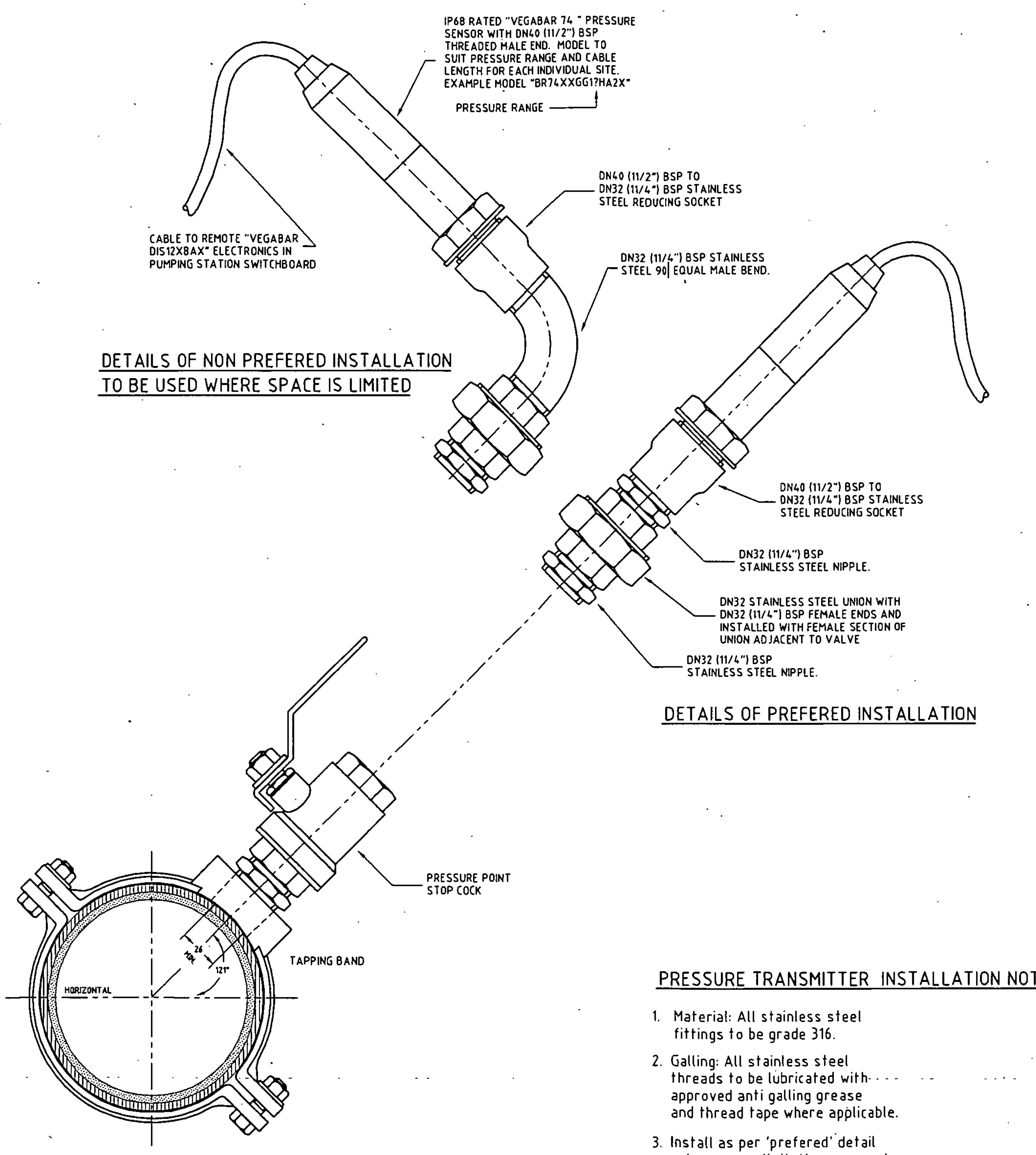
TITLE
SWITCHBOARD
CONSTRUCTION DETAILS

SHEET No. 17
BRISBANE WATER DRAWING No. 486/5/7-0039-017
AMEND. C

STD TEMPLATE SP-IP-VSD-RTU Ver12


DETAIL A
(DOOR SEAL)
CUBICLE
DOOR
Door Seal
Emka 1011-287 EPDM Self Grip Seal
DETAIL B
(SUN SHIELD MOUNTING TO SIDES, REAR AND DOORS)
3mm Aluminium Sun Shield
Sun shield corners radius R15
Note: Screws are not to penetrate cubicle metalwork
DETAIL C
(SUN ROOF FIXING DETAIL)
3mm Aluminium Sun Roof sloping from front to rear
Note: Screws are not to penetrate cubicle metalwork
DETAIL D
(EYE BOLT FIXING DETAIL)
DETAIL I
(GENERATOR BOLTED CONNECTION)
(FIT SHROUD AND LABEL)
1 - 30mm x 6.3mm Cu Busbar per Phase, N & E
3 - 12mm Dia holes per Phase, N & E for cable connections
(lower 12mm hole for external generator connection)
To Main Switch
To Generator Plugs
For Portable Generator Connection
2 - 60mm Insulators
DETAIL E2
(BOLTING DOWN FACILITIES DETAIL)
(INTERNAL)
60x100x10 Galv. Flat bar (Supply loose)
Hold down bracket
15mm Dia
DETAIL E1
(BOLTING DOWN FACILITIES DETAIL)
(EXTERNAL)
Switchboard Cubicle
Neoprene Gasket
PLINTH
Hold down bracket
SET UP CUBICLE TO BE LEVEL & PLUMB BEFORE BOLTING TO CONCRETE PLINTH USING M12 STAINLESS STEEL MECHANICAL ANCHORS.
DETAIL Y
(REINFORCING CONNECTION BOX DETAIL)
WET WELL
DETAIL K
(DOOR SUN SHIELD DETAIL)
SUN SHIELD (REFER DETAIL B)
SUN SHIELD SUPPORTS
DETAIL N
(AERIAL SUPPORT BRACKET DETAIL)
DETAIL G
(CABLE GLAND INSTALLATION DETAIL)
Compression seal
CUBICLE
PLINTH
All cable glands installed with compression seal located within the cubicle
DETAIL F
(GLAND/INSPECTION PLATE FIXING DETAIL)
Note: Screws are not to penetrate reinforcing bar
DETAIL L3
VSD CABLE EARTHING DETAIL
SWITCHBOARD DISCONNECT CUBICLE
VSD CUBICLE
DISCONNECT ZONE
EMC Compliant Cable Glands
TO MOTOR
DETAIL O
(INCLINED MOUNTING PLATE DETAIL)
Generator connection appliance inlet
DETAIL H
(RTU LAPTOP SUPPORT SHELF)
Door stiffner
Barrel Bolt
Hinge
Support shelf in lowered position
Support shelf in raised position
Rubber edging
DETAIL W
(WET WELL CONDUIT SEALING DETAIL)
SWITCHBOARD
PLINTH
SLAB
Cables to Wet well
DETAIL P
(AERIAL FLANGE MOUNTING DETAIL)
(Fit 3mm neoprene gasket between plinth & flange)
(Fixings 316 s/steel bolts, nuts, flat & spring washers)
Sheet 18
AS BUILT
ELECTRICAL AS BUILT CERTIFICATION
REV C COMPANY J&P RICHARDSON
CONTRACTOR LICENCE No. 756
CERTIFIED BY M. DERUYTER DATE: 6/9/2008
A 11.07 RE-ISSUED FOR TENDER P.H. A.W.
C 12.08 AS BUILT P.H. A.W.
B 01.08 ISSUED FOR CONSTRUCTION P.H. A.W.
No. DATE AMENDMENT DRN. APD.
Reference Drawings
DRAFTED P.HAGUE
DRAFTING CHECK A.WITTHOFT
CAD FILE 57-0039set_C
B.C.C. FILE No.
SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION
TITLE
SWITCHBOARD
CONSTRUCTION DETAILS
SHEET No. 18
BRISBANE WATER DRAWING No.
486/5/7-0039-018
AMEND. C





LEVEL PROBE INSTALLATION NOTES

1. Install stainless steel hanging hook for the suspension of the hydrostatic probe.
2. Drill 4 x 6mm holes, 150mm from each end and every 300mm of the cut length, prior to installation.
3. Install so that the conduit slides over the probe the maxmium amount possible. Do not glue the conduit to the end cap.
4. Tighten the securing cable gland.
5. Measurements are to be taken from bottom of the electrode box to 'measurement points' on probes

PRESSURE TRANSMITTER INSTALLATION NOTES

1. Material: All stainless steel fittings to be grade 316.
2. Galling: All stainless steel threads to be lubricated with approved anti galling grease and thread tape where applicable.
3. Install as per 'prefered' detail unless space limitations prevents this method.

	QTY	MATERIALS LIST
1	1	LENGTH OF HEAVY DUTY ORANGE PVC CONDUIT 40mm
2	1	CONDUIT END CAP
3	2	STAINLESS STEEL CABLE GLAND
4	3	CABLE CLAMP SUSPENSION EYELET

Sheet 19

AS BUILT

ELECTRICAL AS BUILT CERTIFICATION

REV	
C	COMPANY J&P RICHARDSON
	CONTRACTOR LICENCE No. 756
	CERTIFIED BY M.DERUYTER DATE: 6/9/2008

No	DATE	AMENDMENT	DRN.	APD.
A	11.07	RE-ISSUED FOR TENDER	P.H.	A.W.
C	12.08	AS BUILT	P.H.	A.W.
B	01.08	ISSUED FOR CONSTRUCTION	P.H.	A.W.

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Reference Drawings

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CAD FILE	57-0039set_C
B.C.C. FILE No.	

Original Signed by A.WITTHOFT 21.06.07
DESIGN R.P.E.Q. No. DATE
Original signed by R.JANFADA 5192 21.06.07
DESIGN CHECK R.P.E.Q. No. DATE

Orig Signed by F.FORNASIER 27.06.07
PRINCIPAL DESIGN MANAGER DATE
Original Signed by P.SHERRIFF 28.06.07
CLIENT DELEGATE DATE

BRISBANE WATER

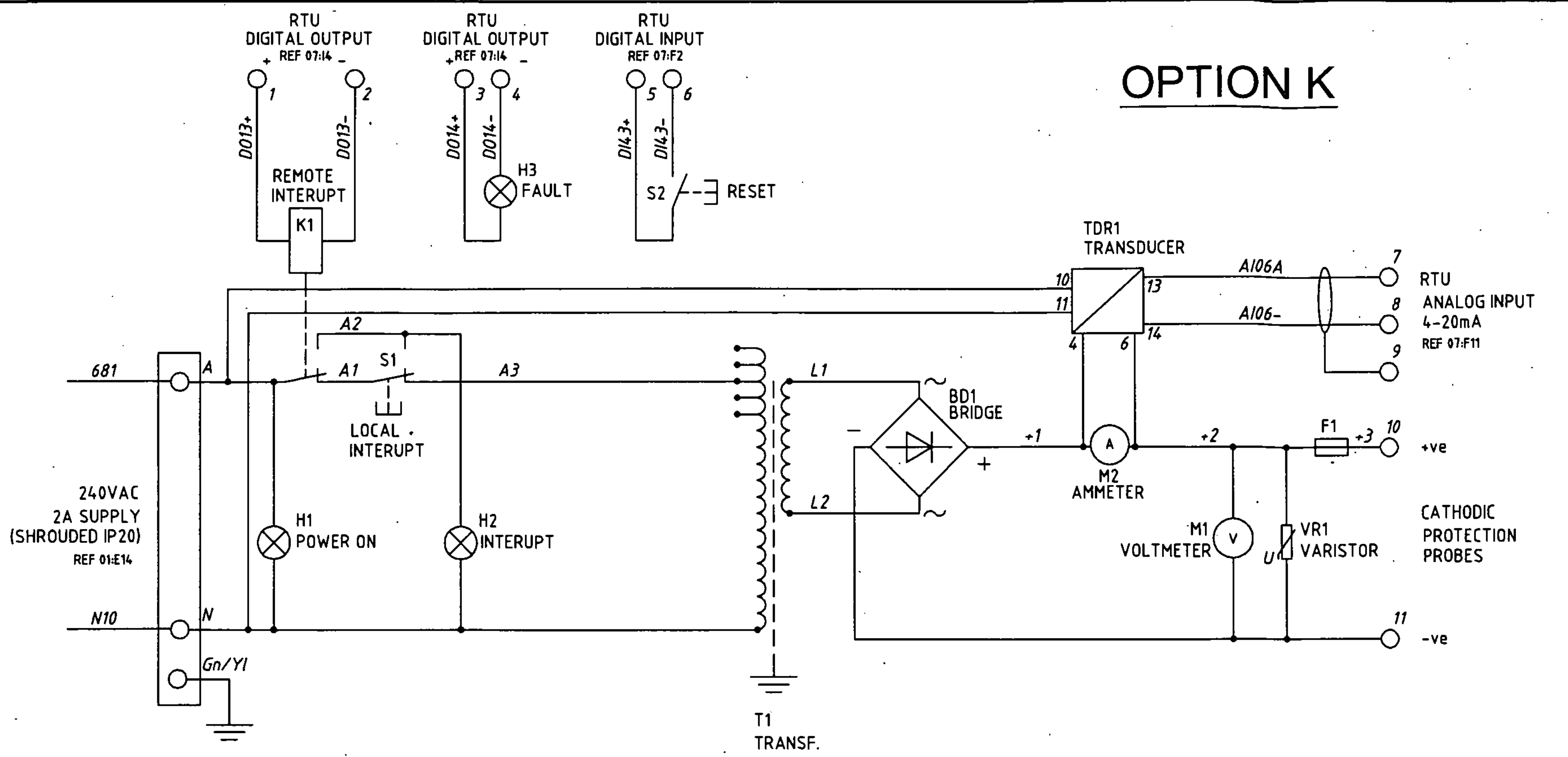
SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION

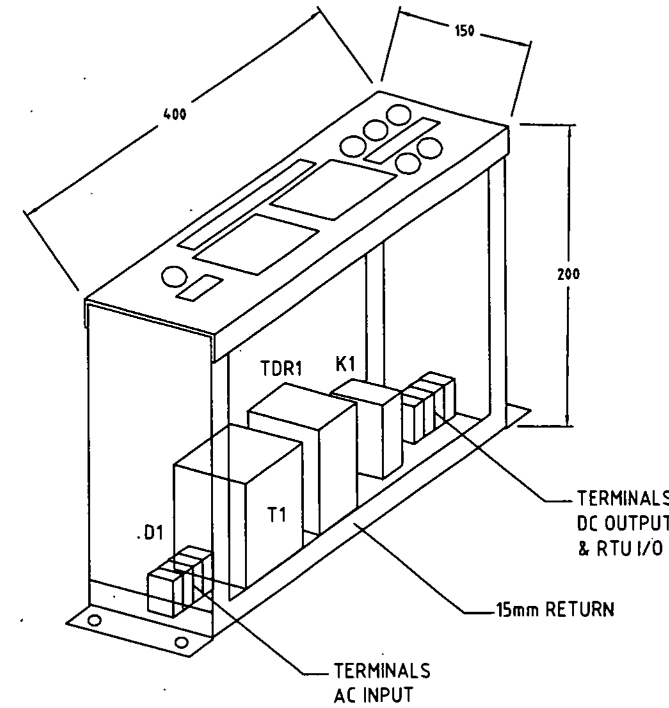
TITLE
LEVEL PROBES
AND PRESSURE TRANSMITTER
INSTALLATION DETAILS

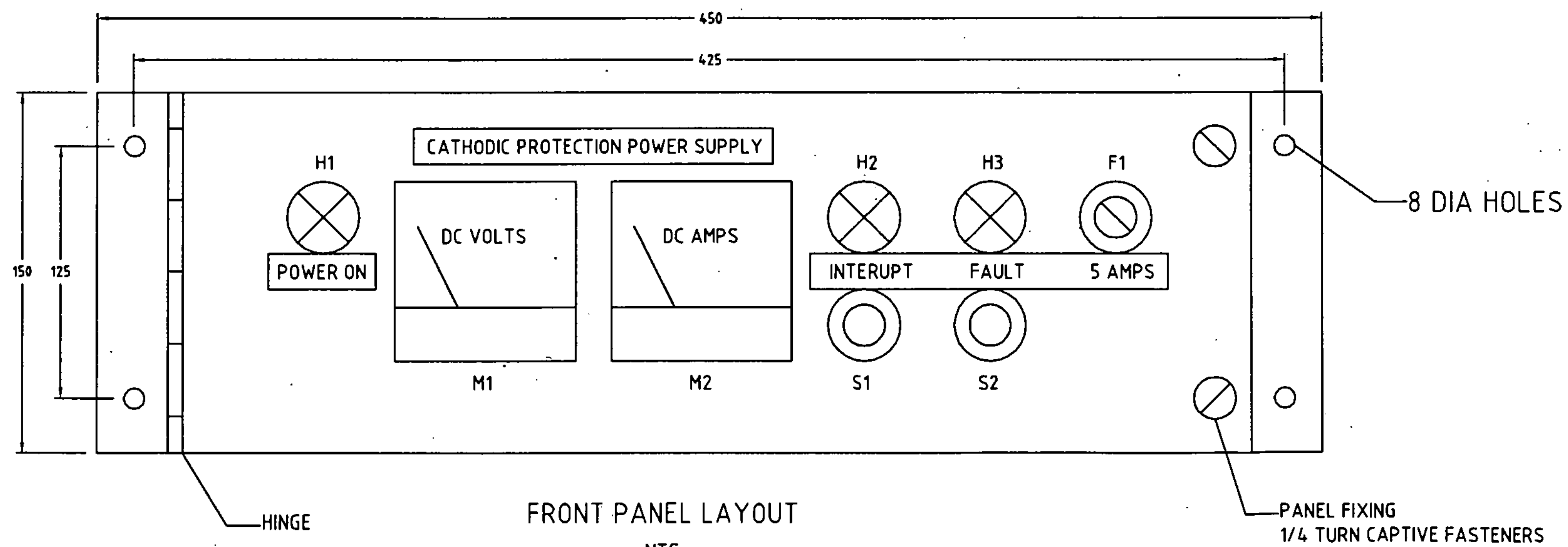
SHEET No. 19
BRISBANE WATER DRAWING No. 486/5/7-0039-019
AMEND. C

STD TEMPLATE SP-2P-VSD-ETB Ver12

OPTION K







FRONT PANEL LAYOUT
NTS

ITEM	QTY	DESCRIPTION (RS_ _ _ _ _ _ = RS COMPONENTS PART NUMBER)
BD1	1	DIODE BRIDGE SINGLE PHASE 35A 600V ISOLATED METAL BASE. RS2278772
F1	1	DC OUTPUT FUSE - PANEL MTG 5x20 FUSE HOLDER c/w 5A FUSE
H1	1	POWER ON INDICATOR 240VAC NEON RED RS576608
H2	1	INTERUPT INDICATOR 240VAC NEON WHITE RS576620
H3	1	FAULT INDICATOR 28VDC LED ARRAY AMBER RS576563
K1	1	REMOTE INTERUPT - RELAY 24VDC - RH2B-UL-24VDC
M1	1	VOLTMETER 0-15 V 69x53 MR73
M2	1	AMMETER 0-5 A 69x53 RS259511 (28 mOhms)
S1	1	LOCAL INTERUPT - MOMENTERY PUSH BUTTON S&S D7P-F4-PX11 - RED
S2	1	FAULT RESET - MOMENTERY PUSH BUTTON S&S D7P-F6-PX10 - BLUE
TDR1	1	TRANSDUCER - MANN INDUSTRIES FTXDMV 0-150mV/4-20mA/240vAC
T1	1	TRANSFORMER GAYRAD TP60
VR1	1	VARISTOR - SURGE SUPPRESSOR RS649150 (CLAMP 76V10Ap) (31VDC CONTINUOUS)
-	14	TERMINALS 4.0mm RAIL MTG + END COVERS & STOPS

Sheet 20

AS BUILT

ELECTRICAL AS BUILT CERTIFICATION

REV	
C	COMPANY J&P RICHARDSON CONTRACTOR LICENCE No. 756 CERTIFIED BY M.DERUYTER DATE: 6/9/2008

No	DATE	AMENDMENT	DRN.	APD.
A	11.07	RE-ISSUED FOR TENDER	P.H.	A.W.
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DESIGN CHECK R.P.E.Q. No. DATE

Orig Signed by F.FORNASIER 27.06.07
PRINCIPAL DESIGN MANAGER DATE
Original Signed by P.SHERRIFF 28.06.07
CLIENT DELEGATE DATE

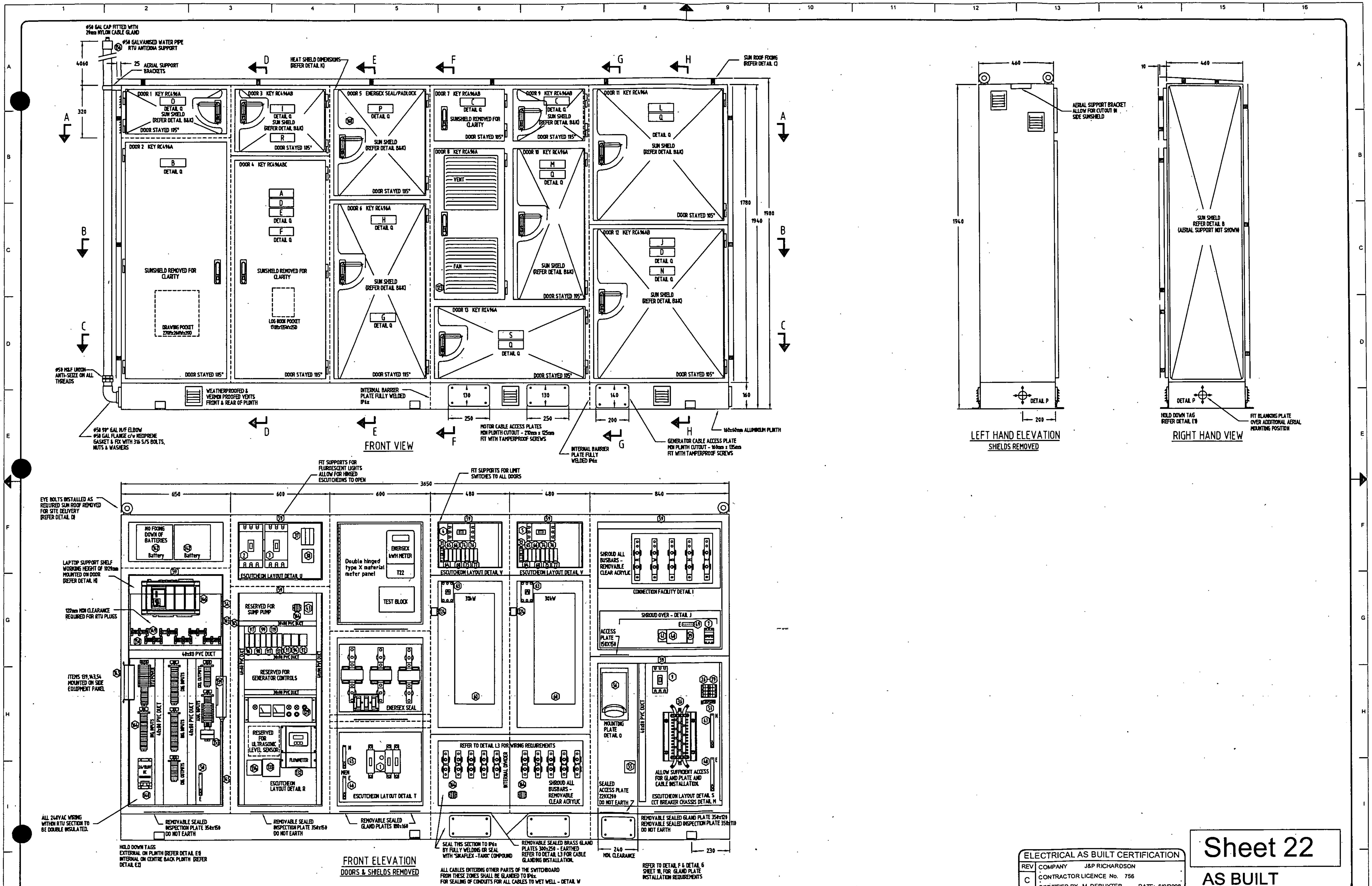
BRISBANE WATER

SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION

TITLE
CATHODIC PROTECTION UNIT
CONSTRUCTION & WIRING DIAGRAM

SHEET No. 20
BRISBANE WATER DRAWING No. 486/5/7-0039-020
AMEND. C

STD TEMPLATE SP-SP-V53-ATB Ver1.2



ELECTRICAL AS BUILT CERTIFICATION

REV C — COMPANY J&P RICHARDSON — CONTRACTOR LICENCE No. 756 — CERTIFIED BY M.DERUYTER — DATE: 6/9/2008

Sheet 22

AS BUILT

No	DATE	AMENDMENT	DRN.	APD.
A	11.07	RE-ISSUED FOR TENDER	P.H.	A.W.
C	12.08	AS BUILT	P.H.	A.W.
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Orig Signed by F.FORNASIER 27.06.07 — PRINCIPAL DESIGN MANAGER — DATE

Original Signed by P.SHERRIFF 28.06.07 — CLIENT DELEGATE — DATE

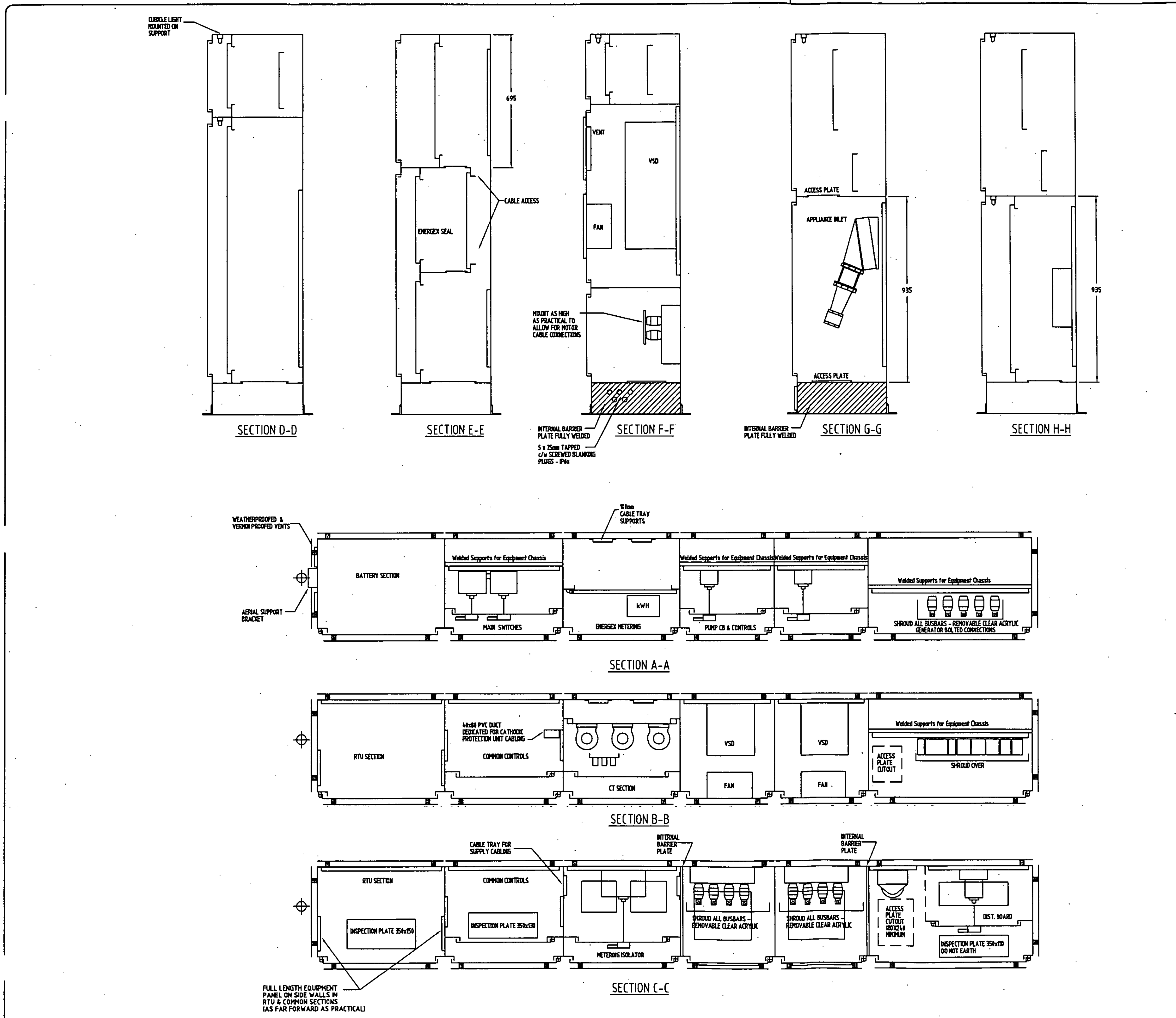
BRISBANE WATER

SITE: SP126 YOUNGS ROAD SEWAGE PUMP STATION

TITLE: SWITCHBOARD GENERAL ARRANGEMENT ELEVATIONS

SHEET No. 22

BRISBANE WATER DRAWING No. 486/5/7-0039-022 — AMEND. C



ELECTRICAL AS BUILT CERTIFICATION
REV C — COMPANY J&P RICHARDSON — CONTRACTOR LICENCE No. 756 — CERTIFIED BY M.DERUYTER — DATE: 6/9/2008

Sheet 23

AS BUILT

No	DATE	AMENDMENT	DRN.	APD.
A	11.07	RE-ISSUED FOR TENDER	P.H.	A.W.
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B	01.08	ISSUED FOR CONSTRUCTION	P.H.	A.W.

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Original signed by R.IANFADA 5192 21.06.07 — DESIGN CHECK — R.P.E.Q. No. DATE

Orig Signed by F.FORNASIER 27.06.07 — PRINCIPAL DESIGN MANAGER — DATE
Original Signed by P.SHERRIFF 28.06.07 — CLIENT DELEGATE — DATE

BRISBANE WATER

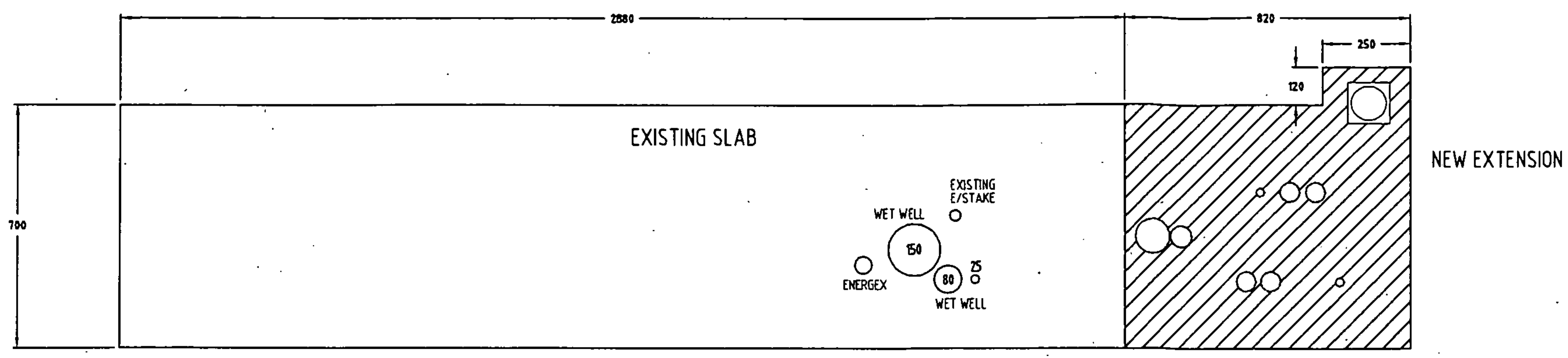
SITE: SP126 YOUNGS ROAD SEWAGE PUMP STATION

TITLE: SWITCHBOARD GENERAL ARRANGEMENT SECTIONS

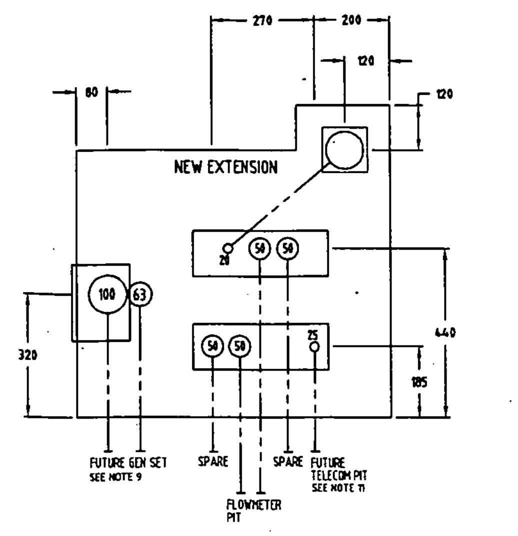
SHEET No. 23

BRISBANE WATER DRAWING No. 486/5/7-0039-023 — AMEND. C

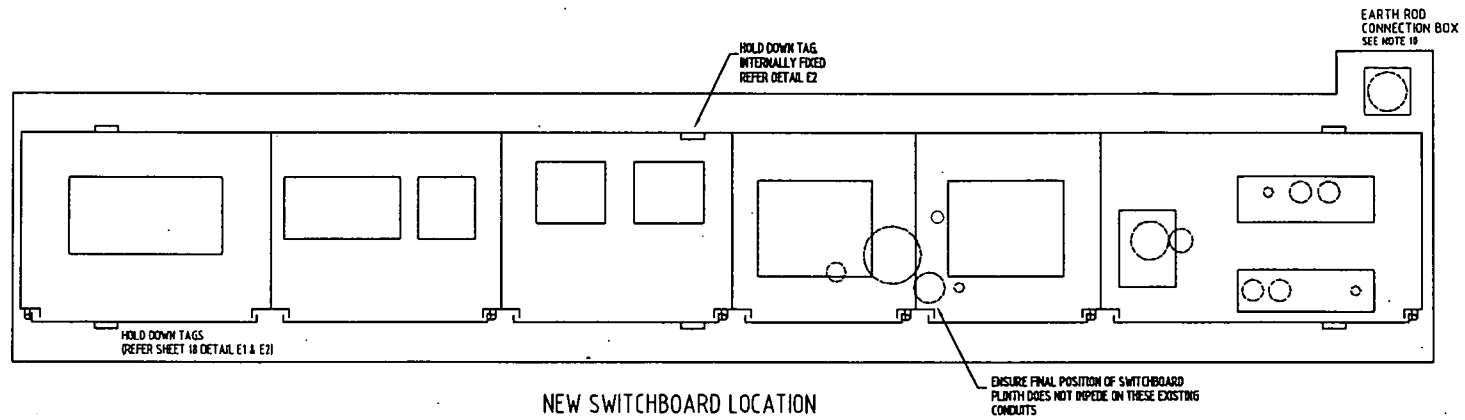
STD TEMPLATE SP-3P-VSD-RTU Ver1.2



CONCRETE SLAB LAYOUT



NEW CONDUIT DETAILS

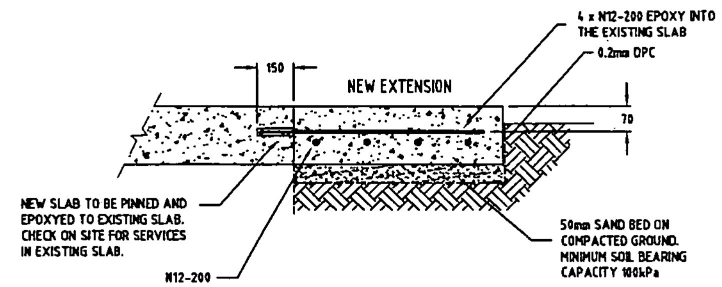


NEW SWITCHBOARD LOCATION

FIX TO CONCRETE SLAB AT FRONT & REAR

(ENSURE EXISTING CONDUITS ARE NOT IMPEDED)

ROAD

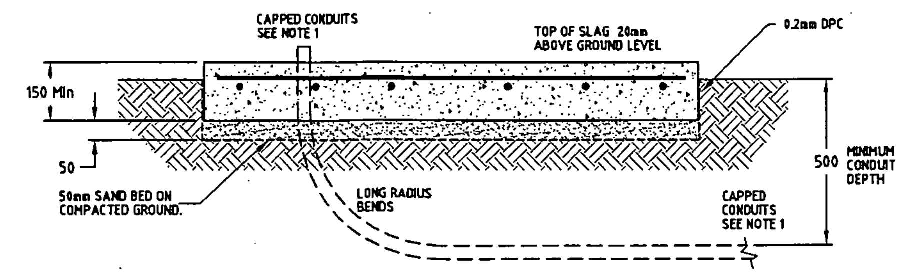


TYPICAL FRONT SECTIONAL ELEVATION

(CONDUITS NOT SHOWN)

NEW & EXISTING SLAB & CONDUITS

ALL DIMENSIONS TO BE CONFIRMED ON SITE



DETAIL - 1

TYPICAL CONDUIT INSTALLATION

CONCRETING NOTES

1- A NEW BASE SLAB EXTENSION SHALL BE POURED TO PROVIDE A STABLE, LEVEL PLATFORM FOR THE NEW SWITCHBOARD. THE NEW SLAB EXTENSION SHALL BE PINNED TO THE EXISTING SLAB AS DETAILED ON THIS DRAWING.

2- ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH CURRENT AUSTRALIAN STANDARDS, CODES AND RELEVANT BUILDING AUTHORITY BY-LAWS.

3- ALL CONCRETE SHALL COMPLY WITH THE AUSTRALIAN STANDARDS CONCRETE STRUCTURES CODE AS3600-2001 AND THE BRISBANE WATER REFERENCE SPECIFICATION FOR CONCRETE WORK PSE-SSS002.

4- ALL CONCRETE SHALL BE GRADE N32 . THE MAXIMUM SIZE OF AGGREGATE IN THE CONCRETE SHALL BE 20mm.

5- EXPOSED EXTERNAL EDGING SHALL FINISHED WITH AN ARRIS TO MATCH THE EXISTING BASE SLAB.

6- THE CONTRACTOR SHALL DETERMINE THE FINAL DIMENSION OF THE WIDTH OF THE NEW BASE SLAB EXTENSION IN ORDER TO MATCH THE EXISTING BASE SLAB.

7- PENETRATIONS FOR CONDUIT STUBS SHALL BE ALLOWED FOR IN ACCORDANCE WITH THE CONDUIT LAYOUT SHOWN ON THIS DRAWING.

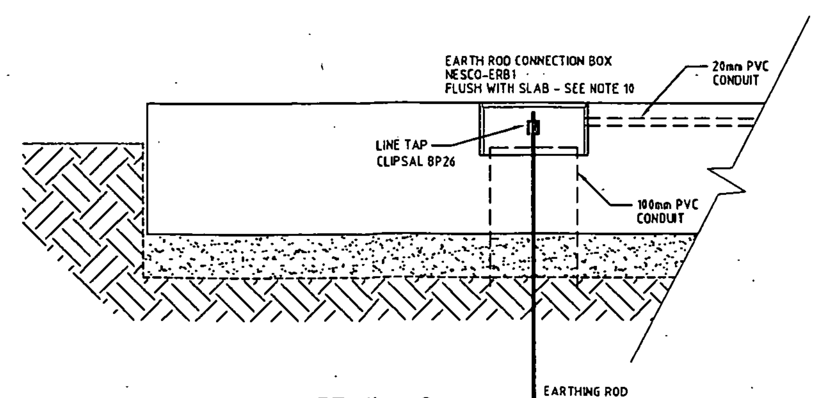
8- THE CONTRACTOR SHALL IDENTIFY ALL THE SERVICES WITHIN THE IMMEDIATE AREA THAT MAY BE AFFECTED BY THE INSTALLATION OF THE NEW SLAB AND CONDUITS. THESE SERVICES SHALL BE PROTECTED AND MAINTAINED.

CONDUIT NOTES

9- PVC HEAVY DUTY ELECTRICAL CONDUITS (ORANGE) CASTED INTO NEW CONCRETE PLINTH EXTENSION. ALL CONDUITS FITTED WITH LONG RADUIS BENDS AND EXTENDING 300mm BEHOND PLINTH EDGE. ALL CONDUIT FITTED WITH END CAPS TO PREVENT THE INGRESS OF MOISTURE AND SOIL.

10- NESCO 'ERB1' EARTH ROD CONNECTION BOX TO BE CAST IN AND FLUSH WITH SLAB. ALLOW A MIN. OF 50mm CLEARANCE FROM CONNECTION BOX TO BASE OF SWITCHBOARD. 100mm CONDUIT CAST VERTICALLY IN SLAB TO EXTEND FROM INSIDE CONNECTION BOX, DOWN TO GROUND LEVEL. THIS CONDUIT ALLOWS FOR THE INSTALLATION OF AN EARTH ELECTRODE. 20mm CONDUIT FOR EARTH IS TO BE MARRIED INTO THIS CONNECTION BOX PRIOR TO POURING ANY CONCRETE WORKS. REFER DETAIL 2

11- 25mm COMMUNICATIONS CONDUIT (WHITE)



DETAIL - 2

EARTH ROD CONNECTION BOX

Sheet 24

AS BUILT

No	DATE	AMENDMENT	DRN.	APD.
A	11.07	RE-ISSUED FOR TENDER	P.H.	A.W.
C	12.08	AS BUILT	P.H.	A.W.
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B.C.C. FILE No.	

Original Signed by A.WITTHOFT		21.06.07
DESIGN	R.P.E.Q. No.	DATE
Original signed by R.JANFADA	5192	21.06.07
DESIGN CHECK	R.P.E.Q. No.	DATE

Orig Signed by F.FORNASIER	27.06.07
PRINCIPAL DESIGN MANAGER	DATE
Original Signed by P.SHERRIFF	28.06.07
CLIENT DELEGATE	DATE

BRISBANE WATER

SITE
SP126
YOUNGS ROAD
SEWAGE PUMP STATION

TITLE
SWITCHBOARD
SLAB & CONDUIT DETAILS

SHEET No. 24

BRISBANE WATER DRAWING No. 486/5/7-0039-024

AMEND. C

STD TEMPLATE SP-2P-VSD-RTU Ver1.2