

Hornick Constructions

Bracken Ridge Road Sewage Pump Station

CONTRACT BW 300077- 02/03

Job Number JO 7002

ELECTRICAL SERVICES

OPERATIONS and MAINTENANCE MANUAL

MANUFACTURED BY

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Completed June 2003

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Email: graemec@sjelectricnsw.com.au ELECTRICAL ENGINEERS. CONTRACTORS & SWITCHBOARD MANUFACTURERS



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GENERAL

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Page 1

General Workplace Health and Safety

- The Queensland Workplace Health and Safety Act (1995) details minimum requirements relating to safe working in the electrical industry. Nothing in this document is designed, in any way, to undermine the authority of the Act.
- All reasonable care must always be taken to ensure the plant is without risk to the health and safety of personnel operating and maintaining plant and equipment.
- Employers have an obligation to ensure the workplace health and safety of all personnel at work.
- It is employer responsibility to ensure that all persons entering or working on the premises use appropriate personal protective equipment.
- Personal protective equipment includes gloves, safety glasses, hard hats, ear protection, safe foot ware and, where necessary, specialist protective clothing for hazardous areas.
- Any item of equipment should always be isolated before maintenance or repairs commence to ensure that inadvertent operation of the item does not result in risk to the health and safety of any person.
- Where the item is isolated, any total or partial shutdown should not allow a hazardous situation to be created.
- Where the item cannot be isolated, another person should be stationed at the controls of the item and an effective means of direct communication should exist between the persons carrying out the maintenance and the person at the controls.

General Operating Principles

- All persons working the premises must be qualified Electrical Engineers or electrical trades persons capable of performing the required tasks competently. All personnel must also be familiar with plant and equipment.
- Adequate information, instruction, training and supervision must be provided to enable personnel to perform work without risk to health and safety.
- Work in an orderly way.
- Plan work in advance to avoid hazardous situations.

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- · Warn others of any hazards.
- Make inquiries before starting work, particularly on any unfamiliar installation or equipment.
- Before any work begins ensure that any instructions received or given are fully understood.
- · Concentrate on the task on hand.
- Do not distract others or allow yourself to be distracted by foolish actions.
- Work from a safe and convenient position that provides a maximum working space that you do not have to over reach, you cannot slip, trip or stumble and so endanger yourself and others.
- Keep the working area tidy and free of unwanted materials and equipment.
- Use insulated tools where possible.
- Inspect tools and equipment regularly and ensure that any necessary maintenance is carried out.
- Keep yourself in good health.
- Do not work if ill or over tired, to the extent that your concentration, movement or alertness is affected. Illness or fatigue can endanger yourself and others.

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Project Overview

As the electrical sub contractor for Hornick Constructions, SJ Electric provided electrical services for one new sewage pump station (SPS 296) and the upgrading of two existing pump stations (SPS 211 & SPS 273) in the Brisbane suburb of Bracken Ridge.

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

- Switchboards.
- Field Cabling.
- Instrumentation.

The switchboard incorporates the latest technology in motor control, power monitoring, and instrumentation. It is important engineers, technicians and operators are familiar with the equipment installed before attempting any adjustments, modifications or maintenance.

The following Sections of this manual contain a comprehensive description of all equipment supplied, by SJ Electric . It is recommended that this manual be referred to before carrying out any work on any equipment.

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Plant Maintenance

To ensure proper operation of the plant the following should be observed :-

- The plant should be kept clean and tidy at all times. Not only is this of aesthetic value, it extends equipment life.
- Check that all plant and equipment is operating correctly. Correctly
 operating equipment promotes overall plant efficiency.
- All items and areas of equipment should be hosed down and cleaned regularly.

WARNING

- Avoid directly hosing any drive motor or electrical item.
- All maintenance, service, modifications and significant deviations from Normal operating conditions should be recorded in the Plant Service Log
- After a month of operation, check the tension of all bolts associated with the plant and thereafter periodically. Bolted connections on painted surfaces can loosen due to thinning of the paint underneath the bolt head bearing surface. Motor mounting bolts and other bolted connections subjected to vibration should be periodically checked for loosening.

WARNING

- Before starting work on any item ensure that the power supply is isolated, tagged off, and the item cannot be started.
- The importance of preventative maintenance cannot be over-emphasized.
 Regular maintenance and suitable care of the equipment will ensure a long and reliable service life of the equipment.
- Many stoppages can be avoided by following the recommended maintenance procedures. Do not wait until you hear the grinding of equipment that has broken down. If you see any item wearing down, replace it, before it causes damage to other associated items.

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Preventive Maintenance

Maintenance procedures recommended to extend switchboard life are outlined as follows:-

- Switchboard exterior should be regularly wiped down with a solvent base cleaner such as "Spray & Wipe". This will ensure longevity of the powder coated surface.
- Accessible areas like distribution boards and motor starter panels should be cleaned with a vacuum cleaner to remove dust and foreign matter.
- PLC panels should be maintained as dust free as possible. Dusting with a
 dry rag is recommended taking care not allow dust inside the I/O
 modules or processor.
- When removing or installing PLC modules care should be taken to ensure that power is turned off to the rack before modules are removed or installed.
- Connections and efficient operation of circuit breakers, contactors and isolators should be checked every 12 months - especially where connected to busbars.
- · Busbar connections should be checked every 12 months.
- Globes for indicator lights should be checked on a weekly basis with any faulty lamps replaced.

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Electrical Control System

General Description

The switchboards are manufactured from 2mm zincaneal or 2mm stainless steel depending on their location and contain several separate sections including:

- Incoming Section.
- Metering.
- Motor Starter Section.
- · Distribution Section.
- RTU Section.

Control and Monitoring System.

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

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MANUFACTURER'S TECHNICAL DATA

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Email: graemec@sjelectricnsw.com.au ELECTRICAL ENGINEERS, CONTRACTORS & SWITCHBOARD MANUFACTURERS



SP296 Brack	ken Ridge Road Bracken Ridge No 2 SPS Electrical Services OM Manual	
		2
MANILLA		
MANILLA BRIGHT DIVIDERS 5 TAB A4		
5 TAB A4		
marbig		
Ref. No. 37100 Made in China		
9 312311 371009		
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TECHNICAL DATA SHEET

For

SPS 296

Circuit Breaker **Equipment Type:**

Main Incomer Location:

Generator Incomer

XS 630 NJ Model Numbers:

Terasaki Manufacturer:

NHP. Supplier:

25 Turbo Drive

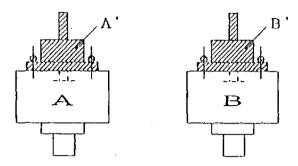
Cooparoo QLD 4151

Ph: 07 3891 6008 Fx: 07 3891 6193

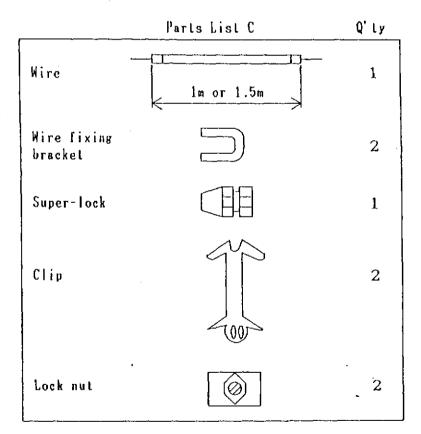
TYPE XLW WIRE SYSTEM INTERLOCK

When unpacking the shinpment, check that the product is free of damage.

The product is shipped with the molded case circuit breakers and Type XLW wire system interlock mechanism combined.



Accessories (in bag):
Two types of accessories are available
(for 1m or 1.5m wire length)



After installing A+A' and B+B' for molded case circuit breakers shown above in the switchboard, use the accessory parts for mutual interlock.

Refer to Arrangement Procedure and the Installation Procedure

TYPE XLW WIRE SYSTEM INTERLOCK

50mm or more

15

m m

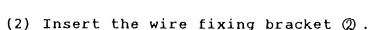
37~

38mm

Installation Procedure:

(1) Put the outer wire and inner wire

① into the wire adjusting bolt ①





Bend the wire fixing bracket (1) so that it does not come off.

(4) Pass the inner wire through the hole and fix it with M3 push screw ().

Fix the wire so that it protrudes approx. 15mm.

When fixing, set the shaft position to 37 to 38mm.

(Push it lightly in the direction indicated by the arrow so that no play is found: the shaft position will be 37 to 38mm.)

(5) For more safety, install the lock nut (5).

Upon completion of the setting at one side, set the remaining side as well in the same manner.

[Check]

Turn on the breaker at one side and also perform the closing operaion of the other breaker, and check that the both are interlocked.

If the breakers are not closeable, it follows that the setting is completed.

If an auxiliary switch is provided, check that the switch does not malfunction.

[Wire Support Method]

Support the wire with the supplied clip so that no external force is applied.

· For 1m wire, support the center position with a clip.

For 1.5m wire, support 2 points at nearly equal intervals, using a clip.

```
(Clip mounting hole diameter: 4.8^{+0.2}_{0}mm) (Clip mounting plate thickness: 0.5 to 1.6mm)
```

· When the wire passes through the plate, use the supplied superlock.

For 1m wire, no clip is required.

For 1.5m wire, support it with 2 clips.

```
(Super-lock mounting diameter: 13<sup>10.5</sup>mm)
(Super-lock mounting plate thickness: 0.5 to 1.6mm)
```

TYPE XLW WIRE SYSTEM INTERLOCK

(When only one of two breakers can be placed in ON-state)

'Arrangement Procedure:

This type can be mechanically interlocked mutually with a single wire between two Tem series molded case circuit breakers (also available between different type of bereaker).

There is no limit to the mounting position as with our XLB see-saw type interlock and XLF slide type interlock; therefore, this type can be located optionally in all directions. (Maximum Pitch=1m. See Fig.1 or 2)

In the presence of a partition wall between two molded case circuit breakers, make a $13^{+0.5}_{0}$ mm dia. hole through the wall and pass the wire for interlocking; thus, it can form a switchboard requireing safety and with a higher importance.

Super-lock used at the wall cutout

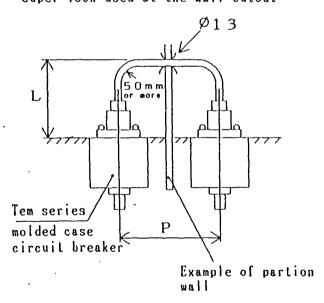
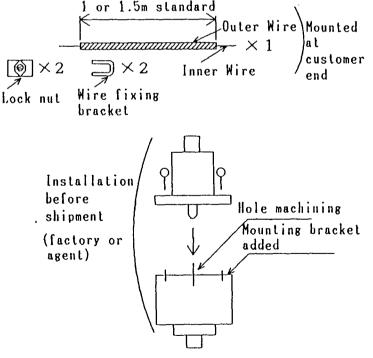


Fig. 1 Norizontal Arrangement



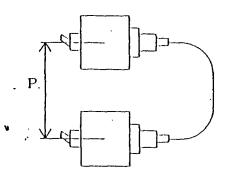


Fig. 2 Vertical Arrangement

Table 1 Hounting Size and Supporting Hethod

Wire length	Mounting position, Pitch(P)		Wire support
1.5m	1000	550 600 1 700	Support 2 points at equal intervals. (Use the supplied clips)
1.Om	650 500 350 *1. *2.	450 ↓ 500 ↓ 530 ↓	Support one center position. (Use the supplied clips)

*1: 60mm + Partition wall thickness between breakers

*2: Arc base distance for vertical arrangement

TemBreak MCCB's



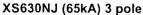
XS630 and XS800 series thermal magnetic type

- ☐ Adjustable range 63 100% of nominal current rating.
- ☐ Standards AS 2184/AS 3947-2.
- ☐ Adjustable thermal, fixed magnetic type.
- ☐ Max. voltage (INSUL) 690V.

XS630CJ (45kA) 3 pole

Ampere

rating	Min	Max	Cat. No.
400	250	400	XS630CJ/4003
630	400	630	XS630CU 630/3 5
630	Non-Auto (9.6	kA for 0.3sec) ⁴)	XS630/NN/31/)



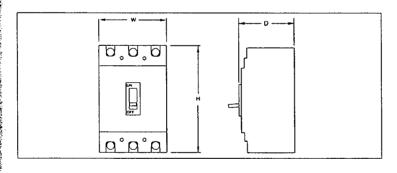
400	250	400	XS630NJ/4003
630	400	630	XS630NJ 630 3

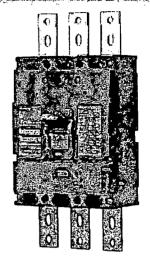
XS800NJ (65kA) 3 pole 3)

800	500	800	XS800NJ 800 3
800	Non-Auto (9.6	kA for 0.3sec) 1)	XS800NN 3 ()

Dimensions (mm)

Description		Height 2)	Width	Depth	kg	
XS630NJ/CJ	3 pole	273	210	103	9.0	
XS800NJ	3 pole	273	210	103	9.4	





Short circuit capacity

Model	I/C	Voltage	
XS630CJ	45 kA (AS 2184)	415V 50Hz	
XS630NJ	65 kA (AS 2184)	415V 50Hz	_
XS800NJ	65 kA (AS 2184)	415V 50Hz	_

Refer this section for ratings to AS 3947-2 and AS 2184, and lcs/lcu.

DC use	I/C ⁵)	Voltage
XS630CJ	40 kA	250V DC
XS630NJ	40 kA	250V DC
XS800NJ	40 kA	250V DC

Product extensions

Chassis (MHC, UHC)	
TemCurve	
Residual current relays	

Base standards IEC 947-2

65 EN 60947 Part 2
VDE 0660 Part 1
AS 3947-2/Australia
AS 2184-1990/Australia
NEMA USA
ANSI C37. 13/USA
JIS C 8372/JAPAN
JEC 160/JAPAN

Approvals

ASTA/UK, Aust. standard
Marine
NK/JAPAN
LR/UK
AB/USA
GL/GERMANY
BV/FRANCE
DNV NORWAY

Notes: 1) Load-break isolating switch only - no short circuit protection.

- 2) Height excludes attached busbar.
- 3) For stocked 4 pole models
- 4) MCCB's only. Short time rating.
- 5) Poles is series.

MCCB Technical data



Connections and mountings

Terminal screw

Conductor

(not supplied)

Assembling plate

Can be changed by the user

Rear-connection type (RC)

MCCB accessories

Bolt stud

fixing bolt

Horizontal (standard)

Breaker

mounting screw

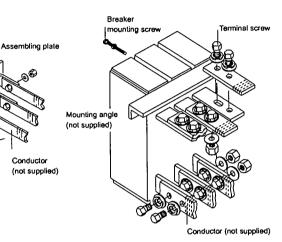


Terminal screw

Conductor

Vertical

Flat bar stud



Applicable breakers

- ☐ XE series XE225NC
- XS series XS250, XS400 XS630, XS800.

- □ XH series XH160, XH250, XH400, XH630, XH800.
- ☐ XM series XM30PB.

Bat stud fixing bol

Applicable breakers

Horizontal 1) XS1250, XV1250NE

XS1600, XS2000NE Vertical

XS2500NE.

Notes: The arrangement of the flat bar can be made by the user.

If not specified the horizontal arrangement will be supplied.

1) Vertical arrangement also available on request, contact NHP for details.

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MCCB Technical data

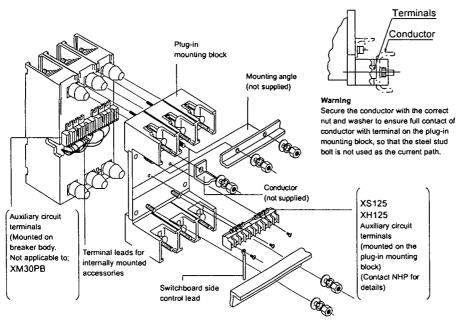


Types of connections and mountings

MCCB accessories

Plug-in Type

Switchboard use



Types of plug-in mounting blocks for switchboard use

Series	Breaker	Pole	Туре
X51 35.23	X57256267#;;		X01/12******
	X\$*25KJ/#		
	XE223NO FE		хойения
	XEZSÜKÜĞĞ		
	x5400 ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;	3) [[4]; <u>4</u>];	
			XDN 525-1524
	Øsetti (1855)	grangstr	XDM6 Str. Str.
	(X 5.1256 1 4.5).		<u>XDNBX:P</u> TUJYJ
XH: FF;			XUVETTIKE
	Wilderfür		X 766 257 25
\$ 1 1 1 1 1 1 1		87 .0 0.2223	XeXexex
	XHZ=QQJ***		X5004 35125
	3X(14000);;;;::::		Apple and the
		30 22 0 10 20 0	Biologica in the state of the s
			<u>ង្គល់ប្តីក្</u> បែត្រូវប្រ
XM: E	(XVI30PB ** 715*)		

IP 20 degree of protection and safety trip ') are available for plug-in type breakers, for switchboard and distribution board use.

Plug-in type

Degree of protection 🗓

The degree of protection provided by the mounting blocks for plug in type TemBreak is IP 20 as defined in IEC Pub 529

Standard Safety Trip (Trip first plug-in mechanism) indent.

☐ The breaker will trip automatically if it is withdrawn while still in the "ON" position. It is not possible to "plug-in' the breaker when it is in the "ON" position.

Note: ') Available on indent only.



MCCE Technical data

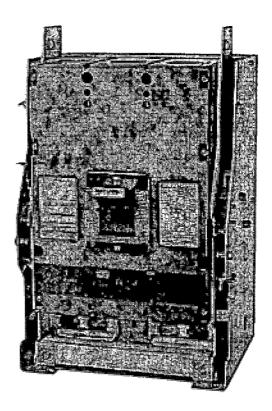


Types of connections and mountings

Draw-out type (DO indent)

Two-position type i

- ☐ XS series
 XS400, XS630, XS800, XS1250.
- ☐ XH series XH160, XH250, XH400, XH630, XH800.
- The plug-in type breaker is housed in the draw-out cradle.
- ☐ The draw out cradle has two positions "connected" and "isolated".
- ☐ The auxiliary circuits are automatically connected or isolated by the auxiliary circuit terminals on the plug-in breaker.
- ☐ Manual connector type is available.
- Safety trip (first draw out mechanism). The breaker will trip automatically if it is drawn out while still in the 'on' position.
- Position keylock in isolated position (optional). Available on request.
- ☐ IP 20 degree of protection (optional). Available on request.





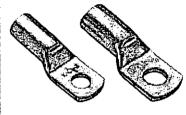
MCCB Technical data



Crimp lugs (compression type)

Nominal wire size (mm²)

Frame (A)	Breaker	1.5	2.5	4	6	10	16	25
XM30	XM30PB	100, 200, 200, 75	1. S.	$L \subset L \cap L \cap L \cap L$	the second of the second	CAL 10-5	Service and the service of	73 () () () () () () () () () (
		©MT2-5,≘ M	MT2.5 = M	ÆMT4∴M5	: : 4MT6≟ M5	MT10 M5	#;MT16=M5	ir Max
125	XS125CJ		CAL2 5 - 8	CAL4-8	" CAL6≌8	CAL10-8	CAL16-8	CAL25-8
	XS125NJ	MT2.5 = MI	MT2.5 ≃MI	3.GMT4≟M8	MT6=M8	MT.10=M8	LTMT16≅M8	:- MT25-M83
	XH125NJ							
	XH125PJ							
	TL100NJ				争争的	10.44		
	TL30F							

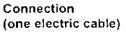


					Nominal wire size (mm²)					
Frame (A)	Breaker	35	50	70	95	120	150	185	240	300
160	XE225NC	CAL-35-8	CAL50-8-V	CAL70-8	CALB95-8	CALB120=8	CALB150-8			
225	XS250NJ	MT35,-M8	MT50.≓M8	MT70 = M8 =	40.0					
250	XH250NJ					a i a				
	XH160PJ			7.7						
400	XS400CJ	CAL35=10	CAL50-102	iCAL70=10⊭	CAL95#10%	CALB120≟10	CALB150-10			
	XS400NJ	MT35,≐M103	MT50 – M10	MT70 = M10 =	MT95 <u>-</u> M101					
	XS400NE									
	XH400NE									
	XV400NE									
	XS400SE									
	XH400SE									
	XH250PJ				1 A 10 A 10 - 5					
	TL250NJ		15 325 le							
	TL400NJ		Marie San	(C) 4 5	on second					
	XH400PJ									
	XH400PE	Terror					Mari N			
630	XS630CJ/NJ	CAL35-12	GAL50-12	CAL70-12	CAL95=12	CAL-120-12	CAL-150-12	CAL185-12	CAL'240=12	. CAL300-12
800	XH630NE/SE	МТ35 М12	MT50 = M12	МТ70.≃М12	MT95∰M12	MT120.≓M12	MT150 = M12.I	ит 185 – М1	MT240-M12	
	XS630NE/SE			4377.489						
	XS800NJ/PJ						/			
	XS800NE/SE			4			· 为中身外。			
	XH800NE/SE		46							
	XH800PE									
1250	XS1250NE	The same of the sa		(CAL70-12)	1CAL95=12/	CAL120-12	CAL 150-12	CAL185⊕12	ICAL240-12	CAL300-12
	XV1250NE			MT70 = M12	MT95 = M12	MT120 M12	-MT150,-M12 ³ l	MT 185 = M1	2 MT240 - M12	14.5

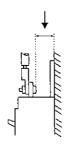
圖型题 Commercially available compression terminals available from CABAC - Cable Accessories and JST Australia.

Key: CAL = CABAC lugs

MT = JST lugs

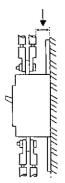


If low clearance occurs use a recommended tape or insulation.



Connection (two electric cables)

If low clearance occurs use a recommended tape or insulation.



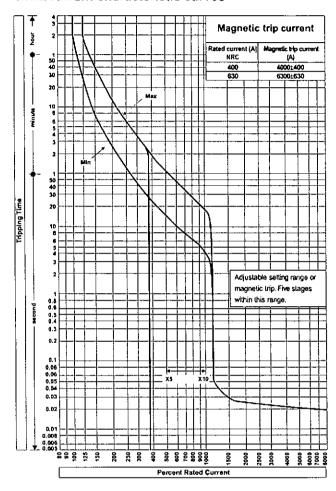


MCCB Technical data

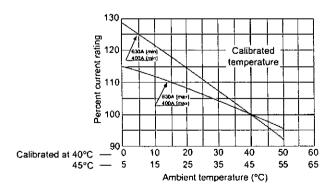


XS630CJ, XS630NJ

Time/current characteristic curves



Ambient compensating curves



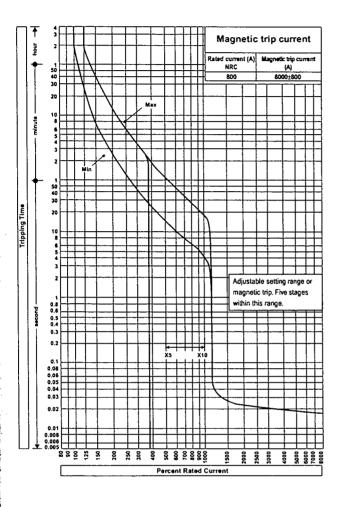


*MCCBTechnical data

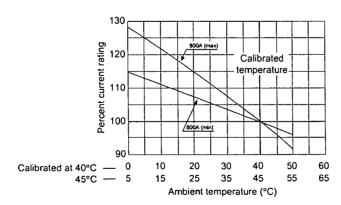


XS800NJ

Time/current characteristic curves



Ambient compensating curves



(E) TERASAKI

MOCE Technical data

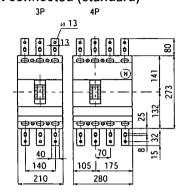
NGIE

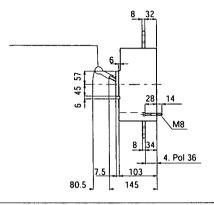
TemBreak 630A frames XS630

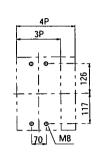
ASL: Arrangement Standard Line

Outline dimensions (mm)

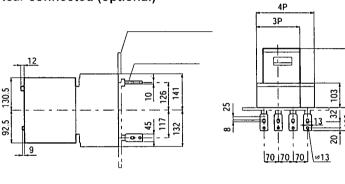
Front connected (standard)

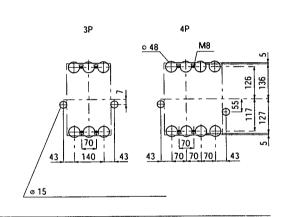


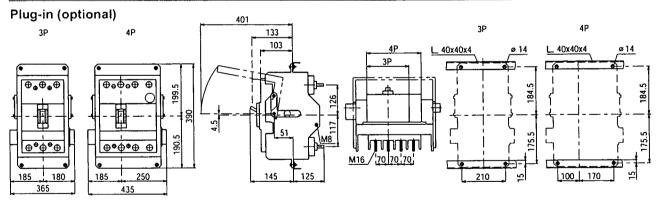




Rear connected (optional)







(E) TERASAKI

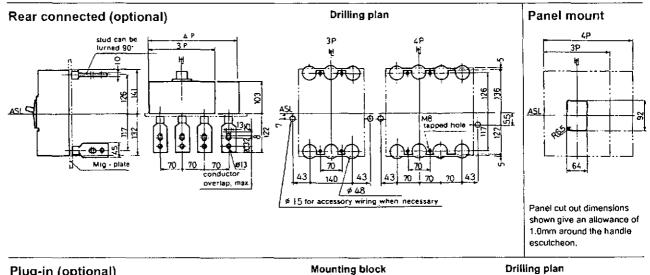
MCCB Technical data

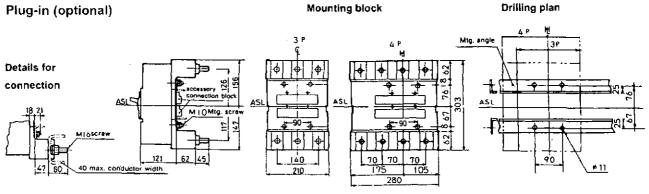


TemBreak 800A frames XS800

ASL: Arrangement Standard Line
H: Handle frame centre line

Outline dimensions (mm)





(I) TERASAKI

MCCB Technical data .



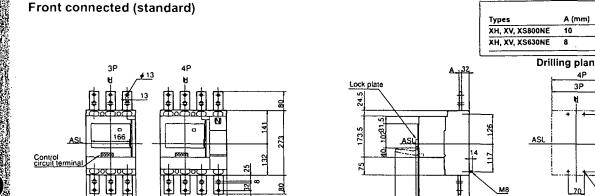
B (mm)

29

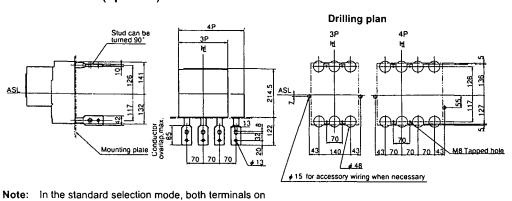
Motor operators for XS630 XS800

MCCB accessories

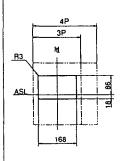
Outline dimensions (mm)



Rear connected (optional)

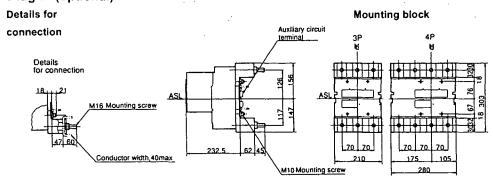


Panel cutout



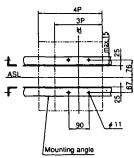
Panel cut out dimensions shown give an allowance of 1.0mm around the motor operator frame.

Plug-in (optional)



the line side and the load side are in the horizontal direction.

Drilling plan



(F) TERASAKI

Application data



Miniature circuit breakers and fuse fault current limiters co-ordination chart

For fault current levels up to 50kA at 415V

Circuit breaker			Maximum fuse – amp			
Туре	Rating amps	Min. fuse amps ')	BS 88	DIN		
			P. P. M. LATTER			
SRCB ((V) SILE)		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		1460 - F		
	######################################		771237000	列列(200万年)		
pine 6 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -			Ŧĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸ			
Din-1/10 &			22/200235			
Din-Tri5 Kies.es. j			**************************************			
				。 "妈妈我想到我们		
			200:15-2			
			######################################			
DROBHUS COMASSE						
(nka); e e e e e e e						
Dinestro Herrica Carrosa				2005		
				200		
				#14.75 3.V250 3.H. 21.S.H		
			en e			

Tembreak MCCB's

Notes:

- Minimum fuse size is based on grading under overload of one MCB with one set of fuses. Where a single set of fuses protects more than one MCB, the minimum fuse size shall be increased to allow for load biasing effects.
- 2) Maximum fuse size based on testing to AS 3439.1 clause 8.2.3.

Tables based on the following maximum pre-arching I 2 t for both BS 88 and DIN fuses: $160A-0.62\times10^5$, $200A-1.2\times10^5$, $250A-2.1\times10^5$. Suitable fuses include NHP, GEC, Siemens and Bovara-Crady.

Fuses with higher current ratings may be used providing I²t values are equal to, or less than the levels above. Semi-conductor fuses have very low I²t values and may suit some applications.

Attention is also drawn to AS 3000 clause 7.10.4.4 regarding the use of fault current limiters in installations containing fire and smoke control equipment, evacuation equipment and lifts.

Q-Pulse Id TM\$1102 Active 10/12/2014 Page 37 of 622

SP296 Bracken Ridge Road Bracken Ridge No 2 SPS Electrical Services OM Manual Page 38 of Q-Pulse Id TM\$1102 Active 10/12/2014



TECHNICAL DATA SHEET

For

SPS 296

Circuit Breaker **Equipment Type:**

Pump Starter Cubicle Location:

XS 250 NJ **Model Numbers:**

Terasaki Manufacturer:

NHP. Supplier:

25 Turbo Drive

Cooparoo QLD 4151

Ph: 07 3891 6008 Fx: 07 3891 6193

SP296 Bracken Ridge Road Bracken Ridge No 2 SPS Electrical Services OM Manual **Assembly process**

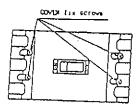
Accessory Assembly for external handle (XFH)

(A)

ALMOVE UNE HOLDED COVER SCREAKS.

II LOOSEN (pes FOLDED CONDS for services,

(B)



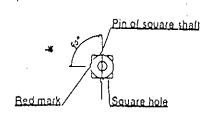


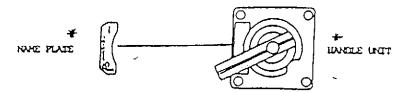
Type XH 250NJ

XS250NJ



SLICK the NWE PLATE to the INVELL UNIT.

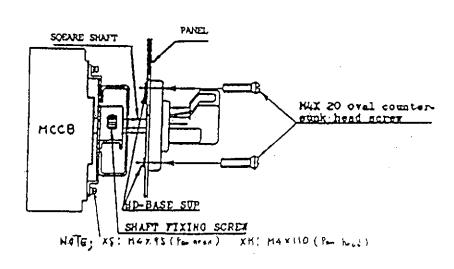




HANDLE UNIT ATTACHMENT

- 1) Place the HANDLE UNIT to the FRONT of PANEL and insert 4pcs MAX 20 oval countersunk head screws, and attach 2pcs HD-BASE SUP from inside of PANEL and Lighton 4 screws.
- After adjust position of square shaft tighten shaft fixing screw (allen type setscrew).

- Hotes 1) This drawing shows clockwise handle assembly. The mounting screws and assembly process is the same for clockwise or anti-clockwise handles.
 - 2) Some mounting kits are marked with an ' * ' the mounting arrangement is mirrored to that shown in the diagrams.
 - 3) NHP supplies anti-clockwise handles as standard





SHAFT



X5-25Q

(E) TERASAKI

TemBreak MCCB's



XS250 and XH250 series

- ☐ Adjustment range 63 100% of nominal current rating.
- ☐ Standards AS 2184/AS 3947-2.
- ☐ Adjustable thermal, fixed magnetic trip.
- ☐ Max. voltage (INSUL) 690V.

XS250NJ (35kA) 3 pole

rating	Min	Max	Cat. No.
160	100	160	XS250NJ 160 3
250	160	250	XS250NJ 250/3
250	Non-Auto (3)	kA for 1sec) 4)	XS250NN 3 // 💉

XS250NJ (35kA) 4 pole

160	100	160	XS250NJ-160r4
250	160	250	XS250NJ 250/4
250	Non-Auto (3F	(A for 1sec) 1)	XS250NN:4)

XH250NJ (50kA) 3 pole

160	100	160	XH250NJ5160 3
250	160	250	XH250NJ 2503

XH250NJ (50kA) 4 pole

160	100	160	XH250NJ 160 4
250	160	250	¥XH250NJ 250,43

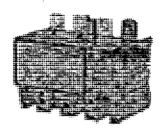
Dimensions (mm)

Description		Height	Width	Depth	kg	
XS250NJ	3 pole	165	105	86	1.85	
XH250NJ	3 pole	165	105	103	2.1	
XS250NJ	4 pole	165	140	86	2.4	
XH250NJ	4 pole	165	140	103	2.6	

Notes: ') Isolating switch only - no protection.

- ²) MCCB's only.
- ') Poles in series.
- ') Short time rating. Refer rating chart for complete technical data. Special low instantaneous magnetic generator protection MCCB's available on request.





Bolt on earth leakage module ELB 250

Short circuit capacity

Model	I/C	Voltage	
XS250NJ	35 kA (AS 2184)	415V 50Hz	
XH250NJ	50 kA	415V 50Hz	
DC use	1/C ³)	Voltage	
XS250NJ	40 kA	250V DC	
XH250NJ	40 kA	250V DC	

Refer this section for ratings to AS 3947-2 and AS 2184, and Ics/Icu.

Product extensions

Chassis (TemWay, MHC, UHC)	
TemCurve	
Residual current relays	

Base standards

IEC 9	147-2
BSE	N 60947 Part 2
VDE	0660 Part 1
AS 3	947-2/Australia
AS 2	184-1990/Australia ²
NEM.	A USA
ANSI	C37. 13/USA
JIS C	8372/JAPAN
JEC	160/JAPAN

Annrovals

Approvais
ASTA/UK, Aust. standards
Marine
NK/JAPAN
LR/UK
AB/USA
GL/GERMANY
BV/FRANCE
DNV NORWAY



. MCCB Technical data-

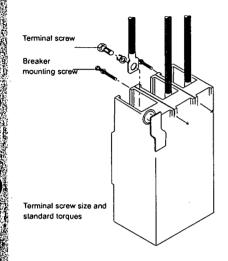


Connections and mountings

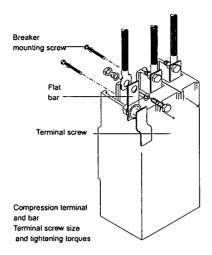
MCCB accessories

Front-connection type (FC)

Compression terminals



Attached flat bar



Types of terminal screws (Compression terminal and bar)

Rreal	kers	and	screw	Siza

	XE series (Economical)		XS series (Standard)		XH series (High-fault level)		XM series (Motor protection)	
Pan headed screw								
			XS125CJ	M8	XH125NJ	M8	XM30PB	M5
			XS125NJ	M8	XH125PJ	M8		
Hex socket head bol	t							
	XE225NC	M8	XS250NJ	M8	XH250NJ	M8		
					XH160PJ	M8		
			XS400	M10	TL250NJ	M10		
			XH400	M10	TL400NJ	M10		
			XV400	M10	XH250PJ	M10		

(a) TERASAKI

MCCB Technical data



Connections and mountings

Rear-connection type (RC)

MCCB accessories

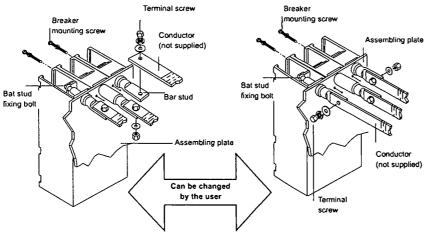
Bolt stud

Horizontal (standard)

Vertical

Flat bar stud

Breaker



Mounting angle (not supplied)

Conductor (not supplied)

Applicable breakers

- ☐ XE series XE225NC
- □ XS series XS250, XS400 XS630, XS800.

☐ **XH** series XH160, XH250, XH400,

XH630, XH800.

☐ XM series XM30PB.

Applicable breakers

Horizontal 1) XS1250, XV1250NE

Vertical XS1600, XS2000NE

XS2500NE.

Notes: The arrangement of the flat bar can be made by the user.

If not specified the horizontal arrangement will be supplied.

1) Vertical arrangement also available on request, contact NHP for details.

(D) TERASAKI

MOCB Technical data:

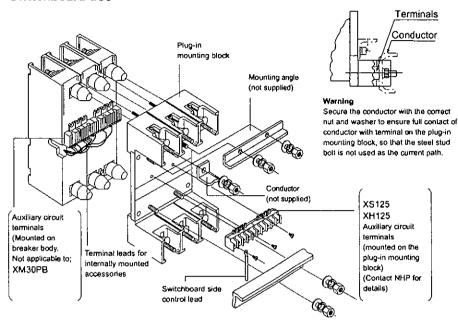


Types of connections and mountings

MCCB accessories

Plug-in Type

Switchboard use



Types of plug-in mounting blocks for switchboard use

Series	Brauher	Marke:	Latini .
	de f. de e les districtes de la constant de la cons		
to the control of the			
	A Sanda de Barrando		

IP 20 degree of protection and safety trip 1) are available for plug-in type breakers, for switchboard and distribution board use.

Plug-in type

Degree of protection 🗓

The degree of protection provided by the mounting blocks for plug in type TemBreak is IP 20 as defined in IEC Pub 529

Standard Safety Trip (Trip first plug-in mechanism) indent.

☐ The breaker will trip automatically if it is withdrawn while still in the "ON" position. It is not possible to "plug-in' the breaker when it is in the "ON" position.

Application table (up to 100A frame)

Breaker	IP cover code	Pole	Qty Req.
XS125	1P 20	2, 3P	1=2
XH125			

Note: ') Available on indent only.

(D) TERASAKI

MCCB Technical data



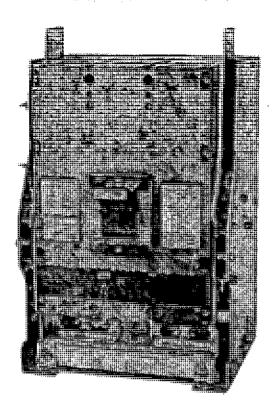
Types of connections and mountings

Draw-out type (DO indent)

Two-position type

Applicable breakers

- Applicable breakers
- ☐ XS series XS400, XS630, XS800, XS1250.
- ☐ XH series XH160, XH250, XH400, XH630, XH800.
- The plug-in type breaker is housed in the draw-out cradle.
- ☐ The draw out cradle has two positions "connected" and "isolated".
- ☐ The auxiliary circuits are automatically connected or isolated by the auxiliary circuit terminals on the plug-in breaker.
- ☐ Manual connector type is available.
- Safety trip (first draw out mechanism). The breaker will trip automatically if it is drawn out while still in the 'on' position.
- Position keylock in isolated position (optional). Available on request.
- ☐ IP 20 degree of protection (optional). Available on request.



(E) TERASAKI

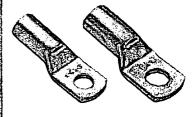
MCCB Technical data



Crimp lugs (compression type)

Nominal wire size (mm²)

Frame (A)	Breaker	1.5	2.5	4	6	10	16	25
XM30	XM30PB	*£CAL1.5=5	CAL2.5-5	No CAL4_5	siCAL6-5	-/-)CAL10–5	CAL16-6	
		MT2.5 M	5 MT2 5 – M	MT4=M5	MT6-M5	MT10=M5	∴ MT16=M	
125	XS125CJ	解3等	CAL2.5 ≧8	∵iCAL4=8	CAL6-8	CAL10-8	CAL16 =8	CAL25-8
	XS125NJ	MT2.5 ±M	8 MT2.5 - M	MT4: M8	MT6-M8	MT10-M8	MT16-M	MT25_M8_
	XH125NJ							
	XH125PJ		25 B		3.1704.53			
	TL100NJ							
	TL30F		(* 1855a),					

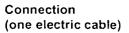


					Nominal	wire size	e (mm²)			
Frame (A)	Breaker	35	50	70	95	120	150	185	240	300
160	XE225NC	CAL35-81	CAL50-8	_ CAL70-84	CALB95-8.AC	ALB120_8	CALB150±8			
225	XS250NJ	MT35,=M8	MT50=M8	MT70 = M8 ==						
250	XH250NJ								•	
	XH160PJ									
400	XS400CJ	CAL35-10	CAL50-10	CAL-70-10	CAL95-10_C	ALB120_10	CALB150-10			
	XS400NJ	MT35/=M10	MT502-M10	MT70 =M10. I	MT95 ≑M10 <i>‡</i> ″					
	XS400NE									
	XH400NE									
	XV400NE									
	XS400SE			19 19 19 19 19 19 19 19 19 19 19 19 19 1						
	XH400SE									
	XH250PJ									
	TL250NJ				1 4 3.5 (4)					
	TL400NJ									
	XH400PJ									
	XH400PE									
630	XS630CJ/N	IJ CAL35-12	GAL50-12	CAL70≛i2b	CAL95-12, (AL 120-12	CAL150=12 (AL185-12	CAL240-12	CAL300-12
800	XH630NE/9	SE MT35 - M12	MT50 - M12	MT7,0M12-I	ИТ95 - М12 М	T120 = M12	MT,150 = M12₹M	IT185 ≟M12	MT240 - M12	
	XS630NE/S	SE SE								
	XS800NJ/F	y Maria					32			
	XS800NE/S	SE SE	表群隊							
	XH800NE/S	SENSON								
	XH800PE									
1250	XS1250NE	**************************************		- CAL70-121	CAL95-129-1	CAL120=12	CAL 150-12 (CAL 185-12	CAL240-12	CAL300-12
	XV1250NE			MT70 - M12	MT95	MT120 - M12	MT150 - M12 N	/T185 ⊋M1	2 MT240 - M12	

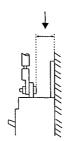
Commercially available compression terminals available from CABAC - Cable Accessories and JST Australia.

Key: CAL = CABAC lugs

MT = JST lugs

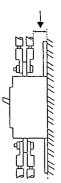


If low clearance occurs use a recommended tape or insulation.



Connection (two electric cables)

If low clearance occurs use a recommended tape or insulation.



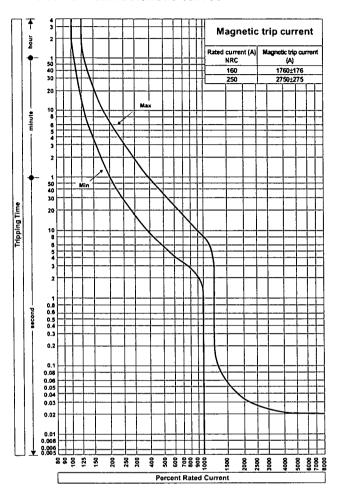


MCCB Technical data

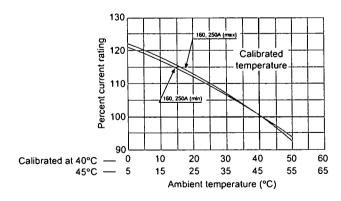


XS250NJ, XH250NJ

Time/current characteristic curves



Ambient compensating curves



(C) TERASAKI

MCCB Technical data 🚁



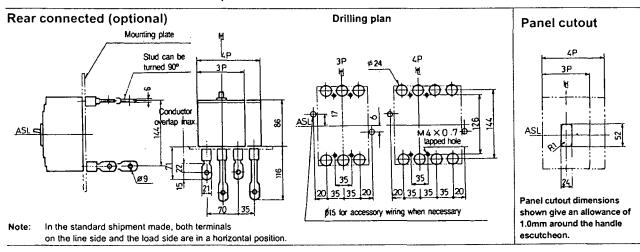
TemBreak XS250NJ

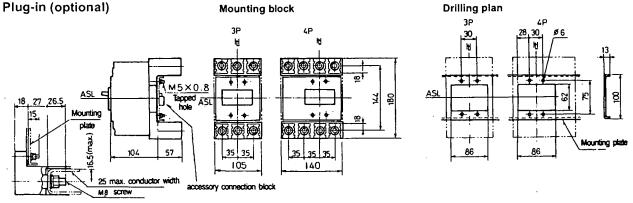
Outline dimensions (mm)

ASL: Arrangement Standard Line 뉘: Handle frame centre line

Front connected (standard) (optional) Preparation With terminal bars Drilling plan of conductor (removable) M8 screv max 6t **ф**•**छ•**क M4X0.7 35 35 35 Mounting screv 87.5 105 86 90 107

Breakers with terminal bars available on request.





(a) TERASAKI

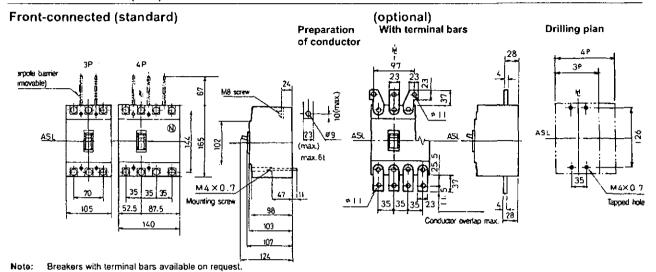
MGGB Technical data

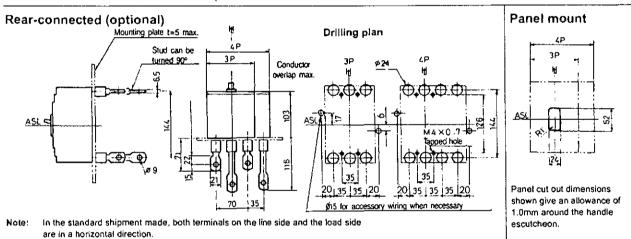


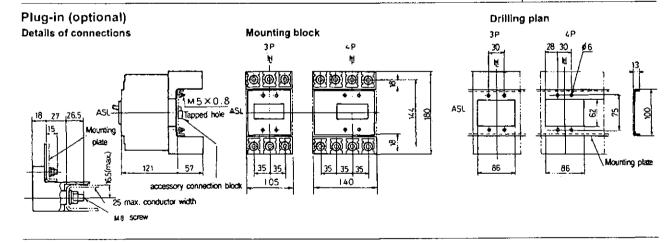
TemBreak XH250NJ

Outline dimensions (mm)

ASL: Arrangement Standard Line 닭: Handle frame centre line







(TERASAKI

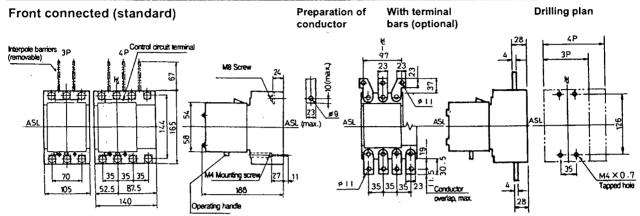
MCCB Technical data



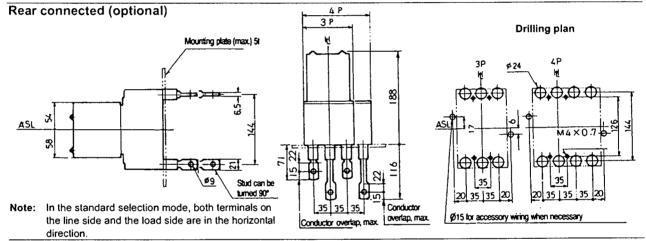
Motor operators for XS250NJ

MCCB accessories

Outline dimensions (mm)



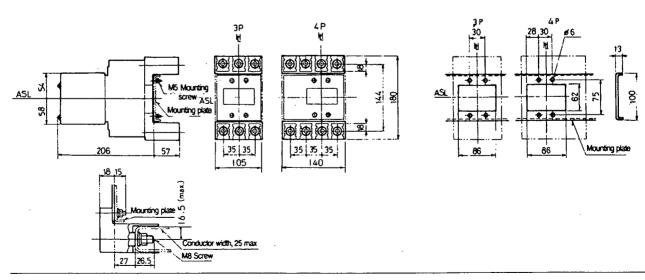
· Breakers with terminals bars available on request.



Plug-in (optional)

Mounting block

Drilling plan



Note: For dimensions and selection of motors for TL225F refer to NHP.

ASL: Arrangement Standard Line 눼: Handle frame centre line

(E) TERASAKI

MCCB Technical data

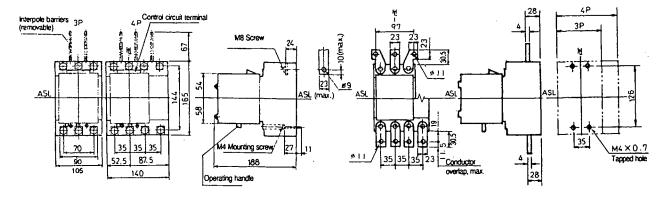


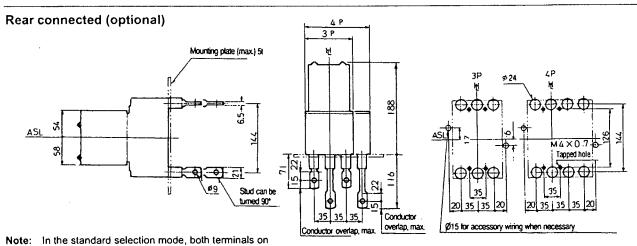
Motor operators for XH250NJ

MCCB accessories

Outline dimensions (mm)

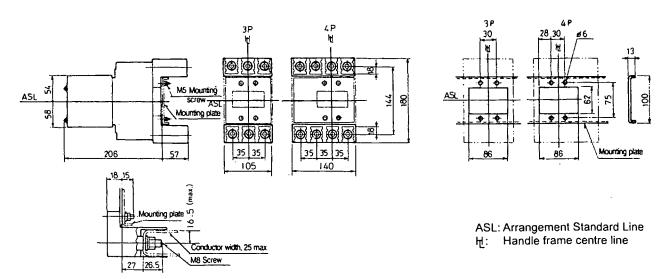
Front connected (standard)





Plug-in (optional)

the line side and the load side are in the horizontal direction





TECHNICAL DATA SHEET

For

SPS 296

Motor Contactors Equipment Type:

Motor Starter Section Location:

CA6-30 **Model Numbers:**

Sprecher & Schuh Manufacturer:

NHP. Supplier:

25 Turbo Drive

Cooparoo QLD 4151

Ph: 07 3891 6008 Fx: 07 3891 6193



AC contactors 3 pole open type with AC coil



Refer catalogue CA 6, 2212, SACS

Ratings to IEC 947 and AS 3497 400/415 V

- For CA 7 contactors with coil terminals on line side, add ... V AC to Catalogue No. Eg - CA 7-9-10-240 V AC 3)
- For CA 7 contactors with coil terminals on load side, add ...V AC-U to Catalogue No. Eg - CA 7-9-10-240 V AC-U







Contactor CA 7-72



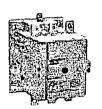
Contactor CA 6-105-El



Contactor CA 6-170-EI



Contactor CA 6-250-El



Contactor CA 6-420-EI

AC 3 400/415 V	AC 3 400/415 V	AC 1 ^s) Amps	AC 1 ') Amps	Auxil stanc	-	ntacts	
kW 1)	Amps 1)	40 °C	60 .C	N/O	N/C	Max.	Cat. No. ²)
4	9	32	ຸ32	1	0	9	CA 7-9-10 VAC
	·			0	1	9	CA 7-9-01 .: V AC 💥 🕹
5.5	12	32	32	1	0	9	CA 7-12-10 VAC-
				0	1	9	CA 7-12-01V, AC
7.5	16	32	32	1	0	9	CA-7-16-10 V. AC
				0	1	9	CA-7-16-01:V AC
11	23	32	32	1	0	9	CA)7-23:10 V AC (V
				0	1	9	CA7-23-01 VAC
15	30	50	45	0:	0	8	CA 7-30-00 V AG
18.5	37	50	45	0	0	8	CA17-37-00 VAC
22	43	85	63	0	0	8	CA743.00 VAC
30	60	100	100	0	0	8	CA 7-60-00 V AC
37	72	100	100	0	0	8	GA 7-72-00 V.AC
45	85	100	100	0	0	8	CA 7-85-00: VAC
55 (45)	95 (33)	160	135	1	1	8	CA 6-85-11). V.AC
75 (55)	130 (40)	160	135	1	1	8	CA:6-105-11V/AC
90 (75)	155 (55)	250	210	1	1	8	GA 6-140-11. V/AC
75 (55)	130 (40)	160	135	1	1	8	CA 6-105 EI-11 V AC:)
90 (75)	155 (55)	250	210	1	1	8	CA 6-140-EI-11: V/AC*)
100 (90)	170 (65)	250	210	1	1	8	CA 6-170 EL-11 VAC:
132 (111)	225 (80)	350	300	1	1	8	CA 6-210-EL-11 VAC:
150 (133)	258 (95)	350	300	1	1	8	CA 6-250-EI-11: VAC)
185 (163)	320 (115)	450	380	1	1	8	GA 6-300-E1-11V AC:)
250 (225)	425 (160)	500	425	1	1	8	CA'6-420-EL111 V.AC')
220 (220)	370 (155)	500	420	2	2	8	CA(5:370): V-AC()
265 (280)	450 (200)	600	510	2	2	8	CA 5-450 (V AC)
325 (355)	550 (250)	780	645	2	2	8	GA 5-550 - V-/AC?)
430 (500)	700 (340)	1000	850	2	2	8	CA 5-700 V. AC:)
520 (550)	860 (380)	1100	930	2	2	8	CA 5-860 V-AC:)
600	1000	1200	1020	1	1	8	GA 5-1000 V-AC)
700	1150	1350	1150	1	1	8	CA:5-1200: V: AC:)

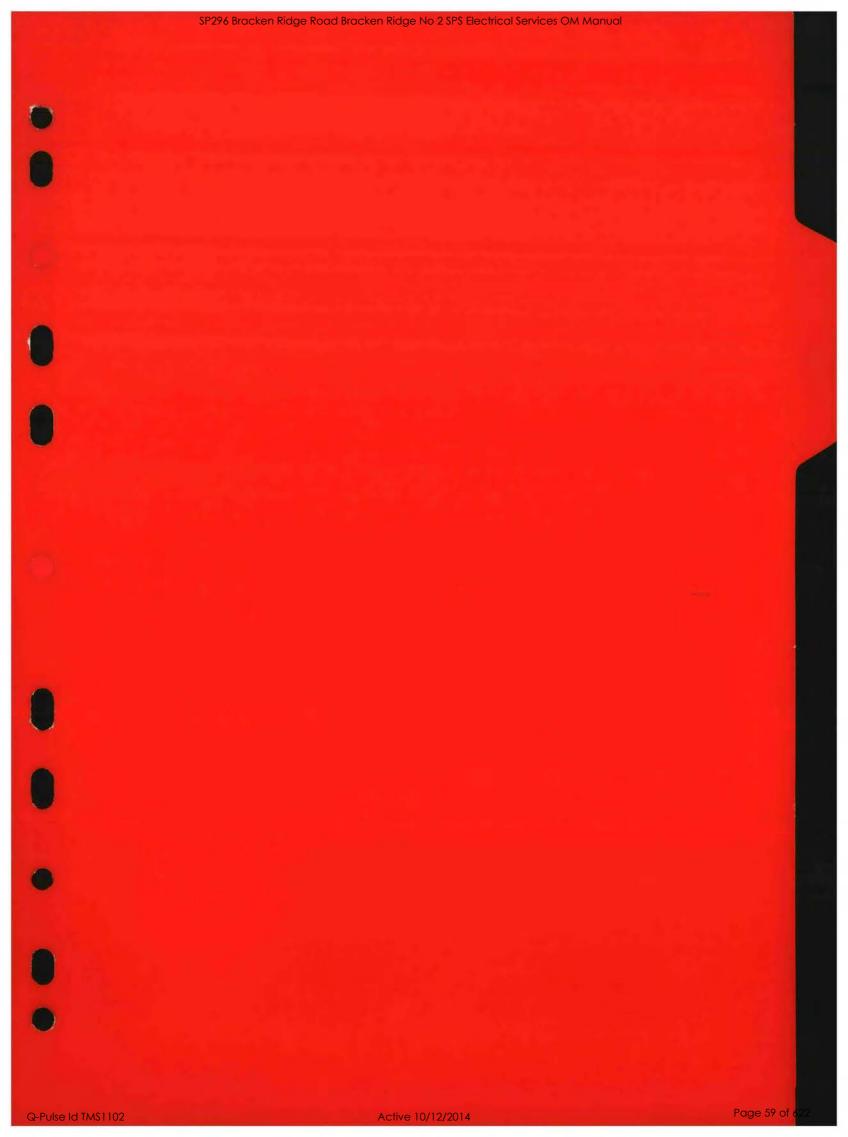
Notes: 1000 volt ratings ().

- Add control voltage to Cat. No. when ordering: 24, 32, 110, 240, 415, 440V 50 Hz. Standard voltages for CA 6-105-El...250-El are 24, 48, 110, 240 and 415 V AC. Standard voltages for CA 6-300-EI...420-EI 48, 110, 240 and 415 V AC. Standard voltages for CA 5-370...1200, 110, 240 and 415 V AC.
- All CA 7 coils can be reversed for line or load side coil terminals as required. Both versions are held in NHP stock for convenience.
- Electronically controlled mechanism (ECM) with interface suffix (EI).
- 55 'C enclosed.
- Contact NHP for recommended cable size.

240/415 V rated coils are suitable for use on 230/400 V in accordance with AS 60038 : 2000.

Q-Pulse Id TM\$1102 Active 10/12/2014 Page 57 of 622







TECHNICAL DATA SHEET

For

SPS 296

Equipment Type: Power Meter.

Location: RTU Section

Model Numbers: PM 290

Manufacturer: Satec

Supplier: VRT Systems

Level1/1 Gardner Close

Milton. Qld 4064 Ph. 07 3367 1388 Fx. 07 3367 1295

Q-Pulse Id TM\$1102 Active 10/12/2014 Page 60 of 622

UNCLEAR TEXT

FINAL TEST REPORT

3all-off 15665

Model PM 290-HD

Logic PCB # m2483a S/N 241475

Eprom version 8.35

9/16/2003 11:02 AM

E.M.D Calibration Test

Omicron/Rotek No 128

Norminal frequency 50 Hz Voltage & Cultern accuracy (+/-0.5% Rdg & +/-0.25% FS & +/-1digit)

PT=	10.0		10.0		CT=		500	00	
INPUT	380.	٠	100 -	٧	INPUT	5	Α	1	Α
RANGES	3770 - 3830		984 - 1016	V	RANGES	4961 - 5039	Α	981 - 1019	Α
V1	3 798	r	998	V	11	4998	Α	1001	Α
V2	3799		998	V	12	4998	Α	1001	A
V3	3807		9 98	V	13	4998	Α	1001	Α
	ra .		140/ 65	- · ·	o . co . co	0 (4 () 23			

Power Souracy (+/-1% of Rdg & +/-0.5% FS & +/-1digit)

INPUT		380 V,	PT= 10.0		5 A	
(MEASURED)			PF = +0.5	(0.500)	PF = -0.5 (-0	0.500)
RANGES	58144 57 8 5 6	KW	27929 - 2 90 71	KW	27929 - 29071	KW
MEASURED	57019	KW	28367	KW	28542	KW
INPUT		100 V,	PT= 10.0		5 A	
(MEASURED)	10 - 2- 4 P		PF = +0.5 ((0.490)	PF = -0.5 (·0.	50 C)
RANGES	14584 - 15436	KW	7139 - 7861	KW	7139 - 7861	KW
MEASURED	0 v (a r)(\$	KW	7401	KW	7478	KW
				•		

Com. - Eprom test Pass

RTC test Pass

Ext. Sgnl, test Pass

Calibration Pass

Power Failure test Pass

Memory test None

Short Circuit test Pass

Relays test Pass

G.L/N.C test None

Ranges test Pass

Status test None

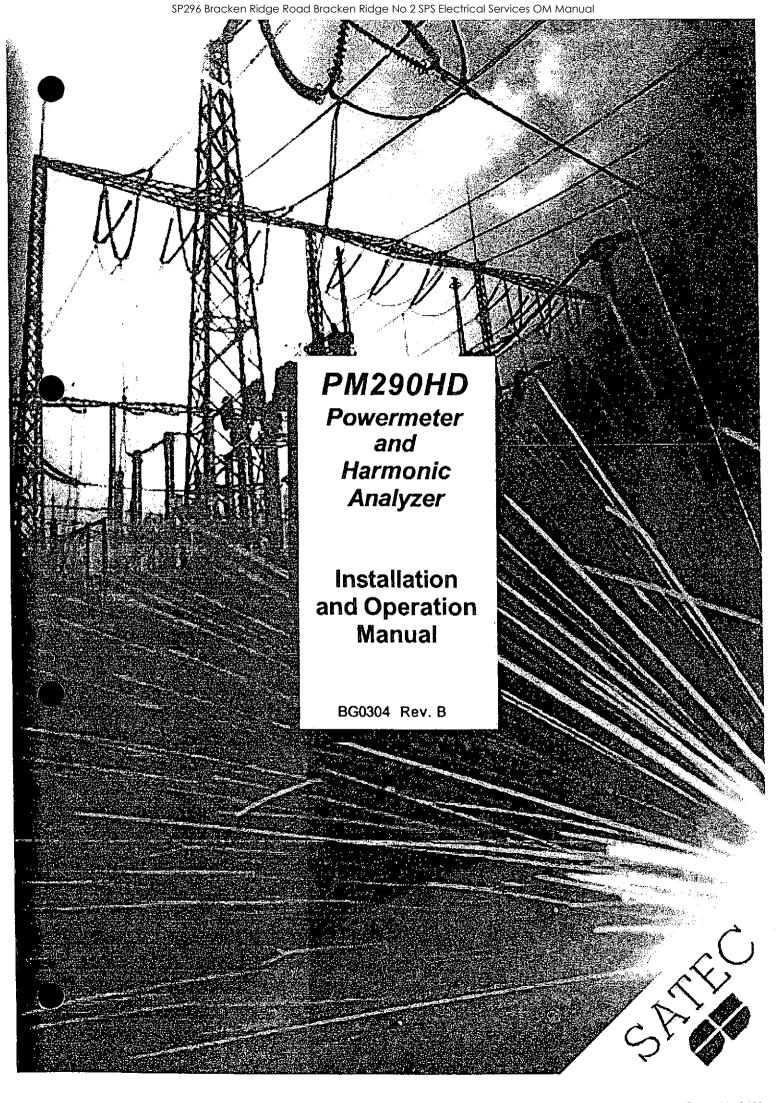
Analog Output test None

Checked by

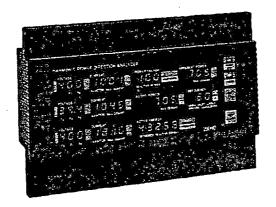
Tested by:

lev Rev:2.1.0





PM290HD POWERMETER & HARMONIC ANALYZER



Installation and Operation Manual

Q-Pulse Id TMS1102

Active 10/12/2014

LIMITED WARRANTY

The manufacturer offers the customer an 24-month functional warranty on the instrument for faulty workmanship or parts from date of dispatch from the distributor. In all cases, this warranty is valid for 36 months from the date of production. This warranty is on a return to factory basis.

The manufacturer does not accept liability for any damage caused by instrument malfunction. The manufacturer accepts no responsibility for the suitability of the instrument to the application for which it was purchased.

Failure to install, setup or operate the instrument according to the instructions herein will void the warranty.

Your instrument may be opened only by a duly authorized representative of the manufacturer. The unit should only be opened in a fully anti-static environment. Failure to do so may damage the electronic components and will void the warranty.

NOTE

The greatest care has been taken to manufacture and calibrate your instrument. However, these instructions do not cover all possible contingencies that may arise during installation, operation or maintenance, and all details and variations of this equipment are not covered by these instructions.

For additional information regarding installation, operation or maintenance of this instrument, contact the manufacturer or your local representative or distributor.

IMPORTANT ...

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

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

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- 5. The secondary of an external current transformer must never be allowed to be open circuit when the primary is energized. Ensure that the current transformer wiring is made through shorting switches and is secured using an external strain relief to reduce mechanical strain on the screw terminals, if necessary.
- Setup procedures must be performed only by qualified personnel familiar with the instrument and its associated electrical equipment.
- 7. DO NOT attempt to open the instrument under any circumstances.

Modbus is a trademark of Modicon, Inc.

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

BG0304 Rev. B

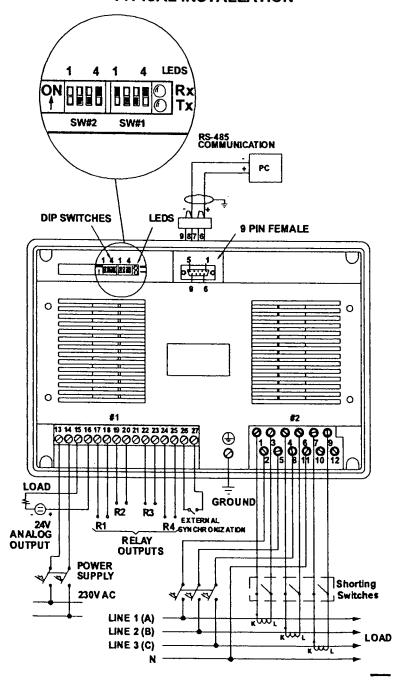
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Quick Start

TYPICAL INSTALLATION



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BASIC and COMMUNICATION PARAMETERS SETUP

(* default setting)

Code	Parameter =	Options	Description : **
CnF	Wiring mode	30P	3-wire open delta using 2 CTs
]	4Ln	4-wire Wye using 3 PTs
	{	3dir	3-wire direct connection using 2 CTs
		4LL*	4-wire Wye using 3 PTs
Pt	PT ratio	1.0+ - 6,500.0	Phase potential transformer ratio
Ct	CT primary current		Primary rating of the phase current
	<u>. </u>	(5*)	transformer
Ct.G	Ground Leakage	1-50,000mA	Primary rating of the ground leakage
	CT primary current	(5000*)	current transformer (Option L only)
P	Power demand period	1, 2, 5, 10, 15*, 20, 30,	Length of demand period for power demand calculations, in minutes.
<u> </u>		60, E	E = external synchronization
AP	Ampere demand	0-1800 s	Length of demand period for ampere
	period	(15*)	demand calculations 0 = peak current measurement
label,	Parameter name	see Section	Relay setpoints
#	and number	3.13	
buF	Buffer size	8*, 32	No. of measurements for RMS sliding averaging
rSt	Reset	diS, En •	Protects all reset functions if disabled
br	Baud rate / data	110, 300, 600,	1200, 2400, 4800, 9600° bps / 7E
	format		en parity), 8n* (8 bits, no parity)
Add	Address		Modbus: 1+-247
H.Sh	incoming flow	SOFt	Software handshaking (XON/XOFF
	control	. ,	protocol)
	(handshaking)	Hard	Hardware handshaking (CTS protocol)
CoP	Communications	ASCI232	ASCII protocol, RS-232
	protocol and	ASCI422	ASCII protocol, RS-422
İ	interface standard	ASCI485*	ASCII protocol, RS-485
İ		bin232	Modbus RTU protocol, RS-232
		bin422	Modbus RTU protocol, RS-422
		bin485	Modbus RTU protocol, RS-485
		Pmt232	Printer mode
Pr	Printout period	1*, 2, 5, 10,	Time interval between successive
1		15, 20, 30, 60	printouts
		minutes	<u> </u>
A	Analog Output	see Section	Internal analog output for measured
	(optional)	3.14	values of specific parameters

1 Introduction

The *PM290HD* is a 3-phase AC Powermeter and Harmonic Analyzer specially designed to meet the needs of users ranging from electrical panel builders to substation operators. The *PM290HD* performs all basic power and harmonic measurements; **Option L** provides additional ground leakage current measurements; **Option B** provides 8 digital inputs for external dry contact monitoring.

Measured Parameters

The PM290HD measures and displays the following parameters:

Parameter	Standard	Option B	Option L
True RMS voltage per phase, neutral o	r •	•	•
line-to-line			
True RMS current per phase	•	•	•
Active Power	•	•	•
Apparent Power	•	•	•
Reactive Power	•	•	•
Active Power Maximum Demand	•	•	•
Active Power Accumulated Demand	•	•	•
Ampere Maximum Demand per phas	Se •	•	•
Apparent Power Maximum Demand	•	•	•1
System Power Factor	•	•	•
Active Energy (Consumption)	•	•	•
Returned Energy	•	•	•
Reactive Energy	•	•	•
Frequency	•	•	•
Unbalanced Current (Zero Sequence) - •	•	•
for 4 wire system			
External Dry Contact Status		•2	
Ground Leakage Current (Option L)			
K-Factor per phase	•	•	•
Voltage & current THD per phase	•	•	•
Directional harmonics via software		•	•
External synchronization input	•	•	•

¹ This parameter can be read only via Modbus communications.

Control and Alarm Relays

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

- High current
- High voltage
- Low voltage

- · High apparent power
- High reactive power
- Low power factor

Chapter 1 Introduction

1

² See Appendix A, Status Inputs.

- · High active power accumulated demand
- High unbalanced current (zero sequence) or High ground leakage current (Option L)
- Total harmonic distortion

Communications Connection (optional)

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

Analog Output (optional)

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

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

- Active power
- Apparent power
- Reactive power
- Frequency

If more than one analog output is desired, up to two AX-8 analog expanders are available, providing up to 17 analog outputs (1 internal + 2x8 external). Contact your distributor for purchasing AX-8 units. An external power supply (15-30 VDC, 24 VDC nominal) is required. See Section 2.2.8 for connection.

Digital Inputs

Eight digital inputs are provided for external dry contacts status monitoring (Option B). The status of these lines (open or closed) is displayed on the front panel and is sent upon request via communication to the host computer.

One optically isolated digital input is provided for external synchronization of the power demand period.

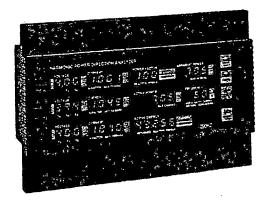
Ground Leakage (Option L)

Option L provides ground leakage current measurements for monitoring and alarm setting. A special ground leakage current transformer (secondary current 5 mA) is required. See Section 2.2.12 for connection.

Getting Started

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

The Front Panel



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

Chapter 1 Introduction

2 Installation and Interfaces

2.1 Mechanical Installation

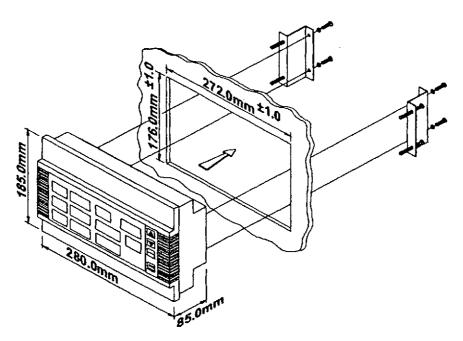
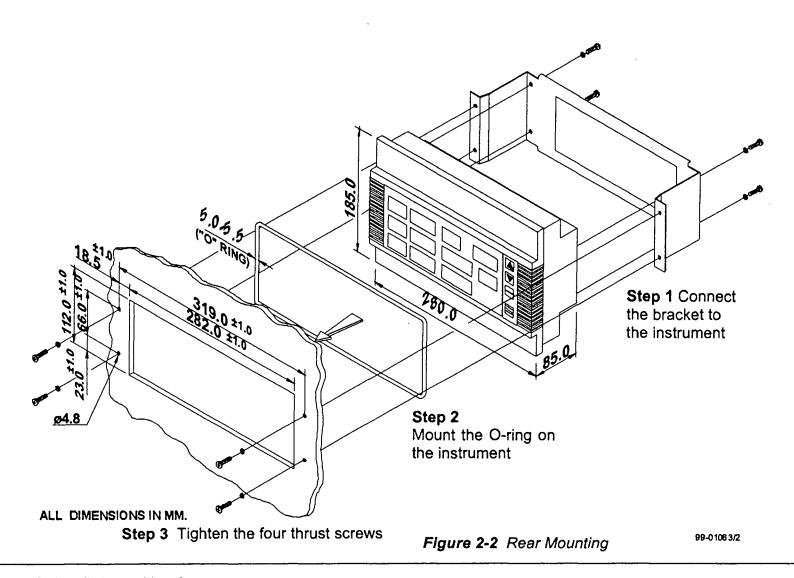


Figure 2-1 Front Panel Mounting (standard)



Chapter 2 Installation and Interfaces

2.2 Electrical Installation

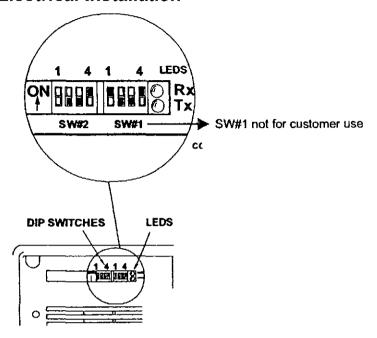


Figure 2-3 Dip Switches: Detail

2.2.1 Dip Switches

SW2 only (SW1 not for customer use):

- 1 N/A
- 2 ON: Analog expander enabled
 - OFF: Analog expander disabled (in this case the internal analog output remains available).
- 3 ON: Setup mode (see Chapter 3) disabled
 - OFF: Setup mode enabled
- 4 ON: Remain at current display page (see Chapter 4) OFF: return to page 1 after 30 seconds.

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

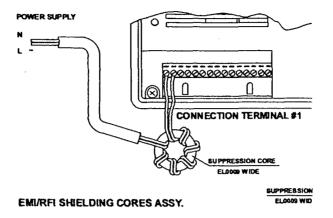


Figure 2-4 Use of Suppression Cores

2.2.2 Power Source Connection

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

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

2.2.3 Voltage Input Connections

660V Input: Direct Connection

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

660V Input: Using Potential Transformers

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

120V Input

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

Chapter 2 Installation and Interfaces

2.2.4 Current Input Connections

See Typical Installation on page iv for current input connections.

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

2.2.5 Ground Connection

Connect the instrument chassis ground to the switchgear earth ground using dedicated wire greater than 2mm²/14AWG. See *Typical Installation* on page iv for ground connection.

2.2.6 Harmonic Measurements

4-wire Connections

In 4-wire connections, all harmonic quantities will be measured correctly. Harmonic voltages are *line-to-neutral* in 4L-L and 4L-n wiring modes (see section 2.2.8).

3-wire Connections

Harmonic measurements can be made only on signals that are present on the instrument inputs. Missing inputs will result in inaccurate readings.

Direct: Harmonic voltages represent the 3-phase *line-to-neutral* voltages that appear on the instrument input transformers. If the system load is not symmetrical, the voltage readings are meaningless. In the case of a symmetrical load, harmonic voltages will not reflect all multiples of order 3 harmonic. Using 2 CTs, harmonic currents will be measured only for 2 phases and the total power harmonics will be calculated inaccurately.

Open Delta: Readings for harmonic voltages represent two *line-to-line* voltages L12 and L23. Current harmonics will be taken using 2 or 3 CTs according to the wiring mode. Total power harmonics will be measured accurately using 2 input *line-to-line* voltages and 2 currents.

2.2.7 K-Factor

Three K-factor values for 3 line currents (L1, L2 and L3) are displayed simultaneously. If only L1 and L3 currents are measured (in a 3-wire connection) then only these two K-factors will be displayed.

Chapter 2 Installation and Interfaces

2.2.8 Wiring Configurations

There are 5 possible wiring configurations:

<u>No.</u>	Wiring Configuration	Wiring Mode
1)	3-wire direct connection using 2 CTs	3dir
2)	3-wire open delta connection using 2 PTs, 2 CTs	30P
3)	4-wire WYE direct connection using 3 CTs	4L-n or 4L-L
4)	4-wire WYE connection using 3 PTs, 3 CTs	4L-n or 4L-L
5)	4-wire grounded delta connection using 3 CTs	4L-n or 4L-L
L-n	= line-to-neutral; L-L = line-to-line voltage readings;	voltage readings in

3-wire configurations always represent line-to-line voltages

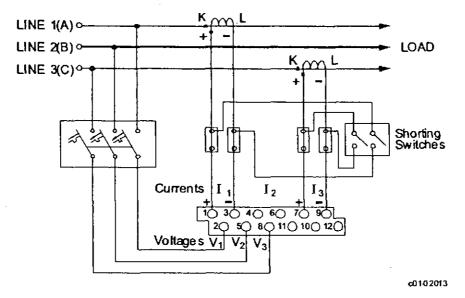


Figure 2-5 3-wire Direct Connection Using 2 CTs -Wiring Mode 3dir

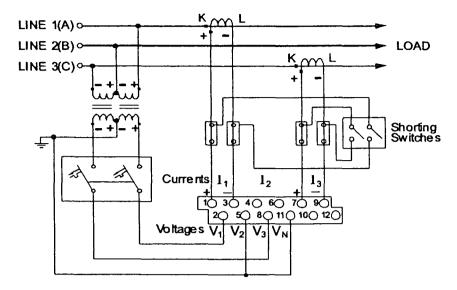


Figure 2-6 3-Wire Open Delta Connection Using 2 PTs, 2 CTs - Wiring Mode 3OP

(Note the connection between terminals 5 and 11)

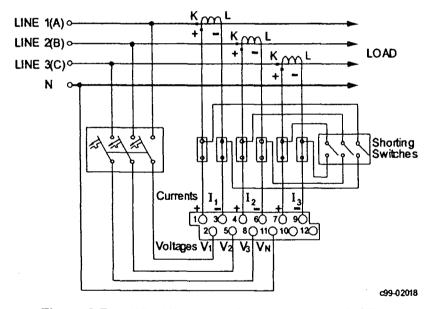


Figure 2-7 4-Wire Wye Direct Connection Using 3 CTs - Wiring Mode 4L-n/4L-L

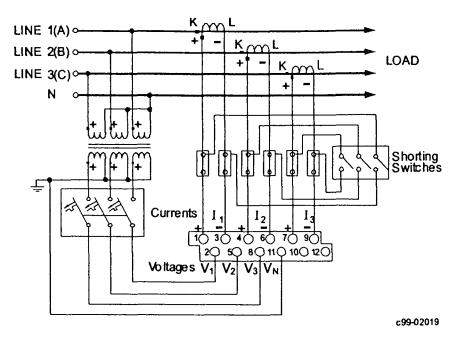


Figure 2-8 4-wire Wye Connection Using 3 PTs, 3 CTs - Wiring Mode 4Ln3/4LL3

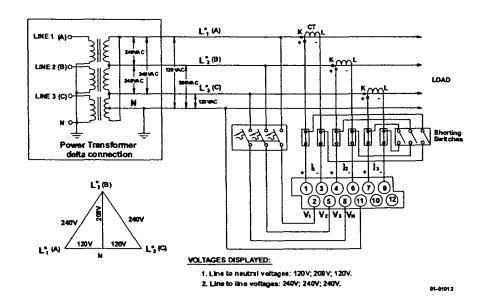


Figure 2-9 4-wire Grounded Delta Connection Using 3 CTs - Wining Mode 4L-n/4L-L

Chapter 2 Installation and Interfaces

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2.2.9 Relay Output Connections

Use relays #1, 2 and 4 for setpoints or KYZ pulsing. The relays energize on trip condition.

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

Figure 2-10 illustrates wiring connections for the relays.

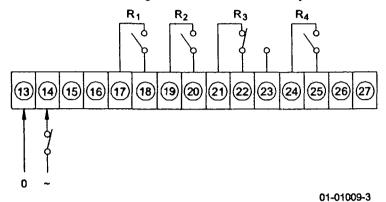


Figure 2-10 Relay Output Connections

2.2.10 Analog Output

The Analog Output requires a galvanically isolated external power supply of 15 to 30 VDC (24 VDC nominal). See *Figure 2-11* for connections: negative to terminal 15 and positive to terminal 16. In certain industrial applications, a circuit may be required to protect against accidental shorts.

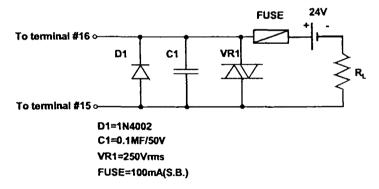


Figure 2-11 Analog Output Connection

2.2.11 Communications

The serial interface connector is a standard D-type 9-pin female plug-in, located at the top center of the rear of the instrument. *Table 2-1* lists the pinout of the connector.

Table 2-1 Connector Pinout

Pin	Name	Function	Line
1	Gnd	Ground (common)	RS-232
2	TxD	Transmit Data	RS-232
3	RxD	Receive Data	RS-232
4	DTR	Data Terminal Ready	RS-232
5	DSR	Data Set Ready	RS-232
6	TxD+	+ Transmit Data	RS-422/RS-485
7	RxD+	+ Receive Data	RS-422/RS-485
8	TxD -	- Transmit Data	RS-422/RS-485
9	RxD -	- Receive Data	RS-422/RS-485

For RS-485 communications, connect together pins 6-7 (TXD+ and RXD+), and pins 8-9 (TXD- and RXD-).

For cable drawings, refer to Appendix C.

2.2.12 Ground Leakage (Option L)

Ground leakage connection is at terminals 26 and 27, using a special ground leakage current transformer with 5mA secondary current.

CURRENT INPUT CT 5A or 1A

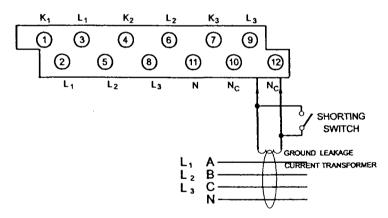


Figure 2-12 Ground Leakage Connection

2.2.13 Status Input (Option B)

This option provides eight dry contact (voltage-free) status input lines. Connections are shown in *Figure 2-13*. The eight status inputs are protected against voltage of up to 25 volts. External protection should be added if greater protection is required.

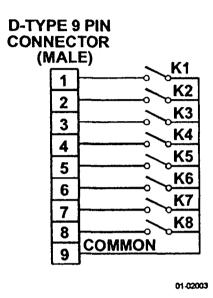


Figure 2-13 Status Input Connection

3 Setup

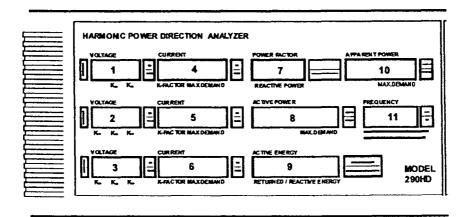
NOTE: Setup is performed *after* installation is completed. To enable setup, make sure that Dip Switch 3 on SW2 located at the top left of the rear of the instrument (see *Figure 2-3*) is down (OFF).

3.1 Setup Procedure

3.1.1 Entering Setup Mode

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

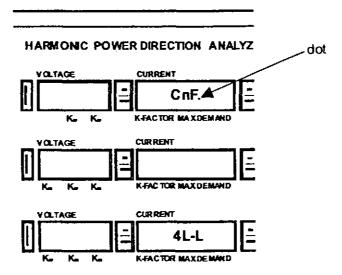
Setup is performed using windows 4, 5, and 6.



Window 4 displays the setup parameter code; window 6 (in some cases, windows 5 and 6) display the value for that parameter. Use the $\uparrow \downarrow \downarrow$ keys to scroll between parameters.

3.1.2 Changing Parameter Values

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



Use the fl \$\frac{1}{2}\$ keys to scroll to the desired value.

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

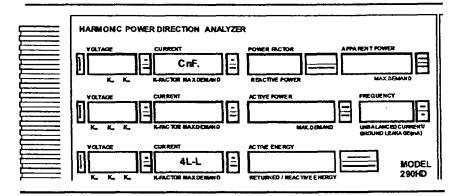
Press RESET again to return to the display mode.

Chapter 3 Setup

3.2 Wiring Mode: CnF

Choose from 4 wiring modes:

- 1) 3OP 3-wire direct connection using 2 CTs
- 2) 4L-n 3-wire open delta connection using 2 PTs, 2 CTs
- 3) **3dir** 4-wire WYE connection using 3 CTs, with or without PTs, using line-to-neutral values
- 4) **4L-L** 4-wire WYE connection using 3 CTs, with or without PTs, using line-to-line values
- Press SELECT; the dot will disappear.
- Use the ↑ ↓ keys to scroll to the appropriate value.
- Press RESET; the dot will re-appear.



Use the 1 key to move to the next setup parameter.

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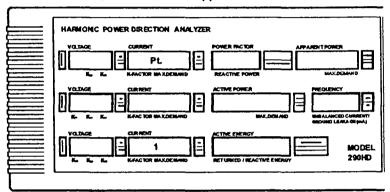
3.3 Potential Transformer Ratio: Pt

Note: Pt must be defined before relay setpoint definition.

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

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

- Press SELECT; the dot will disappear.
- Press RESET; the dot will re-appear.



Use the 1 key to move to the next setup parameter.

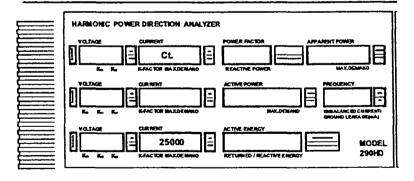
3.4 Current Transformer: Ct

Notes: 1) Ct must be defined before relay setpoint definition.

2) For Option L, ground leakage is represented by Ct.G

This parameter defines the primary value of the Current Transformer.

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



- Use the \(\bar{1}\) key to move to the next setup parameter.

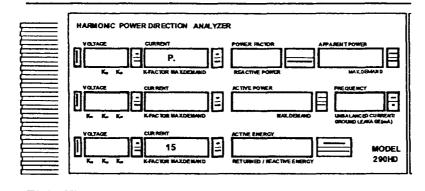
18 Chapter 3 Setup

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3.5 Maximum Power Demand Period: P

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

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

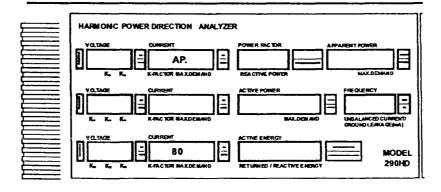


Use the 1 key to move to the next setup parameter.

3.6 Maximum Ampere Demand Period: AP

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

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



Use the 1 key to move to the next setup parameter.

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3.7 Relays

There are 4 relays in the instrument which can be associated with up to 9 setpoints. Three of the relays may also be used for pulsing (see next page). The setpoint names are listed in the following table:

Setpoint Name	Description	Unit	Range
hiU	High voltage	V	0 - Vmax
LoU	Low voltage	V	0 - Vmax
Cur	High current	Α	0 - Imax
PF	Low total Power Factor lag		0 - 1.000
thD	Total harmonic disturbance (voltage and current)	%	0 - 100
Ac.d	High accumulated power demand	kW	0 - Pmax
Un.C <i>or</i> GrL	High unbalanced current or High ground leakage current (Option L)	A	0 - Imax <i>or</i> 0 - GLImax
rE.P	High total reactive power import	kvar	0 - Pmax
AP.P	High total apparent power	kVA	0 - Pmax

Parameter limits:

Vmax (660V input) = (400k)V, where k=1 if no PT, or k=PT ratio if PT used

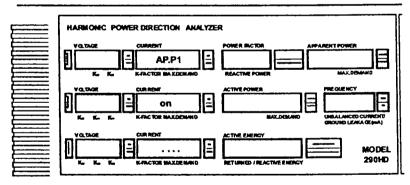
Imax (20% overrange) = 1.2 x CT primary current A Pmax = (Imax x Vmax x 3)/1000 kW @ wiring mode 4L-n

Pmax = (Imax x Vmax x 2)/1000 kW @ wining mode 4L-L, 3OP, 3dir

GLImax = 1.2 x ground leakage CT primary current mA

Wiring mode 4L-n: line-to-neutral voltages

Other wiring modes: line-to-line voltages



- Use the ↑ ↓ keys to scroll to the desired setpoint.. Next to each setpoint name appears the relay number 1, 2, 3 or 4. Dots appear in the lower window if a setpoint value has not yet been defined.
- Press SELECT; the dot after the relay number disappears and the middle window displays 'on'. This allows the user to set or change the value at which the setpoint is activated. *

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- Use the ↑ Ukeys to scroll to the value for the selected setpoint.
- Press SELECT; the middle window displays 'on.d', indicating the time delay until setpoint operation. This may take a value from 0.1 to 99.9 seconds.
- Use the ↑ ↓ keys to define the delay to operation.
- Press SELECT; the middle window displays 'OFF'.
- Use the fi ↓ keys to scroll to the value at which the displayed setpoint will be released.
- Press SELECT; the middle window displays 'OFF.d', indicating the time delay until setpoint release. This may take a value from 1 to 999 seconds.
- Press either: SELECT to move to another setpoint parameter, or RESET to exit this relay and move to another relay/parameter.
- Press RESET to exit the relay after all desired setpoint values are defined; the dot re-appears, and ON setpoint values are displayed in the lower window.
- Press RESET again to exit the parameter.

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

NOTE

To cancel both ON and OFF setpoints, press the $\hat{\Pi}$ and \hat{V} keys simultaneously. A canceled setpoint can be re-instated by pressing either the $\hat{\Pi}$ or \hat{V} key.

Pulses

Pulses may be defined for relays 1, 2 and 4. When one of these relays is displayed, the pulsing value in Window 11 can be set, from 1 to 200 units per pulse.

Pulse Name	Description	Unit
Pul1: Ac.En	Pulse 1 - Active Energy (import)	kWh
Pul2: rE.En	Pulse 2 - Reactive Energy (absolute)	kvarh
Pul4: rEt.E	Pulse 4 - Returned Energy (export)	kWh

^{*} For high setpoints, the on (activating threshold) must be greater than the off (release threshold), and vice versa for low setpoints.

3.8 Memory Buffer: buF

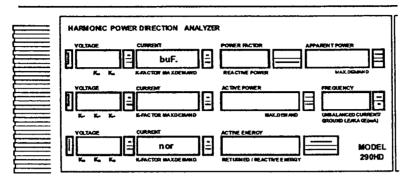
This parameter defines the number of measurements which will serve as the basis for calculating average values of voltage, current and power.

- Press SELECT; the dot will disappear.
- Use the ↑ ↓ keys to scroll to the appropriate value: nor (normal) = 8 (for stable voltage and current situations)

Chapter 3 Setup

unSt (unstable) = 32 (for unstable voltage and current situations.
Readings in this mode will be slower.).

- Press RESET; the dot will re-appear.



Use the 1 key to move to the next setup parameter.

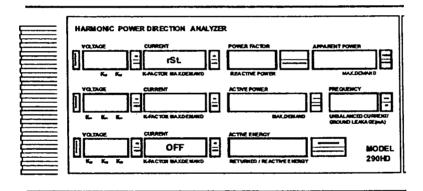
3.9 Reset: rSt

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

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

ON = reset function enabled; OFF = reset function disabled

- Press RESET; the dot will re-appear.



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

3.10 Baud Rate: br

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

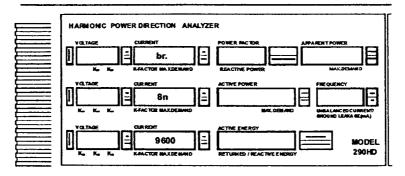
- Press SELECT; the dot will disappear.
- Use the ît ₩ keys to scroll to the appropriate values: middle window: number of bits and parity 7E, 8n, 8E lower window: bits per second 110, 300, 600, 1200, 2400, 4800, 9600

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Both values (windows) change simultaneously.

- Press RESET; the dot will re-appear.

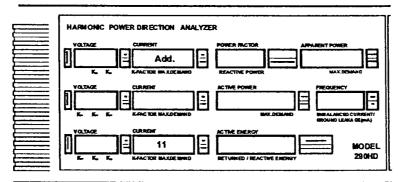


Use the 1 key to move to the next setup parameter.

3.11 Communication Address: Add

Each Powermeter on the network must have a unique address, according to the communication protocol used (see Section 3.13).

- Press SELECT; the dot will disappear.
- Press RESET; the dot will re-appear.



Use the 1 key to move to the next setup parameter.

3.12 Handshake Mode: H.Sh

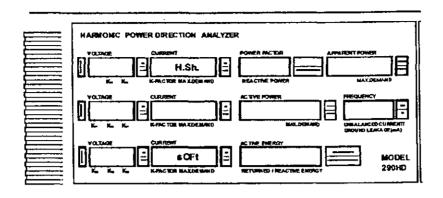
Handshaking refers to a signal from the receiving device indicating its readiness to receive data. Handshaking is achieved by means of either hardware signals or software commands.

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

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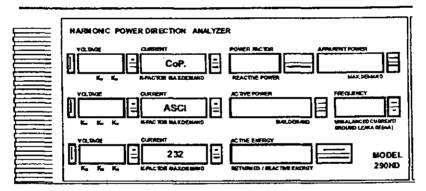


Use the fl key to move to the next setup parameter.

3.13 Communication Protocol: CoP

Here, 3 display windows are used.

- Press SELECT; the dot will disappear.
- Use the fi ∜ keys to scroll to the appropriate values: middle window: protocol ASCII (ASCI), Modbus (bin) or printer (Prnt) lower window: serial line RS-232 (232), RS-422 (422) or RS-485 (485) Both values (windows) change simultaneously.
- Press RESET; the dot will re-appear.



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

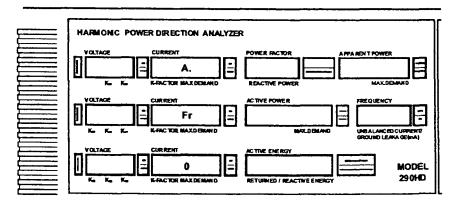
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3.14 Analog Output: A (optional)

Up to 12 parameters may be assigned an analog output:

Parameter name	Description
U.1	Voltage L1 / L12
U.2	Voltage L2 / L23
U.3	Voltage L3 / L31
c.1	Current L1
c.2	Current L2
c.3	Current L3
AP.P	Apparent Power
PF	Power Factor
rE.P	Reactive Power
Ac.P	Active Power
Ac.d	Active Power Accumulated Demand
Fr	Frequency

'A' is the overall code for Analog Output and appears in the upper window. The parameter selected for analog output appears in the middle window; the value is displayed in the lower window.



- Use the ↑↓ keys to choose the parameter from the list above. The selected parameter appears in the middle window.
- Press SELECT; the dot will disappear from the 'A'.
- Use the ↑ ↓ keys to scroll to the appropriate values:

0 (internal analog output), or

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

The middle and lower windows change simultaneously.

- Press RESET; the dot will re-appear.

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

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

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

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

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

3.15 Real Time Clock: RTC

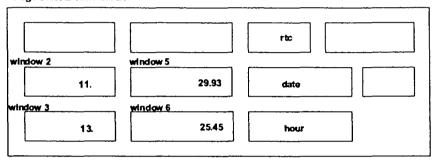
The RTC can be viewed on display page 5.

TO set the RTC:

From page 5 display, press SELECT. The month digits blink in window 2. From this point you are in the RTC Set mode.

- Press SELECT to move between date and time windows; the current selected value will blink.
- Use the ît ₩ keys to scroll to the appropriate values.

Page 5: Real Time Clock



- Press RESET to save your setup and exit the RTC.

NOTE: If you wish to reset the seconds (window 6) to zero, you must exit the RTC from the blinking seconds window. Exiting from any other blinking window will cause the previous seconds setup to remain in effect.

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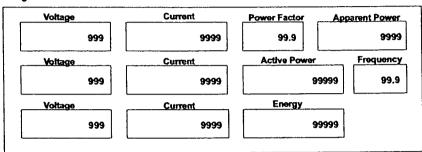
4 Display

Values are displayed on 5 pages with 11 windows per page. Use the

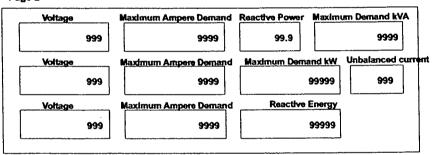
↓ keys to scroll through the pages. The display will return to page 1 after 30 seconds.

4.1 Display Pages

Page 1



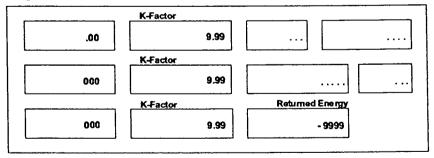
Page 2



Note: For Option L, page 2 displays ground leakage current in place of unbalanced current.

Page 3

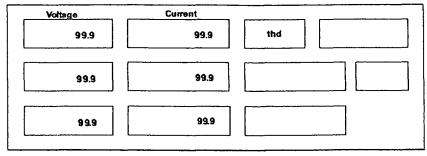
28



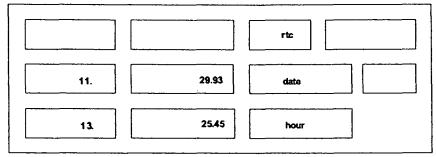
Note: For Option B, this page displays the status of the 8 digital inputs.

Chapter 4 Display

Page 4: Total Voltage and Current Harmonic Distortion



Page 5: Real Time Clock



4.2 Self-Test Diagnostics

The *PM290HD* periodically performs self-test diagnostics. If the instrument fails the self-test diagnostics, it discards the last measurement results, and an error code (from 1 to 8) is displayed for 2 seconds on all LEDs. Error code 8 represents Power Down (Normal).

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

If the Powermeter malfunctions, it is recommended to switch the machine OFF for one minute and then turn the instrument ON again.

4.3 RESET

When the RESET button is pressed continuously for more than 5 seconds, the following parameters are reset to zero:

Energy kWH Returned energy kWH Reactive energy kVARH

To prevent unauthorized resetting, disable the reset function (see Section 3.9).

Chapter 4 Display

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Appendix A: Technical Specifications

Input and Output Ratings

3 galvanically isolated voltage inputs	120 V INPUT USING PT (up to 120+20% V line-to- (Option line voltage) U) Burden: < 0.01 VA				
	660 V DIRECT INPUT (up to 660 V line-to-line voltage or up to 550 V line-to-neutral voltage) Burden: < 0.3 VA				
3 galvanically isolated current inputs	1 A INPUT via CT with 1 A secondary output Burden: < 0.15 VA				
	Measurement up to 1.2 A RMS, 1.76A amplitude Overload withstand: 2 A RMS continuous, 30 A RMS for 1 second				
	5 A INPUT via CT with 5 A secondary output Burden: < 0.15 VA Measurement up to 6 A RMS, 8.8A amplitude				
	Overload withstand: 10 A RMS continuous, 150A RMS for 1 second				
1 galvanically isolated ground current input (Option L)	5mA input via CT with 5mA secondary output Burden: < 0.1 mVA Overload withstand: 30mA RMS continuous, 400mA RMS for 1 second				
External synchronization input	Optically isolated, dry contact sensing input (voltage-free)				
Status inputs (Option B)	8 dry contact sensing inputs (voltage-free); +5 VDC internal power supply				
Relay outputs	3 relays rated at 5A, 250 VAC, 2 contacts (SPST Form A) 1 relay rated at 5A, 250 VAC, 3 contacts (SPDT Form C)				
Real Time Clock	Accuracy: about 1 minute per month @ 25°				
Communication	One optically isolated serial port EIA RS-232, RS-422, and RS-485 standards CONNECTOR: 9-pin female D-type				

Input and Output Ratings

Analog output	Range	0-20 mA/4-20 mA (upon order)					
, maiog output	CMV Isolation	1500 V RMS					
	Offset Temperature						
	Non-Linearity	±0.02%					
	Accuracy	0.06% FS					
	Offset	±100 μA					
	Maximum Load	510 Ω					
	Power Supply						
Display	High-brightness seven-segment digital LEDs, 11 windows. A total of 3 pages with simultaneous display of up to 11 parameters.						
Voltage and	Standard 9.52 mm pitch (UL recognized)						
current input	Screw M 3						
terminals	Maximum wire diameter 2.591 mm (10 AWG)						
Service	Standard 5 mm pitch (UL recognized XCFR2)						
terminals	Screw M2.6						
	Maximum wire diam	neter 2 mm (12 AWG)					
Power supply	88-138V AC, 176-2	65VAC, 50/60 Hz, 20 VA					
	9.6-19V DC						
	19-37V DC 15 W						
	37-72V DC						
	88-138V DC						
	176-265V DC						

Environmental Conditions

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

Construction

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

Standards

UL File #E129258(N)				
CE-EMC: 89/336/ÈÉC as am	en	ded	by 92/31/EEC	and 93/68/EEC
05 11/5 70/00/550				1001105/550

CE-LVD: 73/23/EEC as amended by 93/68/EEC and 93/465/EEC

Measurement Specifications

Parameter, units	Full scale	Accuracy, %		Range	Resolution @ range		
		Rdg	FS	Conditions	7	Front panel display	Comm.
Voltage, V	120V×PT @ For Ln 120V or reading and for 3OP 660V For LL 208V×PT @ For LL 120V or except 3OP 660V×PT @ wiring mode		0.25	10% to 120% FS	0 to 999,000	1 V @ 1 to 999 V ≤1% @ 1,000 to 999,000 V	1 V
Line current, A	660V CT primary current		0.25	2% to 120%FS	0 to 60,000	1 A @ 1 to 9,999 A ≤0.1% @ 10,000 to 65,000A	1 A
Active power, kW	0.36×PT×CT @ 120V input 1.14×PT×CT @ 660V input		0.5	PF ≥ 0.5 Φ	0 to ± 2,147,000	1 kW @ 1 to 99,999/-9.999 ≤0.01% @ 100 to 2,000 MW ≤0.1% @ -10 to -2,000 MW	1 kW
Reactive power, kvar	0.36×PT×CT @ 120V input 1.14×PT×CT @ 660V input		0.5	PF ≤ 0.9 ①	0 to ± 2,147,000	1 kvar @ 1 to 99,999/-9.999 ≤0.01% @100 to 2,000Mvar ≤0.1% @ -10 to -2,000 Mvar	1 kvar
Apparent power, kVA	0.36×PT×CT @ 120V input 1.14×PT×CT @ 660V input		0.5	PF ≥ 0.5 Φ	0 to 2,147,000	1 kVA @ 1 to 9,999 ≤0.1% @ 10 to 2,147 MVA	1 kVA

Appendix A: Technical Specifications

Measurement Specifications

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

Appendix A: Technical Specifications

Measurement Specifications

Parameter, units	Full scale	Accuracy, %			Range	Resolution @ ra	Resolution @ range	
		Rdg	FS	Conditions		Front panel display	Comm.	
Total harmonic distortion, %U ₁ (I ₁)	100		1.5	≥1% FSV (FSI)	0 to 100	0.1	0.1	
K-factor	999.9	5 typical		0.1% to 100% FS	1.0 to 999.9	0.1	0.1	
Voltage harmonics, %U₁	100	1	0.2x <u>FSV</u> U ₁	U₁≥ 10% FSV	0 to 100	0.01	0.01	
Current harmonics, %I ₁	100	1	0.2x <u>FSI</u>	l₁≥ 10% FSI	0 to 100	0.01	0.01	
Harmonic voltage, V	as for voltage	1	0.2	U₁≥ 10% FSV	as for v	oltage	- 	
Harmonic current, A	as for current	1	0.2	l₁≥ 10% FSI	as for current			
Harmonic kW	as for kW	1	0.2		as for kW			
Harmonic kvar	as for kvar	1	0.2		as for kvar			
Harmonic power factor	as for power factor		2 typical		as for p	ower factor		

Appendix A: Technical Specifications

Q-Pulse Id TMS1102

Key:

PT - external potential transformer ratio

CT, CT primary current - the primary current rating of the external current transformer

FSV - voltage full scale

FSI - current full scale

U₁ - voltage fundamental

I₁ - current fundamental

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

NOTES

- 1. Accuracy is expressed as \pm (percentage of reading + percentage of full scale) \pm 1 digit. This does not include inaccuracies introduced by the user's potential and current transformers.
- 2. These specifications assume voltage and current waveforms with THD ≤ 5% (except harmonic measurements) and an operating temperature of 20 to 26 °C.

Appendix B: Communication Cable Drawings

RS-232

25-pin Computer Connector, Hardware Handshake

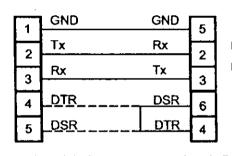
Powermeter DB9 male

	1	GND	GND	7	
	2	Tx	Rx	3	IBM PC/Compatible
		Rx	Tx		DB25 female
1	3	OTO	DCD	2	
	4	DTR	DSR	6	
	5	DSR	DIR	20	 J

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

9-pin Computer Connector, Software Handshake

Powermeter DB9 male

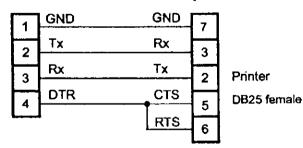


IBM PC/Compatible DB9 female

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

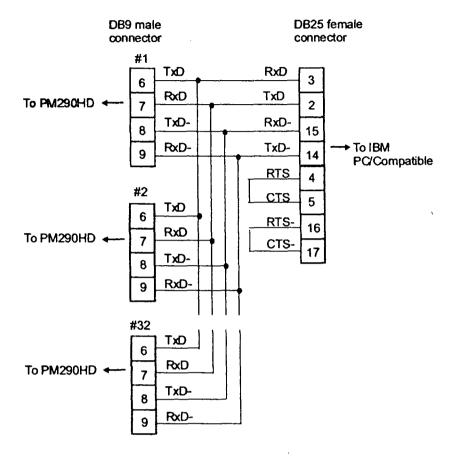
Printer Connector - Example

Powermeter DB9 male



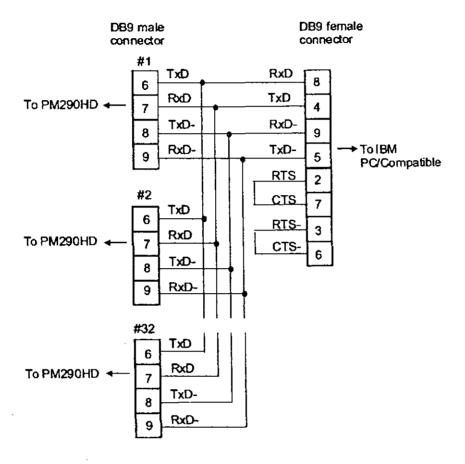
Appendix B: Communication Cable Drawings

RS-422
25-pin Computer Connector

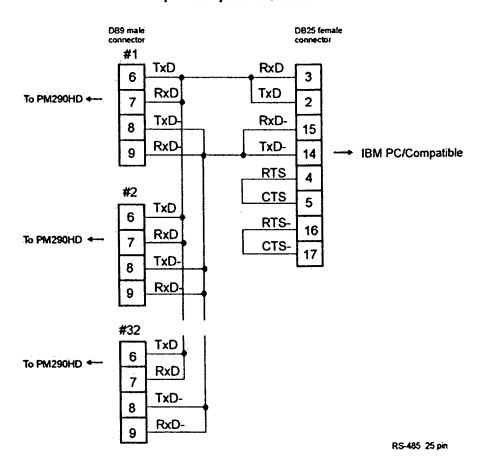


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9-pin Computer Connector

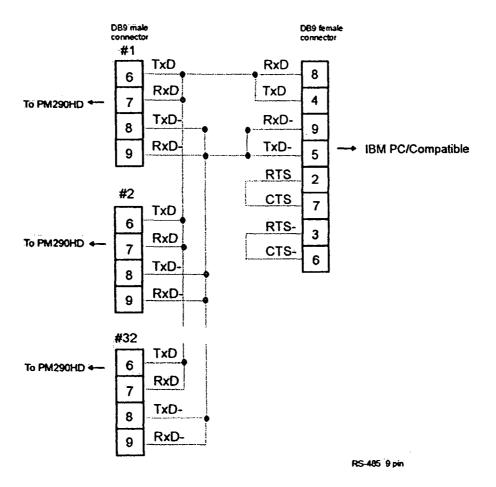


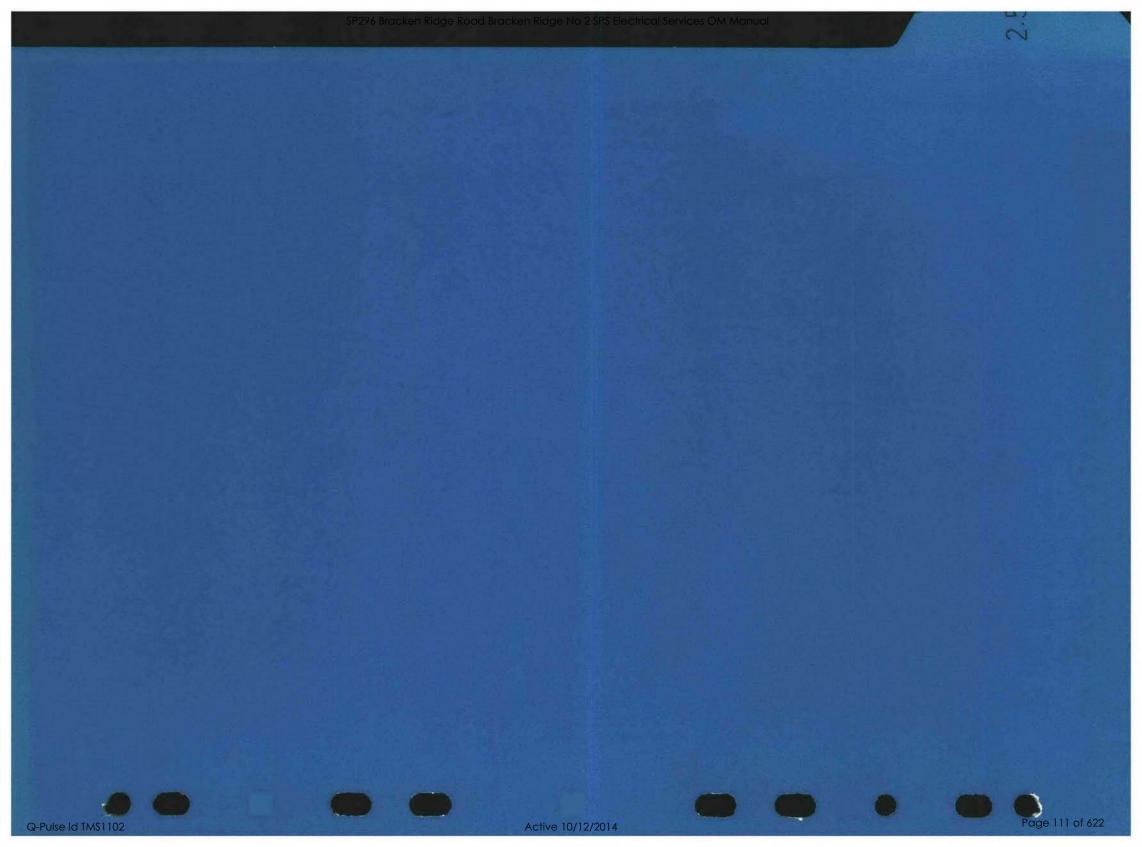
RS-485
25-pin Computer Connector

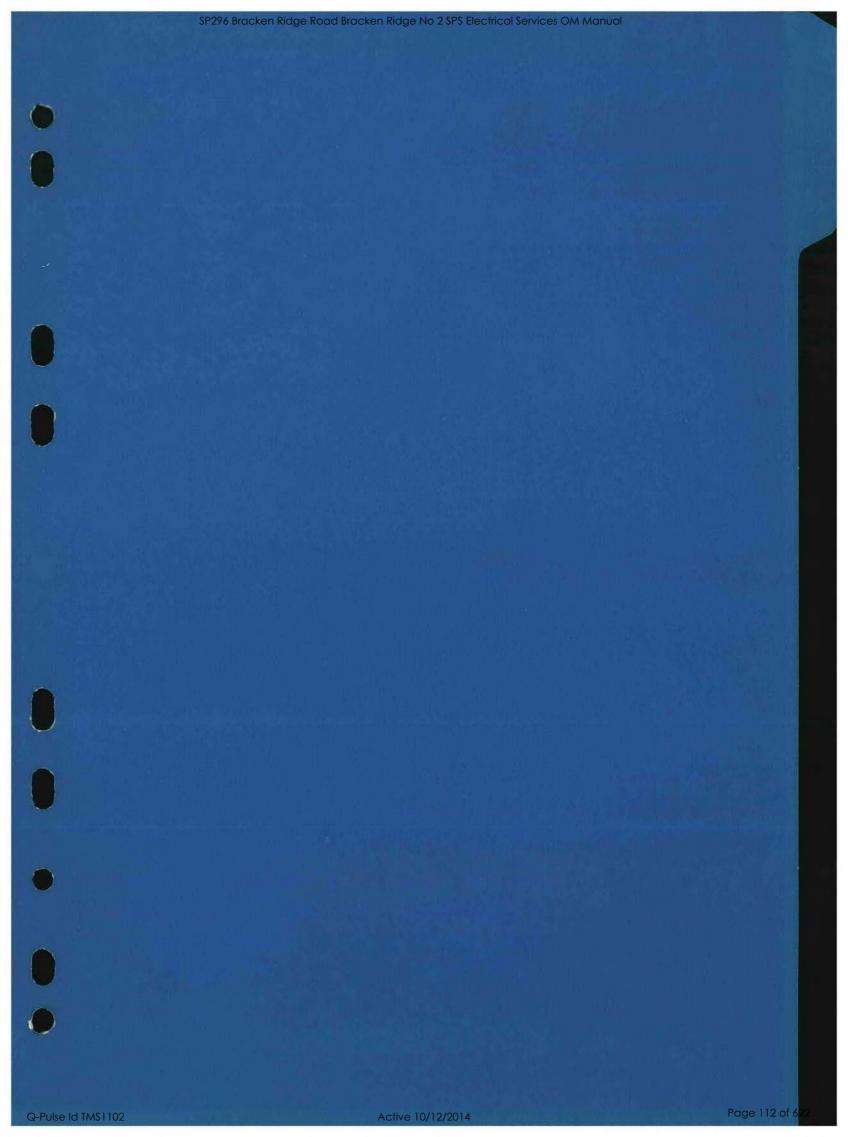


Appendix B: Communication Cable Drawings

9-pin Computer Connector









TECHNICAL DATA SHEET

For

SPS 296

Equipment Type: Variable Speed Drive

Location: Motor Starter Section

Model Numbers: VLT6125HT4C20str3DLF0

0C1

Manufacturer: Danfoss

Supplier: Danfoss.

32 Billabong Street Stafford QLD 4053

Ph: 07 3356 7911 Fx: 07 3855 0016



Modbus RTU Option Card for VLT 5000/6000 Adjustable Frequency Drive

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ADANGER

Rotating shafts and electrical equipment can be hazardous. Perform all electrical work in conformance with the National Electrical Code (NEC) and all local regulations. Installation, start-up and maintenance should be performed only by qualified personnel.

Factory recommended procedures, included in this manual, should be followed. Always disconnect electrical power before working on the unit.

Although shaft couplings or belt drives are generally not furnished by the manufacturer, rotating shafts, couplings and belts must be protected with securely mounted metal guards that are of sufficient thickness to provide protection against flying particles such as keys, bolts and coupling parts. Even when the motor is stopped, it should be considered "alive" as long as its controller is energized. Automatic circuits may start the motor at any time. Keep hands away from the output shaft until the motor has completely stopped and power is disconnected from the controller.

Motor control equipment and electronic controls are connected to hazardous line voltages. When servicing drives and electronic controls, there will be exposed components at or above line potential. Extreme care should be taken to protect against shock. Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case of an emergency. Disconnect power whenever possible to check controls or to perform maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electric control or rotating equipment.

Safety Guidelines

- The drive must be disconnected from the AC line before any service work is done.
- The "Stop/Off" key on the local control panel of the drive does not disconnect the equipment from the AC line and is not to be used as a safety switch.

- Correct protective grounding 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. Ground currents are higher than 3 mA.

Warnings Against Unintended Start

- While the drive is connected to the AC line, the motor can be brought to a stop by means of external switch closures, serial bus commands or references. If personal safety considerations make it necessary to ensure that no unintended start occurs, these stops are not sufficient.
- During programming of parameters, the motor may start. Be certain that no one is in the area of the motor or driven equipment when changing parameters.
- A motor that has been stopped may start unexpectedly
 if faults occur in the electronics of the drive, or if an
 overload, a fault in the supply AC line or a fault in the
 motor connection or other fault clears.
- If the "Local/Hand" key is activated, the motor can only be brought to a stop by means of the "Stop/Off" key or an external safety interlock.

NOTE

It is responsibility of user or person installing drive to provide proper grounding and branch circuit protection for incoming power and motor overload according to National Electrical Code (NEC) and local codes.

The Electronic Thermal Relay (ETR) is UL listed. VLTs provide Class 20 motor overload protection in accordance with the NEC in single motor applications, when parameter 117 is set for "ETR TRIP 1", "ETR TRIP 2", "ETR TRIP 3", or "ETR TRIP 4", and parameter 105 is set for rated motor (nameplate) current.

ADANGER

Touching electrical parts may be fatal – even after equipment has been disconnected from AC line. To be sure that capacitors have fully discharged, wait 14 minutes for 220 and 500 V units, wait 30 minutes for 550-600 V units after power has been removed before touching any internal component.

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Introduction

This manual provides comprehensive instructions on the installation and set up of the Modbus RTU option card for the VLT 5000 and VLT 6000 Adjustable Frequency Drives to communicate over a Modbus network.

For specific information on installation and operation of the adjustable frequency drive, refer to the *VLT Operating Instructions*.

About This Manual

This manual is intended to be used for both instruction and reference. It only briefly touches on the basics of the Modbus RTU protocol whenever necessary to gain an understanding of the Modbus RTU option card for the VLT.

experienced Modbus programmer, it is suggested that you read this manual in its entirety before you start programming since important information can be found in all sections.

This manual is also intended to serve as a guideline when you specify and optimize your communication system. Even if you are an

Assumptions

This manual assumes that you have a controller that supports the interfaces in this document and that all the requirements stipulated in the controller, as well as the

VLT 5000/6000 Adjustable Frequency Drive, are strictly observed, along with all limitations therein.

What You Should Already Know

The VLT Modbus RTU option card is designed to communicate with any controller that supports the interfaces defined in this

document. It is assumed that you have full knowledge of the capabilities and limitations of the controller.



Modbus RTU Overview

The common language used by all Modicon controllers is the Modbus RTU protocol. This protocol defines a message structure that controllers will recognize and use, regardless of the type of networks over which they communicate. It describes the process a controller uses to request access to another device, how it will respond to requests from the other devices, and how errors will be detected and reported. It establishes a common format for the layout and contents of message fields.

During communications on a Modbus RTU network, the protocol determines how each controller will know its device address, recognize a message addressed to it, determine the kind of action to be taken, and extract any data or other information contained in the message. If a reply is required, the controller will construct the reply message and send it.

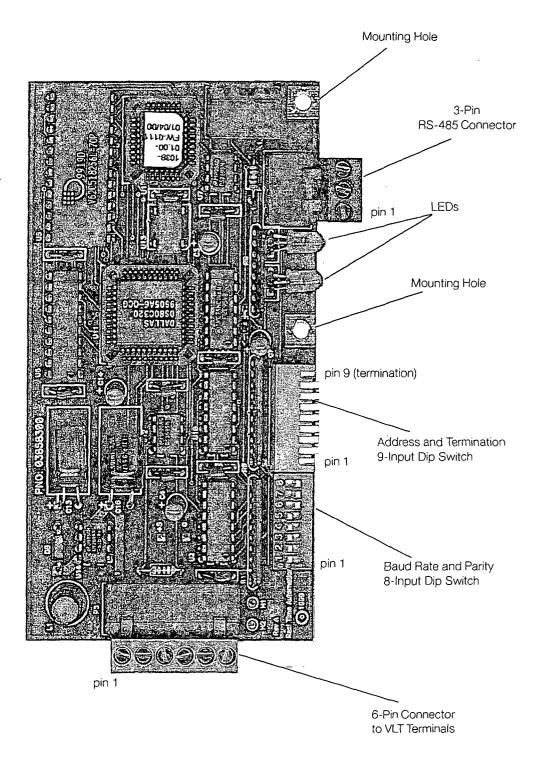
Controllers communicate using a masterslave technique in which only one device (the master) can initiate transactions (called 'queries'). The other devices (slaves) respond by supplying the requested data to the master, or by taking the action requested in the query.

The master can address individual slaves, or can initiate a broadcast message to all slaves. Slaves return a message (called a 'response') to queries that are addressed to them individually. Responses are not returned to broadcast queries from the master.

The Modbus RTU protocol establishes the format for the master's query by placing into it the device (or broadcast) address, a function code defining the requested action, any data to be sent, and an error-checking field. The slave's response message is also constructed using Modbus protocol. It contains fields confirming the action taken, any data to be returned, and an error-checking field. If an error occurred in receipt of the message, or if the slave is unable to perform the requested action, the slave will construct an error message and send it in response.

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VLT Modbus RTU Option Card

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Danfoss

Modbus RTU Option Card Baud Rate and Parity Settings The Modbus communication protocol accesses the internal VLT Danfoss FC protocol to control the drive through serial communications. The Modbus-to-FC interface uses 9600 Baud, 8 Bits, Even Parity, 1 Stop Bit.

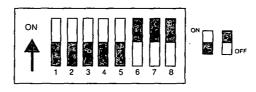
The Modbus option card has a baud rate and parity 8-input dip switch. For Modbus networks operating with Modbus-to-FC properties, set switch positions in accordance with the following instructions. For Modbus networks operating at other than with Modbus-to-FC properties, determine switch positions from the tables provided below.

- Ensure that inputs 1-3 are set to ON (default setting) to select the 9600 baud rate.
- Ensure that inputs 4 and 5 are set to ON (default setting) to select even parity.

Switches 6-8 are unassigned reserved switches. Their setting does not matter.

NOTE

Set baud rate and parity switch settings prior to installing Modbus RTU option card for ease of access.



Baud Rate and Parity Switch

Communication	E	Baud Rat	e.	Pa	rity		Reserve	
Configuration	∫SW1	∑SW2	2SW3	SW4	SW5	SW6	SW7	SW8
Default								
9600, 8N	ON	ON	ON	ON	ON	N/A	N/A	N/A
4800, 80	OFF	ON	ON	OFF	ON	N/A	N/A	N/A
19200, 8E	ON	OFF	.ON	OFF	OFF	N/A	N/A	N/A

Baud	SW1	SW2	-SW3
Rate			
300	OFF	OFF	OFF
1200	OFF	OFF	ON
2400	OFF	ON	OFF
4800	OFF	ON	ON
9600	ON	OFF	OFF
19200	ON	OFF	ON
9600	ON	ON	OFF
9600	ON	ON	ON

Parity	⊮SW4	SW5
N	ON	X
0	OFF	ON
E	OFF	OFF

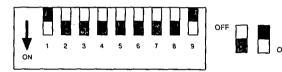
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Modbus RTU Option Card Network Address Settings The Modbus RTU option card has an address and termination 9-input dip switch. The Modbus network address for the VLT is set by dip switch positions on the switch. Pin 9 is an ON/OFF switch for network termination. DIP switch positions are read on power-up only, so position changes will not be recognized until the next power-up.

 Set the Modbus address for the VLT in accordance with the table below. The default input setting is for ADDRESS 1 and termination ON.



Address and Termination

Address (Hex)	SW1 20	SW2 2 ¹	SW3∺ 2 ²	SW4# 23.	TANKS OF A STORY OF	SW6* 2 ⁵	SW7 2f	SW8 2 ⁷	TERM
Default									
01	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
55	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
AA	OFF	ON	OFF	ON	OFF	ON	OFF	ON	ON
F7	ON	ON	ON	OFF	ON	ON	ON	ON	ON

Address Input Selection

VLT Parameter Settings

The Modbus RTU option card interface to the VLT 5000 and VLT 6000 Adjustable Frequency Drive FC protocol requires drive parameter values selected as shown. They are the default settings for those parameters and probably require no change to operate the drive using Modbus. The Modbus RTU option card always transmits to the drive in which it resides as address one (001). See the VLT Operating Instructions for details on selecting and changing parameter values, if necessary.

VLT 5000

- Parameter 500, Address: 001
- Parameter 501, Baud Rate: 9600 baud

VLT 6000

- Parameter 500, Protocol: FC protocol
- Parameter 501, Address: 001
- Parameter 502, Baud Rate: 9600 baud

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Modbus RTU Option Card Environmental Requirements Environmental requirements for the Modbus option card are listed below.

Description	Requirement
Operating temperature	-5° F to +140° F (-20° C to +60° C)
Storage temperature	-40° F to +176° F (-40° C to + 80° C)
Humidity	5% to 95% relative, non-condensing

Installation

The following section describes the installation procedures for the Modbus RTU option card. For additional information on installation and operation of the VLT, refer to the VLT Operating Instructions.

ADANGER

VLT adjustable frequency drive contains dangerous voltages when connected to line voltage. After disconnecting from power line, wait at least 14 minutes for 220 and 500 V units, for 550-600 V units wait at least 30 minutes before touching any electrical components.

AWARNING

Only a competent electrician should carry out electrical installation. Improper installation of motor or VLT can cause equipment failure, serious injury or death. Follow this manual, National Electrical Codes and local safety codes.

ACAUTION

Electronic components of VLT adjustable frequency drive and Modbus option card are sensitive to electrostatic discharge (ESD). ESD can reduce performance or destroy sensitive electronic components. Follow proper ESD procedures during installation or servicing to prevent damage.

ACAUTION

It is responsibility of user or installer of VLT adjustable frequency drive to provide proper grounding and motor overload and branch protection according to National Electrical Codes and local codes.

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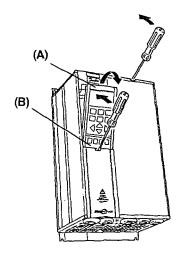
1. Access to Control Card Cassette

IP20/NEMA 1 Drives:

- Remove Local Control Panel (LCP) by pulling out from top of display (A) by hand. LCP connector on panel back will disconnect.
- Remove protective cover by gently prying with a screw driver at notch (B) and lift cover out of guide pin fittings.

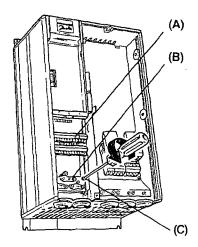
IP54/NEMA 12 Drives:

- Open front panel of drive by loosening captive screws and swing open.
- Disconnect Local Control Panel (LCP) cable.



2. Disconnect Control Card Cassette

- Remove control wiring by unplugging connector terminals (A).
- Remove grounding clamps (B) by removing two screws holding each in place. Save screws for reassembly.
- Loosen two captive screws (C) securing cassette to chassis.

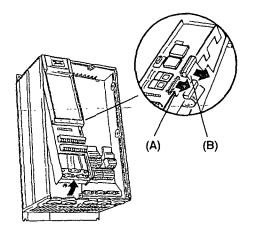


3. Remove Cassette and Ribbon Cables

- Lift control card cassette from bottom.
- Unplug two ribbon cables (A) and (B) from VLT control board.
- Unhinge cassette at top to remove.

NOTE

Ribbon cables will need to bereconnected to same connections from which removed.



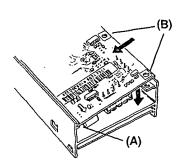
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4. Secure Modbus RTU Option Card

- On back of cassette, insert edge of Modbus RTU option card into slot at side of cassette (A).
- Secure opposite side of card with 2 self-tapping screws provided (B).





5.Wire
Modbus
RTU Option
Card
Connector
to VLT
Terminals

NOTE

Use 0.5 to 1.00mm² Cable (18 to 22 AWG). Torque terminals to 0.5-06 Nm (5 in-lbs). Modbus RTU interface connector terminals 5 and 6 are spares.

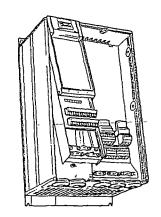
- Wire Modbus interface connector (24 V power) pin 1 to VLT terminal 12 or 13.
- Wire Modbus interface connector (RTxD+) pin 2 to VLT terminal 69.
- Wire Modbus interface connector (com) pin 3 to VLT terminals 20 and 61.
- Wire Modbus interface connector (RTxD-) pin 4 to VLT terminal 68.
- Plug Modbus interface connector into bottom of Modbus option card.

6. Install Ribbon Cables

NOTE

Ribbon cables must be reconnected to same connections from which removed.

- Connect control card cassette to hinge at top of drive.
- · Connect ribbon cables.



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7. Install Control Card Cassette

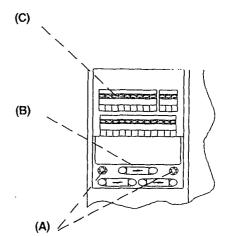
- Fasten control card cassette by alternately tightening two captive screws (A).
- Route control wires through clamp fasteners (B) and secure clamps with two screws.
- Connect control terminals (C) by firmly pressing them into connector receptacles.

IP20/NEMA 1 Drives

- Install LCP by sliding bottom into guide slots on cradle, then press into place ensuring that connector on back of LCP is engaged.
- Replace protective cover by positioning guide pins at bottom of cover into holes in bottom of chassis and snap top of cover into place.

IP54/NEMA 12 Drives

 Plug cable from LCP into connector on main control card.

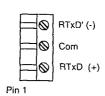


8. Plug in Terminal Connector

- Connect Modbus signal wire (RTxD+) to pin 1 of RS-485 terminal block.
- Connect Modbus signal wire (Com) to pin 2 of RS-485 terminal block.
- Connect Modbus signal wire (RTxD-) to pin 3 of RS-485 terminal block.
- Plug RS-485 terminal block into connector at right side of Modbus option card.

IP54/NEMA 12 Drives

 Close front cover panel and fasten with captive screws.



RS-485 Connector

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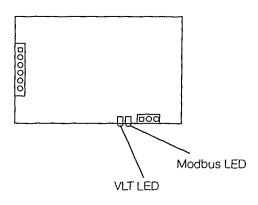


Status LEDs

The Modbus RTU option card has two LEDs. One LED is used as a status for Modbus communications and the other as a status for VLT drive communications. Both LEDs use the same communications patterns. On power up, each LED state is flashed on for 250 milliseconds (Red, Green, Orange, Off). The VLT LED powers up first, then the Modbus

LED. After power up, the following are the only valid states:

- Flashing Green (1 Hz): Communications online (VLT LED) or receiving data (Modbus LED)
- Flashing Red (1 Hz): Communications time out
- Solid Red: Major fault, communications halted



Option Card Operability Loop Back Test

A loop back test to confirm Modbus RTU option card operability can be performed. The option card must be removed from the adjustable frequency drive to gain access to the 8-input dip switch for baud rate and parity and to rewire the option card connectors.

ADANGER

Ensure that power has been removed from adjustable frequency drive for a minimum of 14 minutes for 220 and 500 V units and 30 minutes for 550-600 V units to allow voltage to dissipate.

- Remove the option card in accordance with the procedures described in the installation section of this manual.
- Set the dip switch positions in accordance

with the table below.

- Remove all wiring from both the 6-pin option card connector and the 3-pin RS-485 connector.
- Wire the 6-pin option card connector to the 3-pin RS-485 connector as described below.

RS-485	Connector
o Pin	3
o Pin	2
o Pin	1
	o Pin o Pin

Apply power to the unit.

After the normal status LED check at power-up (see Status LEDs), the loop back test sets both LEDs to orange for a successful test and red if the test fails.

SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
ON	ON	ON	OFF	OFF	ON	ON	ON

Loop BackTest Switch Positions

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Remote Terminal Unit The controllers are setup to communicate on the Modbus network using RTU (Remote Terminal Unit) mode, with each 8-bit byte in a message contains two 4-bit hexadecimal characters. The format for each byte is shown below.

Coding System:

8-bit binary, hexadecimal 0-9, A-F

Two hexadecimal characters contained in each 8-bit

field of the message

Bits Per Byte:

1 start bit

8 data bits, least significant bit sent first 1 bit for even/odd parity; no bit for no parity 1 stop bit if parity is used; 2 bits if no parity

Error Check Field:

Cyclical Redundancy Check (CRC)

Modbus Message Structure

A Modbus message is placed by the transmitting device into a frame with a known beginning and ending point. This allows receiving devices to begin at the start of the message, read the address portion, determine which device is addressed (or all devices, if the message is broadcast), and to know when the message is completed. Partial messages are detected and errors set as a result.

The allowable characters transmitted for all fields are hexadecimal 0-9, A-F. The adjustable frequency drives monitor the network bus continuously, including 'silent' intervals. When

the first field (the address field) is received, each drive or device decodes it to determine whether it is the addressed device.

Modbus messages addressed to zero are converted to broadcast messages using the FC protocol. No response is needed on broadcast messages.

To ensure the attribute data returned is the most current, each attribute access must include one attribute only.

A typical message frame is shown below.

Start	Address	Function	Data	CRC Check	End
T1-T2-T3-T4	8 Bits	8 Bits	n x 8 Bits	16 Bits	T1-T2-T3-T4

Typical Modbus Message Structure

Modbus Message Structure (continued)

Start/Stop Field

Messages start with a silent interval of at least 3.5 character times. This is implemented as a multiple of character times at the 9600 network baud rate (shown as Start T1-T2-T3-T4). The first field then transmitted is the device address. Following the last transmitted character, a similar interval of at least 3.5 character times marks the end of the message. A new message can begin after this interval.

The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 1.5 character times

occurs before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte will be the address field of a new message.

Similarly, if a new message begins earlier that 3.5 character times following a previous message, the receiving device will consider it a continuation of the previous message. This will set an error, since the value in the final CRC field is not valid for the combined messages.

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Modbus Message Structure (continued)

Address Field

The address field of a message frame contains 8 bits. Valid slave device addresses are in the range of 0 – 247 decimal. The individual slave devices are assigned addresses in the range of 1 – 247. (O is reserved for broadcast mode, which all slaves recognize.) A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in this address field to let the master know which slave is responding.

Function Field

The function field of a message frame contains 8 bits. Valid codes are in the range of 1 – 255 decimal. (See Appendix A for a description of supported Modbus functions.) When a message is sent from a master to a slave device, the function code field tells the slave what kind of action to perform.

When the slave responds to the master, it uses the function code field to indicate either a normal (error-free) response, or that some kind of error occurred (called an exception response). For a normal response, the slave simply echoes the original function code. For an exception response, the slave returns a code that is equivalent to the original function code with its most-significant bit set to a logic 1. In addition, the slave places a unique code into the data field of the response message. This tells the master what kind of error occurred, or the reason for the exception. See the *Exception Codes* section in this manual for definitions.

Data Field

The data field is constructed using sets of two hexadecimal digits, in the range of 00 to FF hexadecimal. These are made from one RTU character. The data field of messages sent from a master to slave device contains additional information which the slave must use to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the field. The data field can have a length of zero.

CRC Check Field

Messages include an error-checking field that is based on a cyclical redundancy check (CRC) method. The CRC field checks the contents of the entire message. It is applied regardless of any parity check method used for the individual characters of the message. The CRC value is calculated by the transmitting device, which appends the CRC as the last field in the message. The receiving device recalculates a CRC during receipt of the message and compares the calculated value to the actual value received in the CRC field. If the two values are not equal, an error results.

The error checking field contains a 16-bit binary value implemented as two 8-bit bytes. When this is done, the low-order byte of the field is appended first, followed by the high-order byte. The CRC high-order byte is the last byte sent in the message.

Coil/Register Addressing

All data addresses in Modbus messages are referenced to zero. The first occurrence of a data item is addressed as item number zero. For example:

The coil known as 'coil 1' in a programmable controller is addressed as coil 0000 in the data address field of a Modbus message. Coil 127 decimal is addressed as coil $007E_{\rm HEX}$ (126 decimal).

Holding register 40001 is addressed as register 0000 in the data address field of the message. The function code field already specifies a 'holding register' operation. Therefore, the '4XXXX' reference is implicit. Holding register 40108 is addressed as register 006B_{HEX} (107 decimal).

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Translation from Modbus RTU Protocol to **FC Protocol** Refer to Serial Communication for FC Protocol in the VLT Operating Instructions for details on the Danfoss FC protocol used for Modbus serial communication within the VLT 5000/VLT 6000 Adjustable Frequency Drive.

Parameter Block

PKF

PKE contains AK with the parameter commands and replies, and PNU with the parameter number. The AK value is determined by the Modbus function code. Coil 65 decimal determines whether data written to the drive are stored in EEPROM and RAM (coil 65 = 1) or just RAM (coil 65 = 0). PNU is translated from the register address contained in the Modbus read/write message. The parameter number is translated to Modbus as (10 x parameter number) pecimal.

IND contains the index. The index is used, together with the parameter number, for read/write access. Index has 2 bytes - a low byte and a high byte. However, only the low byte is used for indexing. The high byte is used for reading and writing text. IND is set by a register in Modbus (40001_{HEX}). IND must be cleared by the Modbus master after reading/ writing text.

PWE_{HIGh}/PWE_{Low} PWE contains the parameter value. The parameter value block consists of 2 words (4 bytes). The value depends on the command given (AK). PWE is zero filled on reads. On writes, PWE is filled with the data field of the Modbus write message.

PCD₁/PCD,

PCD contains the process word block. The parameter value block consists of 2 words (4 bytes). The process word block is divided into two blocks of 16 bits and is stored in Modbus as status coils. The mapping of the PCD is shown below.

Process Block Updates

Upon every write to the PCD coils, the process block is written to the drive and returned from the drive. On parameter reads and writes, the PCD is deactivated on messages from the Modbus option card to the drive. The PCD coils are updated on response messages from the drive to the Modbus option card.

Text Blocks

Parameters stored as text strings are accessed the same as the other parameters except PWE is replaced with the text block. The maximum text block size is 20 characters. If a read request for a parameter is for more characters than the parameter stores, the response is space filled. If the read request for a parameter is for less characters than the parameter stores, the response is truncated.

	PCD ₁	PCD₂
Control packet	Control word	Reference value
(master → slave)	(Coils 1 - 16) _{DEC}	(Coils 17 – 32) _{DEC}
Reply packet	Status word	_Given_output_frequenc
(slave → master)	(Coils 33 - 48) _{DEC}	(Coils 49 – 64) _{DEC}

PCD Mapping



FC Protocol Control Word Bit Descriptions

Control Word Bit Descriptions

, Bit	Setting	32.000 4.5 20.040			
00	0	Preset Ref. LSB			
01	0	Preset Ref. MSB			
02	1	DC Brake	no DC Brake		
03	0	Coast Sto	no Coast Stop		
04	1	"Quick" Stop	no "Quick" Sto		
05	4	Freeze Freq.	no Freeze Freq.		
06	a	Ramp Stop	Start		
07	0	no Reset	Reset		
08	0	no Jo	Jog		
09	0	no fui	nction		
10	1	Data Not Valid	Data Valid		
11	0	Relay 1 OFF	Relay 1 ON		
12	0	Relay 2 OFF Relay 2 ON			
13	0	Setup LSB			
14	0	Setup MSB			
15	0	no Reversing	Reversing		

Conversion Factor

Conversion

The different attributes for each parameter can be seen in the section on factory settings. Since a parameter value can only be transferred as a whole number, a conversion factor must be used to transfer decimals.

Example:

Parameter 201: Minimum Frequency, conversion factor 0.1. If parameter 201 is to be set to 10 Hz, a value of 100 must be transferred, since a conversion factor of 0.1 means that the transferred value will be multiplied by 0.1. A value of 100 will, therefore, be understood as 10.0.

Factor
3,6
100.0
10.0
1.0
0.1
0.01
0.001
0.0001

Memory Mapping

Parameter Values

Standard Data Types

Standard data types are int16, int32, uint8, uint16 and uint32. They are stored as 4x registers (40001 – 4FFFF). The parameters are read using function $03_{\rm HEX}$ "Read Holding Registers:" Parameters are written using function $6_{\rm HEX}$ "Preset Single Register" for 1 register (16 bits), and function $10_{\rm HEX}$ "Preset Multiple Registers" for 2 registers (32 bits). Valid sizes to read are 1 register (16 bits) and 2 registers (32 bits).

Nonstandard Data Types

Nonstandard data types are text strings and are stored as 4x registers (40001 – 4FFFF). The parameters are read using function 03_{HEX} "Read Holding Registers" and written using function 10_{HEX} "Preset Multiple Registers." Valid sizes to read are 1 register (2 characters) through 10 registers (20 characters). See *Text Blocks* section in this manual for truncation/ space fill rules. IND (Modbus Register 1) must be written with a value of 0400_{HEX} (read) or 0500_{HEX} (write) prior to reading or writing a text string.

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Memory Mapping (continued)

Status Coils Map (128 coils total)

Address (Decim	al) Description
1 – 16	PCD ₁ Control word (master → slave)
17 – 32	PCD₂ Reference value (master → slave)
33 – 48	PCD ₁ Status word (slave → master)
49 – 64	PCD₂ Given output frequency (slav → master)
65	Write memory storage type bit (used with AK), see PKE
66 - 128	Reserved

Memory Mapping (continued)

VLT 5000 Register Maps (65536 registers total)

Address (Decimal)	Description
00001	IND (index word)
00002	Modbus Communications Timeout Value (10 millisecond units)
00003	Drive Communications Timeout Value (10 millisecond units)
00004:= 00009:	Reserved
00010	Parameter 001, Language
} ↓	\downarrow
00190	Parameter 019, Operating State at Power-up, Local Control
00200=09999	Reserved.
01000	Parameter 100, Configuration
↓	. ↓
01310	Parameter 131, Initial Voltage
01320 = 01999	Reserved
02000	Parameter 200, Output Frequency Range/Direction
(↓	↓ ↓
02340	Parameter 234, Motor Phase Monitor
02350 = 02999	Reserved
03000	Parameter 300, Terminal 16, Digital Input
↓	
03460	Parameter 346, Encoder Loss Function
03470 = 03999	Reserved
04000	Parameter 400, Brake Function
↓	↓
04540	Parameter 454, Dead Time Compensation
04550 = 04999	Reserved
05000	Parameter 500, Address
} ↓	↓
05410	Parameter 541, Data Readout: Warning Word 2
05420=05999	Reserved
06000	Parameter 600, Operating Data: Operating Hours
1	Description Code Name of the Communication Code in the
06310	Parameter 631, Nameplate: Communication Option Ordering No.
06320 = 06999	Reserved
07000	Parameter 700, Relay 6, Output Function
07000	Parameter 700 Rolay 9 Off Delay
07090	Parameter 709, Relay 9, Off Delay
07100 = 65536	Reserved



Memory Mapping (continued)

VLT 6000 Register Maps (65536 registers total)

Address (Decimal)	
00001	IND (index word)
00002	Modbus Communications Timeout Value (10 millisecond units)
00003	Drive Communications Timeout Value (10 millisecond units)
00004 = 00009	Keserved.
00010	Parameter 001, Language
↓	\downarrow
00170	Parameter 017, Operating State at Power-up
00180 = 09999	Reserved
01000	Parameter 100, Configuration
↓	↓
01170	Parameter 117, Motor Thermal Protection
01180 = 01999	Reserved
02000	Parameter 200, Output Frequency Range
$\downarrow \downarrow$	↓
02280	Parameter 228, Warning: High Feedback
02290 = 02999	Reserved
03000	Parameter 300, Terminal 16 Digital Input
↓	↓
03280	Parameter 328, Pulse Feedback, Max. Freq.
03290 03999	Reserved
04000	Parameter 400, Reset Function
 	↓ ↓ ↓ ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ←
04270	Parameter 427, PID Lowpass Filter Time
04280 = 04999	Reserved
05000	Parameter 500, Protocol
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	Developed 500 FINE Franking
05660	Parameter 566, FLN Time Function
05670 = 05999	Reserved
06000	Parameter 600, Operating Data: Operating Hours
00010	December 621 Nameslate: Communication Option Ordering No.
06310	Parameter 631, Nameplate: Communication Option Ordering No.
06320 = 06999	Reserved Parameter 700, Relay 6, Output Function
07000	raiameter 700, nelay 6, Output rundion
07110	Poromotor 711 Polov 0. Off Dolov
07110	Parameter 711, Relay 9, Off Delay
07.120 = 65536	Reserved

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Drive Start Command, with bytes reversed (see FC Protocol Control Word Bit Descriptions): binary (bit 15 through bit 00) 0000010001111100 = 047C

Danfoss Message Translation

Examples

EXAMPLE ONE: Start Motor, Run Speed 40%

Modbus function OF_{HEX} (Force Multiple Coils).

Message sent to Modbus RTU option card from Modbus master

For a man all war of letter	dei wateren an edite kaar		and the second			ز چسرستی براسی استان استان استان	ggmmm
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		<i></i> 441 445				Briti Courti, ji	incres, Cata III i
i i Addresi							
	#			127	1 217	ilit i	TC.
		**************************************					——————————————————————————————————————
FILL HOLE WITH			······································				

The state of the s	man ne dyna se ranje		in a ga ir gair , e mga ang g
		Thores Catelli	
	to be trapped by the state of the same		
	50	16	

Modbus message string:

[01] [0F] [00] [00] [00] [20] [04] [7C] [04] [99] [19] [37] [43]

Start Command: 0000010001111100 = 047C_{HEX} (reversed) (see FC Protocol Control Word Bit Descriptions)

Modbus message string:

[01] [0F] [00] [00] [00] [20] [04] [7C] [04] [99] [19] [37] [43]

NOTE: Speed Command: $4000_{\rm HEX}$ = 100% speed 40% of $4000_{\rm HEX}$ = 1999 $_{\rm HEX}$ (reversed)

Message returned to Modbus master from Modbus RTU option card

		Tree war gereg				
i i i i i i i i i i i i i i i i i i i	. F. Hellani		e Celladar I fi			The mark the sale
. Aconesa.						
- Gt	oF	1 00	20	- M	20	

All values are in hexadecimal.

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Message Translation Examples (continued)

EXAMPLETWO: Ramp-Stop Motor

Message sent to Modbus RTU option card from Modbus master

	imili meriali Tilini i i m				
					includer of the comment
Property of the same property of the contract					
				h: uru: Luu:	
		aali dada Haaani Sila			41
	. 414. I	1	 . 724	E 15.4	i me
			 #14	f tyrru	f ##L* f

L. Parce Data . I Force Date H. F. Parce Date . P. Bran Check	
	a 1
	٩I
en Gellan (8-0 5) septemble de de la Grand (20-11) de la decemble de la Colonia de la	
04 1 00 1 00 1 (856 (10))	٦

Modbus message string:

[01] [0F] [00] [00] [00] [20] [04] [3C] [04] [00] [00] [89] [19]

Stop Command: $0000010000111100 = 043C_{HEX}$ (reversed)

(see FC Protocol Control Word Bit Descriptions)

Speed Command: 0%

Message returned to Modbus master from Modbus RTU option card

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
Slave	Function	Coll Addr HI	Coll Addr LO	No. of Colls.	No of Colls	Error Check
01	0F	00	00	00	20	e-

All values are in hexadecimal.

EXAMPLETHREE: Coast Stop Motor

Message sent to Modbus RTU option card from Modbus master

Byte 0	Byte:1	Byte 2	Byte 3:	Byte 4	Byte 5:	S Byte 6 ≥ 2	Byte 7
Slav?	Function	Coil Addr HI	Coll Addr LO	# of Coils HI	# of Coils LO	Byte Count	Force Data HI
Address			SALES THAT		in attended		Côils (0-7)
01	ΩF	00	00	00	20	04	20
1							

2C	00	00	
Force Data LO Colls (8-15)	Force Data HI Colls (16-23)		A DESTRUMENT
	Byte 9%		

Modbus message string:

[01] [0F] [00] [00] [00] [20] [04] [20] [2C] [00] [00] [--]

Coast Command: $0010110000100000 = 2C20_{HEX}$ (reversed)

(see FC Protocol Control Word Bit Descriptions)

Speed Command: 0%

Message returned to Modbus master from Modbus RTU option card

Byte 0	Byte 1	Byte.2	Byte 3.	Byte 4	Byte 5	Byte 6
Slave	Function	Coil Addr HI	Coil Addr LO	No. of Coils	No. of Coils	CError Check
Address				H. L.	LO	
01	O.L	00	_ 00	00	20	•

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Message Translation Examples (continued) EXAMPLE FOUR: Write Parameter 104,

Motor Frequency, with 60 Hz (Data Type 6 – UINT16)

(Conversion factor = 0)

Modbus Function 06_{HEX} Preset Single Register

Message sent to Modbus RTU option card from Modbus master

Byte 0	Byte 1	Byte 2	Byle 3	Byte 4	Byte 5	Byte 6
Slave Address	Function	Register	Register.	Preset Data	Preset Data	Error Check
01	06	04	OF	00	3C	

Modbus message string:

[01] 06] [04] [0F] [00] [3C] [error check]

Parameter $104 = 0F04_{HEX}$ (reversed)

Note that the starting address of a register is the parameter number x 10 -1 in HEX. $104 \times 10 = 1040 - 1 = 1039 = 0F04_{HEX}$ (reversed)

Modbus message string:

[01] 06] [04] [0F] [00] [3C] [error check]

Speed (60 Hz) = 3C_{HEX}

Message returned to Modbus master from Modbus RTU option card

SEARING COLUMN TO THE PROPERTY OF THE PROPERTY	The state of the s				
THE STORY OF THE PERSON	ir denseru.	. * Fledister *	- Preset Data:	" Preset Ciala"	EHBY Chark
	li aan m	i i kazira i			
I se I no	1				
<u> 41 </u>		<u></u>			100 m 100 m 10 m

All values are in hexadecimal.

EXAMPLE FIVE: Read Parameter 514, (Parameter 520 for VLT 5000) Motor Current = 3 Amps (Data Type 7 – UINT32) (Conversion Factor = -2)

 ${\it Modbus Function}\, {\it O3}_{\rm HEX} {\it Read Holding Registers}$

Message sent to Modbus RTU option card from Modbus master

Byte 0:	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5:	Byte 6
" Slave"	Function	Start Addr HI.	Start Addr LO	No. of Points	No. of Points	Error Chec
Address:				SHI CALL	LO.	last in the second
01	03	14	13	00	02	

Parameter 514 (5139) = 1413_HEX

Message sent to Modbus master from Modbus RTU option card

hilliand the state of the state			
		the transfer of the state of th	

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Message Translation Examples (continued) EXAMPLE SIX: Write Parameter 533, Display Text 1, (VLT 6000 only) with "1234567890" (Data Type 9 – Text String).

Write IND with "0500" to perform a text write.

 ${\it Modbus Function} \ {\it O6}_{\it HEX} \ {\it Preset Single Register}$

Message sent to Modbus RTU option card from Modbus master

	Byled Function	i Pylesi Perioler	Rogales	Presel Data			
parametric district		erman Promen Present	II PARIM LUI.		n		
i ai	06	60	figi	05	00	***	

Message sent to Modbus master from Modbus option card

per entero en la la la dist	en in Huer e		i Byrid ()	Byte 5 Byte 5
en espera	None - Heaster -	i i i i i i i i i i i i i i i i i i i	Pikaki Cela - 1. Pr	KANDANA PILEMATICISER:
	:::::::::::::: 			LO DE LE LE LE LE LE LE LE LE LE LE LE LE LE
O		DD L	05	00

Commands Modbus to text mode.

Modbus Function 10_{HEX} Preset Multiple Registers

Message sent to Modbus RTU option card from Modbus master

Slave	unction St	AND MINISTER					
Address		34	rt Addr L	No. of Registers HI	No. of Registers LO	Byte Count	Data HI (Reg 414D2)
01	10	14	.D1	00_	05	OA	31
					dhiiiiidd		
		8 46 10 % ()	Byre tzacaj				The Bylen Brit
**, Casi #1, *-	Carrie (fill and fill	<u>Comprise in the control of the cont</u>	<u>Dele Hili i i i</u>	* ;; Deb # H1; ;;			fij joka niga
. Hey endire 1 JA		en tialini il il					in (Mary 41405).
	_ 33 1	34	34	#I	37	_ 30	39

Message sent to Modbus master from Modbus RTU option card

Byte 0						
Slave	Function	Stärt Addr HI	Start Addr LO.		No. Registers	Error Check
::::Address:::::				· H	LO.	
01	10	14	D1	00	.05	

All values are in hexadecimal.

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When the VLT responds to the master via the Modbus serial network, it uses the function code field to indicate either a normal (errorfree) response or an error (called an exception response). In an error-free response, the drive simply echoes the original function code. For an exception response, the drive will return a code that is equivalent to the original function

code with its most-significant bit set to a logic 1. In addition, the drive places a unique code into the data field of the response message. This tells the master what kind of error occurred, or the reason for the exception. The tables below identify the codes and describe their meaning.

Modbus Code (decimal)	Meaning
00	The parameter number does not exist
01	There is no write access to the parameter
02	The data value exceeds the parameter limits
03	The used sub-index does not exist
04	The parameter is not of the array type
05	The data type does not match the parameter called
17	Data change in the parameter called is not possible in the present
1	mode of the drive. Some parameters can only be changed when th
	motor has stopped
130	There is no bus access to the parameter called
131	Data Change is not possible because factory setup is selected
255	Message Timeout

VLT Errors

Modbus Code (decimal)	Meaning
64	Invalid Data Address
65	Invalid Message Length
66	Invalid Data Length
67	Invalid Function Code

Modbus Errors



APPENDIX A

Supported Modbus Function Codes Appendix A describes the following functions supported by the Modbus RTU option card.

Read Coil Status (01_{HEX}) Force Single Coil (05_{HEX}) Force Multiple Coils (0F_{HEX}) Read Holding Registers (03 $_{\rm HEX}$) Preset Single Register (06 $_{\rm HEX}$) Preset Multiple Registers (10 $_{\rm HEX}$)

Read Coil Status (01_{HEX})

Description

Reads the ON/OFF status of discrete outputs (0X references, coils) in the slave. Broadcast is never supported for reads.

Query

The query message specifies the starting coil and quantity of coils to be read. Coils are addressed starting at zero. Coils 1-16 are addressed as 0-15.

Example of a request to read coils 1-16 from slave device 01.

Field Name	Example (HEX)
Slave Address	01
Function	01
Starting Address HI	00
Starting Address LO	00
No. of Points HI	00
No. of Points LO	10
Error Check (CRC)	<u> </u>

Response

The coil status in the response message is packed as one coil per bit of the data field. Status is indicated as: 1 = ON; 0 = OFF. The LSB of the first data byte contains the coil addressed in the query. The other coils follow toward the high order end of this byte, and from 'low order to high order' in subsequent bytes.

If the returned coil quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte). The Byte Count field specifies the quantity of complete bytes of data

Field Name	Example (HEX)
Slave Address	01
Function	01
Byte Count	02
Data (Coils 8-1)	55
Data (Coils 16-9)	AA
Error Check (CRC)	_

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Force Single Coil (05_{HEX})

Description

Forces a single coil (0X reference) to either ON or OFF. When broadcast, the function forces the same coil references in all attached slaves.

Query

The query message specifies the coil reference to be forced. Coils are addressed starting at zero. Coil 1 is addressed as 0. Force Data = $0000_{\rm Hex}$ (OFF) or FF $00_{\rm Hex}$ (ON).

Example of a request to set coil 1 (addressed as 0) from slave device 01.

Field Name	Example (HEX)
Slave Address	01
Function	05
Coil Address HI	00
Coil Address LO	00
Force Data HI	FF
Force Data LO	00
Error Check (CRC)	

Response

The normal response is an echo of the query, returned after the coil state has been forced.

Field Name	Example (HEX)
Slave Address	01
Function	05
Force Data HI	FF
Force Data LO	00
Quantity of Coils HI	00
Quantity of Coils LO	0A
Error Check (CRC)	T-

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Force Multiple Coils (0F_{HEX})

Description

Forces each coil (0X reference) in a sequence of coils to either ON or OFF. When broadcast, the function forces the same coil references in all attached slaves.

Query

The query message specifies the coil references to be forced. Coils are addressed starting at zero. Coil 1 is addressed as 0.

Example of a request to set 10 coils starting at coil 1 (addressed as 0) from slave device 01.

Field Name	Example (HEX)
Slave Address	01
Function	OF
Coil Address HI	00
Coil Address LO	00
Quantity of Coils HI	00
Quantity of Coils LO	0A
Byte Count	02
Force Data HI (Coils 8-1)	FF
Force Data LO (Coils 10-9)	03
Error Check (CRC)	

Response

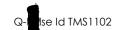
The normal response returns the slave address, function code, starting address, and quantity of coils forced.

Field Name	Example (HEX)
Slave Address	01
Function	0F
Coil Address HI	00
Coil Address LO	00
Quantity of Coils HI	00
Quantity of Coils LO	0A
Error Check (CRC)	

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Read Holding Registers (03_{HEX})

Description

Reads the binary contents of holding registers (4x references) in the slave. Broadcast is never supported for reads.

Query

The query message specifies the starting register and quantity of registers to be read. Registers are addressed starting at zero. Registers 1-4 are addressed as 0-3.

Example of a request to read registers 40001-03 from slave device 01.

Field Name	Example (HEX)
Slave Address	01
Function	03
Starting Address HI	00
Starting Address LO	00
No. of Points HI	00
No. of Points LO	03
Error Check (CRC)	T-

Response

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Field Name	Example (HEX)
Slave Address	01
Function	03
Byte Count	06
Data HI (Register 40001)	55
Data LO (Register 40001)	AA
Data HI (Register 40002)	55
Data LO (Register 40002)	AA
Data HI (Register 40003)	55
Data LO (Register 40003)	AA
_Error_Check-(CRC)	

APPENDIX A



Preset Single Register (06_{HEX})

Description

Presets a value into a single holding register (4x reference). When broadcast, the function presets the same register reference in all attached slaves.

Query

The query message specifies the register reference to be preset. Registers are addressed starting at zero. Register 1 is addressed as 0.

Example of a request to preset register 40002 to 00 $03_{\rm HEX}$ in slave device 01.

Field Name	Example (HEX)
Slave Address	01
Function	06
Register Address HI	00
Register Address LO	01
Preset Data HI	00
Preset Data LO	03
Error Check (CRC)	

Response

The normal response is an echo of the query, returned after the register contents have been passed

Field Name	Example (HEX)
Slave Address	01
Function	06
Register Address HI	00
Register Address LO	01
Preset Data HI	00
Preset Data LO	03
Error Check (CRC)	

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Preset Multiple Registers (10_{HEX})

Description

Presets values into a sequence of holding registers (4x references). When broadcast, the function presets the same register references in all attached slaves.

Query

The query message specifies the register references to be preset. Registers are addressed starting at zero. Register 1 is addressed as 0.

Example of a request to preset two registers starting at 40002 to 00 AA $_{\rm HEX}$ and 01 02 $_{\rm HEX}$, in slave device 1.

Field Name	Example (HEX)
Slave Address	01
Function	10
Starting Address HI	00
Starting Address LO	01
No. of Registers HI	00
No. of Registers LO	02
Byte Count	04
Write Data HI (Register 40001)	00
Write Data LO (Register 40001)	0A
Write Data HI (Register 40002)	01
Write Data LO (Register 40002)	02
Error Check (CRC)] -

Response

The normal response returns the slave address, function code, starting address, and quantity of registers preset.

Field Name	Example (HEX)
Slave Address	01
Function	10
Starting Address HI	00
Starting Address LO	01
No. of Registers HI	
No. of Registers LO	02
Error Check (CRC)	

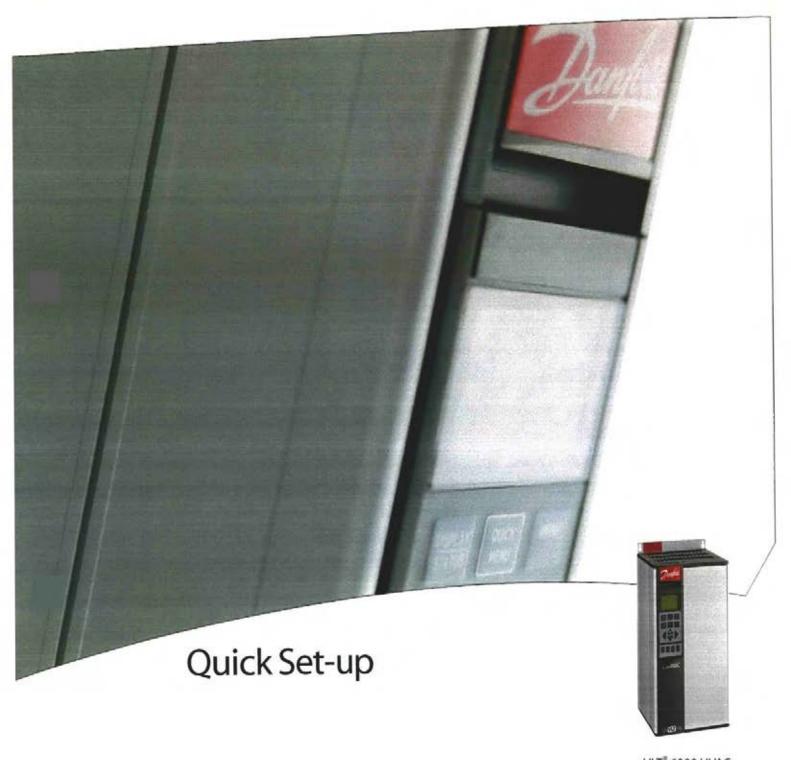
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VLT* 6000 HVAC



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The voltage of the frequency converter is dangerous whenever the equipment is connected to mains. Incorrect

installation of the motor or the frequency converter may cause damage to the equipment, serious personal injury or death.

Consequently, the instructions in this manual, as well as national and local rules and safety regulations, must be complied with.

■ Safety regulations

- 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.
- The [OFF/STOP] key on the control panel of the frequency converter does <u>not</u> disconnect the equipment from mains and is thus <u>not to</u> be used as a safety switch.
- 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.
- Protection against motor overload is included in the factory setting. Parameter 117, Motor thermal protection default value is ETR trip 1.
 Note: The function is initialised at 1.0 x rated motor current and rated motor frequency (see parameter 117, Motor thermal protection).

- Do <u>not</u> 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.
- Reliable galvanic isolation (PELV) is not complied with if the RFI switch is placed in OFF position. This means that all control in - and outputs can only be considered low-voltage terminals with basic galvanic isolation.
- 8. Please note that the frequency converter has more voltage inputs than L1, L2 and L3, when the DC-bus terminals are used.
 Check that <u>all</u> voltage inputs have been disconnected and that the necessary time has passed before repair work is commenced.

■ Warning against unintended start

- 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.
- While parameters are being changed, the motor may start. Consequently, the stop key [OFF/STOP] must always be activated, following which data can be modified.
- 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.

Using VLT 6002-6005, 220 and 500 V:

Using VLT 6006-6550, 220 and 500 V:

Using VLT 6002-6006, 550-600 V:

Using VLT 6008-6027, 550-600 V:

Using VLT 6032-6275, 550-600 V:

wait at least 4 minutes wait at least 15 minutes wait at least 4 minutes wait at least 15 minutes wait at least 30 minutes 175HA490.



■ Mechanical installation

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

The frequency converter must be installed vertically.

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

■ Enclosure protection

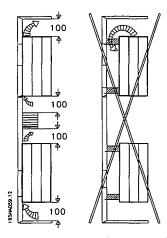
	IP 00	IP 20	Nema 1	IP 54
Bookstyle5	-	OK	-	-
VLT 6002-6032 200-240 V	-	OK	-	OK
VLT 6002-6550 380-460 V	OK	OK	-	OK
VLT 6002-6011 550-600 V		-	OK	-
VLT 6016-6072 550-600 V	-		OK	-
VLT 6100-6275 550-600 V	ОК		OK	-

■ Field-mounting

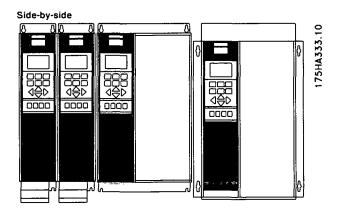
	IP 00	IP 20	Nema 1	IP 54
Bookstyle	-	No		-
VLT 6002-6032 200-240 V		No		OK
VLT 6002-6550 380-460 V	No	No		ОК
IP 20 with 4x top cover				
VLT 6002-6005 200-240 V	-	ОК		ок
VLT 6002-6016 380-460 V	-	ОК		ок
VLT 6002-6011 550-600 V	•	ОК	OK	-
IP 20 with terminal cover				
VLT 6006-6032 200-240 V	-	OK_		ок
VLT 6022-6072 380-460 V		OK		OK
VLT 6016-6072 550-600 V	-		OK	-

■ Spacing when installing of VLT 6002-6005 200-240 V, VLT 6002-6011 380-460 V, VLT 6002-6011 550-600 V, Bookstyle IP 00, IP 20, NEMA 1 and IP 54

Cooling

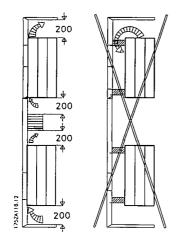


All the above-mentioned units require a minimum space of 100 mm above and below the enclosure.



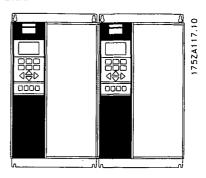
All the above-mentioned units can be installed side by side without any space, since these units do not require any cooling on the sides.

■ Installation of VLT 6006-6032 200-240 V, VLT 6016-6072 380-460 V, VLT 6016-6072 550-600 V, IP 20, NEMA 1 and IP 54 Cooling

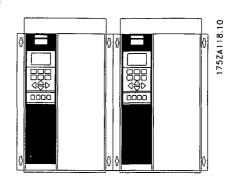


All units in the above-mentioned series require a minimum space of 200 mm above and below the enclosure and must be installed on a plane, vertical surface (no spacers). This applies both to IP 20, NEMA 1, and IP 54 units. These units can be installed side by side without any spacing, since they do not require any cooling on the sides.

Side-by-side

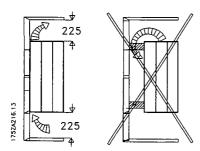


IP 20



IP 54 (flange-by-flange)

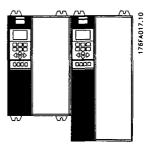
■ Installation of VLT 6042-6062 200-240 V, VLT 6075-6275 380-460 V, VLT 6100-6275 550-600 V, IP 00, IP 20, NEMA 1, and IP 54 Cooling



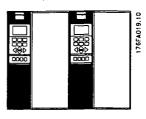
VLT 6075-6275

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

Side-by-side



VLT 6075-6275 IP 00, IP 20 and NEMA 1



VLT 6075-6275 IP 54

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



■ High voltage warning

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

NB!:

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

using VLT 6006-6550 wait at least 30 minutes.

■ Earthing

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

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

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

■ Cables

be installed separate from the motor cables so as to avoid interference overcoupling. Normally, a distance of 20 cm will be sufficient, but it is recommended to keep the greatest possible distance wherever possible, especially where cables are installed in parallel over a substantial distance. With respect to sensitive signal cables, such as telephone cables and data cables, the greatest possible distance is recommended with a minimum of 1 m per 5 m of power cable (mains and motor cable). It must be pointed out that the necessary distance depends on the sensitivity of the installation and the signal cables, and that therefore no precise values can be stated. If cable jaws are used, sensitive signal cables are not to be placed in the same cable jaws as the motor cable or brake cable. If signal cables are to cross power cables, this should be done at an angle of 90 degrees. Remember that all interference-filled in- or outgoing cables to/from a cabinet should be screened/armoured or filtered. See also EMC-correct electrical installation.

Control cables and the filtered mains cable should

■ Screened/armoured cables

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

■ Extra protection with regard to indirect contact

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

If ELCB relays are used, this must be:

- Suitable for protecting equipment with a direct current content (DC) in the faulty current (3-phase bridge rectifier)
- Suitable for power-up with short charging current to earth
- Suitable for a high leakage current



■ RFI switch

Mains supply isolated from earth:

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



NB!:

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



NB!:

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

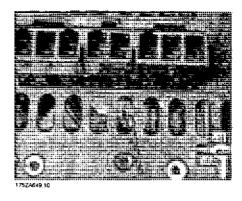


NB!:

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

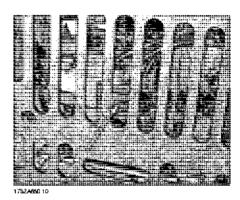
Reliable galvanic isolation (PELV) is lost if the RFI switch is placed in the OFF position. This means that all control in- and outputs can only be considered low-voltage terminals with basic galvanic isolation. In addition, the VLT 6000 HVAC EMC performance will be reduced if the RFI switch is placed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

Mains supply connected to earth: The RFI switch must be ON for all installations on earthed mains supplies.



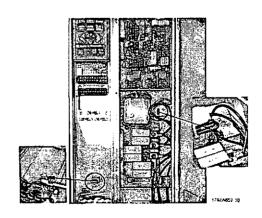
Bookstyle IP 20

VLT 6002 - 6011 380 - 460 V VLT 6002 - 6005 200 - 240 V



Compact IP 20 and NEMA 1

VLT 6002 - 6011 380 - 460 V VLT 6002 - 6005 200 - 240 V VLT 6002 - 6011 550 - 600 V



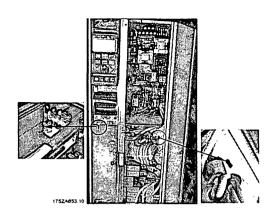
Compact IP 20 and NEMA 1

VLT 6016 - 6027 380 - 460 V

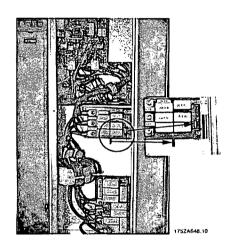
VLT 6006 - 6011 200 - 240 V

VLT 6016 - 6027 550 - 600 V

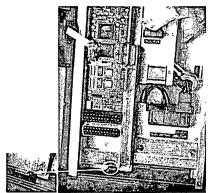




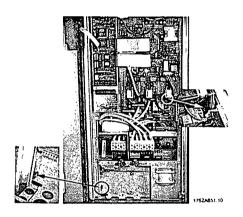
Compact IP 20 and NEMA 1 VLT 6032 - 6042 380 - 460 V VLT 6016 - 6022 200 - 240 V VLT 6032 - 6042 550 - 600 V



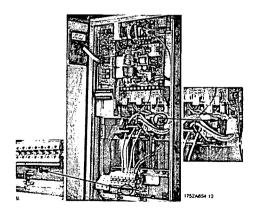
Compact IP 20 NEMA 1 VLT 6052 - 6072 380 - 460 V VLT 6027 - 6032 200 - 240 V VLT 6052 - 6072 550 - 600 V



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



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



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



■ High voltage test

A high voltage test can be carried out by short-circuiting terminals U, V, W, L1, L2 and L3 and energizing by max. 2.5 kV DC for one second between this short-circuit and the chassis.

NB!:

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

■ Heat emission from VLT 6000 HVAC

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

■ Ventilation of integrated VLT 6000 HVAC

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

- Add up the values of P_Φ for all the frequency converters to be integrated in the same panel.
 The highest cooling air temperature (t _{IN}) present must be lower than t_{IN}, MAX (40°C). The day/night average must be 5°C lower (VDE 160). The outlet temperature of the cooling air must not exceed: tout, MAX (45°C).
- 2. Calculate the permissible difference between the temperature of the cooling air (t_{IN}) and its outlet temperature (t_{OUT}): $\Delta t = 45^{\circ} \text{ C-}t_{IN}.$
- 3. Calculate the required quantity of air = $\frac{\sum P \varphi \times 3.1}{\Delta t}$ m³/h insert Δt in Kelvin

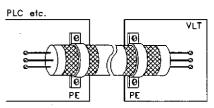
The outlet from the ventilation must be placed above the highest-mounted frequency converter. Allowance must be made for the pressure loss across the filters and for the fact that the pressure is going to drop as the filters are choked.

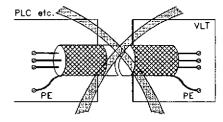


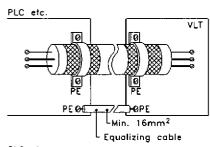
■ Electrical installation - earthing of control cables

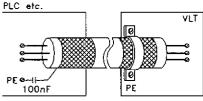
Generally speaking, control cables must be braided screened/armoured and the screen must be connected by means of a cable clamp at both ends to the metal cabinet of the unit.

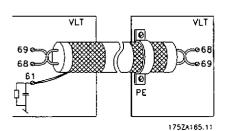
The drawing below indicates how correct earthing is carried out and what to be done if in doubt.











Correct earthing

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

Wrong earthing

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

Protection with respect to earth potential between PLC and VLT

If the earth potential between the frequency converter and the PLC (etc.) is different, electric noise may occur that will disturb the whole system. This problem can be solved by fitting an equalising cable, to be placed next to the control cable. Minimum cable cross-section: 16 mm ².

For 50/60 Hz earth loops

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

Cables for serial communication

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



■ Tightening-up torque and screw sizes

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

These figures apply to the following terminals:

Nos. 91. 92 93

Mains

L1, L2, L3

terminals

Nos. 96. 97. 98

Motor

terminals

U, V, W

Earth

terminal

No. 99

VLT type	Tightening-up	Screw
3 x 200 - 240 V	torque	size
VLT 6002-6005	0.5-0.6 Nm	M3
VLT 6006-6011	1.8 Nm	M4
VLT 6016-6027	3.0 Nm	M5
VLT 6032	4.0 Nm	M6
VLT type	Tightening-up	Bolt
3 x 200 - 240 V	torque	size
VLT 6042-6062	11.3 Nm	M8
VLT type	Tightening-up	Screw
3 x380-460 V	torque	size
VLT 6002-6011	0.5-0.6 Nm	M3
VLT 6016-6027	1.8 Nm	M4
VLT 6032-6072	3.0 Nm	M5
VLT type	Tightening-up	Bolt
3 x 380- 460 V	torque	size
VLT 6075-6125	11.3 Nm	M8
VLT 6150-6275	11.3 Nm	M8
VLT 6350-6550	42.0 Nm	M12
VLT type	Tightening-up	Screw
3 x 550-600 V	torque	size
VLT 6002-6011	0.5-0.6 Nm	M3
VLT 6016-6027	1.8 Nm	M4

3.0 Nm

4.0 Nm

11,3 Nm

11.3 Nm

■ Mains connection

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

Mains voltage 3 x 200-240 V

Nos. 91. 92. 93

Mains voltage 3 x 380-460 V

L1, L2, L3

Mains voltage 3 x 550-600 V



NB!:

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

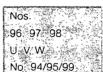
See *Technical data* for correct sizing of cable cross-sections.

■ Pre-fuses

See Technical data for correct sizing of pre-fuses.

■ Motor connection

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



Motor voltage 0-100 % of mains voltage

Earth connection

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

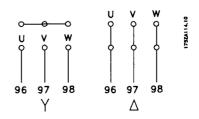
All types of three-phase asynchronous standard motors can be used with a VLT 6000 HVAC unit.

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

NB!:

In older motors without phase coil insulation, a LC filter should be fitted to the frequency converter output. See the

Design Guide or contact Danfoss.



VLT 6032-6042

VLT 6052-6072

VLT 6100-6150

VLT 6175-6275

M5

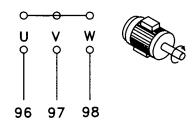
М6

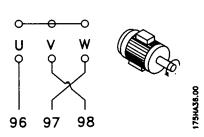
M8

M8



■ Direction of motor rotation



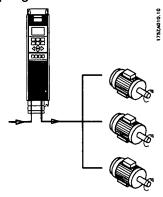


The factory setting is for clockwise rotation with the frequency transformer output connected as follows.

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

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

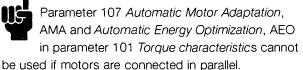
■ Parallel coupling of motors



VLT 6000 HVAC is able to control several motors connected in parallel. If the motors are to have different rpm values, the motors must have different rated rpm values. Motor rpm is changed simultaneously, which means that the ratio between the rated rpm values is maintained across the range. The total current consumption of the motors is not to exceed the maximum rated output current l_{VLT.N} for the frequency converter.

Problems may arise at the start and at low rpm values if the motor sizes are widely different. This is because the relatively high ohmic resistance in small motors calls for a higher voltage at the start and at low rpm values. In systems with motors connected in parallel, the electronic thermal relay (ETR) of the frequency converter cannot be used as motor protection for the individual motor. Consequently, additional motor protection is required, such as thermistors in each motor (or individual thermal relays).

NB!:



■ Motor cables

See *Technical data* for correct sizing of motor cable cross-section and length.

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

NB!:

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

If the EMC specifications regarding emission are to be complied with, the motor cable must be screened, unless otherwise stated for the RFI filter in question. It is important to keep the motor cable as short as possible so as to reduce the noise level and leakage currents to a minimum.

The motor cable screen must be connected to the metal cabinet of the frequency converter and to the metal cabinet of the motor. The screen connections are to be made with the biggest possible surface (cable clamp). This is enabled by different installation devices in the differentT frequency converters. Mounting with twisted screen ends (pigtails) is to be avoided, since these spoil the screening effect at higher frequencies. If it is necessary to break the screen to install a motor isolator or motor contactor, the screen must be continued at the lowest possible HF impedance.

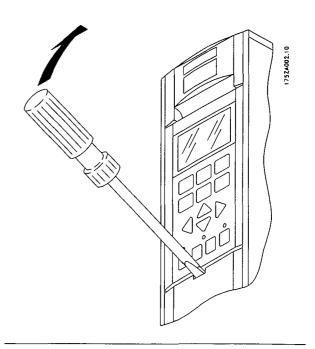


■ Motor thermal protection

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

■ Earth connection

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



■ DC bus connection

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

Terminal nos.

Nos: 88, 89

Contact Danfoss if you require further information.

■ High-voltage relay

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

No. 1

Relay ouput 1 1+3 break, 1+2 make Max 240 V AC, 2 Amp Min. 24 V DC 10 mA or 24 V AC, 100 mA

Max Cross-section:

4 mm²/10 AWG

Torque:

0.5-0.6 Nm

Screw size:

МЗ

■ Control card

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

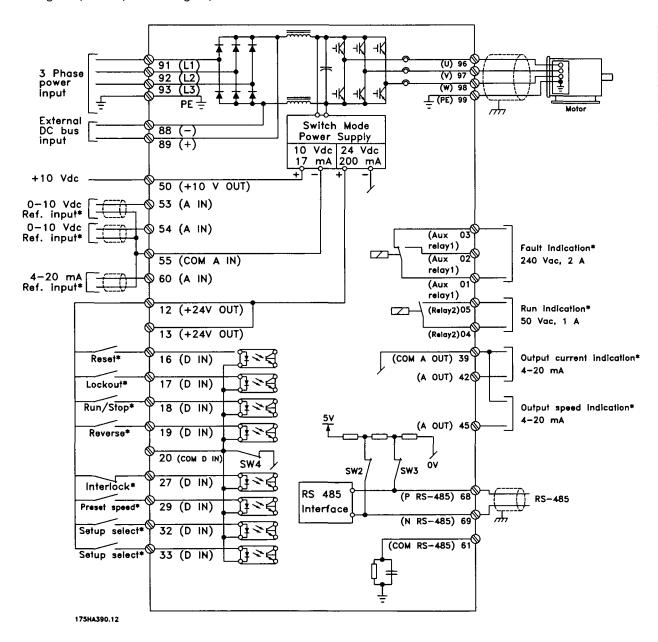
■ Connection example, VLT 6000 HVAC

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

The mains supply is connected to terminals 91 (L1), 92 (L2) and 93 (L3), while the motor is connected to 96 (U), 97 (V) and 98 (W). These numbers can also be seen from the terminals of the frequency converter. An external DC supply or a 12-pulse option can be connected to terminals 88 and 89. Please ask Danfoss for a Design Guide to learn more. Analogue inputs can be connected to terminals 53 [V], 54 [V] and 60 [mA]. These inputs can be programmed for either reference, feedback or thermistor. See Analogue inputs in parameter group 300.

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

There are two analogue/digital outputs (terminals 42 and 45), which can be programmed to show the present status or a process value, such as 0-f_{MAX}. Relay outputs 1 and 2 can be used for giving the present status or a warning. On terminals 68 (P+) and 69 (N-) RS 485 interface, the frequency converter can be controlled and monitored via serial communication.





■ Electrical installation, control cables

Max. control cable cross section: 1.5 mm²/16 AWG

Torque: 0.5-0.6 Nm Screw size: M3

See Earthing of screened/armoured control cables

for correct termination of control cables.

			-								
0	0	0	0	0	0	0	0	0	0	Ø	0
16	17	18	19	20	27	29	32	33	61	68	69
DIN	D IN	D IN	D IN	COM D IN	D IN	D IN	D IN	D IN	COM RS485	P RS485	N RS485

0	0	Ø	0	0	Ø	Ø	0	Ø	Ø	0	0
04	05	12	13	39	42	45	50	53	54	55	60
Ъ	$\overline{}$		$\overline{}$	СОМ	A OUT	A OUT	+10V	A IN	A IN	COM	A IN
RE	LAY		24V UT	A OUT			QUT			A IN	

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



■ Control unit LCP

The front of the frequency converter features a control panel - LCP(Local Control Panel). This is a complete interface for operation and programming of the VLT 6000 HVAC.

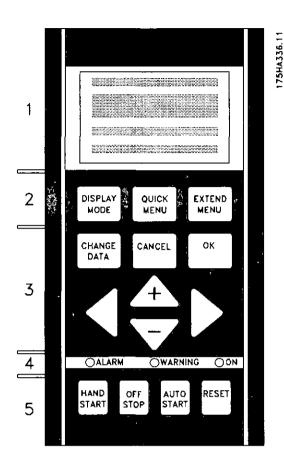
The control panel is detachable and can - as an alternative - be installed up to 3 metres away from the frequency converter, e.g. on the front panel, by means of a mounting kit option.

The functions of the control panel can be divided into five groups:

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

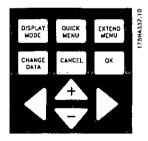
All data are indicated by means of a 4-line alphanumeric display, which, in normal operation, is able to show 4 operating data values and 3 operating condition values continuously. During programming, all the information required for quick, effective parameter Setup of the frequency converter will be displayed. As a supplement to the display, there are three indicator lamps for voltage (ON), warning (WARNING) and alarm (ALARM), respectively.

All frequency converter parameter Setups can be changed immediately via the control panel, unless this function has been programmed to be *Locked* [1] via parameter 016 *Lock for data change* or via a digital input, parameters 300-307 *Lock for data change*.



■ Control keys for parameter setup

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





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



QUICK MENU

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



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



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



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



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



[+/-] is used for selecting parameters and for changing a chosen parameter. These keys are also used to change the local reference.

In addition, the keys are used in Display mode to switch between operation variable readouts.



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

■ Indicator lamps

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

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○ALARM	OWARNING	ODN
Red	Yellow	Green

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

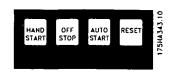


NB!:

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

■ Local control

Underneath the indicator lamps are keys for local control.



HAND START [HAND START] is used if the frequency converter is to be controlled via the control unit. The frequency converter will start the motor, since a start command is given by means of [HAND START].

On the control terminals, the following control signals will still be active when [HAND START] is activated:

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



NB!:

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



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



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



NB!:

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

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

■ Display mode

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



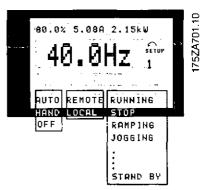
■ Display mode, cont.

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

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

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

· Status line:



The left part of the status line indicates the control element of the frequency converter that is



active. AUTO means that control is via the control terminals, while HAND indicates that control is via the local keys on the control unit.

OFF means that the frequency converter ignores all control commands and stops the motor.

The centre part of the status line indicates the reference element that is active. REMOTE means that the reference from the control terminals is active, while LOCAL indicates that the reference is determined via the [+/-] keys on the control panel.

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

■ Display mode III:

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



■ Display mode I:

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

In this display mode, reference and control are determined via the control terminals.

The text in line 1 gives the operating variable shown in line 2.



Line 2 gives the current output frequency and the active Setup.

Line 4 says that the frequency converter is in Auto mode with remote reference, and that the mo tor is running.

■ Display mode IV:

This display mode is only active in connection with local reference, see also *Reference handling*. In this display mode, the reference is determined via the [+/-] keys and control is carried out by means of the keys underneath the indicator lamps. The first line indicates the required reference. The third line gives the relative value of the present output frequency at any given time in relation to the maximum frequency. The display is in the form of a bar graph.



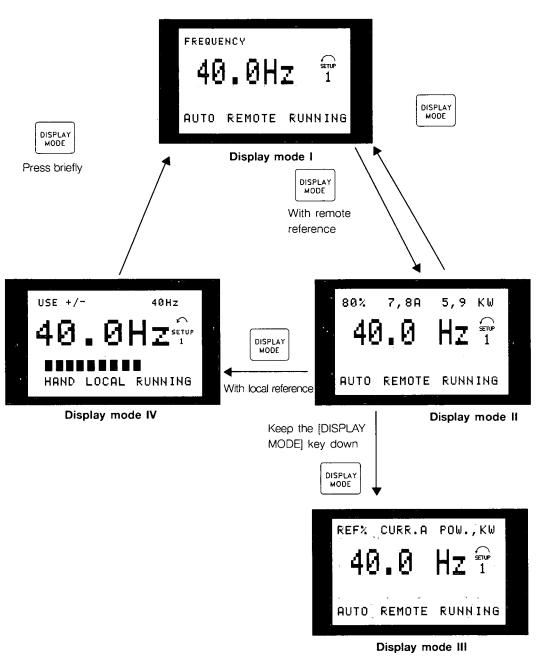
■ Display mode II:

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





■ Navigation between display modes



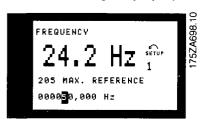
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■ Changing data

Regardless of whether a parameter has been selected under the Quick menu or the Extended menu, the procedure for changing data is the same. Pressing the [CHANGE DATA] key allows change of the selected parameter, and the underlining in line 4 will flash on the display.

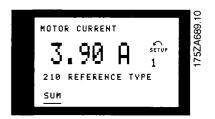
The procedure for changing data depends on whether the selected parameter represents a numerical data value or a functional value.

If the chosen parameter represents a numeric data value, the first digit can be changed by means of the [+/-] keys. If the second digit is to be changed, first move the cursor by using the [<>] keys, then change the data value using the [+/-] keys.



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

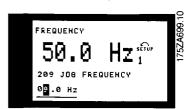
If the selected parameter is a functional value, the selected text value can be changed by means of the [+/-] keys.



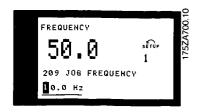
The functional value flashes until signing off by pressing the [OK] button. The functional value has now been selected. Use [CANCEL] to cancel the change.

■ Infinitely variable change of numeric data value

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



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



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

■ Changing of data value, step-by-step

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

■ Manual initialisation

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

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

Parameter

500, Protocol

600, Operating hours

601, hours run

602, kWh counter

603, Number of power-ups

604, Number of overtemperatures

605, Number of overvoltages

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



■ Quick Menu

The QUICK MENU key gives access to 12 of the most important setup parameters of the drive. After programming, the drive will, in many cases, be ready for operation. The 12 Quick Menu parameters are

shown in the table below. A complete description of the function is given in the parameter sections of this manual.

Quick Menu	Parameter	Description
Item Number	Name	
_1	001 Language	Selects language used for all displays.
2	102 Motor Power	Sets output characteristics of drive based on kW size
		of motor.
3	103 Motor Voltage	Sets output characteristics of drive based on voltage
	-	ofmotor.
4	104 Motor Frequency	Sets output characteristics of drive based on nominal
		frequency of motor. This is typically equal to line
		frequency.
5	105 Motor Current	Sets output characteristics of drive based on nominal
		current in amps of motor.
6	106 Motor Nominal Speed	Sets output characteristics of drive based on nominal
	,	full load speed of motor.
7 ·	201 Minimum Frequency	Sets minimum controlled frequency at which motor
	• •	will run.
8	202 Maximum Frequency	Sets maximum controlled frequency at which motor
	, ,	will run.
9	206 Ramp Up Time	Sets time to accelerate motor from 0 Hz to nominal
	, ,	motor frequency set in Quick Menu Item 4.
10	207 Ramp Down Time	Sets time to decelerate motor from nominal motor
	·	frequency set in Quick Menu Item 4 to 0 Hz.
11	323 Relay1 Function	Sets function of high voltage Form C relay.
12	326 Relay 2 Function	Sets function of low voltage Form A relay.



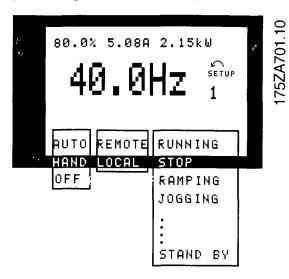
■ Status messages

Status messages appear in the 4th line of the display - see example below.

The left part of the status line indicates the active type of control of the frequency converter.

The centre part of the status line indicates the active reference.

The last part of the status line gives the present status, e.g. "Running", "Stop" or "Stand by".



Auto mode (AUTO)

The frequency converter is in Auto mode, i.e. control is carried out via the control terminals and/or serial communication. See also *Auto start*.

Hand mode (HAND)

The frequency converter is in Hand mode, i.e. control is carried out via the control keys. See *Hand start*.

OFF (OFF)

OFF/STOP is activated either by means of the control key, or by the digital inputs *Hand start* and *Auto start* both being a logic "0". See also *OFF/STOP*

Local reference (LOCAL)

If LOCAL has been selected, the reference is set via the [+/-] keys on the control panel. See also *Display modes*.

Remote reference (REM.)

If REMOTE has been selected, the reference is set via the control terminals or via serial communication. See also *Display modes*.

Running (RUNNING)

The motor speed now corresponds to the resulting reference.

Ramp operation (RAMPING)

The output frequency is now changed in accordance with the preset ramps.

Auto-ramp (AUTO RAMP)

Parameter 208 Automatic ramp-up/down is enabled, i.e. the frequency converter is trying to avoid a trip from overvoltage by increasing its output frequency.

Sleep Boost (SLEEP .BST)

The boost function in parameter 406 *Boost* setpoint is enabled. This function is only possible in *Closed loop* operation.

Sleep mode (SLEEP)

The energy saving function in parameter 403 Sleep mode timer is enabled. This means that at present the motor has stopped, but that it will restart automatically when required.

Start delay (START DEL)

A start delay time has been programmed i parameter 111 *Start delay*. When the delay has passed, the output frequency will start by ramping up to the reference.

Run request (RUN REQ.)

A start command has been given, but the motor will be stopped until a Run permissive signal is received via a digital input.

Jogging (JOG)

Jog has been enabled via a digital input or via serial communication.

Jog request (JOG REQ.)

A JOG command has been given, but the motor will remain stopped until a *Run permissive* signal is received via a digital input.

Freeze output (FRZ.OUT.)

Freeze output has been enabled via a digital input.

Freeze output request (FRZ.REQ.)

A freeze output command has been given, but the motor will remain stopped until a Run permissive signal is received via a digital input.

Reversing and start (START F/R)

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Reversing and start [2] on terminal 19 (parameter 303 Digital inputs) and Start [1] on terminal 18 (parameter 302 Digital inputs) are enabled at the same time. The motor will remain stopped until one of the signals becomes a logic '0'.

Automatic Motor Adaptation running (AMA RUN)

Automatic motor adaptation has been enabled in parameter 107 Automatic Motor Adaptation, AMA.

Automatic Motor Adaptation completed (AMA STOP)

Automatic motor adaptation has ben completed. The frequency converter is now ready for operation after the Reset signal has been enabled. Please note that the motor will start after the frequency converter has received the Reset signal.

Stand by (STANDBY)

The frequency converter is able to start the motor when a start command is received.

Stop (STOP)

The motor has been stopped via a stop signal from a digital input, [OFF/STOP]-buttom or serial communication.

DC stop (DC STOP)

The DC brake in parameter 114-116 has been enabled.

DRIVE ready (UN. READY)

The frequency converter is ready for operation, but terminal 27 is a logic "0" and/or a Coasting command has been received via the serial communication.

Not ready (NOT READY)

The frequency converter is not ready for operation, because of a trip or because OFF1, OFF2 or OFF3 is a logic '0'.

Start disabled (START IN.)

This status will only be displayed if, in parameter 599 Statemachine, Profidrive [1] has been selected and OFF2 or OFF3 is a logic '0'.

Exceptions XXXX (EXCEPTIONS XXXX)

The microprocessor of the control card has stopped and the frequency converter is out of operation. The cause may be noise on the line, motor or control cables, leading to a stop of the control card microprocessor. Check for EMC-correct connection of these cables.



■ List of warnings and alarms

The table gives the different warnings and alarms and indicates whether the fault locks the frequency converter. After Trip locked, the mains supply must be cut and the fault must be corrected. Reconnect the mains supply and reset the frequency converter before being ready. A Trip can be reset manually in three ways

- 1. Via the control key [RESET]
- 2. Via a digital input
- Via serial communication In addition, an automatic reset may be selected in parameter 400 Reset function.

Wherever a cross is placed under both Warning and Alarm, this can mean that a warning precedes the alarm. It can also mean that it is possible to program whether a given fault is to result in a warning or an alarm. This is possible, e.g. in parameter 117 *Motor thermal protection*. After a trip, the motor will be coasting and on the frequency converter alarm and warning will flash. If the fault is removed, only the alarm will flash. After a reset, the frequency converter will be ready to start operation again.

No.	Description	Warning	Alarm	Trip locked
_1	10 Volts low (10 VOLT LOW)	X		
2	Live zero fault (LIVE ZERO ERROR)	X	X	
4	Mains imbalance (MAINS IMBALANCE)	X	X	X
5	Voltage warning high (DC LINK VOLTAGE HIGH)	X		
6	Voltage warning low (DC LINK VOLTAGE LOW)	X		
7	Overvoltage (DC LINK OVERVOLT)	X	X	
8	Undervoltage (DC LINK UNDERVOLT)	Х	X	
9	Inverter overloaded (INVERTER TIME)	×	X	
10	Motor overloaded (MOTOR TIME)	Х	Х	
11	Motor thermistor (MOTOR THERMISTOR)	X	×	
12	Current limit (CURRENT LIMIT)	×	Х	
13	Overcurrent (OVERCURRENT)	X	×	X
14	Earth fault (EARTH FAULT)		X	X
15	Switch mode fault (SWITCH MODE FAULT)		X	X
16	Short-circuit (CURR.SHORT CIRCUIT)	~~~	Х	X
17	Serial communication timeout (STD BUSTIMEOUT)	X	X	
18	HPFB bus timeout (HPFB TIMEOUT)	Х	X	
19	Fault in EEprom on power card (EE ERROR POWER)	X		
20	Fault in EEprom on control card (EE ERROR CONTROL)	X		
22	Auto-optimisation not OK (AMA FAULT)		X	
29	Heat-sink temperature too high (HEAT SINK OVERTEMP.)		Х	
30	Motor phase U missing (MISSING MOT.PHASE U)		X	
31	Motor phase V missing (MISSING MOT.PHASE V)		x	
32	Motor phase W missing (MISSING MOT.PHASE W)		X	
34	HPFB communication fault (HPFB COMM. FAULT)	X	X	
37	Inverter fault (GATE DRIVE FAULT)		X	X
39	Check parameters 104 and 106 (CHECK P.104 & P.106)	Х		
40	Check parameters 103 and 105 (CHECK P.103 & P.106)	X		
41	Motor too big (MOTOR TOO BIG)	X		
42	Motor too small (MOTOR TOO SMALL)	X		
60	Safety stop (EXTERNAL FAULT)		x	
61	Output frequency low (FOUT < FLOW)	X		
62	Output frequency high (FOUT > FHIGH)	×		
63	Output current low (I MOTOR < I LOW)	X	X	
64	Output current high (I MOTOR > I HIGH)	X		
65	Feedback low (FEEDBACK < FDB LOW)	X		
66	Feedback high (FEEDBACK > FDB HIGH)	×		
67	Reference low (REF. < REF. LOW)	×		
68	Reference high (REF. > REF. HIGH)	X		
_69	Temperature auto derate (TEMP.AUTO DERATE)	X		
99	Unknown fault (UNKNOWN ALARM)		X	X

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)







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MG60C502



Rev. 2003-09-03





■ Technical information about Harmonic filters

Harmonic filters reducing the harmonic distortion on the mains supply are available. For details please ask your nearest Danfoss subsidiary for information and technical literature available, literature number MG.80.BX.YY

■ Technical information about the new 75 and 90 kW version of the VLT 6000

VLT 6102 and VLT 6122 superseed VLT 6100 and VLT 6125, so please make sure these units are used in new designs.



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 load-sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic back-up.

Using VLT 6102 HVAC-6122HVAC, 380-460 V: wait at least 20 minutes

Electrical data:

			r 	
		VLT 6102 HVAC	VLT 6122 HVAC	
Output current	I _{VLT,N} [A] (380-440 V)	147	177	
	I _{VLT,N} max. [A] (380-440 V)	162	195	
	IVLT,N [A] (441-460V)	130	160	
	I _{VLT,N} max. [A] (441-460V)	143	176	
Output	SVLT,N [kVA] (380-440 V)	102	123	
	SVLT,N [kVA] (441-460 V)	104	127	
Typical shaft ou	itput [kW]	75	90	
Typical shaft ou	tput [HP]	100	125	
	rent [A] @ 400 V	145	174	
Rated input cur	rent [A] @ 460 V	128	158	
Max. pre-fuses	[A]	225/225	250/250	
Efficiency	<u> </u>		-0.97	
Max. cable cros	ss section (mm²/AWG) IP20	25-95 mm ² / 3/0 copper		
		Aluminum conne	ction to be made	
		with Alu-Cu	u converter.	
Max. cable cros	ss section (mm ² /AWG) IP54 and NEMA 1	35-150 mm ² / 3/0 copper		
		Connection of both copper and		
		aluminium c	able possible.	
Weight	IP20/NEMA 1 [kg]	54	54	
	IP54 [kg]	77	77	
Switch frequen	cy [kHz]	4.5	4.5	
			T	
Power loss at n				
Normal overload torque (110%) [W]		< 1400	< 1600	

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■ Fuses

In case of UL compliance the following fuses must be used:

	Bussman	SIBA	Littel Fuse	Ferraz-Shawmut
6102	FW H-220	2028220-200	L50S-225	A50-P225
6122	FW H-250	2028220-250	L50S-250	A50-P250

In case of non-UL compliance we recommend use of the above mentioned fuses or type gR.

■ Enclosure size

	IP20/NEMA 1	IP54
Height A [mm]	800	940
Width B [mm]	370	400
Depth C [mm]	335	360
Distance a [mm]	780	690
Distance b [mm]	330	374
Free air for cooling ab/be [mm]	225	225
Drawing (enclosure type)	D	F

See also section Mechanical dimensions for picture and details.

■ EMC specifications

When the drive has a built in RFI filter it meets the following specifications (according to EN55011) for conducted emission (see also VLT 6000 Design Guide, MG60B602, section *EMC test results*):

- Class 1B up to 50 m of screened cable
- Class 1A up to 150 m of screened cable
- Class 1A up to 300 m of unscreened cable

■ Acoustic noise

IP20/NEMA 1 enclosure:

67dB (A)

IP54 enclosure:

66dB (A) *

* test pending

■ Tightening torque on power connections

IP20:

Allen screw

15-20 Nm

NEMA 1/IP54:

Allen screw

24 Nm

We offer the same range of accessories as for the existing product range:

■ LC filters

use the same filters as today.

This means:

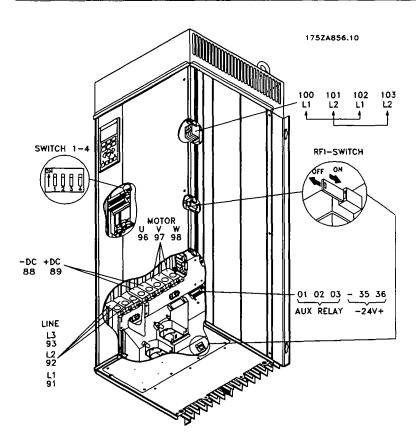
6102	175Z4702
6122	175Z4703

■ Terminal cover for IP20 units

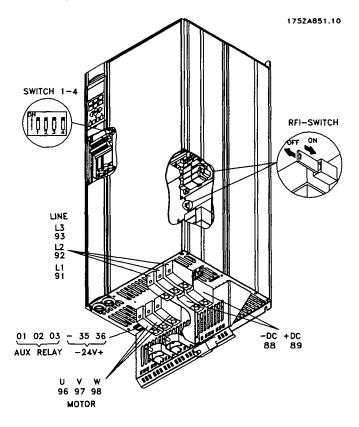
A terminal cover for use with the IP20 units is available. Ordering number: 175Z4280.

MG.60.A7.02 - VLT is a registered Danfoss trademark

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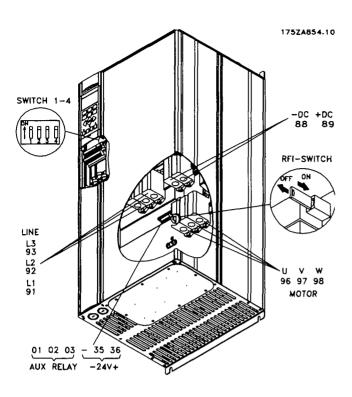


Compact IP54 VLT 6102-6122, 380-500 V



Compact IP20 VLT 6102-6122, 380-500 V

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NEMA 1 VLT 6102-6122, 380-500 V

MG.60.A7.02 - VLT is a registered Danfoss trademark



Addendum

VLT_® 6000 Series

Instruction Manuals MG.60.A6.02

Software Version 2.40

(Software version number can be read in parameter 624)

Additions:

- New parameter 118: Motor power factor (Cos Ø). This parameter allows the user to calibrate the AEO function to the power factor of the motor so that AEO can be used with motors of 6, 8, and 12 poles as well as 2- and 4-pole motors as in the past. Value: 0.50 - 0.99. Default: 0.75.
- Add note to parameter 215, Current limit. NB! If the drive is in current limit and a stop command is initiated with the stop button on the LCP keypad, the drive output is immediately turned off and the motor will coast to a stop.
- New choice in parameter 001, Language. Finnish (SUOMI) [9].
- New choices in parameter 007, Large display readout.

Status word (STATUS WORD [HEX]) [28]

Displays the actual drive status word (see parameter 608).

Control word (CONTROL WORD [HEX]) [29]

Displays the actual control word (see parameter 609).

Alarm word (ALARM WORD [HEX]) [30]

Displays the actual alarm word.

LCP procedure for entering text:

After selecting Display Text in parameter 007, select display line parameter (533 or 534) and press the CHANGE DATA key. Enter text directly into the selected line by using the UP, DN & LEFT, RIGHT arrow keys on the LCP. The UP and DN arrow keys scroll through the available characters. The Left and Right arrow keys move the cursor through the line of text.

To lock in the text, press the **OK** key when the line of text is completed. The **CANCEL** key will cancel the text.

The available characters are:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z Æ Ø Å Ä Ö Ü É Ì Ù è . / - () 0 1 2 3 4 5 6 7 8 9 'space'

'space' is the default value of parameter 533 & 534.

To erase a character that has been entered, it must be replaced with 'space'.

New choices in parameter 417, Feedback function.

Feedback 1 Only [7]

If Feedback 1 Only is selected, terminal 53 is read as the feedback signal and terminal 54 ignored. Feedback 1 is compared to Setpoint 1 for drive control.

Feedback 2 Only [8]

If Feedback 2 Only is selected, terminal 54 is read as the feedback signal and terminal 53 ignored. Feedback 2 is compared to Setpoint 2 for drive control.

August 2002

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rogramming

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VLT 6000 HVAC

Operating instructions Software version: 2.2x







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





The voltage of the frequency converter is dangerous whenever the equipment is connected to mains. Incorrect instal-

lation of the motor or the frequency converter may cause damage to the equipment, serious personal injury or death.

Consequently, the instructions in this manual, as well as national and local rules and safety regulations, must be complied with.

■ Safety regulations

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

tor current and rated motor frequency (see parameter 117, Motor thermal protection). For the North American market: The ETR functions

The function is initialised at 1.0 x rated mo-

ensure overload protection of the motor, Class 20, in accordance with NEC.

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

Warning against unintended start

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



Warning:

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

Using VLT 6002-6005, 220 and 500 V:

Using VLT 6006-6550, 220 and 500 V:

Using VLT 6002-6006, 550-600 V:

Using VLT 6008-6027, 550-600 V:

Using VLT 6032-6275, 550-600 V:

wait at least 4 minutes wait at least 15 minutes wait at least 4 minutes wait at least 15 minutes wait at least 30 minutes

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■ Introduction to Operating Instructions

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

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

Operating Instructions:

These are instructions in how to ensure optimum mechanical and electrical installation, commissioning and service. The Operating Instructions also include a description of the software parameters, thereby enabling easy adaptation of the VLT 6000 HVAC to your application.

Quick Setup Guide:

Helps you to guickly install and commission the VLT 6000 HVAC.

Design Guide:

Used when designing installations that include a VLT 6000 HVAC. The Design Guide gives detailed information about VLT 6000 HVAC and HVAC installations, including a selection tool to enable you to choose the right VLT 6000 HVAC with its relevant options and modules. The Design Guide also contains examples of the most common HVAC applications. Furthermore, the Design Guide has all information relating to serial communication.

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

Introduction to HVAC:

This section tells you the advantages you can obtain by using a VLT 6000 HVAC - such as AEO, Automatic Energy Optimization, RFI filters and other HVAC-relevant functions.

This section also contains examples of application as well as information about Danfoss and CE-labelling.

Installation:

This section tells you how to carry out mechanically correct installation of the VLT 6000 HVAC. In addition, this section includes a description of how to ensure that the in-

stallation of your VLT 6000 HVAC is EMC-correct. Furthermore, a list is given of mains and motor connections, together with a description of the control card terminals.

Programming:

This section describes the control unit and the software parameters for the VLT 6000 HVAC. Also included is a guide to the Quick Setup menu, which allows you to get started on your application very quickly.

All about VLT 6000 HVAC:

This section gives information about status, warning and error messages from the VLT 6000 HVAC. Additionally, information is given on technical data, service, factory settings and special conditions.



Indicates something to be noted by the reader.



Indicates a general warning.

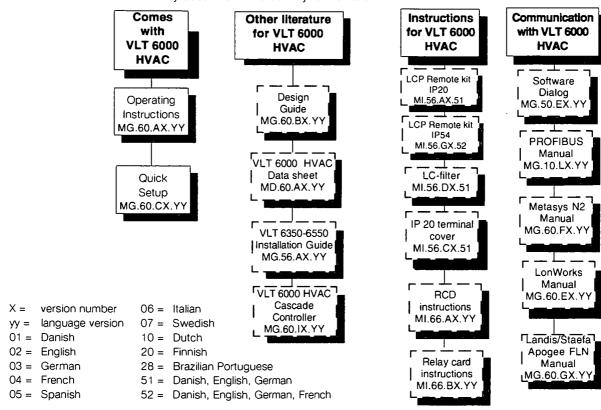


Indicates a high-voltage warning.



■ Available literature

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



■ VLT 6000 advantages in a HVAC installation

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

- VLT 6000 HVAC has been designed for HVAC applications.
- A wide power range from 1.1-250 kW, 1.1-200 kW for 550-600 V units with a unique design.
- IP 20 and IP 54 enclosures that can be mounted side by side. For power sizes ≥ 55 kW (≥ 30kW for 200 V) IP 00 is also available.
- All unit types, except 550-600 V units, are available with an integral RFI filter, complying with EN 55011 class 1-A in the case of a 150 m screened/armoured motor cable and EN 55011 class 1-B in the case of a screened/armoured motor cable up to 50 m long.

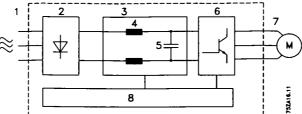
- User-friendly design, which makes VLT 6000 HVAC easy to install, both mechanically and electrically.
- Detachable LCP control panel with Hand-Off-Auto buttons and a graphics display of local speed.
- High starting torque owing to Automatic Energy Optimization (AEO).
- Automatic Motor Adaptation (AMA) ensures optimum motor utilisation.
- Integral PID regulator with option of connecting two feedback signals (in connection with zoning), as well as setting of two set-points.
- Sleep mode, which automatically turns the motor off, e.g. when there is no need for more pressure or flow in a system.
- The "flying start" function enables the unit to catch a rotating fan.
- Automatic ramp up/down to ensure that the VLT 6000 HVAC will not trip during acceleration or deceleration.
- All standard units have three integral, serial protocols - RS 485 FC protocol, Johnson's Metasys N2 and Landis/Staefa Apogee FLN.
 Communication option cards that can be connected are LonWorks, Profibus for the VLT 6000 HVAC.



■ Control principle

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

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



1. Mains voltage

3 x 200 - 240 V AC, 50 / 60 Hz 3 x 380 - 460 V AC, 50 / 60 Hz

3 x 550 - 600 V AC, 50 / 60 Hz

2. Rectifier

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

3. Intermediate circuit

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

4. Intermediate circuit coils

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

■ AEO - Automatic Energy Optimization

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

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

5. Intermediate circuit capacitors

Even out the intermediate circuit voltage.

6. Inverter

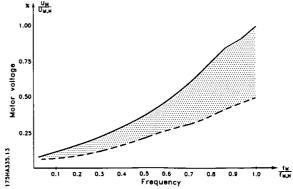
Converts DC voltage into variable AC voltage with a variable frequency.

7. Motor voltage

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

8. Control card

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



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

Advantages of the AEO function

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



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

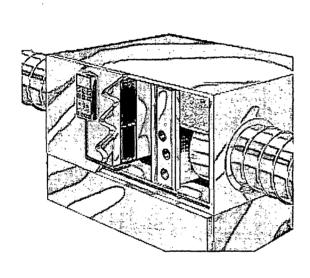
The AHU installation is able to distribute air throughout the building or to one or several parts of a building.

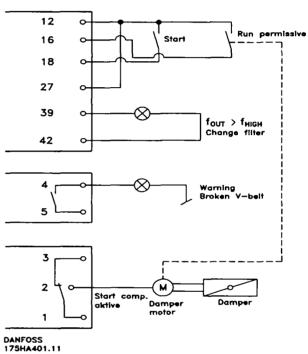
Normally, an AHU installation consists of a fan and a motor that supply air, a fan scroll and a duct system with filters. If centralised air distribution is applied, the efficiency of the installation will increase and major energy savings can be made.

A VLT 6000 HVAC enables excellent control and monitoring, thereby ensuring perfect conditions in the building at all times.

This example shows an application with *Run permissive*, warning against no load and warning for filter change.

The Run permissive function ensures that the VLT frequency converter will not start the motor until the discharge damper has opened. If the V-belt to the fan breaks and if the filter is to be changed, this application will also give a warning on an output.





Set the following parameters:

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



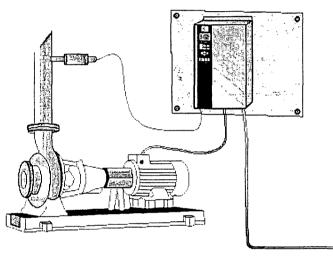
■ Example of application - Constant pressure regulation in water supply system

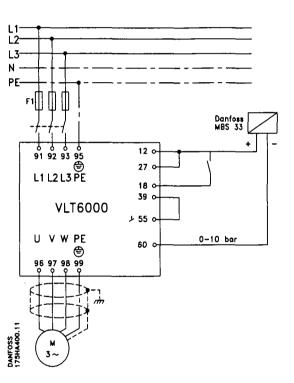
The demand for water from waterworks varies considerably over the 24 hours of a day. In the night, practically no water is used, while in the morning and in the evening the consumption is high. In order to maintain a suitable pressure in the water supply lines in relation to the current demand, the water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

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

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

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





Set the following parameters:

10

Set the following par						
Par: 100 Co	onfiguration			Closed loop	[1]	
Par. 205 M	aximum reference			,5 Hz	7.072.3.3.4.5.	
Par: 302;Te	rminal 18 Digital inputs:		A STANSON STANSON	Start [1]	No. 1	ું દુ
Par. 314	rminal 60, analogue inpu	it current		Feedback sig	gnal.[2]	
Par. 315 Te	erminal 60, min. scaling -			4 mA		
Par. 316 Te	erminal 60, max. scaling			20 mA		
Par. 403 SI	eep mode timer			10 sec.		
Par. 404 SI	eep frequency		5 2 3 5 C	15 Hz		
Par. 405 , W	ake-up frequency			20 Hz		
Par. 406 Bo	oost setpoint			125%		
Par. 414 M	aximum feedback ೄಿಂದ		71.00 Jakes 410.	'10	S 4: - 2 3	
Par. 415	ocess units		7884 SEE	Bar [16]		
Par. 418 Se	etpoint 1 122 / 27 38 %		1	5 bar	7. 7972. Er	
Par. 423	D Proportional gain		3. 2. 5. 4.	0.6		
Par. 424 PI	D integration time		1000	10		



■ CE-labelling

What is CE-labelling?

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

- The machine directive (89/392/EEC) All machines with critical, moving parts are comprised by the machine directive which came into force on 1 January 1995. Since a frequency converter is largely electrical by function, it does not fall under the machine directive. However, if a frequency converter is supplied for use in a machine, we provide information about the safety aspects relating to the frequency converter. We do that by means of a manufacturer's declaration.
- The low voltage directive (73/23/EEC)
 Frequency converters must be CE-labelled in accordance with the low voltage directive which came into force on 1 January 1997. This directive applies to all electrical equipment and units used in the 50-1000 V AC and 75-1500 V DC voltage ranges. Danfoss provides its units with CE-labels in accordance with the directive and issues declarations of conformity upon request.
- The EMC directive (89/336/EEC) EMC is short for electromagnetic compatibility. The presence of electromagnetic compatibility means that the mutual interference between different components/appliances is so small that the functioning of the appliances is not affected. The EMC directive came into force on 1 January 1996. In accordance with the directive, Danfoss CE-labels its products and issues a declaration of conformity upon request.

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

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

NOTE: 550-600 V units are not CE labelled.

■ PC software and serial communication

Danfoss offers a number of serial communication options. Serial communication allows monitoring, programming and controlling one or several units from a centrally placed computer.

All VLT 6000 HVAC units have a RS 485 port as standard with a choice of three protocols. The three protocols selectable in parameter 500 *Protocols* are:

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

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

- Profibus
- LonWorks

■ Software Dialogue

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

■ Modules

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

500-566 Serial communication

NR

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



Unpacking and ordering a VLT frequency converter

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

■ Type code ordering number string

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

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

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

Bookstyle IP 20

	s voltage, rate		
Motor power	er 200-240 V :	380-460 V	
1.1 kW 2.5		VLT 6002	
1.5 kW	VLT 6003	VLT 6003	
2.2 kW	VLT 6004	VLT 6004	
3.0 kW	VLT 6005	VLT 6005	
4.0 kW		VLT 6006	
5.5 kW		VLT 6008	
7.5 kW		VLT 6011	

Mains voltage, rated:

Motor power		380-460 V	550-600 V
1:1:kW	VLT 6002	VLT 6002	VLT 6002
	VLT 6003	VLT 6003 .	VĽT 6003
2:2 kW	VLT-6004	VLT-6004-	-VLT-6004
3.0 kW	VLT 6005	VLT 6005	VLT 6005
4.0 kW	VLT 6006	VLT 6006	VLT 6006
5.5 kW	VLT 6008	VLT 6008	VLT 6008
7.5 kW	VLT 6011	VLT 6011	VLT 6011
11 kW	VLT 6016	VLT 6016	VLT 6016
15 kW	VLT 6022	VLT 6022	VLT 6022
18.5 kW	VLT 6027	VLT 6027	VLT 6027
22 kW	VLT 6032	VLT 6032	VLT 6032
30 kW	VLT 6042	VLT 6042	VLT 6042
37 kW	VLT 6052	VLT 6052	VLT 6052
45 kW	VLT 6062	VLT 6062	VLT 6062

Units in the range of 1.1-45 kW, 220-240 V and 380-460 V come with enclosure IP 20, IP 54. For 550-600 V units, 1.1-7.5 kW are IP20 and NEMA 1 units; 11 kW-45 kW are available in NEMA 1 enclosures.

		Mains voltage	, rated:
Motor power	400 V 1)	460 V 1)	550-600 V
55 kW	VLT 6072	-	VLT 6072
75 kW	VLT 6100	VLT 6072	VLT 6100
90 kW	VLT 6125	VLT 6100	VLT 6125
110 kW	VLT 6150	VLT 6125	VLT 6150
132 kW	VLT 6175	VLT 6150	VLT 6175
160 kW	VLT 6225	VLT 6175	VLT 6225
200 kW	VLT 6275	VLT 6225	VLT 6275
250 kW	VLT 6350	VLT 6275	
315 kW	VLT 6400	VLT 6350	
355 kW	VLT 6500	VLT 6400	
400 kW	VLT 6550	VLT 6500	
450 kW	-	VLT 6550	

Units in the range of 55-450 kW, 400 and 460 V come with enclosure IP 00, IP 20 or IP 54. 550-600 V units are available in IP00 and NEMA 1 enclosures in the range of 55-200 kW.

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

Hardware variants

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

- ST: Standard unit with or without control unit.
- EX: Extended unit for VLT type 6350 6550 with control unit, connection of external 24 V DC supply for back-up of control PCB.
- DX: Extended unit for VLT type 6350 6550 with control unit, built-in mains fuses and disconnector, connection of external 24 V DC supply for back-up of control PCB.

RFI-filter

Bookstyle units always come *with* an integral RFI filter that complies with EN 55011-1B with 20 m screened /armoured motor cable and EN 55011-1A with 150 m screened/armoured motor cable. Units for a mains voltage of 240 V and a motor power of up to and including 3.0 kW (VLT 6005) and units for a mains voltage of 380-460 V and a motor power of up to 7.5 kW (VLT 6011) are always supplied with an integral class 1A & 1B filter. Units for higher motor power than these (3.0 and 7.5 kW, respectively) can be ordered either with or without an RFI filter. 550-600 V units are not available with RFI filters.

Control unit (keypad and display)

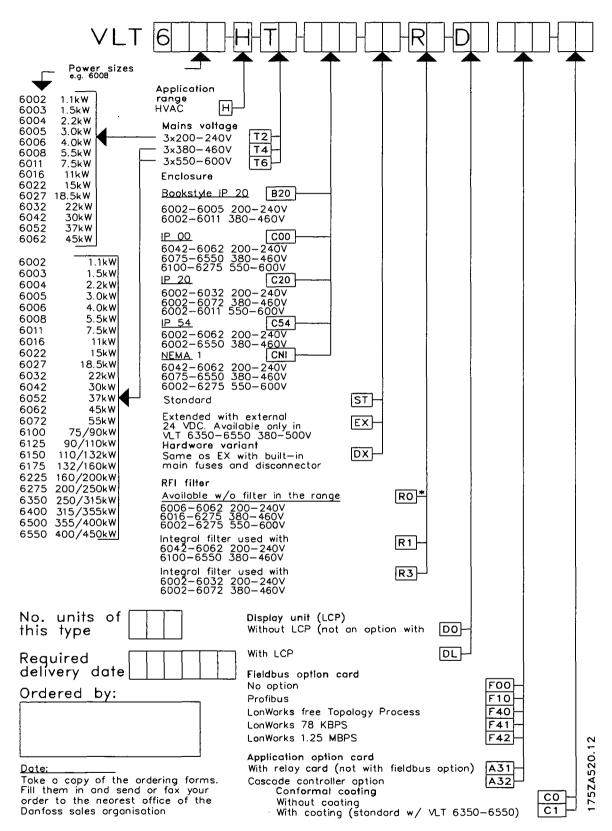
All types of units in the programme, except for IP 54 units, can be ordered either with or without the control unit. IP 54 units always come *with* a control unit.

Conformal Coating

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



■ Ordering form VLT 6000 HVAC



 ⁵⁵⁰⁻⁶⁰⁰V Units do not have an RFI filter available, they are RO only

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General technical data
Mains supply (L1, L2, L3):

Mains supply (L1, L2, L3):	
Supply voltage 200-240 V units	3 x 200/208/220/230/240 V ±10%
Supply voltage 380-460 V units	3 x 380/400/415/440/460 V ±10%
Supply voltage 550-600 V units	3 x 550/575/600 V ±10%
Supply frequency	50/60 Hz ±1%
Max. imbalance of supply voltage:	
VLT 6002-6011/380-460 V and 550-600 V and VLT 6002-6005/200-240 V	
VLT 6016-6072/380-460 V and 550-600 V and VLT 6006-6032/200-240 V	
VLT 6075-6550/380-460 V and VLT 6042-6062/200-240 V	
VLT 6100-6275/550-600 V	
True Power Factor (λ)	,,,
Displacement Power Factor (cos. φ)	
No. of switches on supply input L1, L2, L3	
Max. short-circuit current	• •
Wax. Short-dicale durant	100.000 A
VLT output data (U, V, W):	
Output voltage	0-100% of supply voltage
Output frequency	0 - 120 Hz, 0 - 1000 Hz
Rated motor voltage, 200-240 V units	200/208/220/230/240 V
Rated motor voltage, 380-460 V units	
Rated motor voltage, 550-600 V units	
Rated motor frequency	
Switching on output	
Ramp times	
Torque characteristics:	
Starting torque	110% for 1 min
Starting torque (parameter 110 High break-away torque)	
Acceleration torque	
Overload torque	
Cvonoud torque	
Control card, digital inputs:	
Number of programmable digital inputs	
Terminal nos.	
Voltage level	
Voltage level, logical '0'	
Voltage level, logical '1'	
Maximum voltage on input	
Input resistance, R _i	
Scanning time per input	
Reliable galvanic isolation: All digital inputs are galvanically isolated from the	
the digital inputs can be isolated from the other terminals on the control ca	- · · · · · · · · · · · · · · · · · · ·
DC supply and opening switch 4. See Switches 1-4.	ind by connecting an external 24 V
Control card, analogue inputs:	
No. of programmable analogue voltage inputs/thermistor inputs	
Terminal nos	
Voltage level	
Input resistance, R _i	
No. of programmable analogue current inputs	
Terminal no. ground	
Current range	
Input resistance, R _i	200 Ω
Resolution	10 bit + sign
Accuracy on input	
Scanning time per input	3 msec.
Reliable galvanic isolation: All analogue inputs are galvanically isolated from	the supply voltage (PELV) and other
high-voltage terminals.	



■ General technical data

Control card, pulse input:	
No. of programmable pulse inputs	
Terminal nos.	17, 29, 33
Max. frequency on terminal 17	5 kHz
Max. frequency on terminals 29, 33	20 kHz (PNP open collector)
Max. frequency on terminals 29, 33	65 kHz (Push-pull)
Voltage level	0-24 V DC (PNP positive logics)
Voltage level, logic '0'	< 5 V DC
Voltage level, logic '1'	> 10 V DC
Maximum voltage on input	28 V DC
Input resistance, R _i	
Scanning time per input	
Resolution	
Accuracy (100-1 kHz), terminals 17, 29, 33	
Accuracy (1-5 kHz), terminal 17	
Accuracy (1-65 kHz), terminals 29, 33	
Reliable galvanic isolation: All pulse inputs are galvanically isolated from	
pulse inputs can be isolated from the other terminals on the control card	by connecting an external 24 V DC
supply and opening switch 4. See Switches 1-4.	
Control card, digital/pulse and analogue outputs:	
No. of programmable digital and analogue outputs	
Terminal nos.	
Voltage level at digital/pulse output	
Minimum load to ground (terminal 39) at digital/pulse output	
Frequency ranges (digital output used as pulse output)	
Current range at analogue output	
Maximum load to ground (terminal 39) at analogue output	
Accuracy of analogue output	
Resolution on analogue output.	
Reliable galvanic isolation: All digital and analogue outputs are galvanical	ly isolated from the supply voltage (PELV)
and other high-voltage terminals.	
Control cord, 24 V DC cumplus	
Control card, 24 V DC supply:	10.10
Terminal nos.	
Max. load	
Terminal nos. ground	•
Reliable galvanic isolation: The 24 V DC supply is galvanically isolated from	om the supply voltage (PELV), but has the
same potential as the analogue outputs.	
Control card, RS 485 serial communication:	
Terminal nos.	68 (TX+ BX+) 69 (TX+ BX-)
Reliable galvanic isolation: Full galvanic isolation (PELV).	
richable galvario isolation. Foll galvaria isolation (FEEV).	
Relay outputs:	
No. of programmable relay outputs	2
Terminal nos., control card	4-5 (make)
Max. terminal load on 4-5, control card	50 V AC, 1 A, 60 VA, 75 V DC, 1 A, 30 W
Max. terminal load on 4-5, control card for UL/cUL applications	
Terminal nos., power card and relay card	
Max. terminal load on 1-3, 1-2, power card and relay card	
Max. terminal load on 1-3, 1-2, power card	
	-, - -:

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	e with VLT 6350 - 6550):
	35, 36
9	
	plation if the external 24 V DC supply is also of the PELV type.
-	le
	• VLT 6011 380-460 V
-	v VLT 6011 550-600 V
-	ole
Max. cable cross-section to motor, see	· -
	tion
	temperature class 60/75 °C must be used (VLT 6002 - 6072 380 - 500 V)
	temperature class 75 °C must be used (VLT 6042 - 6062 200 - 240 V, VLT
Control characteristics:	
Frequency range	0 - 1000 Hz
Resolution on output frequency	±0.003 Hz
System response time	3 msec
Speed, control range (open loop)	
Speed, accuracy (open loop)	< 1500 rpm: max. error ± 7.5 rpm
	> 1500 rpm: max, error of 0.5% of actual speed
Process, accuracy (closed loop)	< 1500 rpm: max. error ± 1.5 rpm
	> 1500 rpm; max, error of 0.1% of actual speed
All control characteristics are based on a	4-pole asynchronous motor
Accuracy of Display readout (parameters	
Motor current [5], 0 - 140% load	
Power kW [6], Power HP [7], 0 - 90% loa	dMax. error: ±5.0% of rated output power
Vibration test 0.7 ç	RMS 18-1000 Hz random. 3 directions for 2 hours (IEC 68-2-34/35/36)
- · · · · · · · · · · · · · · · · · · ·	
Ambient temperature	
	2-6011 550-600 V Bookstyle, IP 20
VLT 6002-6062 200-240V, 6002-6550 380-460V, IP 5	4
See Derating for high ambient temperat	· · · · · · · · · · · · · · · · · · ·
	0°C
	ormance10°C
	25 - +65/70°C
-	1000 m
See Derating for high air pressure	
EMC standards applied,	EN 61800-3, EN 55011, EN 55014
	EN 61800-3, EN 55011, EN 55014 I 61000-4-2, IEC 1000-4-3, EN 61000-4-4





NB!

VLT 6002-6275, 550-600 V units do not comply with EMC, Low Voltage

or PELV directives.

VLT 6000 HVAC protection:

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

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6008

24.2

26.6

10.1

5.5

7.5

16/6

6052

6042

6062

6011

30.8

33.9

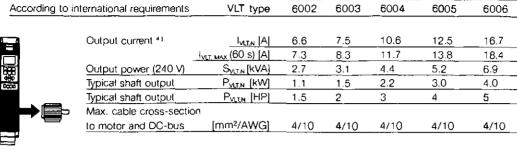
12.8

7.5

10

16/6

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



VLT type

6016



Max. input current (200 V) (RMS) I _{LN} [A] 6.0 7.0			10.0	12.0	16.0	23.0	30.0	
Max. cable cross-section								
power [mm²]/[AWG]21		4/10	4/10	4/10	4/10	4/10	16/6	16/6
Max. pre-fuses	[A]/UL 11 [A]	16/10	16/15	25/20	25/25	35/30	50	60
Mains contactor [E	Danfoss type)	CI 6	CI 6	CI 6	Cl 6	CI 6	Cl 9	CI 16
Efficiency 3)		0.95						
Weight IP 20	[kg]	7	7	9	9	23	23	23
Weight IP 54	[kg]	11.5	11.5	13.5	13.5	35	35	38
Power loss at max. load. [W	/] Total	76	95	126	172	194	426	545
Enclosure	VLT type	Bookst	/le IP 20/0	Compact If	20/IP 54			

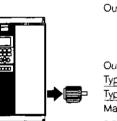
(Bookstyle IP 20 is available in power range VLT 6002-6005)

6032

6027

■ Mains supply 3 x 200 - 240 V

According to international requirements



Output current	I _{VUN} [A] (200-230 V)	46.2	59.4	74.8	88.0	115	143	170
l _{vut, max} (60 s) [A] (200-230 V)	50.6	65.3	82.3	96.8	127	158	187
	I _{vut,n} [A] (240 V)	46.0	<u>5</u> 9.4	74.8	88.0	104	130	154
I _{VE}	_{[MAX} (60 s) [A] (240 V)	50.6	65.3	82.3	96.8	115	143	170
Output power	S _{VLT,N} [kVA] (240 V)	19.1	24.7	31.1	36.6	41.0	52.0	61.0
Typical shaft output	P _{vlī,n} [kW]	11	15	18.5	22	30	37	45
Typical shaft output	P _{ylt,n} [HP]	15	20	25	30	40	50	60
Max. cable cross-se	ection to motor and						_	
DC-bus (mm²/AWG	copper	16/6	35/2	35/2	50/0	70/1/0	95/3/0	120/4/0
	aluminium	16/6	35/2	35/2	50/0	95/3/0% 90	/250mcm ⁵⁾ 12	0/300mcm ⁵⁾
Min. cable cross-se	ection to motor and							
DC-bus	(mm²/AWG)	10/8	10/8	10/8	16/6	10/8	10/8	10/8

6022

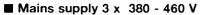


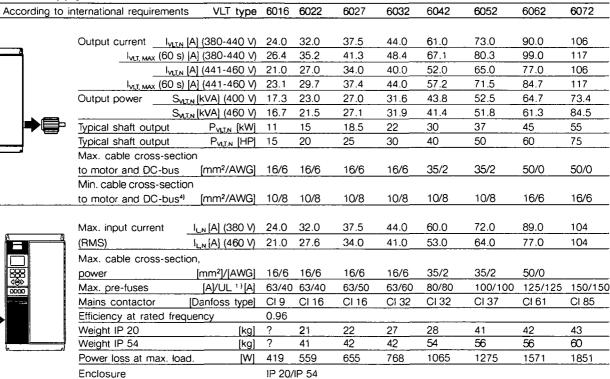
Max. input current (200 \	/) (RMS) I _{LN} [A]	46.0	59.2	74.8	88.0	101.3	126.6	149.9_
Max. cable, cross-se	ction							
power [mm²/AWG]	copper	16/6	35/2	35/2	50/0	70/1/0	95/3/0	120/4/0
	aluminium	16/6	35/2	35/2	50/0	95/3/04 90	/250mcm ^a 12	0/300mcm ^a
Max. pre-fuses	[A]/UL 11 [A]	60	80	125	125	150_	200	250
Mains contactor	(Danfoss type)	CI 32	CI 32	CI 37	CJ 61	CI85	CI85	Cl141
	[AC value]	AC-1	AC-1	AC-1	AC-1			
Efficiency 3)		0.95						
Weight IP 00	[kg]	-	-	-	-	90	90	90
Weight IP 20	[kg]	_23	30	30	48	101	101	101
Weight IP 54	[kg]	38	49	50	55	104	104	104
Power loss at max. load:	[W]	545	783	1042	1243	1089	1361	1613
Enclosure		IP 20+1	VEMA 1 k	it, IP 54/NI	EMA 12			

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



according to in	ternational requirement	s VLT type	6002	6003	6004	6005	6006	6008	6011
	Output current In	j,n [A] (380-440 V)	3.0	4.1	5. 6	7.2	10.0	13.0	16.0
3	IVLT, MAX (60	s) [A] (380-440 V)	3.3	4.5	6.2	7.9	11.0	14.3	17.6
)	<u>_I_v</u>	_{J.N} [A] (441-460 V)	3.0	3.4	4.8	6.3	8.2	11.0	14.0
	L _{VLT, MAX} (60	s) [A] (441-460 V)	3.3	3.7	5.3	6.9	9.0	12.1	15.4
1	Output power	S _{VLN} [kVA] (400 V)	2.2	2.9	4.0	5.2	7.2	9.3	11.5
. —		S _{VLT,N} [kVA] (460 V)	2.4	2.7	3.8	5.0	6.5	8.8	11.2
	Typical shaft output	P _{VLT,N} [kW]	1.1	1.5	2.2	3.0	4.0	5.5	7.5
3	Typical shaft output	P _{VLT,N} [HP]	1.5	2	3	-	5	7.5	10
-	Max. cable cross-sec	ction							
	to motor	[mm²/AWG]	4/10	4/10	4/10	4/10	4/10	4/10	4/10
	Max. input current	I _{LN} [A] (380 V)	2.8	3.8	5.3	7.0	9.1	12.2	15.0
	(RMS)	I _{LN} [A] (460 V)	2.5	3.4	4.8	6.0	8.3	10.6	14.0
0-0	Max. cable cross-see	ction,							
	power	[mm²]/[AWG] ^{2)}	4/10	4/10	4/10	4/10	4/10	4/10	4/10
	Max. pre-fuses	[A]/UL 11 [A]	16/6	16/10	16/10	16/15	25/20	25/25	35/30
	Mains contactor	[Danfoss type]	CI 6	CI 6	CI 6	CI 6	CI 6	CI 6	CI 6
0000	Efficiency 3)		0.96						
	Weight IP 20	[kg]	8	88	8,5	8,5	10,5	10,	5 10,5
	Weight IP 54	[kg]	11.5	11.5	12	12	14	14	14
	Power loss at max. Id	oad. [W] Total	67	92	110	139	198	250	295
	Enclosure	VLT type	Bookst	yle IP 20.	/Compac	t IP 20/IF	² 54		
			(Books	tvle IP 20) is availa	able in th	e VLT 60	02-6011	power rang







^{2.} American Wire Gauge.

Measured using 30 m screened motor cable at rated load and rated frequency.

Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals.
 Always comply with national and local regulations on min. cable cross-section.



73

84.5

S_{VLT,N} [kVA] (400 V)

S_{VLT,N} [kVA] (460 V)

٧	LT®	6000	HVA	1C

123

127

90

147

151

110

180

191

132

218

241

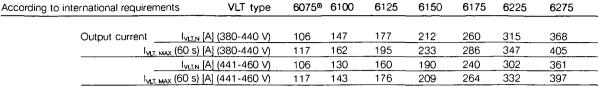
160

255

288

200

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





Typical shaft output (380-440 V) Pvu, [kW] 55 Typical shaft output (441-460 V)P_{VU, N} [HP] **7**5 100 125 150 200 250 300 Max. cross-section of copper cable **7**0 120 2x70 2x70 2x95 2x120 to motor and DC-bus (380-440 V) [mm²]⁵⁾ 95 Max. cross-section of copper cable 2x120 to motor and DC-bus (441-460 V) [mm²]⁵⁾ 70 70 95 2x70 2x70 2x95 Max. cross-section of aluminium cable to motor and DC-bus (380-440 V) [mm²]⁵⁾ 95 90 120 2x70 2x95 2x120 2x150 Max. cross-section of aluminium cable 150 2x120 to motor and DC-bus (441-460 V) [mm²]⁵⁾ 70 120 2x70 2x120 2x150

102

104

75

Max. cross-section of copper cable to motor and DC-bus (380-440 V) [AWG]5) 1/0 3/0 4/0 2x1/0 2x2/0 2x3/0 2x250mcm Max. cross-section of copper cable 1/0 2x1/0 2x3/0 to motor and DC-bus (441-460 V) [AWG]5) 2/0 3/0 2x1/0 2x4/0 Max. cross-section of aluminium cable to motor and DC-bus (380-440 V) [AWG]5) 3/0 250mcm 300mcm 2x2/0 2x4/0 2x250mcm 2x350mcm

Max. cross-section of aluminium cable to motor and DC-bus (441-460 V) [AWG]5) 3/0 4/0 250mcm 2x2/0 2x3/0 2x250mcm 2x300mcm Max. cross-section of cable to motor,

10/8 10/8 10/8 10/8 16/6 and DC-bus4) (mm²/AWG|5) 10/8 16/6 Max. input current ILN[A] (380 V) 103 145 174 206 256 317 366 103 158 185 236 304 356 (RMS) 128 I_{LN}[A] (460 V) Max. cross-section of copper cable 2x120

120 2x70 to power (380-440 V) 70 95 2x70 2x95 Max. cross-section of copper cable to power (441-460 V) 70 70 95 2x70 2x70 2x95 2x120 Max. cross-section of aluminium cable to power (380-440 V) [mm²]⁵⁾ 95 90 120 2x70 2x95 2x120 2x150

1/0

[AWG]5)

to power (441-460 V) [mm²]⁵⁾ 70 120 150 2x70 2x120 2x120 2x150 Max. cross-section of copper cable to power (380-440 V) 4/0 2x250mcm [AWG]5) 1/0 3/0 2x1/0 2x2/0 2x3/0 Max. cross-section of copper cable

Max. cross-section of aluminium cable to power (380-440 V) [AWG]5) 3/0 250mcm 300mcm 2x2/02x4/0 2x250mcm 2x350mcm Max. cross-section of aluminium cable

2/0

3/0

2x1/0

2x3/0

2x4/0

2x1/0

to power (441-460 V) [AWG]5) 3/0 4/0 250mcm 2x2/0 2x3/0 2x250mcm 2x300mcm Min. cable cross-section to motor, [mm²/AWG]⁵⁾ 10/8 10/8 10/8 10/8 10/8 16/6 and DC-bus 4)

[A]/UL ¹³[A] [A]/UL ¹³[A] Max. pre-fuses 150/150 250/220 250/250 300/300 350/350 450/400 500/500 30/30 30/30 Integral pre-fuses 15/15 15/15 15/15 30/30 30/30 CI 300EL Mains contactor [Danfoss Type] CI 85 CI 85 CI 141 CI 141 CI 250EL CI 250EL [A]/UL 11[A] 5.0/5.0 Pre-fuses SMPS 146 109 109 146 146 146 Weight IP 00 [kg] 109 161 161 Weight IP 20 [kg] 121 121 161 161

177 Weight IP 54 [kg] 124 124 177 177 177 0.96-0.97 Efficiency at rated frequency [W] 1430 1970 2380 2860 3810 4770 5720 Power loss at max. load IP 00 / IP 20/ IP 54

1. To comply with UL/cUL, use pre-fuses type Bussmann KTN-R, or Ferraz Shawmut type ATMR. The fuses protect a circuit capable of supplying max. 100,000 amps rms (symmetrical), 500 V max.

- 2. American Wire Gauge.
- 3. Measured using 30 m screened motor cable at rated load and rated frequency.

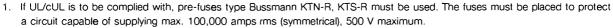
Max. cross-section of aluminium cable

to power (441-460 V)

- Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
- Connection stud 1 x M8 / 2 x M8.
- Not for new designs. For new designs, use VLT 6072



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



^{2.} American Wire Gauge.

^{3.} Measured using 30 m screened motor cable at rated load and rated frequency.

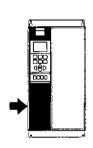
^{4.} Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.

^{5.} Connection stud 1 x M8 / 2 x M8.



■ Technical data, mains supply 3 x 550-600 V

ording to i	international requirements							
		6002	6003	6004	6005	6006	6008	6011
	Output current I _{N.T.N.} [A] (550 V)	2.6	2.9	4.1	5.2	6.4	9.5	11.5
	Ivit, мах (60 s) [А] (550 V)	2.9	3.2	4.5	5.7	7.0	10.5	12.7
	I _{VLT.M} [A] (550 V)	2.4	2.7	3.9	4.9	6.1	9.0	11.0
	l _{VLT, MAX} (60 s) [A] (575 V)	2.6	3.0	4.3	5.4	6.7	9.9	12.1
•	Output S _{MIN} [kVA] (550 V)	2.5	2.8	3.9	5.0	6.1	9.0	11.0
1	S _{MIN} [kVA] (575 V)	2.4	2.7	3.9	4.9	6.1	9.0	11.0
	Typical shaft output P _{VLN} [kW]	1.1 .	1.5	2.2	3	4	5.5	7.5
	Typical shaft output Pvt N [HP]	1.5	. 2	3	4	5	7.5	10
	Max. copper cable cross-section to motor				•		-	
	brake and loadsharing ⁴⁾ [mm2]	4	4	4	4	4	4	4
	(AWG) ²⁾	10	10	10	10	10	10	10



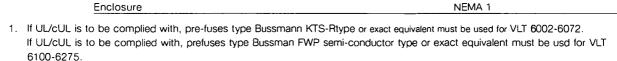
Rated Input Current I _{VLI,N} [A] (550 V)		2.5	2.8	4.0	5.1	6.2	9.2	11.2
l _{vt}	N[A] (600 V)	2.2	2.5	3.6	4.6	5.7	8.4	10.3
Max.copper cable cross-sect power, NEMA 149	ion.					-		
[mm2]		4	4	4	4	4	4	4
[AWG] ²⁾		10	10	10	10	10	10	10
Max. prefuses (mains) ¹¹ [-]/UL [A]		3	4	5	6	8	10	15
Efficiency				0.96				
Weight IP00	[kg] [lbs]							
Weight IP20/NEMA 1	[kg]	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Estimated power loss at	(lbs)	23	23	23	23	23	23	23
max. load (550 V)	[W]	65	73	103	131	161	238	288
Estimated power loss at								
max. load (600 V)	[W]	63	71	102	129	160	236	288
Enclosure				IP20	and NEM	A 1		

- If UL/cUL is to be complied with, pre-fuses type Bussmann KTS-Rtype or exact equivalent must be used for VLT 6002-6072.
 If UL/cUL is to be complied with, prefuses type Bussman FWP semi-conductor type or exact equivalent must be used for VLT 6100-6275.
 - If UL/cUL is to be complied with, use type gG fuse for VLT 6002-6072 and type gR for VLT 6100-6275. Not following the recommendation may result in unnecessary damage of the drive in case of malfunction. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Arms (symmetrical), 600 V maximum.
- 2. American Wire Gauge (AWG).
- 3. Min. cable cross-section is the smallest cable cross-section allowed to be fitted into the terminals to comply with IP20. Always comply with national and local regulations on min. cable cross-section.
- 4. Connection stud 1 x M8 / 2 x M8 for VLT 6100-6275.

Q-Pulse Id TMS1102



000.0	international requirements								
		6016	6022	6027	6032	6042	6052	6062	6072
	Output current I _{VLTN} [A] (550 V)	18	23	28	34	43	54	65	81
	NT, MAX (60 s) [A] (550 V)	20	25	31	37	47	59	72	89
	l _{vlt.n} [A] (550 V)	17	22	27	32	41	52	62	77
	l _{vlt, мах} (60 s) [A] (575 V)	19	24	30	35	45	57	68	85
_	Output S _{VLTN} [kVA] (550 V)	17	22	27	32	41	51	62	77
7	S _{VLT,N} [kVA] (575 V)	17	22	27	32	41	52	62	77
	Typical shaft output PyLIN [kW]	11	15	18.5	22	30	37	45	55
Ì	Typical shaft output P _{VJ,N} [HP]	15	20	25	30	40	50	60	75
ŀ	Max. copper cable cross-section to motor							-	
	brake and loadsharing ⁴⁾ [mm2]	16	16	16	35	35	50	50	50
	[AWG] ²⁾	6	6	6	2	2	1/0	1/0	1/0
=	Min. cable cross-section to motor								
	brake and loadsharing ³⁾ [mm2]	0.5	0.5	0.5	10	10	16	16	16
	[AWG] ²⁾	20	20	20	8	8	6	6	6
									
	Rated Input Current I _{N.T.N.} [A] (550 V)	18	22	27	33	42	53	63	79
	Rated Input Current I _{N.T.N.} [A] (550 V) I _{N.T.N.} [A] (600 V)	18 16	22 21	27 25	33 30	42 38	53 49	63 58	79 72
				_					
	I _{VLIN} [A] (600 V) Max.copper cable cross-section,			_					
a	I _{VLIN} [A] (600 V) Max.copper cable cross-section, power, NEMA 14)	16	21	25	30	38	49	58	72
<u> </u>	I _{VLN} [A] (600 V) Max.copper cable cross-section, power, NEMA 1 ⁴⁾ [mm2]	16	21 16	25	30	38	49 50	58 50	72 50
N. C. C. C. C. C. C. C. C. C. C. C. C. C.	I _{NIN} [A] (600 V) Max.copper cable cross-section, power, NEMA 1 ⁴⁾ [mm2] [AWG] ²⁾	16 16 6	21 16 6	25 16 6	30 35 2	38 35 2	50 1/0	58 50 1/0	72 50 1/0
	I _{NIN} [A] (600 V) Max.copper cable cross-section, power, NEMA 1 ⁴⁾ [mm2] [AWG] ²⁾ Max. prefuses (mains) ¹⁾ [-]/UL [A]	16 16 6	21 16 6	25 16 6	30 35 2	38 35 2 60	50 1/0	58 50 1/0	72 50 1/0
0	I _{VLIN} [A] (600 V) Max.copper cable cross-section, power, NEMA 1 ⁴⁾ [mm2] [AWG] ²⁾ Max. prefuses (mains) ¹⁾ [-]/UL [A] Efficiency Weight IP00 [kg]	16 16 6	21 16 6	25 16 6	30 35 2	38 35 2 60	50 1/0	58 50 1/0	72 50 1/0



451

446

576

576

702

707

852

838

1077

1074

1353

1362

1628 2029

2016

(W)

[W]

If UL/cUL is to be complied with, use type gG fuse for VLT 6002-6072 and type gR for VLT 6100-6275. Not following the recommendation may result in unnecessary damage of the drive in case of malfunction. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Arms (symmetrical), 600 V maximum.

- 2. American Wire Gauge (AWG).
- 3. Min. cable cross-section is the smallest cable cross-section allowed to be fitted into the terminals to comply with IP20. Always comply with national and local regulations on min. cable cross-section.
- 4. Connection stud 1 x M8 / 2 x M8 for VLT 6100-6275.

max. load (550 V)

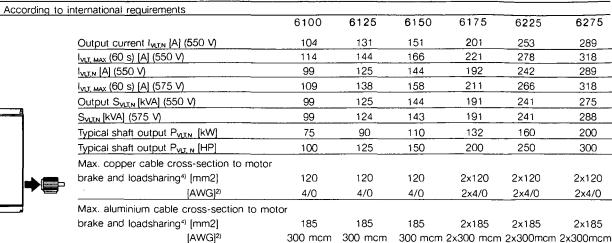
max. load (600 V)

Estimated power loss at

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■ Technical data, mains supply 3 x 550-600 V



6

8

101

92

120

4/0

185

300 mcm

125

6

8

128

117

120

4/0

185

175

6

8

147

134

120

4/0

185

200

2x6

2x8

196

179

2x120

2x4/0

2x185

300 mcm 300 mcm 2x300 mcm 2x300 mcm 2x300mcm

250

2x6

2x8

246

226

2x120

2x4/0

2x185

350

6340

2x6

2x8

281

270

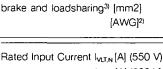
2x120

2x4/0

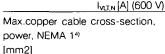
2x185

400

7570



Min. cable cross-section to motor



[AWG	3J ²⁾	
Max.	aluminium cable cros	s-section,
powe	er, NEMA 14)	

[AWC	∋] ²⁾			
Max.	prefuses	(mains)1)	[-]/UL	[A]

[mm2]

Integral prefuses
(softcharge circuit, AC)5) [-]/L
Integral prefuses

(Solicharge circuit, AC) ³⁷ [-]/C	JL [A]	15(Qty.3)	15(Qty.3)	15(Qty.3)_	30(QTy.3)	30(Qty.3)	30(Qty.3)
Integral prefuses							
(softcharge resistors, DC)5	[-]/UL [A]	12(Qty.1)	12(Qty.1)	12(Qty.1)	12(Qty.2)	12(Qty.2)	12(Qty.2)
Integral prefuses ⁶⁾ (SMPS)	[-]/UL [A]	5	5_	5	5	5	5
Efficiency				0.96	S-0.97		
Weight IP00	[kg]	109	109	109	146	146	146
	[lbs]	240	240	240	322	322	322
Weight IP20/NEMA 1	[kg]	121	121	121	161	161	161
	[lbs]	267	267	267	355	355	355_
Estimated power loss at							
max. load (550 V)	(W)	2605	3285	3785	5035	6340	7240

max. load (550 V)
Estimated power loss at max. load (600 V)

Enclosure

V) [W] 2560 3275 3775 5030 IP00 and NEMA 1

If UL/cUL is to be complied with, pre-fuses type Bussmann KTS-Rtype or exact equivalent must be used for VLT 6002-6072.
 If UL/cUL is to be complied with, prefuses type Bussman FWP semi-conductor type or exact equivalent must be used for VLT 6100-6275.

If UL/cUL is to be complied with, use type gG fuse for VLT 6002-6072 and type gR for VLT 6100-6275. Not following the recommendation may result in unnecessary damage of the drive in case of malfunction. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Arms (symmetrical), 600 V maximum.

- 2. American Wire Gauge (AWG).
- 3. Min. cable cross-section is the smallest cable cross-section allowed to be fitted into the terminals to comply with IP20. Always comply with national and local regulations on min. cable cross-section.
- 4. Connection stud 1 x M8 / 2 x M8 for VLT 6100-6275.
- Integral prefuses (softcharge circuit, AC) must be AC Littelfuse KLK or exact equivalent.
 Integral prefuse (softchage resistors, DC) must be KLKD or exact equivalent.
- Integral prefuse (SMPS) must be Bussman KTK type or exact equivalent.



■ Mechanical dimensions

All measurements in mm.

VLT type	Α	В	С		а	b	aa/bb	Туре
Bookstyle IP 20 200-240 V			<u>.</u>					
6002 - 6003	395	90	260		384	70	100	A
6004 - 6005	395	130	260		384	70	100	Α
Bookstyle IP 20 380-460 V								
3002 - 6005	395	90	260		384	70	.100	A
5006 - 6011	395	130	260	-	384	70	100	A
	\$						9 .	
P 00 200-240 V	200	070	005		300		205	
5042 - 6062	800	370	335		<u>7.</u> 80	270	225	B
D 00 000 400 V							,,	
P 00 380-460 V	200	070	2005		700	070	005	
3075 - 6125	800	370	335		780 1	270	225	<u>B</u>
3150 - 6275	1400	420	400 - 1		1380	350	225	B
3350 - 6550	1896	1099	490		- 1		400 (aa)	Н
D 20 200 240 V								
P 20 200-240 V	1005	000	100		1,004	000	100	0
5002 - 6003 5004 - 6005	395	220	160		384	200	100	C
<u> </u>	395	220	200		384	200	100	
5006 - 6011	560	242	260		540	200	200	
<u> </u>	700	242	260		680	200	200	<u>D</u>
5027 - 6032	800	308	296		780	270	200	
6042 - 6062	954	370	335		780	270	225	Ε
IP 20 380-460 V							***	
6002 - 6005	395	220	160		384	200	100	С
3006 - 6011	395	220	200		384 1	200	100	C
6016 - 6027	560	242	260		540	200	200	D
6032 - 6042	700	242	260		680	200	200	D
6052 - 6072	800	308	296		7.80	270	200	D
6075 - 6125	954	370	335		780	270	225	E E
6150 - 6275	1554	420	400		1380	350	225	E
6350 - 6550	2010	1200	600		- 1-	-	400 (aa)	Н
	14		k		F		(- 1 - 7)	
/LT type	Α	В	С	D	а	ь	aa/bb	Туре
P 54 200-240 V	1						, ,	
5002 - 6003	460 ,	282	195	85	260	258	1.00	F
6004 - 6005	530	282	195	85	330	258	3100	F
6006 - 6011	810	355	280	70	560	330	200	F
6016 - 6032	940	400	280	70	690	375	200	F
5042 - 6062	937	495	421	-	830	374	225	G
IP 54 380-460 V		۱ ۵۵۰				3 05-	P.,	1 -
5002 - 6005	460	282	195	85	260	258	100	<u> </u>
<u> </u>	530	282	195	85	330	258	100	<u> </u>
5016 - 6032	810	355	280	70	560	330	200	F
5042 - 6072	940	400	280	70	690	375	200	
6075 - 6125	937	495	421	-	830	374	225	G
6150 - 6275	1572	495	425	-	1465	445	225	G
0050 0550	100010	1 4000	1000				100 / 1	1

aa: Min. air above enclosure bb: Min. air below enclosure

400 (aa)

Н

2010 1200

6350 - 6550

600



■ Mechanical dimensions

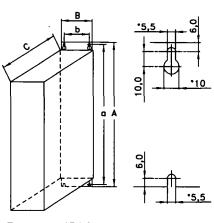
All measurements are in mm.

VLT type	A	В	C	_ a	b	aa/bb*	Type
IP 00 550-600 V			i i			ŗ	<u> </u>
6100-6150	800/31.55	370/14.57	335/13.19	780/30.71	270/10.63	250	В
6175-6275	1400/55.12	420/16.54	400/15.75	1380/54.33	350/13:78	300	В
IP 20/NEMA 1 550-600	V						
6002-6011	395/15:55	220/8.66	200/7.87	384/15.12	200/7.87	100	С
6016-6027	560/22.05	242/9.53	260/10.23	540/21.26	200/7.87	200	D
6032-6042	700/27.56	242/9.53	260/10.23	680/26.77	200/7.87	200	D
6052-6072	800/31.50	308/12.13	296/11.65	780/30.71	270/10.63	200	D.
6100-6150	954/37.60	370/14.57	335/13.19	780/30.71	270/10.63	250	E .
6175-6275	1554/61.22	420/16.54	400/15.75	1380/54.33	350/13:78	300	i E
Option for IP 00 VLT 6075-62	75 A1	B1	C1	_			
IP 20 bottom cover					Land and		
6100 - 6125	. 175	370	335				1- 4-
6150 - 6275	175	420	400				F-2521

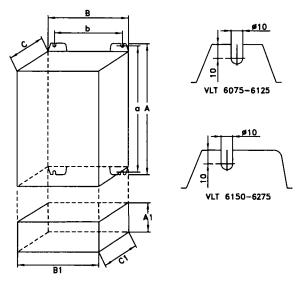
^{*)} aa: Min. air above enclosure bb: Min. air below enclosure



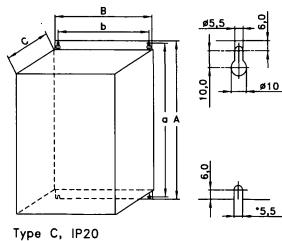
■ Mechanical dimensions

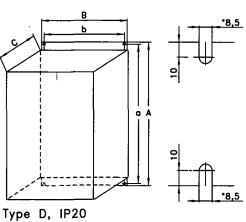


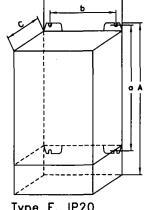




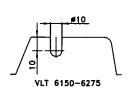
Type B, IP00 With option and enclosure IP20



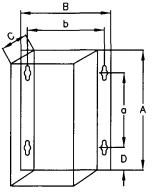


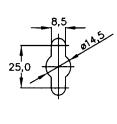




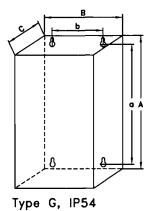


Type E, IP20





Type F, IP54

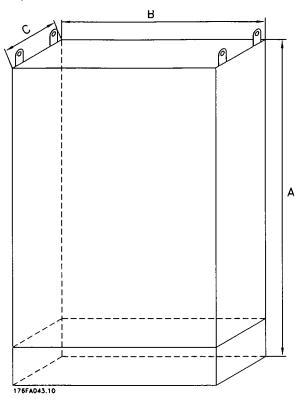




MG.60.A6.02 - VLT is a registered Danfoss trade mark



■ Mechanical dimensions (cont.)



Type H, IP 00, IP 20, IP 54



■ Mechanical installation

installing large units.

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

The VLT frequency converter must be installed vertically.

The VLT frequency converter is cooled by means of air **Field-mounting** circulation. For the unit to be able to release its cooling air, the minimum distance over and below the unit must be as shown in the illustration below. To protect the unit from overheating, it must be ensured that the ambient temperature does not rise above the max. temperature stated for the VLT frequency converter and that the 24-hour average temperature is not exceeded. The max, temperature and 24-hour average can be seen from the General Technical Data.

If the ambient temperature is in the range of 45°C -55°C, derating of the VLT frequency converter will become relevant, see Derating for ambient temperature.

The service life of the VLT frequency converter will be reduced if derating for ambient temperature is not taken into account.

■ Enclosure protection

	IP 00	IP 20 I	NEMA 1	IP 54
Bookstyle	-	OK		-
VLT 6002-6032 200-240 \	<u> </u>	OK		OK
VLT 6002-6550 380-460 \	/ OK	OK		OK
VLT 6002-6011 550-600 \	<u> </u>	ОК	OK	
VLT 6016-6072 550-600 \	<u> </u>		OK	-
VLT 6100-6275 550-600 \	/ OK		OK	-

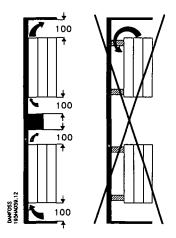
	IP 00	IP 20 NEMA 1	IP 54
Bookstyle	-	No	-
VLT 6002-6032 200-240 V		No	OK
VLT 6002-6550 380-460 V	No	No	OK
IP 20 with 4x top cover			
VLT 6002-6005 200-240 V	-	OK	OK
VLT 6002-6016 380-460 V	-	OK	OK
VLT 6002-6011 550-600 V	-	OK OK	-

IΡ	20	terminal	cove
----	----	----------	------

VLT 6006-6032 200-240 V	-	OK		OK
VLT 6022-6072 380-460 V	-	OK		OK
VLT 6016-6072 550-600 V	-	-	OK	-

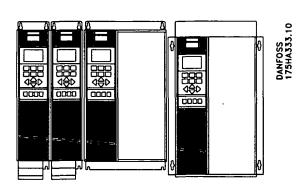
■ Spacing when installing of VLT 6002-6005 200-240 V, VLT 6002-6011 380-460 V, VLT 6002-6011 550-600 V, Bookstyle IP 00, IP 20, NEMA 1 and IP 54.

Cooling



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

Side-by-side

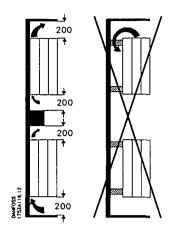


All the above-mentioned units can be installed side by side without any space, since these units do not require any cooling on the sides.



■ Installation of VLT 6006-6032 200-240 V, VLT 6016-6072 380-460 V, VLT 6016-6072 550-600 V, IP 20, NEMA 1 and IP 54

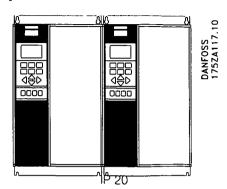
Cooling

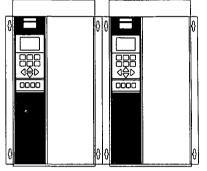


All units in the above-mentioned series require a minimum space of 200 mm above and below the enclosure and must be installed on a plane, vertical surface (no spacers). This applies both to IP 20, NEMA 1, and IP 54 units.

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

Side-by-side

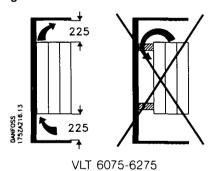




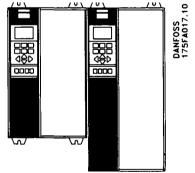
IP 54 (flange-by-flange)

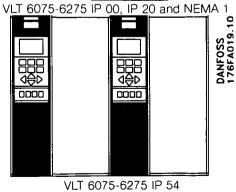
■ Installation of VLT 6042-6062 200-240 V, VLT 6075-6275 380-460 V, VLT 6100-6275 550-600 V, IP 00, IP 20, NEMA 1, and IP 54 Side-by-side

Cooling



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



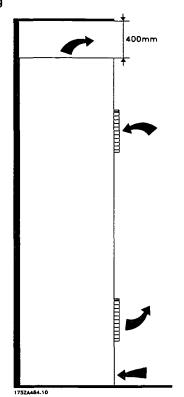


All IP 00 and IP 20 units in the above-mentioned series can be installed side by side without any spacing.

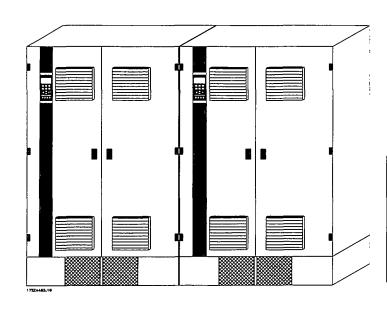


■ Installation of VLT 6350-6550 380-500 V Compact IP 00, IP 20 and IP 54

Cooling



Side-by-side



All units in the above-mentioned series require a minimum space of 400 mm above the enclosure and must be installed on a plane floor. This applies to both IP 00, IP 20 and IP 54 units.

Gaining access to VLT 6350-6550 requires a minimum space of 605 mm in front of the VLT frequency converter.

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

■ IP 00 VLT 6350-6550 380-460 V

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

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■ General information about electrical installation

■ High voltage warning



The voltage of the frequency converter is dangerous whenever the equipment is connected to mains. Incorrect instal-

lation of the motor or the frequency converter may cause damage to the equipment, serious personal injury or death.

Consequently, the instructions in this Design Guide, as well as national and local safety regulations, must be complied with.

Touching the electrical parts may be fatal - even after disconnection from mains:

Using VLT 6002-6005 wait at least 4 minutes and using VLT 6006-6550 wait at least 30 minutes.

NB!

It is the user's or certified electrician's responsibility to ensure correct earthing and

protection in accordance with applicable national and local norms and standards.

■ Earthing

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

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

Connect the different earth systems at the lowest possible conductor impedance. The lowest possible conductor impedance is obtained by keeping the conductor as short as possible and by using the greatest possible surface area. A flat conductor, for example, has a lower HF impedance than a round conductor for the same conductor cross-section C_{VESS} .

If more than one device is installed in cabinets, the cabinet rear plate, which must be made of metal, should be used as a common earth reference plate. The metal cabinets of the different devices are mounted on the cabinet rear plate using the lowest possible HF impedance. This avoids having different HF voltages for the individual devices and avoids the risk of radio interference currents running in connection cables that may be used between the devices. The radio interference will have been reduced.

In order to obtain a low HF impedance, use the fastening bolts of the devices as HF connection to the rear plate. It is necessary to remove insulating paint or similar from the fastening points.

Cables

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

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

If cable jaws are used, sensitive signal cables are not to be placed in the same cable jaws as the motor cable or brake cable.

If signal cables are to cross power cables, this should be done at an angle of 90 degrees.

Remember that all interference-filled in- or outgoing cables to/from a cabinet should be screened/armoured or filtered.

See also EMC-correct electrical installation.

■ Screened/armoured cables

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

See also Use of EMC-correct cables.

■ Extra protection with regard to indirect contact

ELCB relays, multiple protective earthing or earthing can be used as extra protection, provided that local safety regulations are complied with.

In the case of an earth fault, a DC content may develop in the faulty current.

Never use ELCB relays, type A, since such relays are not suitable for DC fault currents. If ELCB relays are used, this must be done in accordance with local regulations.

If ELCB relays are used, they must be:

- Suitable for protecting equipment with a direct current content (DC) in the faulty current (3-phase bridge rectifier)
- Suitable for power-up with short charging current to earth
- Suitable for a high leakage current.



■ RFI switch

Mains supply isolated from earth:

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



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



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



NB!

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

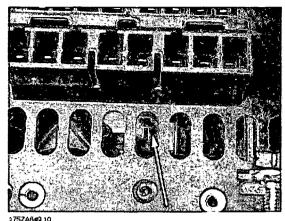


Reliable galvanic isolation (PELV) is lost if the RFI switch is placed in the OFF position. This means that all control in- and

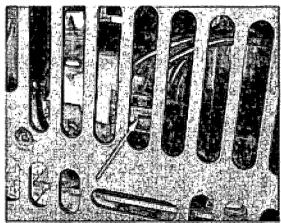
outputs can only be considered low-voltage terminals with basic galvanic isolation. In addition, the VLT 6000 HVAC EMC performance will be reduced if the RFI switch is placed in the OFF position.

Mains supply connected to earth:

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



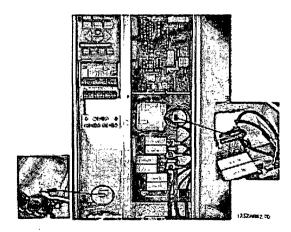
Bookstyle IP 20 VLT 6002 - 6011 380 - 460 V VLT 6002 - 6005 200 - 240 V



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Compact IP 20 and NEMA 1

VLT 6002 - 6011 380 - 460 V VLT 6002 - 6005 200 - 240 V VLT 6002 - 6011 550 - 600 V



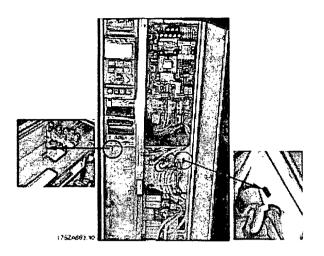
Compact IP 20 and NEMA 1

VLT 6016 - 6027 380 - 460 V

VLT 6006 - 6011 200 - 240 V

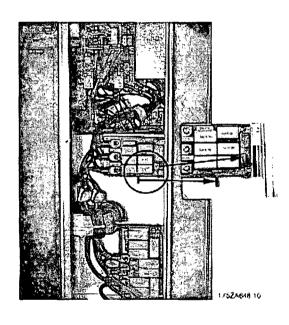
VLT 6016 - 6027 550 - 600 V





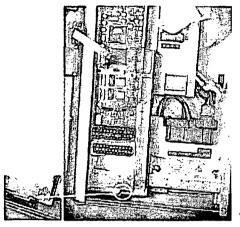
Compact IP 20 and NEMA 1 VLT 6032 - 6042 380 - 460 V

VLT 6016 - 6022 200 - 240 V VLT 6032 - 6042 550 - 600 V



Compact IP 20 NEMA 1

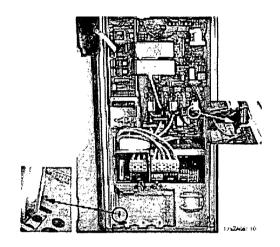
VLT 6052 - 6072 380 - 460 V VLT 6027 - 6032 200 - 240 V VLT 6052 - 6072 550 - 600 V



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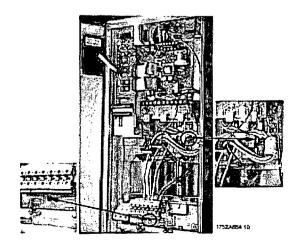
Compact IP 54

VLT 6002 - 6011 380 - 460 V VLT 6002 - 6005 200 - 240 V



Compact IP 54

VLT 6016 - 6032 380 - 460 V VLT 6006 - 6011 200 - 240 V



Compact IP 54

VLT 6042 - 6072 380 - 460 V VLT 6016 - 6032 200 - 240 V

Q-Pulse Id TMS1102



■ High voltage test

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

NI Tr

NB!

The RFI switch must be closed (position ON) when high voltage tests are carried out. The

mains and motor connection must be interrupted in the case of high voltage tests of the total installation if the leakage currents are too high.

■ Heat emission from VLT 6000 HVAC

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

■ Ventilation of integrated VLT 6000 HVAC

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

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

 $\Delta t = 45^{\circ} \text{ C-t}_{IN}.$

3. Calculate the required

quantity of air =
$$\frac{\sum P_{\phi} \times 3.1}{\Delta t}$$
 m³/h

Insert At in Kelvin

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

■ EMC-correct electrical installation

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

Good engineering practice to ensure EMC-correct electrical installation:

- Use only braided screened/armoured motor cables and control cables.
 The screen should provide a minimum coverage of 80%. The screen material must be metal, not limited to but typically copper, aluminium, steel or lead. There are no special requirements for the mains cable.
- Installations using rigid metal conduits are not required to use screened cable, but the motor cable must be installed in conduit separate from the control and mains cables. Full connection of the conduit from the drive to the motor is required. The EMC performance of flexible conduits varies a lot and information from the manufacturer must be obtained.
- Connect the screen/armour/conduit to earth at both ends for motor cables and control cables.
 See also Earthing of braided screened/ armoured control cables.
- Avoid terminating the screen/armour with twisted ends (pigtails). Such a termination increases the high frequency impedance of the screen, which reduces its effectiveness at high frequencies. Use low impedance cable clamps or glands instead.

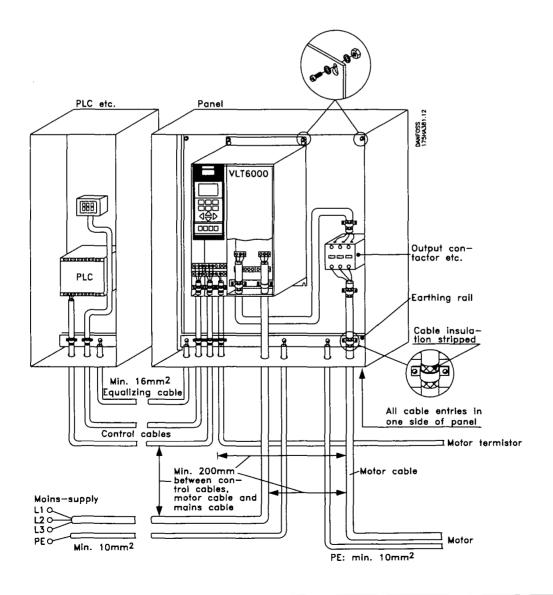
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- Ensure good electrical contact between the mounting plate and the metal chassis of the VLT frequency converter. This does not apply to IP54/NEMA 12 units as theyare designed for wall mounting and VLT 6075-6550, 380-460 VAC, VLT 6042-6062, 200-240 VAC, and VLT 6100-6275 550-600 V in IP20/NEMA1 enclosure.
- Use starwashers and galvanically conductive installation plates to secure good electrical connections for IP00, IP20, and NEMA 1 installations.
- Avoid using unscreened/unarmoured motor or control cables inside cabinets housing the drive(s), where possible.
- An uninterrupted high frequency connection between the VLT frequency converter and the motor units is required for IP54/NEMA 12 units.

The illustration below shows an example of an EMC-correct electrical installation of an IP 20 or NEMA 1 VLT frequency converter. The VLT frequency converter has been fitted in an installation cabinet with an output contactor and connected to a PLC, which in this example is installed in a separate cabinet. Other ways of making the installation may have as good an EMC performance, provided the above guide- lines to engineering practice are followed. Please note that when unscreened cables and control wires are used, some emission requirements are not complied with, although the immunity requirements are fulfilled.

See the section EMC test results for further details.





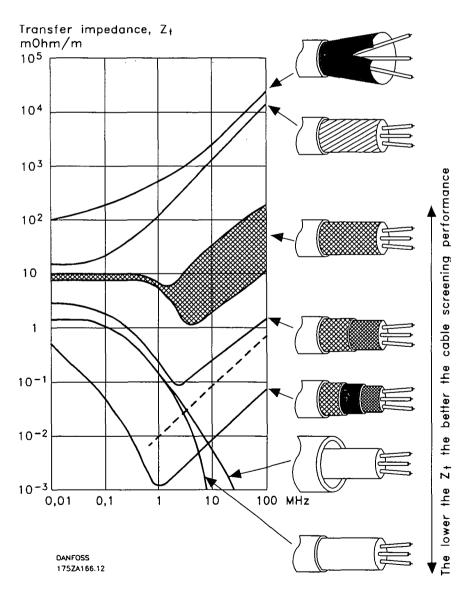
■ Use of EMC-correct cables

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

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

 Z_{T} can be assessed on the basis of the following factors:

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



Aluminium-clad with copper wire.

Twisted copper wire or armoured steel wire cable.

Single-layer braided copper wire with varying percentage screen coverage.

Double-layer braided copper wire.

Twin layer of braided copper wire with a magnetic, screened/ armoured intermediate layer.

Cable that runs in copper tube or steel tube.

Lead cable with 1.1 mm wall thickness with full coverage.

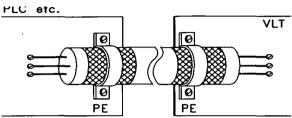
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■ Earthing of screened/armoured control cables

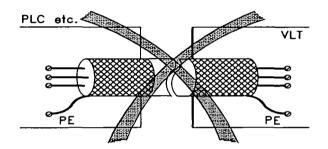
Generally speaking, control cables must be screened/armoured and the screen must be connected by means of a cable clamp at both ends to the metal cabinet of the unit.

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



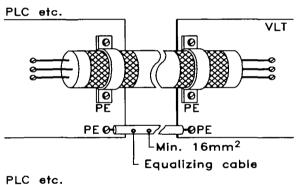
Correct earthing

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



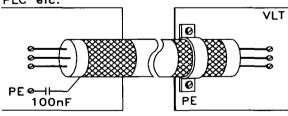
Wrong earthing

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



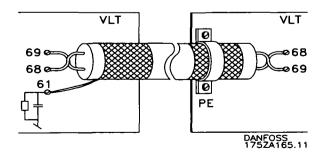
Protection with respect to earth potential between PLC and VLT

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



For 50/60 Hz earth loops

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

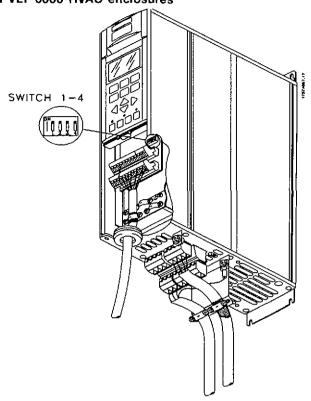


Cables for serial communication

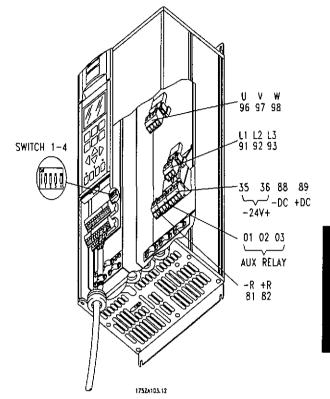
Low-frequency noise currents between two VLT frequency converters can be eliminated by connecting one end of the screen to terminal 61. This terminal is connected to earth via an internal RC link. It is recommended to use twisted-pair cables to reduce the differential mode interference between the conductors.



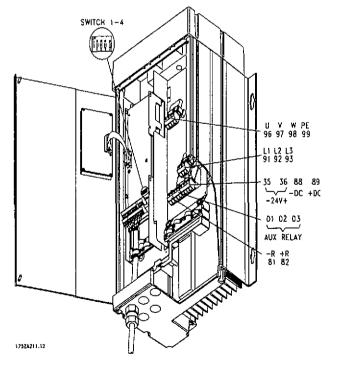
■ VLT 6000 HVAC enclosures



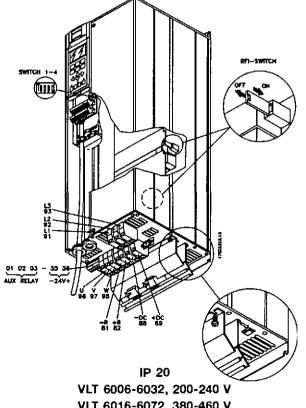
Bookstyle IP 20 VLT 6002-6005, 200-240 V VLT 6002-6011, 380-460 V



Compact IP 20 and NEMA 1 VLT 6002-6005, 200-240 V VLT 6002-6011, 380-460 V VLT 6002-6011, 550-600 V



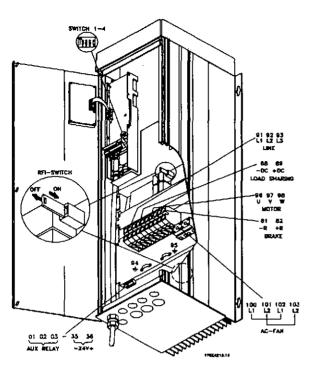
Compact IP 54 VLT 6002-6005, 200-240 V VLT 6002-6011, 380-460 V



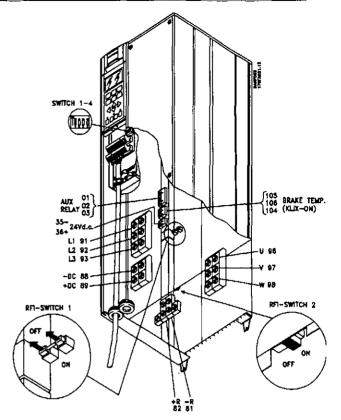
VLT 6016-6072, 380-460 V VLT 6016-6072, 550-600 V



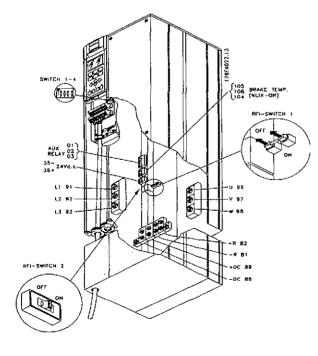
■ VLT 6000 HVAC enclosures



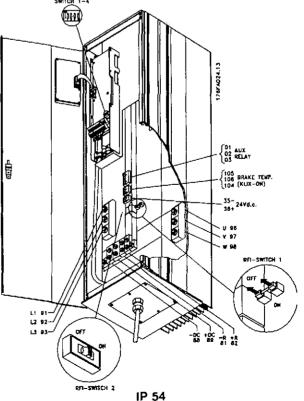
IP 54 VLT 6006-6032, 200-240 V VLT 6016-6062, 380-460 V



IP 00 VLT 6042-6062, 200-240 V VLT 6075-6125, 380-460 V VT 6100-6150, 550-600 V

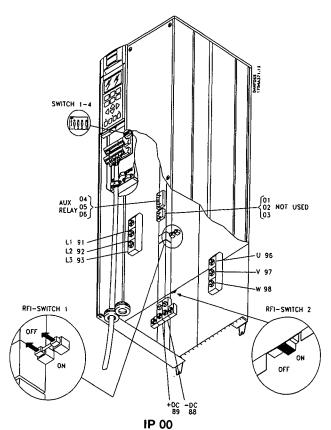


NEMA 1 VLT 6042-6062, 200-240 V VLT 6075-6125, 380-460 V VLT 6100-6150, 550-600 V

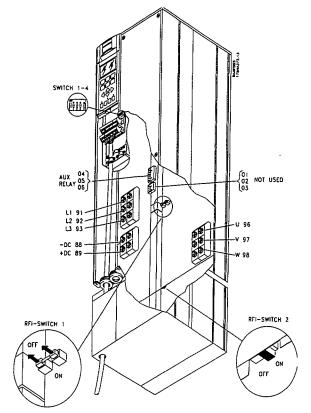


VLT 6042-6062, 200-240 V VLT 6075-6125, 380-460 V

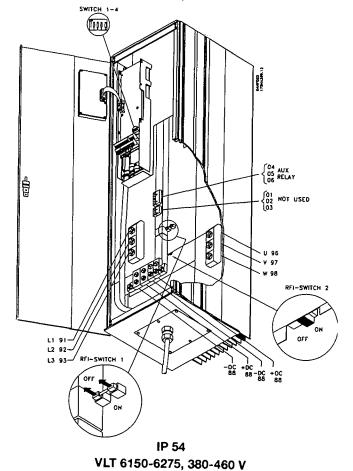




VLT 6150-6275, 380-460 V VLT 6175-6275, 550-600 V



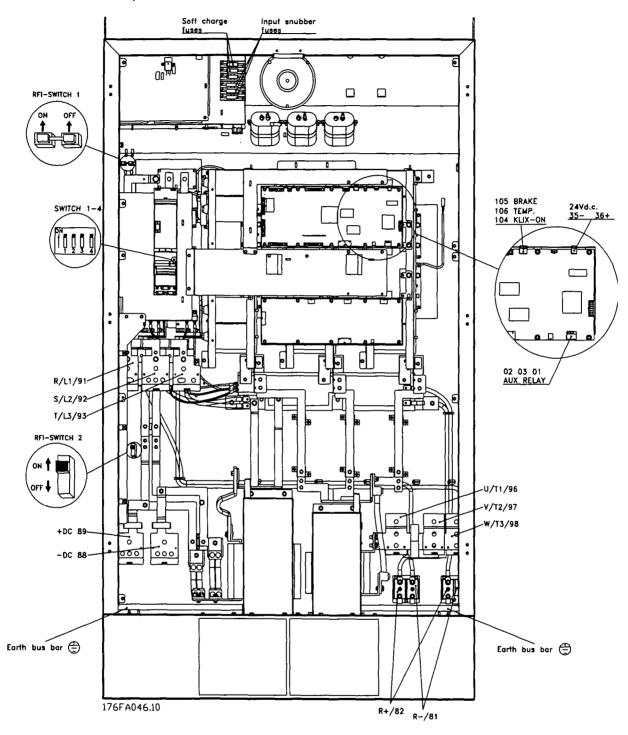
NEMA 1 VLT 6150-6275, 380-460 V VLT 6175-6275, 550-600 V



 $\mbox{MG.60.A7.02}$ - \mbox{VLT} is a registered Danfoss trade mark



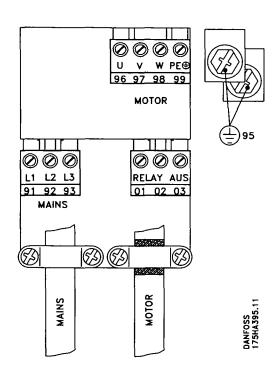
■ Electrical installation, enclosures

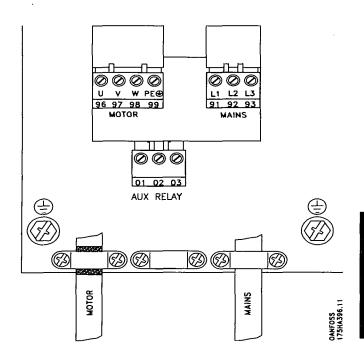


Compact IP 20, NEMA 1, and IP 54 VLT 6350-6550, 380-500 V

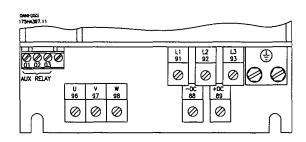


■ Electrical installation, power cables

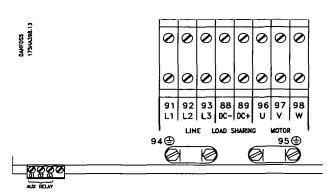




Bookstyle IP 20 VLT 6002-6005, 200-240 V VLT 6002-6011, 380-460 V Compact IP 20, NEMA 1, and IP 54 VLT 6002-6005, 200-240 V VLT 6002-6011, 380-460 V VLT 6002-6011, 550-600 V



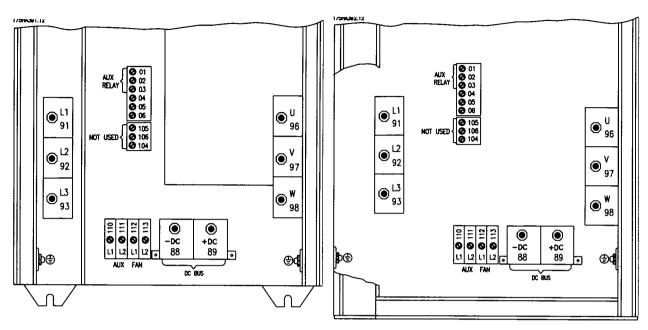
IP 20 and NEMA 1 VLT 6006-6032, 200-240 V VLT 6016-6072, 380-460 V VLT 6016-6072, 550-600 V



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

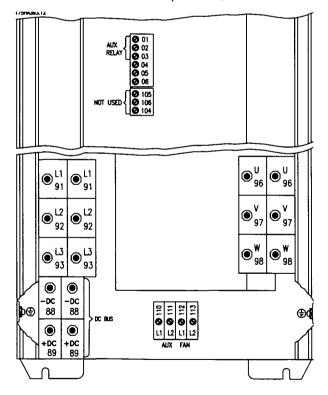


■ Electrical installation, power cables

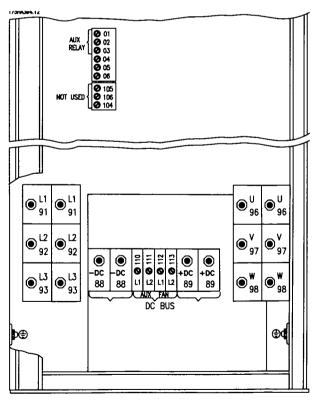


IP 00/20 and NEMA 1 VLT 6042-6062, 200-240 V VLT 6075-6125, 380-460 V VLT 6100-6150, 550-600 V

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



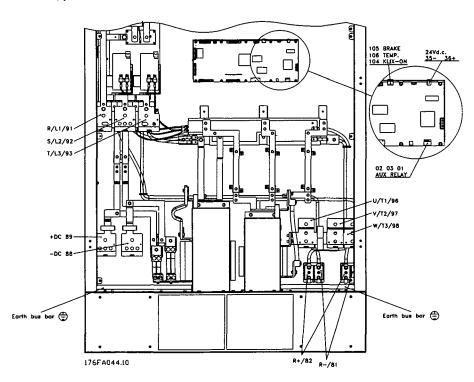
IP 00/20 and NEMA 1 VLT 6150-6275, 380-460 V VLT 6175-6275, 550-600 V



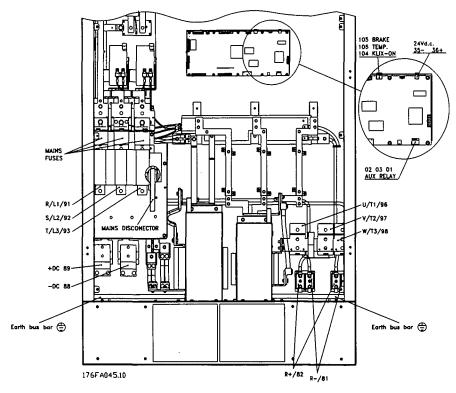
IP 54 VLT 6150-6275, 380-460 V



■ Electrical installation, power cables



Compact IP 20, NEMA 1, and IP 54 without disconnectors and mains fuses



Compact IP 20, NEMA 1, and IP 54 with disconnectors and mains fuses



■ Tightening-up torque and screw sizes

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

These figures apply to the following terminals:

Mains terminals

Nos. 91, 92, 93 L1, L2, L3

Nos. 96, 97, 98 U. V. W

Motor terminals

arth terminal	No. 99
arti terrina	

Earth terminal		No. 99
VLT type	Tightening-up	Screw
3 x 200-240 V	torque	size
VLT 6002-6005	0.5 - 0.6 Nm	M3
VLT 6006-6011	1.8 Nm	M4
VLT 6016-6027	3.0 Nm	M5
VLT 6032	4.0 Nm	M6
VLT type	Tightening-up	Bolt
3 x 200-240 V	torque	size
VLT 6042-6062	11.3 Nm	M8
VLT type	Tightening-up	Screw
3 x 380-460 V	torque	size
VLT 6002-6011	0.5 - 0.6 Nm	M3
VLT 6016-6027	1.8 Nm	M4
VLT 6032-6072	3.0 Nm	M5
VLT type	Tightening-up	Bolt
3 x 380-460 V	torque	size
VLT 6075-6125	11.3 Nm	M8
VLT 6150-6275	11.3 Nm	M8
VLT 6350-6550	42.0 Nm	M12
VLT type	Tightening-up	Screw
3 x 550-600 V	torque	size
VLT 6002-6011	0.5 - 0.6 Nm	M3
VLT 6016-6027	1.8 Nm	M4
VLT 6032-6042	3.0 Nm	M5
VLT 6052-6072	4.0 Nm	M6
VLT 6100-6150	11.3 Nm	M8
VLT 6175-6275	11.3 Nm	M8

■ Mains connection

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

Nos. 91, 92, 93

Mains voltage 3 x 200-240 V Mains voltage 3 x 380-460 V Mains voltage 3 x 550-600 V

NB!



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

See *Technical data* for correct sizing of cable crosssections.

■ Pre-fuses

See Technical data for correct sizing of pre-fuses.

■ Motor connection

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

Nos. 96, 97, 98
U, V, W
No.

Motor voltage 0-100% of mains voltage.
Earth connection.

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

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

Small-size motors are normally star-connected. (220/380 \dot{V} , Δ /Y). Large-size motors are delta-connected (380/660 \dot{V} , Δ /Y).

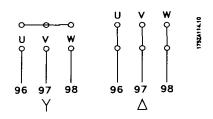
The correct connection and voltage can be read from the motor nameplate.

NB!



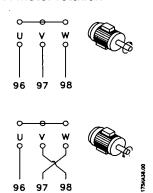
In older motors without phase coil insulation, a LC filter should be fitted to the VLT frequency converter output. See the Design

Guide or contact Danfoss.





Direction of motor rotation

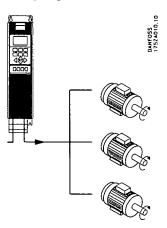


The factory setting is for clockwise rotation with the VLT frequency transformer output connected as follows.

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

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

■ Parallel coupling of motors



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

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

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

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



NB!

Parameter 107 Automatic Motor Adaptation, AMA and Automatic Energy Optimization, AEO

in parameter 101 Torque characteristics cannot be used if motors are connected in parallel.

Motor cables

See Technical data for correct sizing of motor cable cross-section and length.

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



NB!

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

If the EMC specifications regarding emission are to be complied with, the motor cable must be screened, unless otherwise stated for the RFI filter in question. It is important to keep the motor cable as short as possible so as to reduce the noise level and leakage currents to a minimum.

The motor cable screen must be connected to the metal cabinet of the frequency converter and to the metal cabinet of the motor. The screen connections are to be made with the biggest possible surface (cable clamp). This is enabled by different installation devices in the different VLT frequency converters. Mounting with twisted screen ends (pigtails) is to be avoided, since these spoil the screening effect at higher frequencies.

If it is necessary to break the screen to install a motor isolator or motor contactor, the screen must be continued at the lowest possible HF impedance.



■ Motor thermal protection

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

■ Earth connection

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

■ Installation of 24 Volt external DC supply:

Torque: 0.5 - 0.6 Nm Screw size: M3

No. Function

35 (-), 36 (+) 24 V external DC supply

(Available with VLT 6350-6550 only)

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

A pre-fuse of min. 6 Amp, slow-blow, can be fitted to protect the external 24 V DC supply. The power consumption is 15-50 W, depending on the load on the control card.

NB!

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

■ DC bus connection

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

Terminal nos.

Nos. 88, 89

Contact Danfoss if you require further information.

High-voltage relay

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

No. 1 Relay output 1

1+3 break, 1+2 make. Max. 240 V AC, 2 Amp. Min. 24 V DC, 10 mA or 24 V AC, 100 mA.

Max. cross-section:

4 mm²/10 AWG.

Torque:

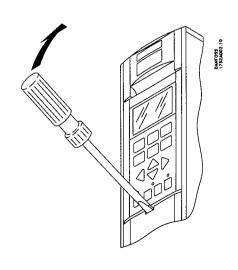
0.5 - 0.6 Nm.

Screw size:

M3.

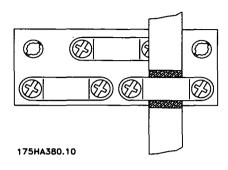
■ Control card

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





■ Electrical installation, control cables



Torque:

0.5 - 0.6 Nm.

Screw size:

M3.

Generally speaking, control cables must be screened/ armoured and the screen must be connected by means of a cable clamp at both ends to the metal cabinet of the unit (see *Earthing of screened/ armoured control cables*). Normally, the screen must also be connected to the body of the controlling unit (follow the instructions for installation given for the unit in question).

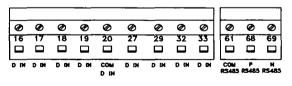
If very long control cables are used, 50/60 Hz earth loops may occur that will disturb the whole system. This problem can be solved by connecting one end of the screen to earth via a 100nF condenser (keeping leads short).

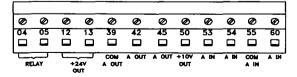
■ Electrical installation, control cables

Max. control cable cross section: 1.5 mm²/16 AWG

Torque: 0.5-0.6 Nm Screw size: M3

See Earthing of screened/armoured control cables for correct termination of control cables.





DANFOSS 175HA379.10

Q-Pulse Id TMS1102

No. Function

Relay output 1 can be used for indicating status and warnings.

Voltage supply to digital inputs. For the 24 V DC to be used for digital inputs, switch 4 on the control card must be closed, position "on".

Digital inputs. See parameters 300-307 Digital inputs.

Ground for digital inputs.

Ground for analogue/digital outputs.

Must be connnected to terminal 55 by means of a three-wire transmitter. See Examples of connection.

42, 45 Analogue/digital outputs for indicating frequency, reference, current and torque. See parameters 319-322 Analogue/digital outputs.

Supply voltage to potentiometer and thermistor 10 V DC.

53, 54 Analogue voltage input, 0 - 10 V DC.

Ground for analogue voltage inputs.

Analogue current input 0/4-20 mA. See parameters 314-316 *Terminal 60*.

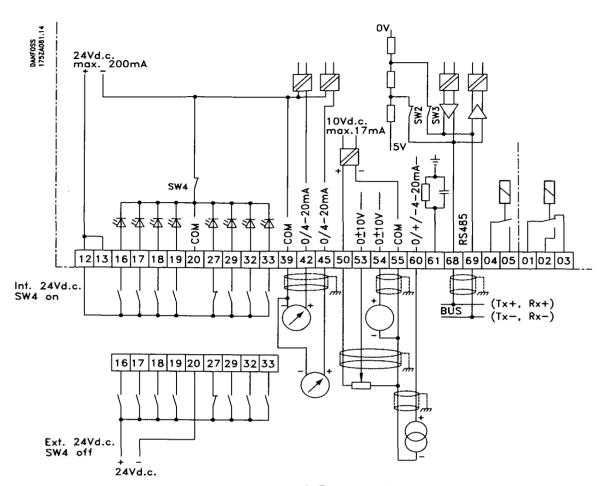
Termination of serial communication. See Earthing of screened/armoured control cables.

This terminal is not normally to be used.

RS 485 interface, serial communication. Where the VLT frequency converter is connected to a bus, switches 2 and 3 (switches 1-4-see next page) must be closed on the first and the last VLT frequency converter. On the remaining VLT frequency converters, switches 2 and 3 must be open. The factory setting

is closed (position on).

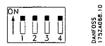




■ Switches 1-4

The dipswitch is located on the control card. It is used for serial communication and external DC supply.

The switching position shown is the factory setting.



Switch 1 has no function.

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

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



NB!

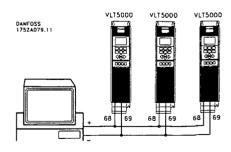
Please note that when Switch 4 is in position "OFF," the external 24 V DC supply is

galvanically isolated from the VLT frequency converter.

Bus connection

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

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



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



■ Connection example, VLT 6000 HVAC

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

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

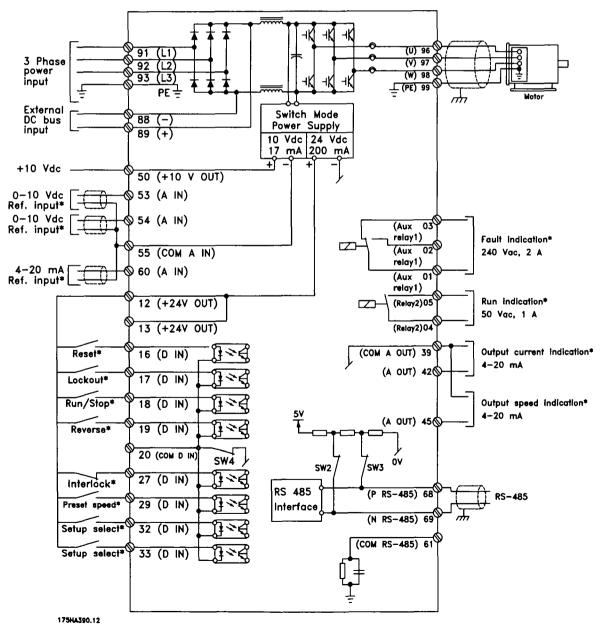
An external DC supply or a 12-pulse option can be connected to terminals 88 and 89. Please ask Danfoss for a Design Guide to learn more.

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

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

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

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

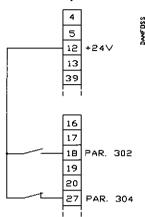


* These terminals can be programmed for other functions.

51

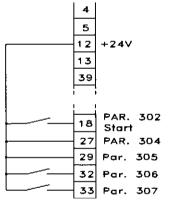


■ Connection examples Single-pole start/stop



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

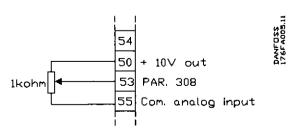
Digital speed up/down



- Speed up and down using terminals 32 and 33. Parameter 306 = Speed up [7]

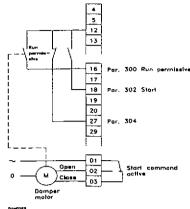
Parameter 307 = Speed down [7] Parameter 305 = Freeze reference [2]

Potentiometer reference



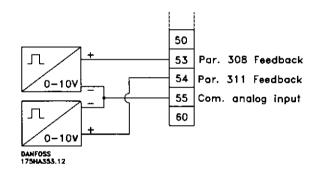
- Parameter 308 = Reference [1] Parameter 309 = Terminal 53, min. scaling Parameter 310 = Terminal 53, max. scaling

Run permissive



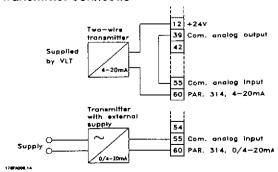
- Start permitted with terminal 16. Parameter 300 = Start enabled [8].
- Start/stop with terminal 18. Parameter 302 = Start [1].
- Quickstop with terminal 27. Parameter 304 = Coasting stop, inverse [0].
- Activated damper (motor) Parameter 323 = Start command active [13].

2-zone regulation



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

Transmitter connection



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



■ Control unit LCP

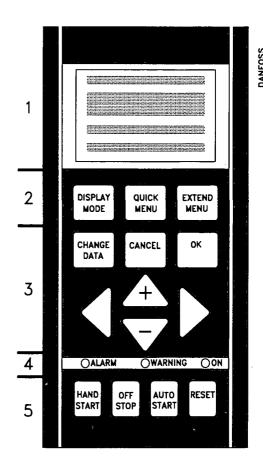
The front of the VLT frequency converter features a control panel - LCP (Local Control Panel). This is a complete interface for operation and programming of the VLT 6000 HVAC.

The control panel is detachable and can - as an alternative - be installed up to 3 metres away from the VLT frequency converter, e.g. on the front panel, by means of a mounting kit option.

The functions of the control panel can be divided into five groups:

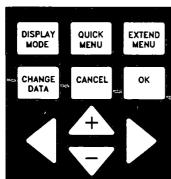
- 1. Display
- 2. Keys for changing display mode
- 3. Keys for changing program parameters
- 4. Indicator lamps
- 5. Keys for local operation.

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



■ Control keys for parameter Setup

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



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



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



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



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



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



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







[+/-] is used for selecting parameters and for changing a chosen parameter. These keys are also used to change the local reference.

In addition, the keys are used in Display mode to switch between operation variable readouts.



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

Indicator lamps

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

OAL	_ARM	O	WARNING	OOM
red	yell	ow	green	

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

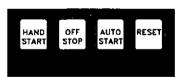


NB!

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

Local control

Underneath the indicator lamps are keys for local control.





[HAND START] is used if the VLT frequency converter is to be controlled via the control unit. The VLT frequency converter will start the motor, since a start command is given by means of [HAND START].

On the control terminals, the following control signals will still be active when [HAND START] is activated:

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



If parameter 201 Output frequency low limit fmin is set to an output frequency greater than 0 Hz. the motor will start and ramp up to this frequency when [HAND START] is activated.



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



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



NB!

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



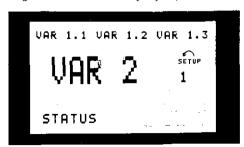
[RESET] is used for resetting the VLT frequency converter after an alarm (trip). Can be selected as Enable [1] or Disable [0] via parameter 015 Reset on LCP.

■ Display mode

In normal operation, any 4 different operating variables can be indicated continuously: 1.1 and 1.2 and 1.3 and 2. The present operating status or alarms and warnings that have arisen are shown in line 2 in the form of a number. In the case of alarms, the alarm in question will be shown in lines 3 and 4, accompanied by an explanatory note. Warnings will flash in line 2, with an explanatory note in line 1. In addition, the display shows the active Setup.

The arrow indicates the direction of rotation; here the VLT frequency converter has an active reversing signal. The arrow body disappears if a stop command is given or if the output frequency falls below 0.01 Hz. The bottom line gives the status of the VLT frequency converter. See next page.

The scroll list on the next page gives the operating data that can be shown for variable 2 in display mode. Changes are made via the [+/-] keys.





■ Display mode, cont.

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

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

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

· Status line:



The left part of the status line indicates the control element of the VLT frequency converter that is active.

AUTO means that control is via the control terminals, while HAND indicates that control is via the local keys on the control unit.

OFF means that the VLT frequency converter ignores all control commands and stops the motor.

The centre part of the status line indicates the reference element that is active. REMOTE means that the reference from the control terminals is active, while LOCAL indicates that the reference is determined via the [+/-] keys on the control panel.

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

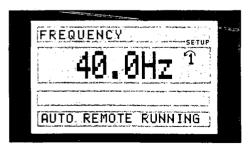
■ Display mode I:

VLT 6000 HVAC offers different display modes depending on the mode selected for the VLT frequency converter. The figure on the next page shows the way to navigate between different display modes.

Below is a display mode, in which the VLT frequency converter is in Auto mode with remote reference at an output frequency of 40 Hz.

In this display mode, reference and control are determined via the control terminals.

The text in line 1 gives the operating variable shown in line 2.



Line 2 gives the current output frequency and the active Setup.

Line 4 says that the VLT frequency converter is in Auto mode with remote reference, and that the motor is running.

■ Display mode II:

This display mode makes it possible to have three operating data values displayed at the same time in line 1

The operating data values are determined in parameters 007-010 *Display readout*.





■ Display mode III:

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



■ Display mode IV:

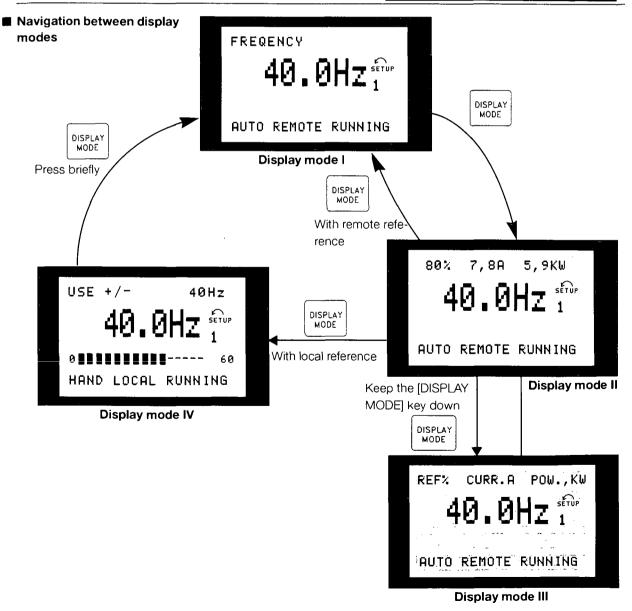
This display mode is only generated in connection with local reference, see also Reference handling. In this display mode, the reference is determined via the [+/-] keys and control is carried out by means of the keys underneath the indicator lamps.

The first line indicates the required reference.

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

graph.





MG.60.A7.02 - VLT is a registered Danfoss trade mark



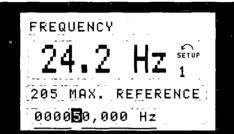
Changing data

Regardless of whether a parameter has been selected under the Quick menu or the Extend menu, the procedure for changing data is the same.

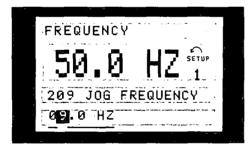
Pressing the [CHANGE DATA] key gives access to changing the selected parameter, following which the underlining in line 4 will flash on the display.

The procedure for changing data depends on whether the selected parameter represents a numerical data value or a functional value.

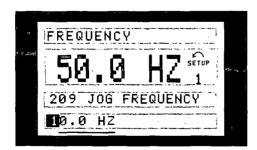
If the chosen parameter represents a numeric data value, the first digit can be changed by means of the [+/-] keys. If the second digit is to be changed, first move the cursor by using the [<>] keys, then change the data value using the [+/-] keys.



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



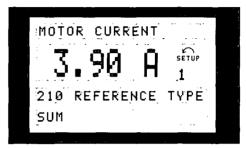
Then the chosen digit is changed infinitely variably by means of the [+/-] keys:



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

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

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



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

Changing of data value, step-by-step

Certain parameters can be changed both step by step and infinitely variably. This applies to *Motor power* (parameter 102), *Motor voltage* (parameter 103) and *Motor frequency* (parameter 104).

This means that the parameters are changed both as a group of numeric data values and as numeric data values infinitely variably.

Manual initialisation

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

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

parameter 500, Protocol

600, Operating hours

601, Hours run

602, kWh counter

603, Number of power-ups

604, Number of overtemperatures

605, Number of overvoltages

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



Quick Menu

The QUICK MENU key gives access to 12 of the most important setup parameters of the drive. After programming, the drive will, in many cases, be ready for operation. The 12 Quick Menu parameters are

shown in the table below. A complete description of the function is given in the parameter sections of this manual.

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

Parameter Data

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

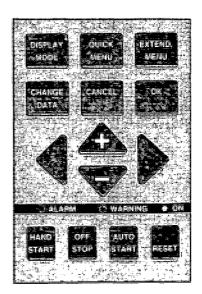
- 1. Press Quick Menu key.
- 2. Use '+' and '-' keys to find parameter you choose to edit.
- 3. Press Change Data key.
- 4. Use '+' and '-' keys to select correct parameter setting. To move to a different digit within parameter, use ◀and ▶arrows. Flashing cursor indicates digit selected to change.
-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

Example of Changing Parameter Data

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

- 1. Press Quick Menu key.
- 2. Press '+' key until you reach Parameter 206, Ramp Up Time.
- 3. Press Change Data key.
- 4. Press ◀ key twice hundreds digit will flash.
- 5. Press '+' key once to change hundreds digit to '1.'

- 6. Press ▶ key to change to tens digit.
- 7. Press '-' key until '6' counts down to '0' and setting for *Ramp Up Time* reads '100 s.'
- 8. Press OK key to enter new value into drive controller.



NB!

Programming of extended parameters functions available through EXTENDED MENU

key is done in accordance with same procedure as described for Quick Menu functions.



■ Programming



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

Operation and Display 000-017

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

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

State when delivered may vary from factory setting.

Function:

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

Description of choice:

There is a choice of the languages indicated.

■ The Setup configuration

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

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

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

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

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

002 Active Setup (ACTIVE SETUP)	
Value:	
Factory Setup (FACTORY SETUP)	[0]
★ Setup 1 (SETUP 1)	[1]
Setup 2 (SETUP 2)	[2]
Setup 3 (SETUP 3)	[3]
Setup 4 (SETUP 4)	[4]
MultiSetup (MULTI SETUP)	[5]

Function:

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

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

In addition, a pre-programmed Setup called the

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

Description of choice:

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

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

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

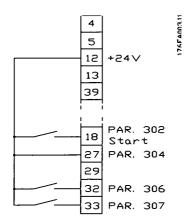


004 LCP copy (LCP COPY)

Download power-independent par.

(DOWNLOAD SIZE INDEP.)

Connection examples Setup change



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

003 Copying of Setups (SETUP COPY Value: ★ No copying (NO COPY) [0] Copy active Setup to Setup 1 (COPY TO SETUP 1) [1] Copy active Setup to Setup 2 (COPY TO SETUP 2) [2] Copy active Setup to Setup 3 (COPY TO SETUP 3) [3] Copy active Setup to Setup 4 (COPY TO SETUP 4) [4] Copy active Setup to all (COPY TO ALL) [5]

Function:

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



NB!

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

Description of choice:

The copying starts when the required copying function has been selected and the [OK] key has been pressed.

The display indicates when copying is in progress.

COT LOT COPY (LOT COT 1)	
Value:	
★ No copying (NO COPY)	[0]
Upload all parameters	
(UPLOAD ALL PARAMET.)	[1]
Download all parameters	
(DOWNLOAD ALL PARAM.)	[2]

[3]

Function:

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

Description of choice:

Select *Upload all parameters* [1] if all parameter values are to be transmitted to the control panel.

Select *Download all parameters* [2] if all transmitted parameter values are to be copied to the VLT frequency converter on which the control panel has been mounted.

Select Download power-independent par. [3] if only the power-independent parameters are to be downloaded. This is used if downloading to a VLT frequency converter that has a different rated power than the one from where the parameter Setup originates.



NB!

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

■ Setup of user-defined readout

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



005 Max. value of user-defined read	out
(CUSTOM READOUT)	
Value:	
0.01 - 999,999.99	★ 100.00

Function:

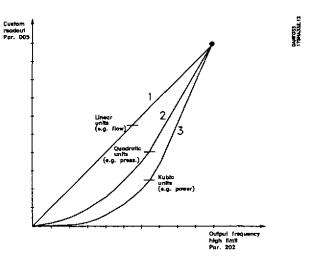
This parameter allows a choice of the max, value of the user-defined readout. The value is calculated on the basis of the present motor frequency and the unit selected in parameter 006 Unit for user-defined readout. The programmed value is reached when the output frequency in parameter 202 Output frequency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

Description of choice:

Set the required value for max, output frequency.

006 Unit for	user-defin	ed readout	
(CUST.	READ. UN	IT)	
Value:			
★ No unit ¹	[0]	GPM ¹	[21]
% ¹	[1]	gal/s ¹	[22]
rpm 1	[2]	gal/min 1	[23]
ppm 1	[3]	gal/h ¹	[24]
pulse/s ¹	[4]	lb/s 1	[25]
l/s ¹	[5]	lb/min 1	[26]
I/min 1	[6]	lb/h ¹	[27]
l/h ¹	[7]	CFM ¹	[28]
kg/s ¹	[8]	ft ³ /s ¹	[29]
kg/min ¹	[9]	ft³/min ¹	[30]
kg/h ¹	[10]	ft ³ /h ¹	[31]
m^3/s 1	[11]	ft³/min ¹	[32]
m³/min ¹	[12]	ft/s 1	[33]
m³/h ¹	[13]	in wg ²	[34]
m/s ¹	[14]	ft wg 2	[35]
mbar ²	[15]	PSI ²	[36]
bar ²	[16]	lb/in²	[37]
Pa ²	[17]	HP ³	[38]
kPa ²	[18]		
MWG ²	[19]		
kW ³	[20]		

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



Function:

Select a unit to be shown in the display in connection with parameter 005 Max. value of userdefined readout.

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

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

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

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

Description of choice:

Select the required unit for User-defined readout.

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



2]
3]
4}
5]
6]
7]
8]
9]
0]
1]
2]
3]
4]
5]
6]
7]
•
8]
, 9j

Function:

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

See the description of the control unit.

Description of choice:

No readout can only be selected in parameters 008-010 Small display readout.

Resulting reference [%] gives a percentage for the resulting reference in the range from Minimum reference, Ref_{MIN} to Maximum reference, Ref_{MAX}. See also reference handling.

Reference [unit] gives the resulting reference in Hz in Open loop. In Closed loop, the reference unit is selected in parameter 415 Process units.

Frequency [Hz] gives the output frequency from the VLT frequency converter.

% of maximum output frequency [%] is the present output frequency as a percentage value of parameter 202 Output frequency high limit, f_{MAX}. Motor current [A] states the phase current of the motor measured as effective value.

Power [kW] states the actual power consumed by the motor in kW.

Power [HP] states the actual power consumed by the motor in HP.

Output energy [kWh] states the energy consumed by the motor since the latest reset was made in parameter 618 Reset of kWh counter.

Hours run [Hours] states the number of hours that the motor has run since the latest reset in parameter 619 Reset of hours-run counter.

User-defined readout [-] is a user-defined value, calculated on the basis of the present output frequency and unit, as well as the scaling in parameter 005 Max. value of user-defined readout. Select unit in parameter 006 Unit for user-defined readout.

Setpoint 1 [unit] is the programmed setpoint value in parameter 418 Setpoint 1. The unit is decided in parameter 415 Process units. See also Feedback handling.

Setpoint 2 [unit] is the programmed setpoint value in parameter 419 Setpoint 2. The unit is decided in parameter 415 Process units.

Feedback 1 [unit] gives the signal value of the resulting feedback 1 (Term. 53). The unit is decided in parameter 415 Process units. See also Feedback handling.

Feedback 2 [unit] gives the signal value of the resulting feedback 2 (Term. 53). The unit is decided in parameter 415 Process units.

Feedback [unit] gives the resulting signal value using the unit/scaling selected in parameter 413 Minimum feedback, FB_{MIN}, 414 Maximum feedback, FB_{MAX} and 415 Process units.

Motor voltage [V] states the voltage supplied to the motor

DC link voltage [V] states the intermediate circuit voltage in the VLT frequency converter.

Thermal load, motor [%] states the calculated/ estimated thermal load on the motor. 100% is the cut-out limit. See also parameter 117 Motor thermal protection.

Thermal load, VLT [%] states the calculated/estimated thermal load on the VLT frequency converter. 100% is the cut-out limit.

Digital input [Binary code] states the signal status from the 8 digital inputs (16, 17, 18, 19, 27, 29, 32 and 33). Terminal 16 corresponds to the bit at the far left. '0' = no signal, '1' = connected signal.

Analogue input 53 [V] states the voltage value on terminal 53.

Analogue input 54 [V] states the voltage value on terminal 54.

Analogue input 60 [mA] states the voltage value on terminal 60.

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

Q-Pulse Id TM\$1102



Relay status [binary code] indicates the status of each relay. The left (most significant) bit indicates relay 1 followed by 2 and 6 through 9. A "1" indicates the relay is active, a "0" indicates inactive. Paramater 007 uses an 8-bit word with the last two positions not used. Relays 6-9 are provided with the cascade controller and four relay option cards Pulse reference [Hz] states a pulse frequency in Hz connected to terminal 17 or terminal 29.

External reference [%] gives the sum of the external references as a percentage (the sum of analogue/pulse/serial communication) in the range from Minimum reference, Ref_{MIN} to Maximum reference, Ref_{MAX}.

Heat sink temp. [°C] states the present heat sink temperature of the VLT frequency converter. The cut-out limit is 90 \pm 5°C; cutting back in occurs at 60 \pm 5°C.

Communication option card waming [Hex] gives a warning word if there is a fault on the communication bus. This is only active if communication options have been installed. Without communication options, 0 Hex is displayed. LCD display text shows the text programmed in parameter 533 Display text 1 and 534 Display text 2 via the serial communication port.

008 Small display readout 1.1 (SMALL READOUT 1)

Value:

See parameter 007 Large display readout

★ Reference [Unit]

• •

Function:

This parameter enables a choice of the first of three data values to be shown on the display, line 1, position 1.

This is a useful function, i.a. when setting the PID regulator, in order to see how the process reacts to a change of reference.

For display read-outs, press the [DISPLAY/STATUS] button. Data option *LCP display text* [27] cannot be selected with *Small display readout*.

Description of choice:

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

009 Small display readout 1.2 (SMALL READOUT 2)

Value:

See parameter 007 Large display readout

★ Motorcurrent [A]

[5]

Function:

See the functional description for parameter 008 Small display readout.

Description of choice:

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

010 Small display readout 1.3

(SMALL READOUT 3)

Value:

Se parameter 007 Large display readout

★ Power [kW]

[6]

Function:

See the functional description for parameter 008 Small data readout.

Description of choice:

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

011 Unit of local reference

(UNIT OF LOC REF)

Value:

[2]

★ Hz (HZ)

[0

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

Function:

This parameter decides the local reference unit.

Description of choice:

Choose the required unit for local reference.



*, ~° ₃
[0]
[1]

Function:

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

Description of choice:

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

013 OFF/STOP on LCP (STOP BUTTON)	
Value:	
Disable (DISABLE)	[0]
★ Enable (ENABLE)	[1]

Function:

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

Description of choice:

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



NB!

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

014 Auto start on LCP (AUTO START	BTTN)
Value	
Disable (DISABLE)	[0]
★ Enable (ENABLE)	[1]

Function:

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

Description of choice:

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

015	Reset	on LC	P (RE	SET B	υπο	N)		
Valu	e:		***************************************				3 2	
Disa	able (D	ISABL	Ξ)					[0]
★ Ena	able (El	NABLE)					[1]

Function:

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

Description of choice:

If Disable [0] is selected in this parameter, the [RESET] key will be inactive.



NB!

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

016 Lock for data change	, ,
(DATA CHANGE LOCK)	
Value:	
★ Not locked (NOT LOCKED)	[0]
Locked (LOCKED)	[1]

Function:

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

Description of choice:

If Locked [1] is selected, data modifications in the parameters cannot be made, although it will still be possible to carry out data modifications via the bus. Parameters 007-010 *Display readout* can be changed via the control panel.

It is also possible to lock for data modifications in these parameters by means of a digital input, see parameters 300-307 *Digital inputs*.

[1]



VLT® 6000 HVAC

017 Operating state at power up, local (POWER UP ACTION) control Value. ★ Auto restart (AUTO RESTART) [0] [1]

OFF/Stop (OFF/STOP)

Function:

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

Description of choice:

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

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

NB!

If [HAND START] or [AUTO START] cannot be activated by the keys on the control panel

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

■ Load and Motor 100-117



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

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

■ Configuration

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

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

100 Configuration (CONFIG. MODE)	
Value:	
★ Open loop (OPEN LOOP)	[0]
Closed Joon (CLOSED LOOP)	[1]

Function:

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

Description of choice:

If Open loop [0] is selected, normal speed control is obtained (without feedback signal), i.e. if the reference is changed, the motor speed will change. If Closed loop [1] is selected, the internal process regulator is activated to enable accurate regulation in relation to a given process signal.

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

101 Torque characteristics		
(VT CHARACT)		
Value:	 	
Automatic Energy Optimisation		
(AFO FUNCTION)	10	λl

Function:

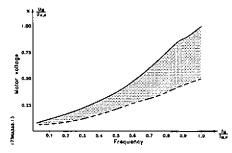
Parallel motors (MULTIPLE MOTORS)

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

Description of choice:

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

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



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



NB!

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

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

★ Depends on the unit

Function:

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

Description of choice:

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

103 Mo	tor voltage, U _{M.N}	
(Mc	OTOR VOLTAGE)	
Value:		
200 V		[200]
208 V		[208]
220 V		[220]
230 V		[230]
240 V		[240]
380 V		[380]
400 V		[400]
415 V		[415]
440 V		[440]
460 V		[460]
480 V		[480]
500 V		[500]
575 V		[575]

★ Depends on the unit

NOTE: 550 motor voltage must be manually programmed - pre-sets are not available.

Function:

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

Description of choice:

Select a value that equals the nameplate data on the motor, regardless of the mains voltage of the VLT frequency converter.

Furthermore, alternatively it is possible to set the value of the motor voltage <u>infinitely variable</u>, see also the procedure for *Infinitely variable change of numeric data value*.

NB!

Changing parameters 102, 103 or 104 will automatically reset parameters 105 and 106

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



104 Motor frequency, f_{M.N} (MOTOR FREQUENCY) Value: ★ 50 Hz (50 Hz) [50] 60 Hz (60 Hz) [60]

Function:

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

Description of choice:

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

Furthermore, it is also possible to set the value for motor frequency <u>infinitely variably</u> in the 24-1000 Hz range.

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

Value:

0.01 - I_{VLT,MAX} A

★Depends on the unit

Function:

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

Description of choice:

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



NB!

It is important to enter the correct value, since this forms part of the VVC+ control fea-

ture.

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

Value:

100 - f_{M,N} x 60 (max. 60000 rpm)

★ Depends on parameter 102 Motor power, P_{M.N}.

Function:

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

Description of choice:

Choose a value that corresponds to the motor nameplate data.



NB!

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

The max. value equals $f_{M,N} \times 60$.

 $f_{M,N}$ is set in parameter 104 Motor frequency, $f_{M,N}$.

107 Automatic motor adaptation, AMA

(AUTO MOTOR ADAPT)

Value:

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

Function:

Automatic motor adaptation is a test algorithm that measures the electrical motor parameters at motor standstill. This means that AMA itself does not supply any torque.

AMA is useful when commissioning systems, where the user wants to optimise the adjustment of the VLT frequency converter to the motor applied. This feature is used in particular where the factory setting does not adequately cover the motor in question.

For the best adjustment of the VLT frequency converter, it is recommended to carry out AMA on a cold motor.

It must be noted that repeated AMA runs may lead to a heating of the motor that will result in an increase of the stator resistance R_{S} . However, this is not normally critical.



NB!

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



It is possible via parameter 107 Automatic motor adaptation, AMA to choose whether a complete automatic motor adaptation Automatic adaptation [1] is to be carried out, or whether reduced automatic motor adaptation Automatic adaptation with LC-filter [2] is to be made.

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

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



68

NB!

AMA is not allowed on motors connected in parallel.

Description of choice:

Select Automatic adaptation [1] if the VLT frequency converter is to carry out a complete automatic motor adaptation.

Select Automatic adaptation with LC-filter [2] if a LC-filter has been placed between the VLT frequency converter and the motor.

Procedure for automatic motor adaptation:

- 1. Set the motor parameters in accordance with the motor nameplate data given in parameters 102-106 *Nameplate data*.
- 2. Connect 24 V DC (possibly from terminal 12) to terminal 27 on the control card.
- Select Automatic adaptation [1] or Automatic adaptation with LC-filter [2] in parameter 107 Automatic motor adaptation, AMA.

- Start up the VLT frequency converter or connect terminal 18 (start) to 24 V DC (possibly from terminal 12).
- After a normal sequence, the display reads:
 AMA STOP. After a reset, the VLT frequency converter will be ready to start operation again.

If the automatic motor adaptation is to be stopped:

1. Press the [OFF/STOP] key.

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

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

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

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

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

Value:

0.0 - parameter 103 Motor voltage, U_{M,N}

★ Depends on par. 103 Motor voltage, U_{MN}

Function:

This parameter specifies the start-up voltage of the permanent VT characteristics at 0 Hz for motors connected in parallel.

The start-up voltage represents a supplementary voltage input to the motor. By increasing the start-up voltage, motors connected in parallel receive a higher start-up torque. This is used especially for small motors (< 4.0 kW) connected in parallel, as they have a higher stator resistance than motors above 5.5 kW.

This function is only active if *Parallel motors* [1] has been selected in parameter 101 *Torque characteristics*.

Description of choice:

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

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109 Resonance damping (RESONANCE DAMP.) Value:

0 - 500 %

★100 %

Function:

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

Description of choice:

Adjust the damping percentage until the motor resonance has disappeared.

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

Value:

0.0 (OFF) - 0.5 sec.

* OFF

Function:

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

Description of choice:

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

111 Start delay (START DELAY)

Value:

0.0 - 120.0 sec.

★ 0.0 sec.

Function:

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

Description of choice:

Set the desired time until acceleration is to begin.

112 Motor preheater (MOTOR PREHEAT)

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

Function:

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

Description of choice:

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

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

Value:

0 - 100 %

★ 50 %

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

Function:

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

Description of choice:

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



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



■ DC braking

In DC braking, the motor receives a DC current that brings the shaft to a halt. Parameter 114 DC braking current, decides the DC braking current as a percentage of the rated motor current IMN.

In parameter 115 DC braking time, the DC braking time is selected, and in parameter 116 DC brake cut-in frequency, the frequency is selected at which DC braking becomes active.

If terminal 19 or 27 (parameter 303/304 Digital input) has been programmed to DC braking inverse and shifts from logic '1' to logic '0', the DC braking will be activated.

When the start signal on terminal 18 changes from logic '1' to logic '0', the DC braking will be activated when the output frequency becomes lower than the brake coupling frequency.

NB!

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

114 DC braking current (DC BRAKE CURRENT)

$$0 - \frac{I_{VLT,MAX}}{I_{M,N}} \times 100 \, [\%] \qquad \qquad \star 50 \, \%$$

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

Function: **

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

Description of choice:

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

Make sure not to supply too high abraking current for too long,

since otherwise the motor will be

damaged because of mechanical overload or the heat generated in the motor.

115 DC braking time

(DC BRAKE TIME)

0.0 - 60.0 sec.

★ OFF

Function:

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

Description of choice:

Set the desired time.

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

Value:

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

★ OFF

Function:

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

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Description of choice:

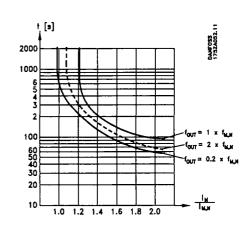
Set the desired frequency.

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

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117 Motor thermal protection	
(MOT. THERM PROTEC)	
Value:	
No protection (NO PROTECTION)	[0]
Thermistor warning (THERMISTOR WARNING)	[1]
Thermistor trip (THERMISTOR FAULT)	[2]
ETR Warning 1 (ETR WARNING 1)	[3]
★ETR Trip 1 (ETR TRIP 1)	[4]
ETR Warning 2 (ETR WARNING 2)	[5]
ETR Trip 2 (ETR TRIP 2)	[6]
ETR Warning 3 (ETR WARNING 3)	[7]
ETR Trip 3 (ETR TRIP 3)	[8]
ETR Warning 4 (ETR WARNING 4)	[9]
ETR Trip 4 (ETR TRIP 4)	[10]



Function:

The VLT frequency converter is able to monitor the motor temperature in two different ways:

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

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

Description of choice:

Select *No protection* [0] if no warning or tripping is required when the motor is overloaded.

Select *Thermistor warning* [1] if a warning is desired when the connected thermistor gets too hot.

Select *Thermistor trip* [2] if cutting out (trip) is desired when the connected thermistor overheats.

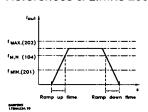
Select *ETR Warning* 1-4, if a warning is to come up on the display when the motor is overloaded according to the calculations.

The VLT frequency converter can also be programmed to give off a warning signal via one of the digital outputs.

Select ETR Trip 1-4 if tripping is desired when the motor is overloaded according to the calculations.



■ References & Limits 200 - 228



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

This parameter group also includes:

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

200 Output frequency range (FREQUENCY RANGE) Value:

★ 0 - 120 Hz (0 - 120 HZ)

[0]

0 - 1000 Hz (0 - 1000 HZ)

[1]

Function:

This is where to select the maximum output frequency range to be set in parameter 202 Output frequency high limit, f_{MAX} .

Description of choice:

Select the required output frequency range.

201 Output frequency low limit, f_{MIN} (MIN. FREQUENCY)

Value:

 $0.0 - f_{\text{MAX}}$

★ 0.0 Hz

Function:

This is where to select the minimum output frequency.

Description of choice:

A value from 0.0 Hz to the *Output frequency high limit*, f_{MAX} frequency set in parameter 202 can be selected.

202 Output frequency high limit, f_{MAX} (MAX. FREQUENCY)

Value:

f_{MIN} - 120/1000 Hz

(par. 200 Output frequency range)

★ 50 Hz

Function:

In this parameter, a maximum output frequency can be selected that corresponds to the highest speed at which the motor can be.

NB!
The output frequency of the VLT frequency converter can never assume a value higher than 1/10 of the switching frequency (parameter 407 Switching frequency).

Description of choice:

A value from f_{MIN} to the choice made in parameter 200 Output frequency range can be selected.



■ Reference handling

Reference handling is shown in the block diagram underneath.

The block diagram shows how a change in a parameter can affect the resulting reference.

Parameters 203 to 205 Reference handling, minimum and maximum reference and parameter 210 Reference type define the way reference handling can be carried out. The mentioned parameters are active both in a closed and in an open loop.

Remote references are defined as:

- External references, such as analogue inputs 53, 54 and 60, pulse reference via terminal 17/29 and reference from serial communication.
- Preset references.

The resulting reference can be shown in the display by selecting *Reference* [%] in parameters 007-010 *Display readout* and in the form of a unit by selecting *Resulting reference* [unit].

See the section on *Feedback handling* in connection with a closed loop.

The sum of the external references can be shown in the display as a percentage of the range from *Minimum reference*, Ref_{MIN} to *Maximum reference*, Ref_{MAX} . Select *External reference*, % [25] in parameters 007-010 *Display readout* if a readout is required.

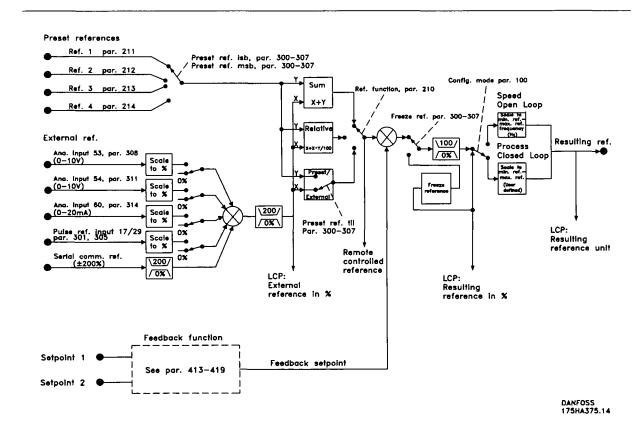
It is possible to have both preset references and external references at the same time. In parameter 210 *Reference type* a choice is made of how the preset references are to be added to the external references.

Furthermore, an independent local reference exists, where the resulting reference is set by means of the [+/-] keys. If local reference has been selected, the output frequency range is limited by parameter 201 Output frequency low limit, f_{MIN} and parameter 202 Output frequency high limit, f_{MAX} .

NB!

If the local reference is active, the VLT frequency converter will always be in Open loop [0], regardless of the choice made in parameter 100 Configuration.

The unit of the local reference can be set either as Hz or as a percentage of the output frequency range. The unit is selected in parameter 011 *Unit of local reference*.



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

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203 Reference site (REFERENCE SITE)

Value:

★ Hand/Auto linked reference
 (LINKED TO HAND/AUTO)) [0]
 Remote reference (REMOTE) [1]

Local reference (LOCAL) [2]

Function:

This parameter decides which resulting reference is to be active. If *Hand/Auto linked reference* [0] is selected, the resulting reference will depend on whether the VLT frequency converter is in Hand or Auto mode.

The table shows which references are active when Hand/Auto linked reference [0], Remote reference [1] or Local reference [2] has been selected. The Hand mode or Auto mode can be selected via the control keys or via a digital input, parameters 300-307 Digital inputs.

Reference handling	Hand mode	Auto mode
Hand/Auto [0]	Local ref. active	Remote ref. active
Remote [1]	Remote ref. active	Remote ref. active
Local [2]	Local ref. active	Local ref. active

Description of choice:

If Hand/Auto linked reference [0] is chosen, the motor speed in Hand mode will be decided by the local reference, while in Auto mode it depends on remote references and any setpoints selected. If Remote reference [1] is selected, the motor speed will depend on remote references, regardless of whether Hand mode or Auto mode has been chosen.

If Local reference [2] is selected, the motor speed will only depend on the local reference set via the control panel, regardless of whether Hand mode or Auto mode has been selected.

204 Minimum reference, Ref_{MIN}

(MIN. REFERENCE)

Value:

Parameter 100 Configuration = Open loop [0]. 0.000 - parameter 205 Ref_{MAX} ★ 0.000 Hz

Parameter 100 Configuration = Closed loop [1]. -Par. 413 Minimum feedback

- par. 205 *Ref_{MAX}* ★ 0.000

Function:

The Minimum reference gives the minimum value that can be assumed by the sum of all references. If Closed loop has been selected in parameter 100 Configuration, the minimum reference is limited by parameter 413 Minimum feedback.

Minimum reference is ignored when the local

reference is ignored when the local reference is active (parameter 203 Reference site). The unit for the reference can be seen from the following table:

Control of the contro	Unit
Par. 100 Configuration = Open loop	Hz
Par. 100 Configuration = Closed loop	Par. 415

Description of choice:

Minimum reference is set if the motor is to run at a minimum speed, regardless of whether the resulting reference is 0.

205 Maximum reference, Ref_{MAX} (MAX. REFERENCE)

Value:

Parameter 100 Configuration = Open loop [0]
Parameter 204 Ref_{MIN} - 1000.000 Hz★ 50.000 Hz

Parameter 100 Configuration = Closed loop [1] Par. 204 Ref_{MIN}

- par. 414 Maximum feedback ★ 50.000 Hz

Function:

The Maximum reference gives the maximum value that can be assumed by the sum of all references. If Closed loop [1] has been selected in parameter 100 Configuration, the maximum reference cannot be set above parameter 414 Maximum feedback. The Maximum reference is ignored when the local reference is active (parameter 203 Reference site).

[1]



VLT® 6000 HVAC

Function, cont.:

The reference unit can be determined on the basis of the following table:

	Unit
Par. 100 Configuration = Open loop	Hz
Par. 100 Configuration = Closed loop	Par. 415

Description of choice:

Maximum reference is set if the motor speed is not to exceed the set value, regardless of whether the resulting reference is higher than Maximum reference.

206 Ramp-up time (RAMP UP TIME)

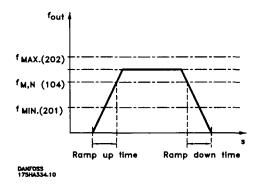
Value:

1 - 3600 sec.

★ Depends on the unit

Function:

The ramp-up time is the acceleration time from 0 Hz to the rated motor frequency $f_{M,N}$ (parameter 104 *Motor frequency, f_{M,N}*). It is assumed that the output current does not reach the current limit (set in parameter 215 *Current limit I_{LIM}*).



Description of choice:

Program the desired ramp-up time.

207 Ramp-down time (RAMP DOWN TIME)

Value:

1 - 3600 sec.

★ Depends on the unit

Function:

The ramp-down time is the deceleration time from the rated motor frequency $f_{M,N}$ (parameter 104 *Motor frequency*, $f_{M,N}$) to 0 Hz, provided there is no overvoltage in the inverter because of the motor acting as a generator.

Description of choice:

Program the desired ramp-down time.

208 Automatic ramp-down (AUTO RAMPING) Value: Disable (DISABLE) [0]

Function:

★ Enable (ENABLE)

This function ensures that the VLT frequency converter does not trip during deceleration if the ramp-down time set is too short. If, during deceleration, the VLT frequency converter registers that the intermediate circuit voltage is higher than the max. value (see *List of warnings and alarms*), the VLT frequency converter automatically extends the ramp-down time.

NB!

If the function is chosen as *Enable* [1], the ramp time may be considerably extended in re-

lation to the time set in parameter 207, Ramp-down time.

Description of choice:

Program this function as *Enable* [1] if the VLT frequency converter periodically trips during ramp-down. If a quick ramp-down time has been programmed that may lead to a trip under special conditions, the function can be set to *Enable* [1] to avoid trips.

209 Jog frequency (JOG FREQUENCY)

Value

Par. 201 Output frequency Low limit - par. 202

Output frequency high limit ★ 10.0 Hz

Function:

The jog frequency f_{JOS} is the fixed output frequency at which the VLT frequency converter is running when the jog function is activated.

Jog can be activated via the digital inputs.

Description of choice: Set the desired frequency.



■ Reference type

The example shows how the resulting reference is calculated when Preset references are used together with Sum and Relative in parameter 210, Reference type. See Calculation of resulting reference. See also the drawing in Reference handling.

The following parameters have been set:

Par. 204 Minimum reference:	10 Hz
Par. 205 Maximum reference:	50 Hz
Par. 211 Preset reference:	15%
Par. 308 Terminal 53, analogue input:	Reference [1]
Par. 309 Terminal 53, min. scaling:	0 V
Par. 310 Terminal 53, max. scaling:	10 V

When parameter 210 *Reference type* is set to Sum [0], one of the adjusted *Preset references* (par. 211-214) will be added to the external references as a percentage of the reference range. If terminal 53 is energized by an analogue input voltage of 4 V, the resulting reference will be as follows:

Par. 210 Reference type = Sum [0]

Par. 204 Minimum reference	= 10.0 Hz
Reference contribution at 4 V	= 16.0 Hz
Par. 211 Preset reference	= 6.0 Hz
Resulting reference	= 32 0 Hz

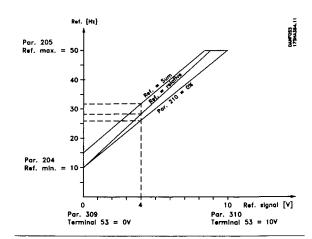
If parameter 210 Reference type is set to Relative [1], one of the adjusted Preset references (par. 211-214) will be totaled as a percentage of the sum of the present external references. If terminal 53 is energized by an analogue input voltage of 4 V, the resulting reference will be as follows:

Par. 210 Reference type = Relative [1]

Par. 204 Minimum reference	= 10.0 Hz
Reference contribution at 4 V	= 16.0 Hz
Par. 211 Preset reference	= 2.4 Hz
Resulting reference	= 28.4 Hz

The graph in the next column shows the resulting reference in relation to the external reference varied from 0-10 V.

Parameter 210 Reference type has been programmed for Sum [0] and Relative [1], respectively. In addition, a graph is shown in which parameter 211 Preset reference 1 is programmed for 0%.



210 Reference type	
(REF. FUNCTION)	
Value:	
★ Sum (SUM)	[0]
Relative (RELATIVE)	[1]
External/preset (EXTERNAL/PRESET)	[2]

Function:

It is possible to define how the preset references are to be added to the other references. For this purpose, *Sum* or *Relative* is used. It is also possible - by using the *External/preset* function - to select whether a shift between external references and preset references is wanted.

See Reference handling.

Description of choice:

If Sum [0] is selected, one of the adjusted preset references (parameters 211-214 Preset reference) is added to the other external references as a percentage of the reference range (Ref_{MIN}-Ref_{MAX}). If Relative [1] is selected, one of the adjusted preset references (parameters 211-214 Preset reference) is totaled as a percentage of the sum of the present external references.

If External/preset [2] is selected, it is possible to shift between external references and preset references via terminal 16, 17, 29, 32 or 33 (parameter 300, 301, 305, 306 or 307 Digital inputs). Preset references will be a percentage value of the reference range. External reference is the sum of the analogue references, pulse references and any references from serial communication.

NB!

If Sum or Relative is selected, one of the preset references will always be active. If the preset references are to be without influence, they should be

references are to be without influence, they should be set to 0% (as in the factory setting) via the serial communication port.



	1 (PRESET REF. 1)
Procet reterence	
I ICOCLICICION	

212 Preset reference 2 (PRESET REF. 2)

213 Preset reference 3 (PRESET REF. 3)

214 Preset reference 4 (PRESET REF. 4)

Value:

-100.00 % - +100.00 %

★ 0.00%

of the reference range/external reference

Function:

Four different preset references can be programmed in parameters 211-214 *Preset reference*. The preset reference is stated as a percentage value of the reference range (Ref_{MIN} - Ref_{MAX}) or as a percentage of the other external references, depending on the choice made in parameter 210 *Reference type*.

The choice between the preset references can be made by activating terminal 16, 17, 29, 32 or 33, cf. the table below.

Terminal 17/29/33	Terminal 16/29/32	
preset ref. msb	preset ref. Isb	
0	0	Preset ref. 1
0	1	Preset ref. 2
1	0	Preset ref. 3
1	1	Preset ref 4

Description of choice:

Set the required preset reference(s) that is/are to be the options.

215 Current limit, ILIM		
(CURRENT LIMIT)		
Value:		
0.1 - 1.1 x l _{VLT,N}	★ 1.1 x	I _{VLT,N} [A]

Function:

This is where the maximum output current I_{LIM} is set. The factory setting corresponds to the rated output current. Current limit should not be used for motor protection; parameter 117 is for motor protection. Current limit is for protection of the VLT frequency converter. If the current limit is set within the range of 1.0-1.1 x I_{NLTN} (the rated output current of the VLT frequency converter), the VLT frequency converter can only handle a load intermittently, i.e. for short periods at a time. After the load has been higher than I_{NLTN} , it must be ensured that for a period the load is lower than I_{NLTN} .

Please note that if the current limit is set to less than I_{NLTN} , the acceleration torque will be reduced correspondingly.

Description of choice:

Set the required maximum output current lum.

216 Frequency bypass, bandwidth (FREQUENCY BYPASS B.W.)

Value:

0 (OFF) - 100 Hz

★ Disable

Function:

Some systems call for some output frequencies to be avoided because of mechanical resonance problems.

The frequencies to avoid can be programmed in parameters 217-220 Frequency bypass. In this parameter (216 Frequency bypass, bandwidth), a definition can be given of a bandwidth around each of these frequencies.

Description of choice:

The bypass bandwidth is equal to the programmed bandwidth frequency. This bandwidth will be centered around each bypass frequency.

BYPASS FREQ. 1) requency bypass 2 BYPASS FREQ. 2)	3	*
		*
YPASS FREQ. 2)	are en	
requency bypass 3		
YPASS FREQ. 3)	-	
requency bypass 4	,	
YPASS FREQ. 4)		
	requency bypass 3 BYPASS FREQ. 3) requency bypass 4 BYPASS FREQ. 4)	3YPASS FREQ. 3) requency bypass 4

0 - 120/1000 Hz

★ 120.0 Hz

The frequency range depends on the selection made in parameter 200 *Output frequency range*.

Function:

Some systems call for some output frequencies to be avoided because of mechanical resonance problems in the system.

Description of choice:

Enter the frequencies to be avoided. See also parameter 216 Frequency bypass, bandwidth.



221 Warning: Low current, I_{LOW} (WARN, LOW CURR.)

Value:

0.0 - par. 222 Warning: High current, I_{HIGH}

★0.0A

Function:

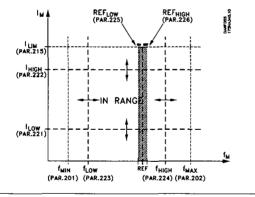
When the motor current is below the limit, I_{LOW}, programmed in this parameter, the display shows a flashing CURRENT LOW, provided *Warning* [1] has been selected in parameter 409 *Function in case of no load*. The VLT frequency converter will trip if parameter 409 *Function in case of no load* has been selected as *Trip* [0].

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.

The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

Description of choice:

The lower signal limit l_{LOW} must be programmed within the normal working range of the frequency converter.



222 Warning: High current, I_{HIGH} (WARN. HIGH CURR.)

Value:

Parameter 221 - IVILLMAX

★ I_{VLT,MAX}

Function:

If the motor current is above the limit, I_{HIGH} , programmed in this parameter, the display shows a flashing CURRENT HIGH.

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.

The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

Description of choice:

The upper signal limit of the motor frequency, f_{HiGH} , must be programmed within the normal working range of the frequency converter. See drawing at parameter 221 *Warning: Low current, I_{LOW}*.

223 Warning: Low frequency, f_{Low} (WARN. LOW FREQ.)

Value:

0.0 - parameter 224

★ 0.0 Hz

Function:

If the output frequency is below the limit, f_{LOW} , programmed in this parameter, the display will show a flashing FREQUENCY LOW.

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference. The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

Description of choice:

The lower signal limit of the motor frequency, f_{LOW} , must be programmed within the normal working range of the frequency converter. See drawing at parameter 221 *Warning: Low current*, I_{LOW} .



224 Warning: High frequency, f_{HIGH} (WARN. HIGH FREQ.)

Value:

Par. 200 *Output frequency range* = 0-120 Hz [0]. parameter 223 - 120 Hz ★ 120.0 Hz

Par. 200 *Output frequency range* = 0-1000 Hz [1]. parameter 223 - 1000 Hz ★ 120.0 Hz

Function:

If the output frequency is above the limit, f_{HIGH} , programmed in this parameter, the display will show a flashing FREQUENCY HIGH.

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference. The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

Description of choice:

The higher signal limit of the motor frequency, f_{HIGH} must be programmed within the normal working range of the frequency converter. See drawing at parameter 221 *Warning: Low current, I_{LOW}*.

225 Warning: Low reference, REF_{Low} (WARN. LOW REF.)

Value:

-999,999.999 - REF_{HIGH} (par.226) ★ -999,999.999

Function:

When the remote reference lies under the limit, Ref_{LOW}, programmed in this parameter, the display shows a flashing REFERENCE LOW.

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference. The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

The reference limits in parameter 226 *Warning: High reference, Ref_{High}*, and in parameter 227 *Warning: Low reference, Ref_{Low}*, are only active when remote reference has been selected.

In *Open loop mode* the unit for the reference is Hz, while in *Closed loop mode* the unit is programmed in parameter 415 *Process units*.

Description of choice:

The lower signal limit, Ref_{Low}, of the reference must be programmed within the normal working range of the frequency converter, provided parameter 100 *Configuration* has been programmed for *Open loop* [0]. In *Closed loop* [1] (parameter 100), Ref_{Low} must be within the reference range programmed in parameters 204 and 205.

226 Warning: High reference, REF_{HIGH} (WARN, HIGH REF.)

Value:

 REF_{Low} (par. 225) - 999,999.999 \star 99

***** 999,999.999

Function:

If the resulting reference lies under the limit, Ref_{HIGH}, programmed in this parameter, the display shows a flashing REFERENCE HIGH.

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.

The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

The reference limits in parameter 226 Warning: High reference, Ref_{HIGH}, and in parameter 227 Warning: Low reference, Ref_{Low}, are only active when remote reference has been selected.

In *Open loop* the unit for the reference is Hz, while in *Closed loop* the unit is programmed in parameter 415 *Process units*.

Description of choice:

The upper signal limit, Ref_{HIGH}, of the reference must be programmed within the normal working range of the frequency converter, provided parameter 100 *Configuration* has been programmed for *Open loop* [0]. In *Closed loop* [1] (parameter 100), Ref_{HIGH} must be within the reference range programmed in parameters 204 and 205.



227 Warning: Low feedback, FB_{Low} (WARN LOW FDBK)

Value:

-999,999.999 - FB_{ніGн} (parameter 228)

★ -999.999.999

Function:

If the feedback signal is below the limit, FB_{LOW}, programmed in this parameter, the display will show a flashing FEEDBACK LOW.

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.

The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

In *Closed loop*, the unit for the feedback is programmed in parameter 415 *Process units*.

Description of choice:

Set the required value within the feedback range (parameter 413 *Minimum feedback*, FB_{MIN} , and 414 *Maximum feedback*, FB_{MAX}).

228 Warning: High feedback, FB_{HIGH} (WARN, HIGH FDBK)

Value:

FB_{LOW} (parameter 227) - 999,999.999

999.999,999

Function:

If the feedback signal is above the limit, FB_{HIGH} , programmed in this parameter, the display will show a flashing FEEDBACK HIGH.

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.

The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

In *Closed loop*, the unit for the feedback is programmed in parameter 415 *Process units*.

Description of choice:

Set the required value within the feedback range (parameter 413 *Minimum feedback*, *FB_{MIN}*, and 414 *Maximum feedback*, *FB_{MAX}*).



■ Inputs and outputs 300-328

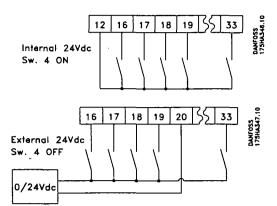


In this parameter group, the functions that relate to the input and output terminals of the VLT frequency converter are defined. The

digital inputs (terminals 16, 17, 18, 19, 27, 32 and 33) are programmed in parameters 300-307. The table below gives the options for programming the inputs. The digital inputs require a signal of 0 or 24 V DC. A signal lower than 5 V DC is a logic '0', while a signal higher than 10 V DC is a logic '1'.

The terminals for the digital inputs can be connected to the internal 24 V DC supply, or an external 24 V DC supply can be connected.

The drawings in the next column show one Setup using the internal 24 V DC supply and one Setup using an external 24 V DC supply.





Switch 4, which is located on the Dip switch control card, is used for separating the common potential of the internal 24 V DC supply from

the common potential of the external 24 V DC supply. See *Electrical installation*.

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

Digital inputs	terminal no.	16	17	18	19	27	29	32	33
	parameter	300	301	302	303	304	305	306	307
Value:							3		
					· , · · · · · · · · · · · · · · · · · ·				
No function	(NO OPERATION)	[O]	[0]	[0]	[0]	C C	[0]	★[0]	★[0]
Reset	(RESET)	★[1]	[1]		3.33	100	[1]	À[1] \(\)	[1]
Coasting stop, inverse	(COAST INVERSE)				13.74	★[0]		4	
Reset and coasting stop,	(RESET & COAST			2					
inverse	INVERSE)	ŝ,				-[1]	ille auto		5
Start	(START)			★ [1]		3.74			
Reversing	(REVERSE)		1500		★ [1]	2			
Reversing and start	(START REVERSE)	130			[2]		1		
DC-braking, inverse	(DC BRAKE INVERSE)	2 a 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3			[3]	[2]	1		180 E. L.
Safety interlock	(SAFETY INTERLOCK)	27.20	1. 45%	(3)	333	[-[3]			100,55
Freeze reference	(FREEZE REFERENCE)	-[2]	★[2]	1	0.5		[2]	₃ [2]	[2]
Freeze output	(FREEZE OUTPUT)	[3]	[3]	7.3	- 1	4.103	[3]	[3]	[3]
Selection of Setup, Isb	(SETUP SELECT LSB)	[4]				7.5	[4]	[4]	
Selection of Setup, msb	(SETUP SELECT MSB)	9.00	[4]	1			[5]	V.	[4]
Preset reference, on	(PRESET REF. ON)	[5]	[5]	4879		1.24	[6]	[5]	[5]
Preset reference, Isb	(PRESET REF. LSB)	[6]		946	* * *	# 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	[7]	[6]	
Preset reference, msb	(PRESET REF. MSB)		r: [6]			C. A	[8]		[6]
Speed down	(SPEED DOWN)	44,000	[7]	7.5			[9]		[7] L
Speed up	(SPEED UP)	[7]				1.5	[10]	[7]	
Run permissive	(RUN PERMISSIVE)	[8]	[8]			4.045	[11]	[8]	[8]
Jog	(JOG)	[9]	[9]	100			★ [12]	[9]	[9]
Data change lock	(PROGRAMMING LOCK)	[10]	[10]				[13]	[10]	[1.0]
Pulse reference	(PULSE REFERENCE)	175	[11]		32	100	[14]		
Pulse feedback	(PULSE FEEDBACK)		1.00		343	3. 35	18. A		[11]
Hand start	(HAND START)	[11]	[12]		10070	W. 51	[15]	[11]	[12]
Auto start	(AUTOSTART)	[12]	[13].			312.	[16]	[12]	8[13]



Function:

In parameters 300-307 *Digital inputs* it is possible to choose between the different possible functions related to the digital inputs (terminals 16-33). The functional options are given in the table on the previous page.

Description of choice:

No function is selected if the VLT frequency converter is not to react to signals transmitted to the terminal.

Reset resets the VLT frequency converter after an alarm; however, trip locked alarms cannot be reset by cycling mains power supply. See table in *List of warnings and alarms*. Reset will occur on the rising edge of the signal.

Coasting stop, inverse is used to force the VLT frequency converter to "release" the motor immediately (the output transistors are "turned off") to make it coast freely to stop. Logic '0' implements coasting to stop.

Reset and coasting stop, inverse is used for activating coasting stop at the same time as reset. Logic '0' implements coasting stop and reset. Reset will be activate on the falling edge of the signal.

DC braking, inverse is used for stopping the motor by energizing it with a DC voltage for a given time, see parameters 114-116 *DC brake*.

Please note that this function is only active if the value of parameters 114 *DC brake current* and 115 *DC braking time* is different from 0. Logic '0' implements DC braking. See *DC braking*.

Safety interlock has the same function as Coasting stop, inverse, but Safety interlock generates the alarm message 'external fault' on the display when terminal 27 is logic '0'. The alarm message will also be active via digital outputs 42/45 and relay outputs 1/2, if programmed for Safety interlock. The alarm can be reset using a digital input or the [OFF/STOP] key.

Start is selected if a start/stop command is required. Logic '1' = start, logic '0' = stop.

Reversing is used for changing the direction of rotation of the motor shaft. Logic '0' will not implement reversing. Logic '1' will implement reversing. The reversing signal only changes the direction of rotation; it does not activate the start function. Is not active together with *Closed loop*.

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Reversing and start is used for start/stop and reversing using the same signal.

A start signal via terminal 18 at the same time is not allowed.

Is not active together with Closed loop.

Freeze reference freezes the present reference. The frozen reference can now only be changed by means of *Speed up* or *Speed down*. The frozen reference is saved after a stop command and in case of mains failure.

Freeze output freezes the present output frequency (in Hz). The frozen output frequency can now only be changed by means of *Speed up* or *Speed down*.

NB!

If Freeze output is active, the VLT frequency converter cannot be stopped via terminal 18.

The VLT frequency converter can only be stopped when terminal 27 or terminal 19 has been programmed for *DC braking, inverse*.

Selection of Setup, Isb and Selection of Setup, msb enables a choice of one of the four Setups. However, this presupposes that parameter 002 Active Setup has been set at Multi Setup [5].

	Setup, msb	Setup, Isb	
Setup 1	0	0	
. Setup 2	0	1	
Setup 3	1	0	
Setup 4	1	1	

Preset reference, on is used for switching between remote reference and preset reference. This assumes that Remote/preset [2] has been selected in parameter 210 Reference type. Logic '0' = remote references active; logic '1' = one of the four preset references is active in accordance with the table below.

Preset reference, Isb and Preset reference, msb enables a choice of one of the four preset references, in accordance with the table below.

	Preset ref. msb	Preset ref. lsb
Preset ref. 1	0	0
Preset ref. 2	. 0	1
Preset ref. 3	1	0
Preset ref. 4	1	1



Speed up and Speed down are selected if digital control of the up/down speed is desired. This function is only active if Freeze reference or Freeze output has been selected.

As long as there is a logic '1' on the terminal selected for Speed up, the reference or the output frequency will increase by the Ramp-up time set in parameter 206.

As long as there is a logic '1' on the terminal selected for Speed down, the reference or the output frequency will increase by the Ramp-down time set in parameter 207.

Pulses (logic '1' minimum high for 3 ms and a minimum pause of 3 ms) will lead to a change of speed of 0.1% (reference) or 0.1 Hz (output frequency).

Example:

•	Terminal	Terminal	Freeze ref./
	(16)	(17)	Freeze output
No speed chang	e 0	0	1
Speed down	0	1	1
Speed up	1	0	1
Speed down	1	1	1

The speed reference frozen via the control panel can be changed even if the VLT frequency converter has stopped. In addition, the frozen reference will be rememberd in case of a mains failure.

Run permissive. There must be an active start signal via the terminal, where Run permissive has been programmed, before a start command can be accepted. Run permissive has a logic 'AND' function related to Start (terminal 18, parameter 302 Terminal 18, Digital input), which means that in order to start the motor, both conditions must be fulfilled. If Run permissive is programmed on several terminals, Run permissive must only be logic '1' on one of the terminals for the function to be carried out. See Example of application - Speed control of fan in ventilation system.

Jog is used to override the output frequency to the frequency set in parameter 209 Jog frequency and issue a start command. If local reference is active, the VLT frequency converter will always be in Open loop [0], regardless of the selection made in parameter 100 Configuration.

Jog is not active if a stop command has been given via terminal 27.

Data change lock is selected if data changes to parameters are not to be made via the control unit; however, it will still be possible to carry out data changes via the bus.

Pulse reference is selected if a pulse sequence (frequency) is selected as a reference signal. 0 Hz corresponds to Ref_{MIN}, parameter 204 *Minimum* reference, Ref_{MIN}.

The frequency set in parameter 327 Pulse reference, max. frequency corresponds to parameter 205 Maximum reference, Ref_{MAX}.

Pulse feedback is selected if a pulse sequence (frequency) is selected as a feedback signal. Parameter 328 Pulse feedback, max. frequency is where the maximum frequency for pulse feedback is set.

Hand start is selected if the VLT frequency converter is to be controlled by means of an external hand/off or H-O-A switch. A logic '1' (Hand start active) will mean that the VLT frequency converter starts the motor. A logic '0' means that the connected motor stops. The VLT frequency converter will then be in OFF/STOP mode, unless there is an active Auto start signal. See also the description in Local control.

NB!

An active Hand and Auto signal via the digital inputs will have higher priority than the [HAND START]-[AUTO START] control keys.

Auto start is selected if the VLT frequency converter is to be controlled via an external auto/off or H-O-A switch. A logic '1' will place the VLT frequency converter in auto mode allowing a start signal on the control terminals or the serial communication port. If Auto start and Hand start are active at the same time on the control terminals, Auto start will have the highest priority. If Auto start and Hand start are not active, the connected motor will stop and the VLT frequency converter will then be in OFF/STOP mode.



Analogue inputs

Two analogue inputs for voltage signals (terminals 53 and 54) are provided for reference and feedback signals. Furthermore, an analogue input is available for a current signal (terminal 60). A thermistor can be connected to voltage input 53 or 54.

The two analogue voltage inputs can be scaled in the range of 0-10 V DC; the current input in the range of 0-20 mA.

The table below gives the possibilities for programming the analogue inputs.

Parameter 317 *Time out* and 318 *Function after time out* allow activation of a time-out function on all analogue inputs. If the signal value of the reference or feedback signal connected to one of the analogue input terminals drops to below 50% of the minimum scaling, a function will be activated after the time out determined in parameter 318, *Function after time out*.

Analogue inputs	terminal no.	53(voltage)	54(voltage)	60(current)
	parameter	308	311	314
Value:				
No operation	(NO OPERATION)	[<u>0]</u>	[0] ★	<u>[0]</u>
Reference	(REFERENCE	[1]★		(1) ★
Feedback	(FEEDBACK)	[2]	[2]	[2]
Thermistor	(THERMISTOR)	[3]	[3]	

308—Terminal 53, analogue input voltage (AI [V] 53 FUNCT.) Function:

This parameter is used to select the required function to be linked to terminal 53.

Description of choice:

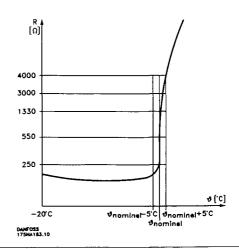
No operation. Is selected if the VLT frequency converter is not to react to signals connected to the terminal.

Reference. Is selected to enable change of reference by means of an analogue reference signal. If reference signals are connected to several inputs, these reference signals must be added up.

Feedback. If a feedback signal in connected, there is a choice of a voltage input (terminal 53 or 54) or a current input (terminal 60) as feedback. In the case of zone regulation, feedback signals must be selected as voltage inputs (terminals 53 and 54). See Feedback handling.

Thermistor. Is selected if a thermistor integrated in the motor is to be able to stop the VLT frequency converter in case of motor overtemperature. The cut-out value is 3 kohm.

If a motor features a Klixon thermal switch instead, this can also be connected to the input. If motors run in parallel, the thermistors/thermal switches can be connected in series (total resistance < 3 kohm). Parameter 117 *Motor thermal protection* must be programmed for *Thermal warning* [1] or *Thermistor trip* [2], and the thermistor must be inserted between terminal 53 or 54 (analogue voltage input) and terminal 50 (+10 V supply).



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

Active 10/12/2014



309 Terminal 53, min. scaling

(AI 53 SCALE LOW)

Value:

0.0 - 10.0 V

★ 0.0 V

Function

This parameter is used for setting the signal value that has to correspond to the minimum reference or the minimum feedback, parameter 204 *Minimum reference*, *Ref_{MIN}*/413 *Minimum feedback*, *FB_{MIN}*. See *Reference handling* or *Feedback handling*.

Description of choice:

Set the required voltage value.

For reasons of accuracy, voltage losses in long signal lines can be compensated for.

If the time-out function is to be applied (parameters 317 *Time out* and 318 *Function after time out*), the value must be set to > 1 V.

310 Terminal 53, max. scaling

(AI 53 SCALE HIGH)

Value: 🖔

0.0 - 10.0 V

★ 10.0 V

Function:

This parameter is used for setting the signal value that has to correspond to the maximum reference value or the maximum feedback, parameter 205 Maksimum reference, Ref_{MAX}/414 Maximum feedback, FB_{MAX}. See Reference handling or Feedback handling.

Description of choice:

Set the required voltage value.

For reasons of accuracy, voltage losses in long signal lines can be compensated for.

311 Terminal 54, analogue input voltage (AI [V] 54 FUNCT.)

Value:

See description of parameter 308. ★ No operation

Function:

This parameter chooses between the different functions available for the input, terminal 54. Scaling of the input signal is effected in parameter 312 *Terminal 54, min. scaling* and in parameter 313 *Terminal 54, max. scaling*.

Description of choice:

See description of parameter 308.

For reasons of accuracy, voltage losses in long signal lines should be compensated for.

312 Terminal 54, min. scaling

(AI 54 SCALE LOW)

Value:

0.0 - 10.0 V

★ 0.0 V

Function:

This parameter is used for setting the signal value that corresponds to the minimum reference value or the minimum feedback, parameter 204 *Minimum reference*, *Ref_{Min}*/413 *Minimum feedback*, *FB_{Min}*. See *Reference handling* or *Feedback handling*.

Description of choice:

Set the required voltage value.

For reasons of accuracy, voltage losses in long signal lines can be compensated for.

If the time-out function is to be applied (parameters 317 *Time out* and 318 *Function after time out*), the value must be set to > 1 V.

313 Terminal 54, max. scaling (AI 54 SCALE HIGH)

Value:

0.0 - 10.0 V

★ 10.0 V

Function:

This parameter is used for setting the signal value that corresponds to the maximum reference value or the maximum feedback, parameter 205 Maximum reference, Ref_{MAX}/414 Maximum feedback, FB_{MAX}. See Reference handling or Feedback handling.

Description of choice:

Set the required voltage value.

For reasons of accuracy, voltage losses in long signal lines can be compensated for.



314 Terminal 60, analogue input current

(AI [mA] 60 FUNCT.)

Value:

See description of parameter 308.

★ Reference

Function:

This parameter allows a choice between the different functions available for the input, terminal 60. Scaling of the input signal is effected in parameter 315 *Terminal 60, min. scaling* and in parameter 316 *Terminal 60, max. scaling*.

Description of choice:

See description of parameter 308 Terminal 53, analogue input voltage.

315 Terminal 60, min. scaling (AI 60 SCALE LOW)

Value:

0.0 - 20.0 mA

★ 4.0 mA

Function:

This parameter determines the signal value that corresponds to the minimum reference or the minimum feedback, parameter 204 *Minimum reference*, *Ref_{MIN}*/413 *Minimum feedback*, *FB_{MIN}*. See *Reference* handling or *Feedback* handling.

Description of choice:

Set the required current value.

If the time-out function is to be used (parameters 317 *Time out* and 318 *Function after time out*), the value must be set to > 2 mA.

316 Terminal 60, max. scaling

(AI 60 SCALE HIGH)

Value:

0.0 - 20.0 mA

★ 20.0 mA

Function:

This parameter determines the signal value that corresponds to the maximum reference value, parameter 205 *Maximum reference value, Ref_{MAX}*. See *Reference handling* or *Feedback handling*.

Description of choice:

Set the desired current value.

317 Time out

(LIVE ZERO TIME)

value:

1 - 99 sec.

★ 10 sec.

[0]

[1]

[2]

[3]

[4]

[5]

Function:

If the signal value of the reference or feedback signal connected to one of the input terminals 53, 54 or 60 drops to below 50% of the minimum scaling during a period longer than the preset time, the function selected in parameter 318 Function after time out will be activated.

This function will only be active if, in parameter 309 or 312, a value has been selected for *terminals 53* and 54, min. scaling that exceeds 1 V, or if, in parameter 315 *Terminal 60*, min. scaling, a value has been selected that exceeds 2 mA.

Description of choice:

Set the desired time.

318 Function after time out

(LIVE ZERO FUNCT.)

Value:

★ Off (NO FUNCTION)

Freeze output frequency

(FREEZE OUTPUT FREQ.)

Stop (STOP)

Jog (JOG FREQUENCY)

Max. output frequency (MAX FREQUENCY)

Stop and trip (STOP AND TRIP)

Function:

This is where to select the function to be activated after the end of the time-out period (parameter 317 *Time out*).

If a time-out function occurs at the same time as a bus time-out function (parameter 556 *Bus time interval function*), the time-out function in parameter 318 will be activated.

Description of choice:

The output frequency of the VLT frequency converter can be:

- frozen at the present value [1]
- overruled to stop [2]
- overruled to jog frequency [3]
- overruled to max. output frequency [4]
- overruled to stop with subsequent trip [5].



■ Analogue/digital outputs

The two analogue/digital outputs (terminals 42 and 45) can be programmed to show the present status or a process value such as $0 - f_{MAX}$.

If the VLT frequency converter is used as a digital output, it gives the present status by means of 0 or 24 V DC.

If the analogue output is used for giving a process value, there is a choice of three types of output signal:

0-20 mA, 4-20 mA or 0-32000 pulses (depending on the value set in parameter 322 *Terminal 45*, *output*, *pulse scaling*.

If the output is used as a voltage output (0-10 V), a pull-down resistor of 500 Ω should be fitted to terminal 39 (common for analogue/digital outputs). If the output is used as a current output, the resulting impedance of the connected equipment should not exceed 500 Ω .

Analogue/digital outputs terminal no.	42	45 .
parameter	319	321
Value:	8 80 20 4	4.5. Mar 2013
No function (NO FUNCTION)	[0]	[0]
Drive ready (UN. READY)	[1]	[1]
Standby (STAND BY)	[2]	[2]
Running (RUNNING)	[3]	[3]
Running at ref. value (RUNNING AT REFERENCE)	_[4]	[4]
Running, no warning (RUNNING NO WARNING)	[5]	[5]
Local reference active (DRIVE IN LOCAL REF.)	[6]	[6]
Remote references active (DRIVE IN REMOTE REF.)	[7]	[7]
Alarm (ALARM)	[8]	[8]
Alarm or warning (ALARM OR WARNING)	[9]	[9]
No alarm (NO ALARM)	[10]	[10]
Current limit (CURRENT LIMIT)	[11]	[11]
Safety interlock (SAFETY INTERLOCK)	[12]	[12]
Start command active (START SIGNAL APPLIED)	[13]	[13]
Reversing (RUNNING IN REVERSE)	[14]	[14]
Thermal warning (THERMAL WARNING)	[15]	[15]
Hand mode active (DRIVE IN HAND MODE)	[16]	[16]
Auto mode active (DRIVE IN AUTO MODE)	[17]	[17]
Sleep mode (SLEEP MODE)	[18]	[18]
Output frequency lower than f _{Low} parameter 223 (FOUT < F LOW)	[19]	[19]
Output frequency higher than f _{HIGH} parameter 223 (FOUT > F HIGH)	[20]	[20]
Out of frequency range (FREQ. RANGE WARN.)	[21]	[21]
Output current lower than I _{LOW} parameter 221 (I OUT < I LOW)	[22]	[22]
Output current higher than I _{HIGH} parameter 222 (I OUT > I HIGH)	[23]	[23]
Out of current range (CURRENT RANGE WARN)	[24]	[24]
Out of feedback range (FEEDBACK RANGE WARN.)	[25]	[25]
Out of reference range (REFERENCE RANGE WARN)	[26]	[26]
Relay 123 (RELAY 123)	[27]	[27]
Mains imbalance (MAINS IMBALANCE)	[28]	[28]
Output frequency, 0 - f _{MAX} ⇒ 0-20 mA (OUT. FREQ. 0-20 mA)	[29]	<u>* [29]</u>
Output frequency, 0 - f _{Max} ⇒ 4-20 mA (OUT. FREQ. 4-20 mA)	[30]	[30]
Output frequency (pulse sequence), 0 - f _{MAX} ⇒ 0-32000 p (OUT. FREQ. PULSE)	[31]	[31]
External reference, Ref _{MIN} - Ref _{MAX} ⇒ 0-20 mA (EXT. REF. 0-20 mA)	[32]	[32]
External reference, Ref _{MIN} - Ref _{MAX} ⇒ 4-20 mA (EXTERNAL REF. 4-20 mA)	[33]	[33]
External reference (pulse sequence), Ref _{MiN} - Ref _{Max} ⇒ 0-32000 p (EXTERNAL REF. PULSE)	[34]	[34]
Feedback, FB _{MIN} - FB _{MAX} ⇒ 0-20 mA (FEEDBACK 0-20 mA)	[35]	[35]
Feedback, FB _{MIN} - FB _{MAX} ⇒ 4-20 mA (FEEDBACK 4-20 mA)	[36]	[36]
Feedback (pulse sequence), FB _{MIN} - FB _{MAX} ⇒ 0 - 32000 p (FEEDBACK PULSE)	[37]	[37]
Output current, 0 - I _{MAX} ⇒ 0-20 mA (MOTOR CUR. 0- 20 mA)	★ [38]	[38]
Output current, 0 - I _{MAX} \Rightarrow 4-20 mA (MOTOR CUR. 4-20 mA)	[39]	[39]
Output current (pulse sequence), $0 - I_{MAX} \Rightarrow 0 - 32000 p$ (MOTOR CUR. PULSE) Output power, $0 - P_{NOM} \Rightarrow 0-20 \text{ mA}$ (MOTOR POWER 0-20 mA)	[40]	[40]
Output power, $0 - P_{NOM} \Rightarrow 0 - 20 \text{ m/A} \text{ (MOTOR POWER } 0 - 20 \text{ m/A})$	[41]	[41] [42]
	[42]	
Output power (pulse sequence), $0 - P_{NOM} \Rightarrow 0 - 32000 p$ (MOTOR POWER PULSE)	[43]	[43]

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

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Function:

This output can act both as a digital or an analogue output. If used as a digital output (data value [0]-[59]), a 0/24 V DC signal is transmitted; if used as an analogue output, either a 0-20 mA signal, a 4-20 mA signal or a pulse sequence of 0-32000 pulses is transmitted.

Description of choice:

No function. Selected if the VLT frequency converter is not to react to signals.

Drive ready. The VLT frequency converter control card receives a supply voltage and the frequency converter is ready for operation.

Stand by. The VLT frequency converter is ready for operation, but no start command has been given. No warning.

Running. A start command has been given.

Running at ref. value. Speed according to reference.

Running, no warning. A start command has been given. No warning.

Local reference active. The output is active when the motor is controlled by means of the local reference via the control unit.

Remote references active. The output is active when the VLT frequency converter is controlled by means of the remote references.

Alarm. The output is activated by an alarm.

Alarm or warning. The output is activated by an alarm or a warning.

No alarm. The output is active when there is no alarm.

Current limit. The output current is greater than the value programmed in parameter 215 *Current limit I*_{LIM}.

Safety interlock. The output is active when terminal 27 is a logic '1' and Safety interlock has been selected on the input.

Start command active. Is active when there is a start command or the output frequency is above 0.1 Hz.

Reversing. There is 24 V DC on the output when the motor rotates anti-clockwise. When the motor rotates clockwise, the value is 0 V DC.

Thermal warning. The temperature limit in either the motor, the VLT frequency converter or a thermistor connected to an analogue input has been exceeded.

Hand mode active. The output is active when the VLT frequency converter is in Hand mode.

Auto mode active. The output is active when the VLT frequency converter is in Auto mode.

Sleep mode. Active when the VLT frequency converter is in Sleep mode.

Output frequency lower than f_{LOW} . The output frequency is lower than the value set in parameter 223 Warning: Low frequency, f_{LOW} .

Output frequency higher than f_{HIGH} . The output frequency is higher than the value set in parameter 224 Warning: High frequency, f_{HIGH} .

Out of frequency range. The output frequency is outside the frequency range programmed in parameter 223 Warning: Low frequency, f_{LOW} and 224 Warning: High frequency, f_{HIGH} .

Output current lower than I_{LOW} . The output current is lower than the value set in parameter 221 Warning: Low current, I_{LOW} .

Output current higher than I_{HIGH}. The output current is higher than the value set in parameter 222 Warning: High current, I_{HIGH}.

Out of current range. The output current is outside the range programmed in parameter 221 Warning: Low current, I_{LOW} and 222 Warning, High current, I_{HIGH}.



Out of feedback range. The feedback signal is outside the range programmed in parameter 227 Warning: Low feedback, FB_{LOW} and 228 Warning: High feedback, FB_{HIGH}.

Out of reference range. The reference lies outside the range programmed in parameter 225 Warning: Low reference, Ref_{LOW} and 226 Warning, High reference, Ref_{HIGH}.

Relay 123. This function is only used when a profibus option card is installed.

Mains imbalance. This output is activated at too high mains imbalance or when a phase is missing in the mains supply. Check the mains voltage to the VLT frequency converter.

 $0-f_{MAX} \Rightarrow 0-20 \text{ mA}$ and $0-f_{MAX} \Rightarrow 4-20 \text{ mA}$ and

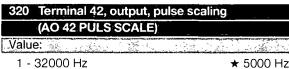
 $0-f_{MAX} \Rightarrow 0-32000 p$, which generates an output signal proportional to the output frequency in the interval 0 - f_{MAX} (parameter 202 Output frequency, high limit, f_{MAX}).

External Ref_{MIN} - Ref_{MAX} \Rightarrow 0-20 mA and External Ref_{MIN} - Ref_{MAX} ⇒ 4-20 mA and External Ref_{MIN} - Ref_{MAX} \Rightarrow 0-32000 p, which generates an output signal proportional to the resulting reference value in the interval Minimum reference, Ref_{MIN} - Maximum reference, Ref_{MAX} (parameters 204/205).

 FB_{MIN} - $FB_{MAX} \Rightarrow 0-20 \text{ mA}$ and FB_{MIN} - $FB_{MAX} \Rightarrow 4-20 \text{ mA}$ and

 $FB_{MIN}FB_{MAX} \Rightarrow 0-32000 p$, an output signal proportional to the reference value in the interval Minimum feedback, FB_{MIN} - Maximum feedback, FB_{MAX} (parameters 413/414) is obtained.

- $0 I_{VLT, MAX} \Rightarrow 0-20 \text{ mA}$ and
- $0 I_{VLT, MAX} \Rightarrow 4-20 \text{ mA}$ and
- $0 I_{VLT, MAX} \Rightarrow 0-32000 p$, an output signal proportional to the output current in the interval 0 - IVLT.MAX is obtained.
- $0 P_{NOM} \Rightarrow 0-20 \text{ mA}$ and
- $0 P_{NOM} \Rightarrow 4-20 \text{ mA}$ and
- $0 P_{NOM} \Rightarrow 0-32000 p$, which generates an output signal proportional to the present output power. 20 mA corresponds to the value set in parameter 102 Motor power, $P_{M,N}$.



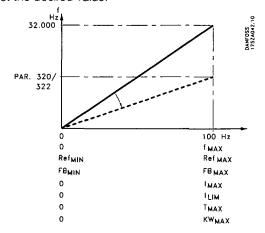
★ 5000 Hz

Function:

This parameter allows scaling of the pulse output signal.

Description of choice:

Set the desired value



321 Terminal 45, output (AO 45 FUNCTION)

See description of parameter 319 Terminal 42, Output.

Function:

This output can function both as a digital or an analogue output. When used as a digital output (data value [0]-[26]) it generates a 24 V (max. 40 mA) signal. For the analogue outputs (data value [27] - [41]) there is a choice of 0-20 mA, 4-20 mA or a pulse sequence.

Description of choice:

See description of parameter 319 Terminal 42, Output.

322 Terminal 45, output, pulse scaling			
(AO 45 PULS SCALE)			
Value:			
1 22000 47	- 5000 ⊔-		

1 - 32000 Hz

Function:

This parameter allows scaling of the pulse output signal.

Description of choice:

Set the desired value.

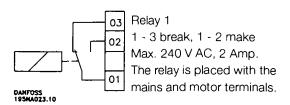
★ = factory setting. () = display text [] = value for use in communication via serial communication port

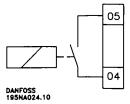
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■ Relay outputs

Relay outputs 1 and 2 can be used to give the present status or a warning.





Relay 2 4 - 5 make Max. 50 V AC, 1 A, 60 VA. Max. 75 V DC, 1 A, 30 W. The relay is placed on the control card, see Electrical installation, control cables.

Relay outputs Relay no.	1	2
parameter	323	326
Value		
No function (NO FUNCTION)	[0]	[0]
Ready signal (READY)	[1]	[1]
Standby (STAND BY)	[2]	[2]
Running (RUNNING)	[3]	★ [3]
Running at ref. value (RUNNING AT REFERENCE)	[4]	[4]
Running, no warning (RUNNING NO WARNING)	[5]	[5]
Local reference active (DRIVE IN LOCAL REF)	[6]	[6]
Remote references active (DRIVE IN REMOTE REF.)	[7]	[7]
Alarm (ALARM)	★ [8]	[8]
Alarm or warning (ALARM OR WARNING)	[9]	[9]
No alarm (NO ALARM)	[10]	[10]
Current limit (CURRENT LIMIT)	[11]	[11]
Safety interlock (SAFETY INTERLOCK)	[12]	[12]
Start command active (START SIGNAL APPLIED)	[13]	[13]
Reversing (RUNNING IN REVERSE)	[14]	[14]
Thermal warning (THERMAL WARNING)	[15]	[15]
Hand mode active (DRIVE IN HAND MODE)	[16]	[16]
Auto mode active (DRIVE IN AUTO MODE)	[17]	[17]
Sleep mode (SLEEP MODE)	[18]	[18]
Output frequency lower than f _{LOW} parameter 223 (F OUT < F LOW)	[19]	[19]
Output frequency higher than f _{HIGH} parameter 224 (F OUT > F HIGH)	[20]	[20]
Out of frequency range (FREQ RANGE WARN.)	[21]	[21]
Output current lower than I _{Low} parameter 221 (I OUT < I LOW)	[22]	[22]
Output current higher than I _{HIGH} parameter 222 (I OUT > I HIGH)	[23]	[23]
Out of current range (CURRENT RANGE WARN.)	[24]	[24]
Out of feedback range (FEEDBACK RANGE WARN.)	[25]	[25]
Out of reference range (REFERENCE RANGE WARN.)	[26]	[26]
Relay 123 (RELAY 123)	[27]	[27]
Mains imbalance (MAINS IMBALANCE)	[28]	[28]
Control word 11/12 (CONTROL WORD 11/12)	[29]	[29]

Description of choice:

See description of [0] - [28] in Analogue/digital outputs.

Control word bit 11/12, relay 1 and relay 2 can be activated via the serial communication. Bit 11 activates relay 1 and bit 12 activates relay 2.

If the parameter 556 Bus time interval function becomes active, relay 1 and relay 2 will become cut off if they are activated via the serial communication. See paragraph Serial communication in the Design Guide.

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

Q-Pulse Id TMS1102



323 Relay 1, output function

(RELAY1 FUNCTION)

Function:

This output activates a relay switch.

Relay switch 01 can be used for bringing status and warnings. The relay is activated when the conditions for the relevant data values have been fulfilled. Activation/deactivation can be programmed in parameter 324 *Relay 1, ON delay* and parameter 325 *Relay 1, OFF delay*.

See General technical data.

Description of choice:

See data choice and connections in Relay outputs.

324 Relay 01, ON delay (RELAY1 ON DELAY)

Value:

0 - 600 sec.

★ 0 sec.

Function:

This parameter allows a delay of the cut-in time of relay 1 (terminals 1-2).

Description of choice:

Enter the desired value.

325 Relay 01, OFF delay

(RELAY1 OFF DELAY)

Value: 0 - 600 sec.

★ 0 sec.

Function:

This parameter makes it possible to delay the cut-out time of relay 01 (terminals 1-2).

Description of choice:

Enter the desired value.

326 Relay 2, output function

(RELAY2 FUNCTION)

Value:

See functions of relay 2 on previous page.

Function:

This output activates a relay switch.

Relay switch 2 can be used for bringing status and warnings. The relay is activated when the conditions for the relevant data values have been fulfilled. See *General technical data*.

Description of choice:

See data choice and connections in Relay outputs.

327 Pulse reference, max. frequency (PULSE REF. MAX)

Value:

100 - 65000 Hz at terminal 29

★ 5000 Hz

100 - 5000 Hz at terminal 17

Function:

This parameter is used to set the pulse value that must correspond to the maximum reference, parameter 205 *Maximum reference*, *Ref_{MAX}*.

The pulse reference signal can be connected via terminal 17 or 29.

Description of choice:

Set the required maximum pulse reference.

328 Pulse feedback, max. frequency (PULSE FDBK MAX.)

Value:

100 - 65000 Hz at terminal 33

★ 25000 Hz

Function:

This is where the pulse value that must correspond to the maximum feedback value is set. The pulse fedback signal is connected via terminal 33.

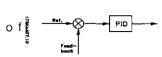
Description of choice:

Set the desired feedback value.



■ Application functions 400-427

1 n



this parameter group, the special functions the VLT frequency converter are set up, e.g. PID regulation,

setting of the feedback range and the Setup of the Sleep mode function.

Additionally, this parameter group includes:

- Reset function.
- Flying start.
- Option of interference reduction method.
- Setup of any function upon loss of load, e.g. because of a damaged V-belt.
- Setting of switching frequency.
- Selection of process units:

400 Reset function (RESET FUNCTION)

\star	Manual reset (MANUAL RESET)
	Automatic reset x 1 (AUTOMATIC X 1)
	Automatic reset x 2 (AUTOMATIC X 2)

Automatic reset x 2 (AUTOMATIC X 2) [2]
Automatic reset x 3 (AUTOMATIC X 3) [3]
Automatic reset x 4 (AUTOMATIC X 4) [4]
Automatic reset x 5 (AUTOMATIC X 5) [5]

Automatic reset x 10 (AUTOMATIC X 10) [6]
Automatic reset x 15 (AUTOMATIC X 15) [7]

Automatic reset x 20 (AUTOMATIC X 20) [8] Infinite automatic reset (INFINITE AUTOMATIC) [9]

Function:

This parameter allows a choice of whether to reset and restart manually after a trip, or whether the VLT frequency converter is to be reset and restarted automatically. In addition, there is a choice of the number of times the unit is to attempt a restart. The time between each reset attempt is set in parameter 401, *Automatic restart time*.

Description of choice:

If Manual reset [0] is selected, resetting must be effected via the "Reset" key or via a digital input. If the VLT frequency converter is to carry out an automatic reset and restart after a trip, select data value [1]-[9].



The motor may start without warning.

VLT® 6000 HVAC

401 Automatic restart time (AUTORESTART TIME)

Value:

0 - 600 sec.

★ 10 sec.

Function:

This parameter allows setting of the time from tripping until the automatic reset function begins. It is assumed that automatic reset has been selected in parameter 400 Reset function.

Description of choice:

Set the desired time.

402 Flying start

(FLYING START)

Value:
Disable (DISABLE)

Disable (DISABLE) [0]

★ Enable (ENABLE) [1]

DC brake and start (DC BRAKE AND START)

Function:

[0]

[1]

This function makes it possible for the VLT frequency converter to 'catch' a spinning motor, which - e.g. because of a mains failure - is no longer controlled by the VLT frequency converter.

This function is activated whenever a start command is active.

For the VLT frequency converter to be able to catch the spinning motor, the motor speed must be lower than the frequency that corresponds to the frequency in parameter 202 *Output frequency high limit*, f_{MAX} .

Description of choice:

Select *Disable* [0] if this function is not required. Select *Enable* [1] if the VLT frequency converter is to be able to 'catch' and control a spinning motor. Select *DC brake and start* [2] if the VLT frequency converter is to brake the motor by means of the DC brake first, and then start. It is assumed that parameters 114-116 *DC braking* are enabled. In the case of a substantial 'windmilling' effect (spinning motor), the VLT frequency converter is not able to 'catch' a spinning motor unless *DC brake and start* has been selected.



When parameter 402, Flying Start, is enabled, motor may turn in forward and backward directions a few revolutions

even with no speed reference applied.



Sleep mode

Sleep mode makes it possible to stop the motor when it is running at low speed and thus has almost no load. If consumption in the system goes back up, the VLT frequency converter will start the motor and supply the power required.



NB!

Energy can be saved with this function, since the motor is only in operation when the system it

Sleep mode is not active if *Local reference* or *Jog* has been selected

The function is active in both *Open loop* and *Closed loop*.

In parameter 403 Sleep mode timer, the Sleep mode is activated. In parameter 403 Sleep mode timer, a timer is set that determines for how long the output frequency can be lower than the frequency set in parameter 404 Sleep frequency. When the timer runs out, the VLT frequency converter will ramp down the motor to stop via parameter 207 Ramp-down time. If the output frequency rises above the frequency set in parameter 404 Sleep frequency, the timer is reset.

While the VLT frequency converter has stopped the motor in sleep mode, a theoretical output frequency is calculated on the basis of the reference signal. When the theoretical output frequency rises above the frequency in parameter 405 *Wake up frequency*, the VLT frequency converter will restart the motor and the output frequency will ramp up to the reference.

In systems with constant pressure regulation, it is advantageous to provide extra pressure to the system before the VLT frequency converter stops the motor. This extends the time during which the VLT frequency converter has stopped the motor and helps to avoid frequent starting and stopping of the motor, e.g. in the case of system leaks.

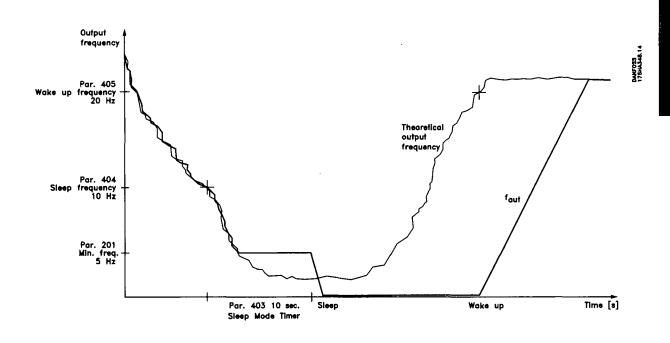
If 25% more pressure is required before the VLT frequency converter stops the motor, parameter 406 *Boost setpoint* is set to 125%.

Parameter 406 Boost setpoint is only active in Closed loop.



NB!

In highly dynamic pumping processes, it is recommended to switch off the *Flying Start* function (parameter 402).



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

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403 Sleep mode timer

(SLEEP MODE TIMER)

Value:

0 - 300 sec. (301 sec. = OFF)

★ OFF

Function:

This parameter enables the VLT frequency converter to stop the motor if the load on the motor is minimal. The timer in parameter 403 Sleep mode timer starts when the output frequency drops below the frequency set in parameter 404 Sleep frequency.

When the time set in the timer has expired, the VLT frequency converter will turn off the motor.

The VLT frequency converter will restart the motor, when the theoretical output frequency exceeds the frequency in parameter 405 Wake up frequency.

Description of choice:

Select OFF if this function is not wanted. Set the threshold value that is to activate Sleep mode after the output frequency has fallen below parameter 404 Sleep frequency.

404 Sleep frequency (SLEEP FREQUENCY)

Value.

000,0 - par. 405 Wake up frequency

★ 0.0 Hz

Function:

When the output frequency falls below the preset value, the timer will start the time count set in parameter 403 Sleep mode. The present output frequency will follow the theoretical output frequency until f_{MIN} is reached.

Description of choice:

Set the required frequency.

405 Wake up frequency (WAKEUP FREQUENCY)

Par 404 Sleep frequency - par. 202 f_{MAX}

★ 50 Hz

Function:

When the theoretical output frequency exceeds the preset value, the VLT frequency converter restarts the motor.

Description of choice:

Set the required frequency.

406 Boost setpoint (BOOST SETPOINT)

Value:

0 - 200 %

★ 100 % of setpoint

Function:

This function can only be used if Closed loop has been selected in parameter 100.

In systems with constant pressure regulation, it is advantageous to increase the pressure in the system before the VLT frequency converter stops the motor. This extends the time during which the VLT frequency converter stops the motor and helps to avoid frequent starting and stopping of the motor, e.g. in the case of leaks in the water supply system.

Description of choice:

Set the required Boost setpoint as a percentage of the resulting reference under normal operation. 100% corresponds to the reference without boost (supplement).

407 Switching frequency (SWITCHING FREQ.)

Value:

Depends on the size of the unit.

Function:

- The preset value determines the switching frequency of the inverter, provided Fixed switching frequency [1] has been selected in parameter 408 Interference reduction method. If the switching frequency is changed, this may help to minimise possible acoustic noise from the motor.

NB!

The output frequency of the VLT frequency converter can never assume a value higher

than 1/10 of the switching frequency.

Description of choice:

When the motor is running, the switching frequency is adjusted in parameter 407 Switching frequency, until the frequency has been achieved at which the motor is as quiet as possible.

NB!

Switching frequencies higher than 4.5 kHz implement automatic derating of the maximum

output of the VLT frequency converter. See Derating of high switching frequency in this manual.



408 Interference reduction method	
(NOISE REDUCTION)	
Value:	
★ ASFM (ASFM)	[0]
Fixed switching frequency	
(FIXED SWITCHING FREQ.)	[1]
LC filter fitted (LC-FILTER CONNECTED)	[2]

Function:

Used to select different methods for reducing the amount of acoustic interference from the motor.

Description of choice:

ASFM [0] guarantees that the maximum switching frequency, determined by parameter 407, is used at all times without derating of the VLT frequency converter. This is done by monitoring the load. Fixed switching frequency [1] makes it possible to set a fixed high/low switching frequency. This can generate the best result, as the switching frequency can be set to lie outside the motor interference or in a less irritating area. The switching frequency is adjusted in parameter 407 Switching frequency. LCfilter fitted [2] is to be used if an LC-filter is fitted between the VLT frequency converter and the motor, as the VLT frequency converter will otherwise not be able to protect the LC-filter.

409 Function in case of no load		
(FUNCT. LOW CURR.)	. *	
Value:		
Trip (TRIP)		[0]
★ Warning (WARNING)		[1]

Function:

This parameter can be used e.g. for monitoring the V-belt of a fan to make sure it has not snapped. This function is activated when the output current goes below parameter 221 Warning: Low current.

Description of choice:

In the case of a Trip [1], the VLT frequency converter will stop the motor.

If Warning [2] is selected, the VLT frequency converter will give a warning if the output current drops below the threshold value in parameter 221 Warning: Low current, ILOW.

410 Function at mains failure	
(MAINS FAILURE)	
Value:	
★Trip (TRIP)	[0]
Autoderate & warning	
(AUTODERATE & WARNING)	[1]
Warning (WARNING)	[2]

Function:

Select the function which is to be activated if the mains imbalance becomes too high or if a phase is missing.

Description:

At Trip [0] the VLT frequency converter will stop the motor within a few seconds (depending on drive size).

If Autoderate & warning [1] is selected, the drive will export a warning and reduce the output current to 30 % of I_{VLTN} to maintain operation.

At Warning [2] only a warning will be exported when a mains failure occurs, but in severe cases, other extreme conditions might result in a trip.

NB!

If Warning has been selected, the life expectancy of the drive will be reduced when the mains failure persists.

NB!

At phase loss the cooling fans of IP 54 drives cannot be powered and the VLT might trip on overheating. This applies to drive types VLT 6042-6062, 200-240 V and 6075-6550, 380-460 V.

411 Function at overtemperature (FUNCT. OVERTEMP) Value: ★Trip (TRIP) [0] Autoderate & warning (AUTODERATE & WARNING) [1]

Function:

Select the function which is to be activated when the VLT is exposed to an overtemperature condition.

Description:

At Trip [0] the VLT frequency converter will stop the motor and export an alarm.

At Autoderate & warning [1] the VLT will first reduce the switching frequency to minimize internal losses. If the overtemperature condition persists, the VLT will reduce the output current until the heat sink temperature stabilizes. When the function is active, a warning will be exported.

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

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412 Trip delay overcurrent, I_{LIM} (OVERLOAD DELAY) Value:

0 - 60 sec. (61=OFF)

★ 60 sec.

Function:

When the frequency converter registers that the output current has reached the current limit I_{LIM} (parameter 215 *Current limit*) and stays there for the duration selected, a cut-out will be performed.

Description of choice:

Select for how long the frequency converter is to be able to keep up with the output current at the current limit I_{LIM} before it cuts out.

In OFF mode, parameter 412 *Trip delay overcurrent,* I_{LM} is inactive, i.e. cut-outs are not performed.

■ Feedback signals in open loop

Normally, feedback signals and thus feedback parameters are only used in *Closed loop* operation; in VLT 6000 HVAC units, however, the feedback parameters are also active in *Open loop* operation. In *Open loop mode*, the feedback parameters can be used to show a process value in the display. If the present temperature is to be displayed, the temperature range can be scaled in parameters 413/414 *Minimum/Maximum feedback*, and the unit (°C, °F) in parameter 415 *Process units*.

413 Minimum feedback, FB _{MIN}	
(MIN. FEEDBACK)	
Value:	
-999,999.999 - FB _{MAX}	★ 0.000

Function:

Parameters 413 *Minimum feedback, FB_{MIN}* and 414 *Maximum feedback, FB_{MAX}* are used to scale the display indication, thereby ensuring that it shows the feedback signal in a process unit proportionally to the signal at the input.

Description of choice:

Set the value to be shown on the display at minimum feedback signal value (par. 309, 312, 315 *Min. scaling*) on the selected feedback input (parameters 308/311/314 *Analogue inputs*).

414	Maximum feedback,	FB _{MAX}	
	(MAX. FEEDBACK)		
Valu	e:		
FB	мы - 999.999.999	*	100.000

Function:

See the description of par. 413 *Minimum feedback*, FB_{MIN} .

Description of choice:

Set the value to be shown on the display when maximum feedback (par. 310, 313, 316 *Max. scaling*) has been achieved at the selected feedback input (parameters 308/311/314 *Analogue inputs*).

415 Units relating to closed loop				
	DBK. UNIT)		
Value:				
No unit	[0]	°C	[21]	
★%	[1]	GPM	[22]	
rpm	[2]	gal/s	[23]	
ppm	[3]	gal/min	[24]	
pulse/s	[4]	gal/h	[25]	
I/s	[5]	lb/s	[26]	
I/min	[6]	lb/min	[27]	
I/h	[7]	lb/h	[28]	
kg/s	[8]	CFM	[29]	
kg/min	[9]	ft ³ /s	[30]	
kg/h	[10]	ft³/min	[31]	
m³/s	[11]	ft³/h	[32]	
m³/min	[12]	ft/s	[33]	
m³/h	[13]	in wg	[34]	
m/s	[14]	ft wg	[35]	
mbar	[15]	PSI	[36]	
bar	[16]	lb/in²	[37]	
Pa	[17]	HP	[38]	
kPa	[18]	°F	[39]	
mVS	[19]			
kW	[20]			

Function:

Selection of unit to be shown on the display. This unit will be used if *Reference [unit]* [2] or *Feedback [unit]* [3] has been selected in one of the parameters 007-010, as well as in the Display mode. In *Closed loop*, the unit is also used as a unit for *Minimum/Maximum reference* and *Minimum/Maximum feedback*, as well as *Setpoint 1* and *Setpoint 2*.

Description of choice:

Select the required unit for the reference/feedback signal.



■ PID for process control

The PID controller maintains a constant process condition (pressure, temperature, flow, etc.) and adjusts motor speed on the basis of a reference/setpoint and the feedback signal.

A transmitter supplies the PID controller with a feedback signal from the process to indicate its actual state. The feedback signal varies with the process load

This means that deviations occur between the reference/setpoint and the actual process state. Such deviations are evened out by the PID regulator, in that it regulates the output frequency up or down in relation to the deviation between the reference/setpoint and the feedback signal.

The integral PID regulator in VLT 6000 HVAC units has been optimised for use in HVAC applications. This means that a number of specialised functions are available in VLT 6000 HVAC units.

Formerly, it was necessary to get a BMS (Building Management System) to handle these special functions by installing extra I/O modules and by programming the system.

Using the VLT 6000 HVAC, there is no need for extra modules to be installed. For example, only one required reference/setpoint and the handling of feedback need to be programmed.

There is in-built a option for connecting two feedback signals to the system, making two-zone regulation possible.

Correction for voltage losses in long signal cables can be carried out when using a transmitter with a voltage output. This is done in parameter group 300 *Min./ Max. scaling*.

Feedback

The feedback signal must be connected to a terminal on the VLT frequency converter. Use the list below to decide which terminal to use and which parameters to program.

Feedback type	<u>Terminal</u>	<u>Parameters</u>
Pulse	33	307
Voltage	53, 54	308, 309, 310 or
		311, 312, 313
Current	60	314, 315, 316
Bus feedback 1	68+69	535
Bus feedback 2	68+69	536

Please note that the feedback value in parameter 535/536 Bus feedback 1 and 2 can only be set via serial communication (not via the control unit).

Furthermore, the minimum and maximum feedback (parameters 413 and 414) must be set to a value in the process unit that corresponds to the minimum and maximum scaling value for signals connected to the terminal. The process unit is selected in parameter 415 *Process units*.

Reference

In parameter 205 Maximum reference, Ref_{MAX}, a maximum reference that scales the sum of all references, i.e. the resulting reference, can be set. The *minimum reference* in parameter 204 indicates the smallest value that the resulting reference can assume.

The reference range cannot exceed the feedback range.

If *Preset references* are required, set these in parameters 211 to 214 *Preset reference*. See *Reference type*.

See also Reference handling.

If a current signal is used as a feedback signal, voltage can be used as analogue reference. Use the list below to decide which terminal to use and which parameters to program.

Reference type	<u>Terminal</u>	<u>Parameters</u>
Pulse	17 or 29	301 or 305
Voltage	53 or 54	308, 309, 310 or
		311, 312, 313
Current	60	314, 315, 316
Preset reference		211, 212, 213,
	214	
Setpoints		418, 419
Bus reference	68+69	

Please note that the bus reference can only be set via serial communication.



NB.

Terminals that are not in use may preferably be set to No function [0].



■ PID for process regulation, cont.

Inverse regulation

Normal regulation means that the motor speed increases when the reference/setpoint is higher than the feedback signal. If there is a need for inverse regulation, in which the speed is reduced when the feedback signal is lower than the reference/setpoint, Inverse must be programmed in parameter 420 PID normal/inverse control.

Anti Windup

The process regulator is factory preset with an active anti-windup function. This function ensures that when either a frequency limit, current limit or voltage limit is reached, the integrator will be initialised for a frequency that corresponds to the present output frequency. This avoids integration on a deviation between the reference/setpoint and the actual state of the process, the controller of which is not possible by means of a speed change. This function can be disabled in parameter 421 PID anti windup.

Start-up conditions

In some applications, optimum setting of the process regulator will mean that it takes an excessive time for the required process state to be reached. In such applications it might be an advantage to fix an output frequency to which the VLT frequency converter is to bring the motor before the process regulator is activated. This is done by programming a *PID start-up frequency* in parameter 422.

Differentiator gain limit

If there are very quick variations in a given application with respect to the reference/setpoint signal or the feedback signal, the deviation between reference/setpoint and the actual process state will quickly change. The differentiator may thus become too dominant. This is because it reacts to the deviation between the reference/setpoint and the actual process state. The quicker the deviation changes, the stronger the resulting differentiator frequency contribution. The differentiator frequency contribution can thus be limited to allow the setting of a reasonable differentiation time for slow changes and a suitable frequency contribution for quick changes. This is done in parameter 426, PID Differentiator gain limit.

Lowpass filter

If there are ripple currents/voltages on the feedback signal, these can be dampened by means of a built-in lowpass filter. Set a suitable lowpass filter time constant. This time constant represents the limit frequency of the ripples occurring on the feedback signal. If the lowpass filter has been set to 0.1s, the limit frequency will be 10 RAD/sec., corresponding to (10/ $2 \times \pi$) = 1.6 Hz. This means that all currents/voltages that vary by more than 1.6 oscillations per second will be removed by the filter.

In other words, regulation will only be carried out on a feedback signal that varies by a frequency of less than 1.6 Hz. Choose a suitable time constant in parameter 427, *PID Lowpass filter time*.

Optimisation of the process regulator

The basic settings have now been made; all that remains to be done is to optimise the proportional gain, the integration time and the differentiation time (parameters 423, 424 and 425). In most processes, this can be done by following the guidelines given below.

- 1. Start the motor.
- 2. Set parameter 423 PID proportional gain to 0.3 and increase it until the process shows that the feedback signal is unstable. Then reduce the value until the feedback signal has stabilised. Now lower the proportional gain by 40-60%.
- Set parameter 424 PID integration time to 20 s and reduce the value until the process shows that the feedback signal is unstable. Increase the integration time until the feedback signal stabilises, followed by an increase of 15-50%.
- 4. Parameter 425 PID differentiation time is only used in very fast-acting systems. The typical value is 1/4 of the value set in parameter 424 PID Integration time. The differentiator should only be used when the setting of the proportional gain and the integration time have been fully optimised.

NB!

If necessary, start/stop can be activated a number of times in order to provoke an unstable feedback signal.

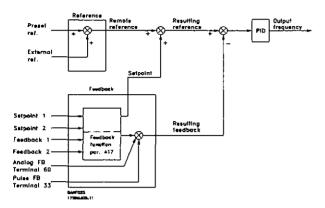
★ = factory setting. () = display text [] = value for use in communication via serial communication port

Q-Pulse Id TMS1102



■ PID overview

The block diagram below shows reference and setpoint in relation to the feedback signal.



As can be seen, the remote reference is totalled with setpoint 1 or setpoint 2. See also *Reference handling*. Which setpoint is to be totalled with the remote reference depends on the selection made in parameter 417 *Feedback function*.

■ Feedback handling

The feedback handling can be seen from the block diagram on the next page.

The block diagram shows how and by which parameters the feedback handling can be affected. Options as feedback signals are: voltage, current, pulse and bus feedback signals. In zone regulation, feedback signals must be selected as voltage inputs (terminals 53 and 54). Please note that Feedback 1 consists of bus feedback 1 (parameter 535) totalled with the feedback signal value of terminal 53. Feedback 2 consists of bus feedback 2 (parameter 536) totalled with the feedback signal value of terminal 54.

In addition, the VLT 6000 HVAC has an integral calculator capable of converting a pressure signal into a "linear flow" feedback signal. This function is activated in parameter 416 Feedback conversion.

The parameters for feedback handling are active both in closed and open loop modes. In open loop, the present temperature can be displayed by connecting a temperature transmitter to a feedback input. In a closed loop, there are - roughly speaking - three possibilities of using the integral PID regulator and setpoint/feedback handling:

- 1 setpoint and 1 feedback
- 2. 1 setpoint and 2 feedbacks
- 3. 2 Setpoints and 2 feedbacks

1 setpoint and 1 feedback

If only 1 setpoint and 1 feedback signal are used, parameter 418 Setpoint 1 will be added to the remote reference. The sum of the remote reference and Setpoint 1 becomes the resulting reference, which will then be compared with the feedback signal.

1 setpoint and 2 feedbacks

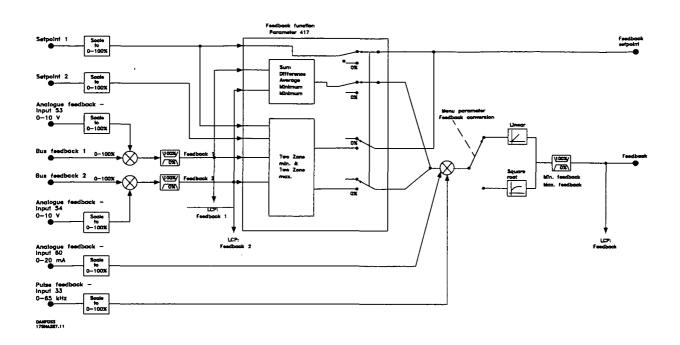
Just like in the above situation, the remote reference is added to Setpoint 1 in parameter 418. Depending on the feedback function selected in parameter 417 Feedback function, a calculation will be made of the feedback signal with which the sum of the references and the setpoint is to be compared. A description of the individual feedback functions is given in parameter 417 Feedback function.

2 Setpoints and 2 feedbacks

Used in 2-zone regulation, where the function selected in parameter 417 *Feedback function* calculates the setpoint to be added to the remote reference.



■ Feedback handling (continued)



416 Feedback conversion (FEEDBACK CONV.)

Value:

★ Linear (LINEAR) Square root (SQUARE ROOT) [0] [1]

Function:

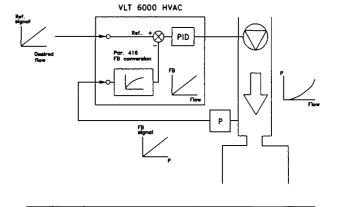
In this parameter, a function is selected which converts a connected feedback signal from the process to a feedback value that equals the square root of the connected signal.

This is used, e.g. where regulation of a flow (volume) is required on the basis of pressure as feedback signal (flow = constant x √pressure). This conversion makes it possible to set the reference in such a way that there is a linear connection between the reference and the flow required. See drawing in next column. Feedback conversion should not be used if 2-zone regulation in parameter 417 Feedback function has been selected.

Description:

If *Linear* [0] is selected, the feedback signal and the feedback value will be proportional.

If Square root [1] is selected, the VLT frequency converter translates the feedback signal to a squared feedback value.





417 Feedback function	
(2 FEEDBACK, CALC.)	
Value:	- di (c
Minimum (MINIMUM)	[0]
★ Maximum (MAXIMUM)	[1]
Sum (SUM)	[2]
Difference ('DIFFERENCE)	[3]
Average (AVERAGE)	[4]
2-zone minimum (2 ZONE MIN)	[5]
2-zone maximum (2 ZONE MAX)	[6]

Function:

This parameter allows a choice between different calculation methods whenever two feedback signals are used.

Description of choice:

If Minimum [0] is selected, the VLT frequency converter will compare feedback 1 with feedback 2 and regulate on the basis of the lower feedback value. Feedback 1 = Sum of parameter 535 Bus feedback 1 and the feedback signal value of terminal 53. Feedback 2 = Sum of parameter 536 Bus feedback 2 and the feedback signal value of terminal 54.

If Maximum [1] is selected, the VLT frequency converter will compare feedback 1 with feedback 2 and regulate on the basis of the higher feedback value. If Sum [2] is selected, the VLT frequency converter will total feedback 1 with feedback 2. Please note that the remote reference will be added to Setpoint 1. If Difference [3] is selected, the VLT frequency converter will subtract feedback 1 from feedback 2. If Average [4] is selected, the VLT frequency converter will calculate the average of feedback 1 and feedback 2. Please note that the remote reference will be added to the Setpoint 1.

If 2-zone minimum [5] is selected, the VLT frequency converter will calculate the difference between Setpoint 1 and feedback 1 as well as Setpoint 2 and feedback 2.

After this calculation, the VLT frequency converter will use the larger difference. A positive difference, i.e. a setpoint higher than the feedback, is always larger than a negative difference.

If the difference between Setpoint 1 and feedback 1 is the larger of the two, parameter 418 Setpoint 1 will be added to the remote reference.

If the difference between Setpoint 2 and feedback 2 is

the larger of the two, the remote reference will be added to the parameter 419 Setpoint 2.

If 2-zone maximum [6] is selected, the VLT frequency converter will calculate the difference between Setpoint 1 and feedback 1 as well as Setpoint 2 and feedback 2.

After the calculation, the VLT frequency converter will use the smaller difference. A negative difference, i.e. one where the setpoint is lower than the feedback, is always smaller than a positive difference.

If the difference between Setpoint 1 and feedback 1 is the smaller of the two, the remote reference will be added to the parameter 418 Setpoint 1.

If the difference between Setpoint 2 and feedback 2 is the smaller of the two, the remote reference will be added to parameter 419 Setpoint 2.

418 Setpoint 1 (SETPOINT 1)

Value:

Ref_{MIN} - Ref_{MAX}

★ 0.000

Function:

Setpoint 1 is used in closed loop as the reference to compare the feedback values with. See description of parameter 417 Feedback function.

The setpoint can be offset with digital, analog or bus references, see *Reference handling*.

Used in Closed loop [1] parameter 100 Configuration.

Description of choice:

Set the required value. The process unit is selected in parameter 415 *Process units*.



419 Setpoint 2 (SETPOINT 2) Value: Ref_{MIN} - Ref_{MAX} **★** 0.000

Eunction:

Setpoint 2 is used in closed loop as the reference to compare the feedback values with. See description of parameter 417 Feedbackfunction.

The setpoint can be offset with digital, analog or bus signals, see reference handling.

Used in Closed loop [1] parameter 100 Configuration and only if 2-zone minimum/maximum is selected in parameter 417 Feedbackfunction.

Description of choice:

Set the required value. The process unit is selected in parameter 415 Process units.

420 PID normal/inverse control (PID NOR/INV. CTRL) Value: **★** Normal (NORMAL) [0] Inverse (INVERSE) [1]

Function:

It is possible to choose whether the process regulator is to increase/reduce the output frequency if there is a deviation between reference/setpoint and the actual process state.

Used in Closed loop [1] (parameter 100).

Description of choice:

If the VLT frequency converter is to reduce the output frequency in case the feedback signal increases, select Normal [0].

If the VLT frequency converter is to increase the output frequency in case the feedback signal increases, select Inverse [1].

421 PID an	ti windup	
(PID A	NTI WINDUP)	
Value:	The second second	4.0
Off (DISABI	_E)	[O]
★ On (ENABL	.E)	[1]

Eunction:

It is possible to choose whether the process regulator is to continue regulating on a deviation even if it is not possible to increase/reduce the output frequency. Used in Closed loop [1] (parameter 100).

Description of choice:

The factory setting is On [1], which means that the integration link is adjusted to the actual output frequency if either the current limit, the voltage limit or the max./min. frequency has been reached. The process regulator will not be engaged again, until either the deviation is zero or its prefix has changed. Select Off [0] if the integrator is to continue integrating to the deviation even if it is not possible to remove the deviation by regulation.

NB!

If Off [0] is selected, it will mean that when the deviation changes its prefix, the integrator will first have to integrate down from the level obtained as

a result of the former error, before any change to the output frequency occurs.

422 PID start-up frequency (PID START VALUE) f_{MIN} - f_{MAX} (parameter 201 and 202) ★ 0 Hz

Function:

When the start signal comes, the VLT frequency converter will react in the form of Open loop [0] following the ramp. Only when the programmed start frequency has been obtained, will it change over to Closed loop [1]. In addition, it is possible to set a frequency that corresponds to the speed at which the process normally runs, which will enable the required process conditions to be reached sooner. Used in Closed loop [1] (parameter 100).

Description of choice:
Set the required start frequency.



If the VLT frequency converter is running at the current limit before the desired start

frequency is obtained, the process regulator will not be activated. For the regulator to be activated anyway, the start frequency must be lowered to the required output frequency. This can be done during

operation.

NB!

PID start frequency is always applied in clockwise direction.

423 PID proportional gain (PID PROP. GAIN)

Value:

0.00 - 10.00

★ 0.01

Function:

The proportional gain indicates the number of times the deviation between the reference/setpoint and the feedback signal is to be applied.

Used in Closed loop [1] (parameter 100).

Description of choice:

Quick regulation is obtained by a high gain, but if the gain is too high, the process may become unstable.

424 PID integration time (PID INTEGR.TIME)

0.01 - 9999.00 sec. (OFF)

Function:

The integrator provides a constant change of the output frequency during constant error between the reference/setpoint and the feedback signal.

The greater the error, the quicker the integrator frequency contribution will increase. The integration time is the time needed by the integrator to reach the same gain as the proportional gain for a given deviation.

Used in Closed loop [1] (parameter 100).

Description of choice:

Fast regulation is obtained in connection with a short integration time. However, this time



NB!

the PID will not function correctly.

Some value other than OFF must be set or

may be too short, which means that the process may be destabilised as a result of overswings. If the integral time is long, major deviations from the required set point may occur, since the process regulator will take a long time to regulate in relation to a given error.

425 PID differentiation time

(PID DIFF. TIME)

0.00 (OFF) - 10.00 sec.

★ OFF

Function:

The differentiator does not react to a constant error. It only contributes when the error changes.

The quicker the error changes, the stronger the contribution from the differentiator will be. This influence is proportional to the speed by which the deviation changes.

Used in Closed loop [1] (parameter 100).

Description of choice:

Fast regulation can be obtained by means of a long differentiation time. However, this time may be too long, which means that the process may be destabilised as a result of overswings.

426 PID differentiator gain limit (PID DIFF. GAIN)

5.0 - 50.0

Function:

It is possible to set a limit for the differentiator gain. The differentiator gain will increase if there are fast changes, which is why it can be beneficial to limit this gain, thereby obtaining a pure differentiator gain at slow changes and a constant differentiator gain where quick changes to the deviation are made. Used in Closed loop [1] (parameter 100).

Description of choice:

Select a limit to differentiator gain as required.



427 PID lowpass filter time (PID FILTER TIME) Value: 0.01 - 10.00**★** 0.01

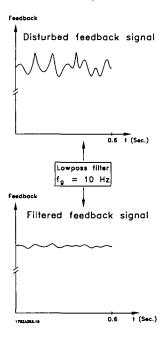
Function: Oscillations on the feedback signal are dampened by the lowpass filter in order to reduce their impact on the process regulation. This can be an advantage e.g. if there is a lot of noise on the signal. Used in Closed loop [1] (parameter 100).

Description of choice:

Select the desired time constant (τ) . If a time constant (τ) of 0.1 s is programmed, the break frequency for the lowpass filter will be 1/0.1 = 10 RAD/sec., corresponding to $(10/(2 \times \pi)) = 1.6 \text{ Hz}.$

The process regulator will thus only regulate a feedback signal that varies by a frequency lower than 1.6 Hz.

If the feedback signal varies by a higher frequency than 1.6 Hz, the Process regulator will not react.



500-566 Serial communication

All information concerning the use of RS 485 serial interface is not included in this manual. Please contact Danfoss and ask for the VLT 6000 HVAC Design Guide.



■ Service functions 600-631

This parameter group contains functions such as operating data, data log and fault log. It also has information on the nameplate data of the VLT frequency converter.

These service functions are very useful in connection with operating and fault analysis in an installation.

600-605 Operating data

* ,		3	
Description	Display	Unit	Range
Operating data:	text		
Operating hours	(OPERATING HOURS)	Hours	0 - 130,000.0
Hours run	(RUNNING HOURS)	Hours	0 - 130,000.0
kWh counter	(KWH COUNTER)	kWh	
No. of cut-ins	(POWER UP'S)	Nos.	0 - 9999
No. of overtemps.	(OVER TEMP'S)	Nos.	0 - 9999
No. of overvoltages	(OVER VOLT'S)	Nos.	0 - 9999
	Description Operating data: Operating hours Hours run kWh counter No. of cut-ins No. of overtemps.	Description Operating data: text Operating hours (OPERATING HOURS) Hours run (RUNNING HOURS) kWh counter (KWH COUNTER) No. of cut-ins (POWER UP'S) No. of overtemps. (OVER TEMP'S)	Description Operating data: text Operating hours Hours run KWh counter No. of cut-ins No. of overtemps. Display Unit Display Dours Dours Dours Non SWh Dours No. of cut-ins UNIT Display Unit Display Unit Display Unit Display Dours Do

- Unit-dependent

Second se	~~~	 ***************************************	~~~ ~~~~~~~~~~~	anderbuishaning and an annual
Eunction:		 		
3 FUNCTION. 3	2 **	 10 to		For Fact Street Control
£ 1/01/01/07/1		 2	carrie de mande	The second of the second

These parameters can be read out via the serial communication port, as well as via the display in the parameters.

Description of choice:

Parameter 600 Operating hours:

Gives the number of hours in which the VLT frequency converter has been in operation. The value is saved every hour and when the power supply to the unit is cut off. This value cannot be reset.

Parameter 601 Hours run:

Gives the number of hours in which the motor has been in operation since being reset in parameter 619 Reset of hours-run counter. The value is saved every hour and when the power supply to the unit is cut off.

Parameter 602 kWh counter:

Gives the output power of the VLT frequency converter. The calculation is based on the mean value in kWh over one hour. This value can be reset using parameter 618 Reset of kWh counter. Range: 0 - depends on unit.

Parameter 603 No. of cut-ins:

Gives the number of cut-ins of supply voltage to the VLT frequency converter.

Parameter 604 No. of overtemps:

Gives the number of overtemperature errors on the heat-sink of the VLT frequency converter.

Parameter 605 No. of overvoltages:

Gives the number of overvoltages on the intermediate circuit voltage of the VLT frequency converter. The count is only taken when Alarm 7 *Overvoltage* is active.



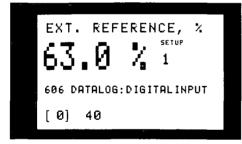
606 - 614 Data log

Value:				
Parameter	Description	Display	Unit	Range
No.	Data log:	text		-
606	Digital input	(LOG: DIGITAL INP)	Decimal	0 - 255
607	Control word	(LOG: BUS COMMAND)	Decimal	0 - 65535
608	Status word	(LOG: BUS STAT WD)	Decimal	0 - 65535
609	Reference	(LOG: REFERENCE)	%	0 - 100
610	Feedback	(LOG: FEEDBACK)	Par. 414	-999,999.999 - 999,999.999
611	Output frequency	(LOG: MOTOR FREQ.)	Hz	0.0 - 999.9
612	Output voltage	(LOG: MOTOR VOLT)	Volt	50 - 1000
613	Output current	(LOG: MOTOR CURR.)	Amp	0.0 - 999.9
614	DC link voltage	(LOG: DC LINK VOLT)	Volt	0.0 - 999.9

Function:

With these parameters, it is possible to see up to 20 saved values (data logs) - [1] being the most recent and [20] the oldest log. When a start command has been given, a new entry to the data log is made every 160 ms. If there is a trip or if the motor has stopped, the 20 latest data log entries will be saved and the values will be visible in the display. This is useful, e.g. in the case of service after a trip.

The data log number is given in square brackets; [1]



Data logs [1]-[20] can be read by first pressing [CHANGE DATA], followed by the [+/-] keys to change data log numbers.

Parameters 606-614 *Data log* can also be read out via the serial communication port.

Description of choice:

Parameter 606 Data log: Digital input:

This is where the latest log data are shown in decimal code, representing the status of the digital inputs. Translated into binary code, terminal 16 corresponds to the bit to the extreme left and to decimal code 128. Terminal 33 corresponds to the bit to the extreme right and to decimal code 1.

The table can be used, e.g., for converting a decimal number into a binary code. For example, digital 40 corresponds to binary 00101000. The nearest smaller decimal number is 32, corresponding to a signal on terminal 18.40-32 = 8, corresponds to the signal on terminal 27.

Terminal 16 17 18 19 27 29 32 33 Decimal number 128 64 32 16 8 4 2 1

Parameter 607 Data log: Control word:

This is where the latest log data are given in decimal code for the control word of the VLT frequency converter.

The control word read can only be changed via serial communication.

The control work is read as a decimal number which is to be converted into hex.

See the control word profile under the section *Serial communication* in the Design Guide.

Parameter 608 Data log: Status word:

This gives the latest log data in decimal code for the status word.

The status word is read as a decimal number which is to be converted into hex.

See the status word profile under the section *Serial* communication in the Design Guide.

Parameter 609 Data log: Reference:

This gives the latest log data for the resulting reference.

Parameter 610 Data log: Feedback:

This gives the latest log data for the feedback signal.

Parameter 611 Data log: Output frequency:
This gives the latest log data for the output frequency.

Parameter 612 Data log: Output voltage:

This gives the latest log data for the output voltage.

Parameter 613 Data log: Output current:

This gives the latest log data for the output current.

Parameter 614 Data log: DC-link voltage:

This gives the latest log data for the intermediate circuit voltage.

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

106 MG.60.A7.02 - VLT is a registered Danfoss trade mark



615 Fault log: Error code (F. LOG: ERROR CODE) Value: [Index 1-10] Error Code: 0 - 99

Function:

This parameter makes it possible to see the reason why a trip (cut-out of the VLT frequency converter) occurs.

10 [1-10] log values are stored.

The lowest log number [1] contains the latest/most recently saved data value; the highest log number [10] contains the oldest data value.

If there is a trip on the VLT 6000 HVAC, it is possible to see its cause, the time and possibly the values for output current or output voltage.

Description of choice:

Stated as an error code in which the number refers to a table in *List of warnings and alarms*.

The fault log is <u>only</u> reset after manual initialisation. (See *Manual initialisation*).

616 Fault log: Time (F. LOG: TIME) [Value: [Index 1-10] Hours: 0 - 130,000.0

Function:

This parameter makes it possible to see the total number of hours run in connection with the 10 latest trips.

10 [1-10] log values are stored.

The lowest log number [1] contains the latest/most recently saved data value, while the highest log number [10] contains the oldest data value.

Description of choice:

The fault log is <u>only</u> reset after manual initialisation. (See *Manual initialisation*).

617 Fault log: Va	lue	
(F. LOG: VAL	UE)	
Value:		
[Index 1 - 10]		Value: 0 - 9999

Function:

This parameter makes it possible to see the value at which a trip occurred. The unit of the value depends on the alarm active in parameter 615 Fault log: Error code.

Description of choice:

The fault log is <u>only</u> reset after manual initialisation. (See *Manual initialisation*).

618 Reset of kWh counter (RESET KWH COUNT) Value: ★ No reset (DO NOT RESET) Reset (RESET COUNTER) [0]

Function:

Reset to zero of parameter 602 kWh counter.

Description of choice:

If Reset [1] has been selected and when the [OK] key is pressed, the kWh counter of the VLT frequency converter is reset. This parameter cannot be selected via the serial port, RS 485.



NB!

When the [OK] key has been activated, the reset has been carried out.

619 Reset of hours-run counter		
(RESET RUN. HOUR)		
Value: _,	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
★ No reset (DO NOT RESET)	[0]	
Reset (RESET COUNTER)	[1]	

Function:

Reset to zero of parameter 601 Hours-run.

Description of choice:

If Reset [1] has been selected and when the [OK] key is pressed, parameter 601 Hours-run is reset. This parameter cannot be selected via the serial port, RS 485.



NB

When the [OK] key has been activated, the reset has been carried out.



620 Operating mode (OPERATION MODE) | Value: ★ Normal function (NORMAL OPERATION) [0] Function with de-activated inverter (OPER. W/INVERT.DISAB) [1] Control card test (CONTROL CARD TEST) [2] Initialisation (INITIALIZE) [3]

In addition to its normal function, this parameter can be used for two different tests.

Furthermore, it is possible to reset to the default factory settings for all Setups, except parameters 500 *Address*, 501 *Baud rate*, 600-605 *Operating data* and 615-617 *Fault log*.

Description of choice:

Normal function [0] is used for normal operation of the motor.

Function with de-activated inverter [1] is selected if control is desired over the influence of the control signal on the control card and its functions - without the motor shaft running.

Control card [2] is selected if control of the analogue and digital inputs, analogue and digital outputs, relay outputs and the control voltage of +10 V is desired.

A test connector with internal connections is required for this test.

The test connector for the *Control card* [2] is set up as follows:

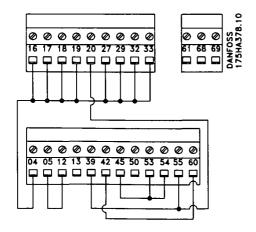
connect 4-16-17-18-19-27-29-32-33; connect 5-12;

connect 39-20-55;

COTTROCT 03 20 00

connect 42 - 60;

connect 45-53-54.



Use the following procedure for the control card test:

- 1) Select Control card test.
- 2) Cut off the mains supply and wait for the light in the display to go out.
- 3) Insert the test plug (see preceding column).
- 4) Connect to mains.
- The VLT frequency converter expects the [OK] key to be pressed (the test cannot be run without LCP).
- 6) The VLT frequency converter automatically tests the control card.
- Remove the test connector and press the [OK] key when the VLT frequency converter displays "TEST COMPLETED".
- 8) Parameter 620 Operating mode is automatically set to Normal function.

If the control card test fails, the VLT frequency converter will display "TEST FAILED". Replace the control card.

Initialisation [3] is selected if the factory setting of the unit is to be generated without resetting parameters 500 *Address*, 501 *Baud rate*, 600-605 *Operating data* and 615-617 *Fault log*.

Procedure for initialisation:

- 1) Select Initialisation.
- .2) Press the [OK] key.
- 3) Cut off the mains supply and wait for the light in the display to go out.
- 4) Connect to mains.
- 5) Initialisation of all parameters will be carried out in all Setups with the exception of parameters 500 Address, 501 Baud rate, 600-605 Operating data and 615-617 Fault log.

Manual initialisation is another option. (See *Manual initialisation*).



621 - 631 Nameplate

Value:		
Parameter	Description	Display text
No.	Nameplate:	
621	Unit type	(DRIVE TYPE)
622	Power component	(POWER SECTION)
623	VLT ordering no.	(ORDERING NO)
624	Software version no.	(SOFTWARE VERSION)
625	LCP identification no.	(LCP ID NO.)
626	Database identification no.	(PARAM DB ID)
627	Power component identification no.	(POWER UNIT DB ID)
628	Application option type	(APPLIC. OPTION)
629	Application option ordering no.	(APPLIC. ORDER NO)
630	Communication option type	(COM. OPTION)
631	Communication option ordering no.	(COM. ORDER NO)

Function:

The main data for the unit can be read from parameters 621 to 631 *Nameplate* via the display or the serial communication port.

Description of choice:

Parameter 621 Nameplate: Unit type:

VLT type gives the unit size and mains voltage.

Example: VLT 6008 380-460 V.

Parameter 622 Nameplate: Power component: This gives the type of power card fitted to the VLT frequency converter. Example: STANDARD.

Parameter 623 Nameplate: VLT ordering no.: This gives the ordering number for the VLT type in question. Example: 1757805.

Parameter 624 Nameplate: Software version no.: This gives the present software version number of the unit. Example: V 1.00.

Parameter 625 Nameplate: LCP identification no.: This gives the identification number of the LCP of the unit. Example: ID 1.42 2 kB.

Parameter 626 Nameplate: Database identification no.:

This gives the identification number of the software's database. Example: ID 1.14.

Parameter 627 Nameplate: Power component identification no.:

This gives the identification number of the database of the unit. Example: ID 1.15.

Parameter 628 Nameplate: Application option type:

This gives the type of application options fitted with the VLT frequency converter.

Parameter 629 Nameplate: Application option ordering no.:

This gives the ordering number for the application option.

Parameter 630 Nameplate: Communication option type:

This gives the type of communication options fitted with the VLT frequency converter.

Parameter 631 Nameplate: Communication option ordering no.:

This gives the ordering number for the communication option.



NB!

Parameters 700-711 for the relay card are only activated if a relay option card is installed in the VLT 6000 HVAC.

700 Relay 6, function (RELAY6 FUNCTION) 703 Relay 7, function (RELAY7 FUNCTION) 706 Relay 8, function (RELAY8 FUNCTION)

709 Relay 9, function (RELAY9 FUNCTION)

Function:

This output activates a relay switch.

Relay outputs 6/7/8/9 can be used for showing status and warnings. The relay is activated when the conditions for the relevant data values have been fulfilled. Activation/deactivation can be programmed in parameters 701/704/707/710 Relay 6/7/8/9, ON delay and parameters 702/705/708/711 Relay 6/7/8/ 9, OFF delay.

Description of choice:

See data choice and connections in Relay outputs.

701 Relay 6, ON delay (RELAY6 ON DELAY)

704 Relay 7, ON delay (RELAY7 ON DELAY)

707 Relay 8, ON delay (RELAY8 ON DELAY)

710 Relay 9, ON delay (RELAY9 ON DELAY)

∘Value: ⊾

0 - 600 sec.

★ 0 sec.

Function:

This parameter allows a delay of the cut-in time of relays 6/7/8/9 (terminals 1-2).

Description of choice:

Enter the required value.

702 Relay 6, OFF delay (RELAY6 OFF DELAY) 705 Relay 7, OFF delay (RELAY7 OFF DELAY)

708 Relay 8, OFF delay (RELAY8 OFF DELAY) 711 Relay 9, OFF delay (RELAY9 OFF DELAY)

Value:

0 - 600 sec.

★ 0 sec.

Function:

This parameter is used to delay the cut-out time of relays 6/7/8/9 (terminals 1-2).

Description of choice:

Enter the required value.

■ Electrical installation of the relay card

The relays are connected as shown below.

Relay 6-9:

A-B make, A-C break Max. 240 V AC, 2 Amp.

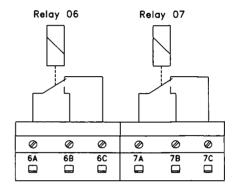
Max. cross-section: 1.5mm² (AWG 28-16).

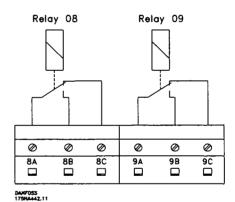
Torque:

0.22 - 0.25 Nm.

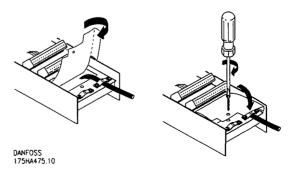
Screw size:

M2.





To achieve double isolation, the plastic foil must be mounted as shown in the drawing below.





■ Status messages

Status messages appear in the 4th line of the display - see example below.

The left part of the status line indicates the active type of control of the VLT frequency converter.

The centre part of the status line indicates the active reference.

The last part of the status line gives the present status, e.g. "Running", "Stop" or "Stand by".



Auto mode (AUTO)

The VLT frequency converter is in Auto mode, i.e. control is carried out via the control terminals and/or serial communication. See also *Auto start*.

Hand mode (HAND)

The VLT frequency converter is in Hand mode, i.e. control is carried out via the control keys. See also *Hand start*.

OFF (OFF)

OFF/STOP is activated either by means of the control key, or by the digital inputs *Hand start* and *Auto start* both being a logic '0'. See also *OFF/STOP*.

Local reference (LOCAL)

If LOCAL has been selected, the reference is set via the [+/-] keys on the control panel. See also *Display modes*.

Remote reference (REM.)

If REMOTE has been selected, the reference is set via the control terminals or via serial communication. See also *Display modes*.

Running (RUNNING)

The motor speed now corresponds to the resulting reference.

Ramp operation (RAMPING)

The output frequency is now changed in accordance with the preset ramps.

Auto-ramp (AUTO RAMP)

Parameter 208 *Automatic ramp-down* is enabled, i.e. the VLT frequency converter is trying to avoid a trip from overvoltage by increasing its output frequency.

Sleep Boost (SLEEP .BST)

The boost function in parameter 406 *Boost setpoint* is enabled. This function is only possible in *Closed loop* operation.

Sleep mode (SLEEP)

The energy saving function in parameter 403 *Sleep mode timer* is enabled. This means that at present the motor has stopped, but that it will restart automatically when required.

Start delay (START DEL)

A start delay time has been programmed i parameter 111 *Start delay*. When the delay has passed, the output frequency will start by ramping up to the reference.

Run request (RUN REQ.)

A start command has been given, but the motor will be stopped until a *Run permissive* signal is received via a digital input.

Jogging (JOG)

Jog has been enabled via a digital input or via serial communication.

Jog request (JOG REQ.)

A JOG command has been given, but the motor will remain stopped until a *Run permissive* signal is received via a digital input.

Freeze output (FRZ.OUT.)

Freeze output has been enabled via a digital input.





Status messages, cont.

Freeze output request (FRZ.REQ.)

A freeze output command has been given, but the motor will remain stopped until a *Run permissive* signal is received via a digital input.

Reversing and start (START F/R)

Reversing and start [2] on terminal 19 (parameter 303 Digital inputs) and Start [1] on terminal 18 (parameter 302 Digital inputs) are enabled at the same time. The motor will remain stopped until one of the signals becomes a logic '0'.

Automatic Motor Adaptation running (AMA RUN)

Automatic motor adaptation has been enabled in parameter 107 *Automatic Motor Adaptation, AMA*.

Automatic Motor Adaptation completed (AMA STOP)

Automatic motor adaptation has ben completed. The VLT frequency converter is now ready for operation after the *Reset* signal has been enabled. Please note that the motor will start after the VLT frequency converter has received the *Reset* signal.

Stand by (STANDBY)

The VLT frequency converter is able to start the motor when a start command is received.

Stop (STOP)

The motor has been stopped via a stop signal from a digital input, [OFF/STOP]-buttom or serial communication.

DC stop (DC STOP)

The DC brake in parameter 114-116 has been enabled.

DRIVE ready (UN. READY)

The VLT frequency converter is ready for operation, but terminal 27 is a logic '0' and/or a *Coasting* command has been received via the serial communication.

Control ready (CTR.READY)

112

This status is only active when a profibus option card is installed.

Not ready (NOT READY)

The VLT frequency converter is not ready for operation, because of a trip or because OFF1, OFF2 or OFF3 is a logic '0'.

Start disabled (START IN.)

This status will only be displayed if, in parameter 599 *Statemachine*, *Profidrive* [1] has been selected and OFF2 or OFF3 is a logic '0'.

Exceptions XXXX (EXCEPTIONS XXXX)

The microprocessor of the control card has stopped and the VLT frequency converter is out of operation. The cause may be noise on the mains, motor or control cables, leading to a stop of the control card microprocessor.

Check for EMC-correct connection of these cables.

■ List of warnings and alarms

The table gives the different warnings and alarms and indicates whether the fault locks the VLT frequency converter. After Trip locked, the mains supply must be cut and the fault must be corrected. Reconnect the mains supply and reset the VLT frequency converter before being ready. A Trip can be reset manually in three ways

- 1) Via the control key [RESET]
- 2) Via a digital input
- Via serial communication
 In addition, an automatic reset may be selected in parameter 400 Reset function.

Wherever a cross is placed under both Warning and Alarm, this can mean that a warning precedes the alarm. It can also mean that it is possible to program whether a given fault is to result in a warning or an alarm. This is possible, e.g. in parameter 117 *Motor thermal protection*. After a trip, the motor will be coasting and on the VLT frequency converter alarm and warning will flash. If the fault is removed, only the alarm will flash. After a reset, the VLT frequency converter will be ready to start operation again.

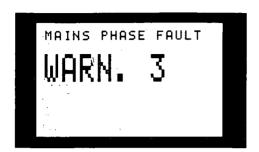
No.	Description	Warning	Alarm	Trip locked	
1	10 Volts low (10 VOLT LOW)	×			
2	Live zero fault (LIVE ZERO ERROR)	Χ	X		
4	Mains imbalance (MAINS IMBALANCE)	Χ	Х	X	
5	Voltage warning high (DC LINK VOLTAGE HIGH)	×			
6	Voltage warning low (DC LINK VOLTAGE LOW)	X			
7	Overvoltage (DC LINK OVERVOLT)	X	X		
8	Undervoltage (DC LINK UNDERVOLT)	X	X		
9	Inverter overloaded (INVERTER TIME)	Х	Х		, ,
10	Motor overloaded (MOTOR TIME)	Χ	Х		
11	Motor thermistor (MOTOR THERMISTOR)	X	X		
12	Current limit (CURRENT LIMIT)	X	X		
13	Overcurrent (OVERCURRENT)	X	X	X	
14	Earth fault (EARTH FAULT)		X	X	
15	Switch mode fault (SWITCH MODE FAULT)		X	X	
16	Short-circuit (CURR.SHORT CIRCUIT)		X	X	
17	Serial communication timeout (STD BUSTIMEOUT)	X	X		
18	HPFB bus timeout (HPFB TIMEOUT)	X	X		
19	Fault in EEprom on power card (EE ERROR POWER)	Х			
20	Fault in EEprom on control card (EE ERROR CONTROL)	Х			
22	Auto-optimisation not OK (AMA FAULT)		X		
29	Heat-sink temperature too high (HEAT SINK OVERTEMP.)		Х		
30	Motor phase U missing (MISSING MOT.PHASE U)		Χ		
31	Motor phase V missing (MISSING MOT.PHASE V)		Х		
32	Motor phase W missing (MISSING MOT.PHASE W)		Χ		
34	HPFB communication fault (HPFB COMM. FAULT)	X	Χ		
37	Inverter fault (GATE DRIVE FAULT)	-	X	X	•
39	Check parameters 104 and 106 (CHECK P.104 & P.106)	X			
40	Check parameters 103 and 105 (CHECK P.103 & P.106)	X			
41	Motor too big (MOTOR TOO BIG)	X			
42	Motor too small (MOTOR TOO SMALL)	X			
60	Safety stop (EXTERNAL FAULT)		Х		
61	Output frequency low (FOUT < FLOW)	X	-		
62	Output frequency high (FOUT > FHIGH)	X			
63	Output current low (I MOTOR < I LOW)	X	Χ		
64	Output current high (I MOTOR > I HIGH)	X			
65	Feedback low (FEEDBACK < FDB LOW)	X			
66	Feedback high (FEEDBACK > FDB HIGH)	Χ			
67	Reference low (REF. < REF. LOW)	Χ			-
_68	Reference high (REF. > REF. HIGH)	X			<u> </u>
<u>69</u>	Temperature auto derate (TEMP.AUTO DERATE)	X			·
99	Unknown fault (UNKNOWN ALARM)		Χ	X	

All about VLT 6000 HVAC



Warnings

A warning will flash in line 2, while an explanation is given in line 1.



■ Alarms

If an alarm is given, the present alarm number will be shown in line 2. Lines 3 and 4 of the display will offer an explanation.



WARNING 1

Under 10 V (10 VOLT LOW)

The 10 V voltage from terminal 50 on the control card is below 10 V.

Remove some of the load from terminal 50, as the 10 Volts supply is overloaded. Max. 17 mA/min. 590 Ω .

WARNING/ALARM 2

Live zero fault (LIVE ZERO ERROR)

The current or voltage signal on terminal 53, 54 or 60 is below 50% of the value preset in parameter 309, 312 and 315 *Terminal*, *min.* scaling.

WARNING/ALARM 4

Mains imbalance (MAINS IMBALANCE)

High imbalance or phase missing on the supply side. Check the supply voltage to the VLT frequency converter.

WARNING 5

Voltage warning high (DC LINK VOLTAGE HIGH)

The intermediate circuit voltage (DC) is higher than *Voltage warning high*, see table below. The controls of the VLT frequency converter are still enabled.

WARNING 6

Voltage warning low (DC LINK VOLTAGE LOW)

The intermediate circuit voltage (DC) is lower than *Voltage warning low*, see table below. The controls of the VLT frequency converter are still enabled.

WARNING/ALARM 7 Overvoltage (DC LINK OVERVOLT)

If the intermediate circuit voltage (DC) is higher than the *Overvoltage limit* of the inverter (see table below), the VLT frequency converter will trip after a fixed period. The length of this period depends on the unit.

Alarr	n/war	ning	limits:
	6000		

VLT 6000 HVAC	3 x 200 - 240 V	3 x 380 - 460 V	3 x 550-600 V
	[VDC]	[VDC]	[VDC]
Undervoltage	211	402	557
Voltage warning low	222	423	613
Voltage warning high	384	762	943
Overvoltage	425	798	975

The voltages stated are the intermediate circuit voltage of the VLT frequency converter with a tolerance of \pm 5 %. The corresponding mains voltage is the intermediate circuit voltage divided by 1,35.



Warnings and alarms, cont.

WARNING/ALARM 8

Undervoltage (DC LINK UNDERVOLT)

If the intermediate circuit voltage (DC) drops below the undervoltage limit of the inverter, the VLT frequency converter will trip after a fixed period, the length of the period depending on the unit.

Furthermore, the voltage will be stated in the display. Check whether the supply voltage matches the VLT frequency converter, see *Technical data*.

WARNING/ALARM 9

Inverter overload (INVERTER TIME)

The electronic, thermal inverter protection reports that the frequency converter is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection gives a warning at 98% and trips at 100%, while giving an alarm. The VLT frequency converter cannot be reset until the counter is below 90%.

The fault is that the VLT frequency converter is overloaded by more than 100% for too long.

WARNING/ALARM 10

Motor overtemperature (MOTOR TIME)

According to the electronic thermal protection (ETR), the motor is too hot. Parameter 117 *Motor thermal protection* allows a choice of whether the VLT frequency converter is to give a warning or an alarm when the *Motor thermal projection* reaches 100%. The fault is that the motor is overloaded by more than 100% of the preset, rated motor current for too long. Check that the motor parameters 102-106 have been set correctly.

WARNING/ALARM 11

Motor thermistor (MOTOR THERMISTOR)

The thermistor or the thermistor connection has been disconnected. Parameter 117 *Motor thermal protection* allows a choice of whether the VLT frequency converter is to give a warning or an alarm. Check that the thermistor has been correctly connected between terminal 53 or 54 (analogue voltage input) and terminal 50 (+ 10 V supply).

WARNING/ALARM 12

Current limit (CURRENT LIMIT)

The current is higher than the value in parameter 215 Current limit I_{LIM} and the VLT frequency converter trips after the time set in parameter 412 *Trip delay overcurrent*, I_{LIM} has passed.

WARNING/ALARM 13 Overcurrent (OVER CURRENT)

The inverter peak current limit (approx. 200% of the rated current) has been exceeded. The warning will last approx. 1-2 seconds, following which the VLT frequency converter will trip and give off an alarm. Turn off the VLT frequency converter and check whether the motor shaft can be turned and whether the motor size matches the VLT frequency converter.

ALARM: 14

Earth fault (EARTH FAULT)

There is a discharge from the output phases to earth, either in the cable between the frequency converter and the motor or in the motor itself.

Turn off the VLT frequency converter and remove the earth fault.

ALARM: 15

Switch mode fault (SWITCH MODE FAULT)

Fault in the switch mode power supply (internal ± 15 V supply).

Contact your Danfoss supplier.

ALARM: 16

Short-circuiting (CURR. SHORT CIRCUIT)

There is short-circuiting on the motor terminals or in the motor itself.

Cut off the mains supply to the VLT frequency converter and remove the short-circuit.

WARNING/ALARM 17

Serial communication timeout (STD BUSTIMEOUT)

There is no serial communication with the VLT frequency converter.

This warning will only be enabled if parameter 556 Bus time interval function has been set to a value different from OFF.

If parameter 556 Bus time interval function has been set to Stop and trip [5], the VLT frequency converter will first give off an alarm, then ramp down and finally trip while giving off an alarm. It is possible to increase parameter 555 Bus time interval.





Warnings and alarms, cont.

WARNING/ALARM 18 HPFB bus timeout (HPFB TIMEOUT)

There is no serial communication with the communication option card of the VLT frequency converter. The warning will only be enabled if parameter 804 *Bus time interval function* has been set to anything but OFF. If parameter 804 *Bus time interval function* has been set to *Stop and trip*, the VLT frequency converter will first give off an alarm, then ramp down and finally trip while giving off an alarm.

Parameter 803 Bus time interval could possibly be increased.

WARNING 19

Fault in the EEprom on the power card (EE ERROR POWER)

There is a fault on the power card EEPROM. The VLT frequency converter will continue to function, but is likely to fail at the next power-up. Contact your Danfoss supplier.

WARNING 20

Fault in the EEprom on the control card (EE ERROR CONTROL)

There is a fault in the EEPROM on the control card. The VLT frequency converter will continue to function, but is likely to fail at the next power-up. Contact your Danfoss supplier.

ALARM: 22

Auto-optimisation not OK (AMA FAULT)

A fault has been found during automatic motor adaptation. The text shown in the display indicates a fault message.



NB!

AMA can only be carried out if there are <u>no</u> alarms during tuning.

CHECK 103, 105

[0]

Parameter 103 or 105 has a wrong setting. Correct the setting and start AMA all over.

LOW P.105

[1]

The motor is too small for AMA to be carried out. If AMA is to be enabled, the rated motor current (parameter 105) must be higher than 35% of the rated output current of the VLT frequency converter.

ASYMMETRICAL IMPEDANCE

[2]

AMA has detected an asymmetrical impedance in the motor connected to the system. The motor could be defective.

MOTOR TOO BIG

[3]

The motor connected to the system is too big for AMA to be carried out. The setting in parameter 102 does not match the motor used.

MOTOR TOO SMALL

[4]

[5]

The motor connected to the system is too small for AMA to be carried out. The setting in parameter 102 does not match the motor used.

TIME OUT

AMA fails because of noisy measuring signals. Try to start AMA all over a number of times, until AMA is carried out. Please note that repeated AMA runs may heat the motor to a level where the stator resistance $R_{\rm S}$ is increased. In most cases, however, this is not critical.

INTERRUPTED BY USER

[6]

AMA has been interrupted by the user.

INTERNAL FAULT

[7]

An internal fault has occurred in the VLT frequency converter. Contact your Danfoss supplier.

LIMIT VALUE FAULT

[8]

The parameter values found for the motor are outside the acceptable range within which the VLT frequency converter is able to work.

MOTOR ROTATES

[9]

The motor shaft rotates. Make sure that the load is not able to make the motor shaft rotate. Then start AMA all over.

Q-Pulse Id TMS1102



Warnings and alarms, cont.

ALARM 29

Heat sink temperature too high (HEAT SINK OVER TEMP.):

If the enclosure is IP 00, IP 20 or NEMA 1, the cutout temperature of the heat-sink is 90°C. If IP 54 is used, the cut-out temperature is 80°C.

The tolerance is \pm 5°C. The temperature fault <u>cannot</u> be reset, until the temperature of the heat-sink is below 60°C.

The fault could be the following:

- Ambient temperature too high
- Too long motor cable
- Too high switching frequency.

ALARM: 30

Motor phase U missing (MISSING MOT.PHASE U):

Motor phase U between VLT frequency converter and motor is missing.

Turn off the VLT frequency converter and check motor phase U.

ALARM: 31

Motor phase V missing (MISSING MOT.PHASE V):

Motor phase V between VLT frequency converter and motor is missing.

Turn off the VLT frequency converter and check motor phase V.

ALARM: 32

Motor phase W missing (MISSING MOT.PHASE U):

Motor phase W between VLT frequency converter and motor is missing.

Turn off the VLT frequency converter and check motor phase W.

WARNING/ALARM: 34 HPFB communication fault (HPFB COMM. FAULT)

The serial communication on the communication option card is not working.

ALARM: 37

Inverter fault (GATE DRIVE FAULT):

IGBT or the power card is defective. Contact your Danfoss supplier.

Auto-optimisation warnings 39-42

Automatic motor adaptation has stopped, since some parameters have probably been set wrongly, or the motor used in too big/small for AMA to be carried out. A choice must thus be made by pressing [CHANGE DATA] and choosing 'Continue' + [OK] or 'Stop' + [OK]. If parameters need to be changed, select 'Stop'; start up AMA all over.

WARNING: 39

CHECK PAR. 104, 106

Parameters 104 Motor frequency $f_{M,N}$, or 106 Rated motor speed $n_{M,N}$, have probably not been set correctly. Check the setting and select 'Continue' or [STOP].

WARNING: 40

CHECK PAR. 103, 105

Parameter 103 *Motor voltage, U_{M,N}* or 105 *Motor current, I_{M,N}* has not been set correctly. Correct the setting and restart AMA.

WARNING: 41

MOTOR TOO BIG (MOTOR TOO BIG)

The motor used is probably too big for AMA to be carried out. The setting in parameter 102 *Motor* power, $P_{M,N}$ may not match the motor. Check the motor and choose 'Continue' or [STOP].

WARNING: 42

MOTOR TOO SMALL (MOTOR TOO SMALL)

The motor used is probably too small for AMA to be carried out. The setting in parameter 102 *Motor* power, $P_{M,N}$ may not match the motor. Check the motor and select 'Continue' or [STOP].

ALARM: 60

Safety stop (EXTERNAL FAULT)

Terminal 27 (parameter 304 *Digital inputs*) has been programmed for a *Safety interlock* [3] and is a logic '0'.

WARNING: 61

Output frequency low (FOUT < FLOW)

The output frequency is lower than parameter 223 Warning: Low frequency, f_{LOW} .



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WARNING: 62

Output frequency high (FOUT > FHIGH)

The output frequency is higher than parameter 224 Warning: High frequency, f_{HIGH} .

WARNING/ALARM: 63

Output current low (I MOTOR < I LOW)

The output current is lower than parameter 221 Warning: Low current, I_{LOW}. Select the required function in parameter 409 Function in case of no load.

WARNING: 64

Output current high (I MOTOR > I HIGH)

The output current is higher than parameter 222 Warning: High current, I_{High}.

WARNING: 65

Feedback low (FEEDBACK < FDB LOW)

The resulting feedback value is lower than parameter 227 *Warning:* Low feedback, FB_{LOW}.

WARNING: 66

Feedback high (FEEDBACK > FDB HIGH)

The resulting feedback value is higher than parameter 228 Warning: High feedback, FB_{HIGH}.

WARNING: 67

Remote reference low

(REF. < REF LOW)

The remote reference is lower than parameter 225 Warning: Low reference, REF_{LOW}.

WARNING: 68

Remote reference high

(REF. > REF HIGH)

The remote reference is higher than parameter 226 Warning: High reference, REF_{HIGH}.

WARNING: 69

Temperature auto derate (TEMP.AUTO DERATE)

The heat sink temperature has exceeded the maximum value and the auto derating function (par. 411) is active. *Warning: Temp. Auto derate.*

WARNING: 99

Unknown fault (UNKNOWN ALARM)

An unknown fault has occurred which the software is not able to handle.

Contact your Danfoss supplier.

■ Aggressive environments

In common with all electronic equipment, a VLT frequency converter contains a large number of mechanical and electronic components, all of which are vulnerable to environmental effects to some extent.



The VLT frequency converter should not therefore be installed in environments with airborne liquids, particles or

gases capable of affecting and damaging the electronic components. Failure to take the necessary protective measures increases the risk of stoppages, thus reducing the life of the VLT frequency converter.

<u>Liquids</u> can be carried through the air and condense in the VLT frequency converter. In addition to this, liquids may cause corrosion of components and metal parts.

Steam, oil and salt water may cause corrosion of components and metal parts.

In such environments, equipment with enclosure rating IP 54 is recommended.

Airborne <u>particles</u> such as dust particles may cause mechanical, electrical or thermal failure in the VLT frequency converter.

A typical indicator of excessive levels of airborne particles is dust particles around the VLT frequency converter fan.

In very dusty environments, equipment with enclosure rating IP 54 or a cabinet for IP 00/20 equipment is recommended.

In environments with high temperatures and humidity, corrosive gases such as sulphur, nitrogen and chlorine compounds will cause chemical processes on the VLT frequency converter components. Such chemical reactions will rapidly affect and damage the electronic components.

In such environments, it is recommended that equipment is mounted in a cabinet with fresh air ventilation, keeping aggressive gases away from the VLT frequency converter.



NB!

Mounting VLT frequency converters in aggressive environments will increase the risk of stoppages and furthermore considerably reduce the life of the converter.

Before the installation of the VLT frequency converter, the ambient air should be checked for liquids, particles and gases. This may be done by observing existing installations in this environment. Typical indicators of harmful airborne liquids are water or oil on metal parts, or corrosion of metal parts.

Excessive dust particle levels are often found on installation cabinets and existing electrical installations. One indicator of aggressive airborne gases is blackening of copper rails and cable ends on existing installations.

■ Calculation of resulting reference

The calculation made below gives the resulting reference when parameter 210 Reference type is programmed for Sum [0] and Relative [1], respectively.

External reference is the sum of references from terminals 53, 54, 60 and serial communication. The sum of these can never exceed parameter 205 *Max. reference*.

External reference can be calculated as follows:

Ext. ref. = \frac{\text{(Par. 205 Max. ref. - Par. 204 Min. ref.) x Ana. signal Term. 53 [V]}{\text{Par. 310 Term. 53 Max. scaling - Par. 309 Term. 53 Min. scaling}} \frac{\text{(Par. 205 Max. ref. - Par. 204 Min. ref.) x Ana. signal Term. 54 [V]}}{\text{Par. 310 Term. 53 Max. scaling - Par. 309 Term. 53 Min. scaling}} \frac{\text{Par. 313 Term. 54 Max. scaling - Par. 312 Term. 54 Min. scaling}}{\text{Par. 205 Max. ref. - Par. 204 Min. ref.) x Par. 314 Term. 60 [mA]}} \frac{\text{serial com. reference x (Par. 205 Max. ref. - Par. 204 Min. ref.)}}{\text{16384 (4000 Hex)}}

Par. 210 Reference type is programmed = Sum [0].

Res. ref. = (Par. 205 Max. ref. - Par. 204 Min. ref.) x Par. 211-214 Preset ref. + External ref. + Par. 204 Min. ref. + Par. 418/419 Setpoint (only in closed loop)

Par. 210 Reference type is programmed = Relative [1].

Res. ref. = External reference x Par. 211-214 Preset ref. + Par. 204 Min. ref. + Par. 418/419 Setpoint (only in closed loop)



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■ Galvanic isolation (PELV)

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

In VLT 6000 HVAC all control terminals as well as terminals 1-3 (AUX relay) are supplied from or in connection with extra low voltage (PELV).

Galvanic (ensured) isolation is obtained by fulfilling requirements concerning higher isolation and by providing the relevant creapage/clearance distances. These requirements are described in the EN 50178 standard.

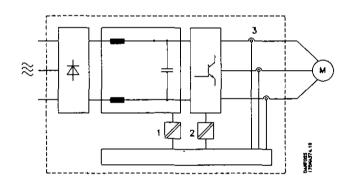
For additional information on PELV see RFI switching.

ing. Galvanic isolation The components that make up the electrical isolation, as described below, also comply with the requirements concerning higher isolation and the relevant test as described in EN 50178.

The galvanic isolation can be shown in three locations (see drawing below), namely:

- Power supply (SMPS) incl. signal isolation of U_{DC},indicating the intermediate current voltage.
- 2. Gate drive that runs the IGTBs (trigger transformers/opto-couplers).
- Current transducers (Hall effect current transducers).

NOTE: 550-600 V units do not meet PELV requirements in accordance with EN 50178.



■ Earth leakage current

Earth leakage current is primarily caused by the capacitance between motor phases and the motor cable screen. When an RFI filter is used, this contributes additional leakage current, as the filter circuit is connected to earth through capacitors. See drawing on the following page.

The size of the leakage current to the ground depends on the following factors, in order of priority:

- 1. Length of motor cable
- 2. Motor cable with or without screen
- 3. Switching frequency
- 4. RFI filter used or not

120

5. Motor grounded on site or not.

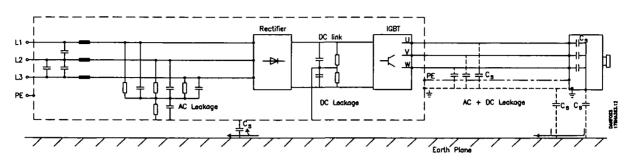
The leakage current is of importance to safety during handling/operation of the frequency converter if (by mistake) the frequency converter has not been earthed.

NB!

Since the leakage current is > 3.5 mA, reinforced earthing must be established, which is required if EN 50178 is to be complied with. Never use ELCB relays (type A) that are not suitable for DC fault currents from three-phase rectifier loads.

If ELCB relays are used, they must be:

- Suitable for protecting equipment with a direct current content (DC) in the fault current (3-phase bridge rectifier)
- Suitable for power-up with short pulse-shaped charging current to earth
- Suitable for a high leakage current (300 mA).



Leakage currents to earth

■ Extreme running conditions

Short circuit

VLT 6000 HVAC is protected against short circuits by means of current measurement in each of the three motor phases. A short circuit between two output phases will cause an overcurrent in the inverter. However, each transistor of the inverter will be turned off individually when the short circuit current exceeds

the permitted value.

After a few microseconds the driver card turns off the inverter and the frequency converter will display a fault code, although depending on impedance and motor frequency.

Earth fault

The inverter cuts out within a few micorseconds in case of an earth fault on a motor phase, although depending on impedance and motor frequency.

Switching on the output

Switching on the output between the motor and the frequency converter is fully permitted. It is not possible to damage VLT 6000 HVAC in any way by switching on the output. However, fault messages may appear.

Motor-generated overvoltage

The voltage in the intermediate circuit is increased when the motor acts as a generator. This occurs in two cases:

- The load drives the motor (at constant output frequency from the frequency converter), i.e. the load generates energy.
- During deceleration ("ramp-down") if the moment of inertia is high, the load is low and the rampdown time is too short for the energy to be dissipated as a loss in the VLT frequency converter, the motor and the installation.

The control unit attempts to correct the ramp if possible.

The inverter turns off to protect the transistors and the intermediate circuit capacitors when a certain voltage level is reached.

Mains drop-out

During a mains drop-out, VLT 6000 HVAC continues until the intermediate circuit voltage drops below the minimum stop level, which is typically 15% below VLT 6000 HVAC's lowest rated supply voltage.

The time before the inverter stops depends on the mains voltage before the drop-out and on the motor load.

Static overload

When VLT 6000 HVAC is overloaded (the current limit in parameter 215 *Current limit*, I_{LIM} has been reached), the controls will reduce the output frequency in an attempt to reduce the load. If the overload is excessive, a current may occur that makes the VLT frequency converter cut out after approx. 1.5 sec.

Operation within the current limit can be limited in time (0-60 s) in parameter 412 $Trip\ delay$ overcurrent, I_{LIM} .



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■ Peak voltage on motor

When a transistor in the inverter is opened, the voltage across the motor increases by a dV/dt ratio that depends on:

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

The natural induction causes an overshot U_{PEAK} in the motor voltage before it stabilises itself at a level which depends on the voltage in the intermediate circuit. The rise time and the peak voltage U_{PEAK} affect the service life of the motor. If the peak voltage is too high, motors without phase coil insulation are the ones that will primarily be affected. If the motor cable is short (a few meters), the rise time and peak voltage are lower.

If the motor cable is long (100 m), the rise time and peak voltage will increase.

If very small motors are used without phase coil insulation, it is recommended to fit a LC filter after the frequency converter. Typical values for the rise time and peak voltage U_{PEAK} measured on the motor terminals between two phases:

VLT,6002-6006 200 V, VLT,6002-6011 400 V						
Cable	Mains	Rise	Peak			
length	voltage	time	voltage			
50 metres	380 V	0.3 µsec.	850 V			
50 metres	460 V	0.4 μsec.	950 V			
150 metres	380 V	1.2 μsec.	1000 V			
150 metres	460 V	1.3 µsec.	1300 V			

		_ 100 V
Mains	Rise	Peak
voltage	time	voltage
metres 380 V 0.1 μs		900 V
380 V	0.2 μsec.	1000 V
3275 380-4	60 V, 6042-60	62 20 0-240 V
Mains		Peak
voltage	du/dt	voltage
460 V	670 V/μsec.	815 V
460 V	620 V/μsec.	915 V
550 380-4	60 V	* * * * * * * * * * * * * * * * * * * *
Mains		Peak
voltage	du/dt	voltage
460 V	415 V/μsec.	760 V
11.550-60	0 V	
Mains	Rise	Peak
Voltage	Time	Voltage
600 V	0.36 µsec.	1360 V
072 550-6	0 0 V	
Mains	Rise	Peak
Voltage	Time	Voltage
575 V	0.38 µsec.	1430 V
3275 550-6	00 V	
Mains	Rise	Peak
Voltage	Time	Voltage
	Mains voltage 380 V 380 V 380 V 380 V 380-4 Mains voltage 460 V 460 V 3550 380-4 Mains voltage 460 V 011,550-60 Mains Voltage 600 V 6072 550-6 Mains Voltage 575 V 6275 550-6 Mains	voltage time 380 V 0.1 μsec. 380 V 0.2 μsec. 3275 380-460 V, 6042-600 Mains voltage du/dt 460 V 670 V/μsec. 460 V 620 V/μsec. 3550 380-460 V Mains voltage du/dt 460 V 415 V/μsec. 311 550-600 V Mains Nottage Time 600 V 0.36 μsec. 3072 550-600 V Mains Nottage Time 575 V 0.38 μsec. 3275 550-600 V Mains Rise Nottage 3275 550-600 V Rise 3275 550-600 V Rise 3275 550-600 V Rise

VLT 6008-6027 200 V, VLT 6016-6072 400 V

■ Switching on the input

Switching on the input depends on the mains voltage in question.

The table below states the waiting time between cut-ins.

Mains voltage	380 V	415 V	460 V
Waiting time	48 s	65 s	89 s

0.80 µsec.

1122 V

600 V

■ Acoustic noise

The acoustic interference from the frequency converter comes from two sources:

- 1. DC intermediate circuit coils
- 2. Integral fan.

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Below are the typical values measured at a distance of 1 m from the unit at full load and are nominal maximum values:

VLT 6002-6006 200 V, VLT 6002-6011 400	V
IP 20 units:	50 dB(A)
IP 54 units:	62 dB(A)
VLT 6008-6027 200 V; VLT 6016-6062 400	V
IP 20 units:	61 dB(A)
IP 54 units:	66 dB(A)
VLT-6042-6062 200-240 V	100 g 18 18 48 18
IP 00/20 units:	70 dB(A)
IP 54 units:	65 dB(A)
VLT 6072 380-460 V	
IP 20 units:	67 dB(A)
IP 54 units:	66 dB(A)

NAME OF THE OWNER, OF	-	90000-0000	mergyman.	*****	****	********	***	Annual Post
171	T /	COL	75 6	207	C 2	00	460	17
VI	_ ` '			3 <i>7</i> I		ou-	400	·v

IP 00/20 units:

70 dB(A)

13 m

IP 54 units: 75 dB(A)

VLT 6350-6550 380-460 V

IP 00 units:

71 dB(A)

IP 20/54 units:

82 dB(A)

VLT 6002-6011 550-600 V

IP 20/NEMA 1 units: 62 dB

VLT 6016-6072 550-600 V IP 20/NEMA 1 units: 66 dB

VLT 6100-6275 550-600 V

IP 20/NEMA 1 units: 75 dB

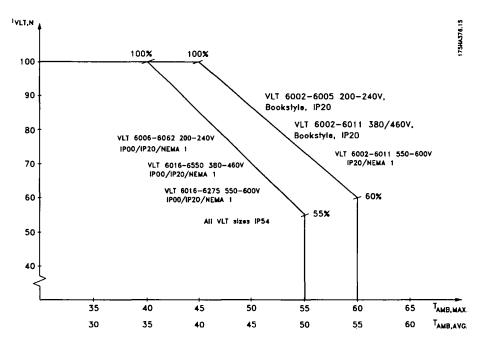
* Measured 1 meter from the unit at full load.

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■ Derating for ambient temperature

The ambient temperature ($T_{AMB,MAX}$) is the maximum temperature allowed. The average ($T_{AMB,AVG}$) measured over 24 hours must be at least 5°C lower. If VLT 6000 HVAC is operated at temperatures above 45 °C, a derating of the continuous output current is necessary.

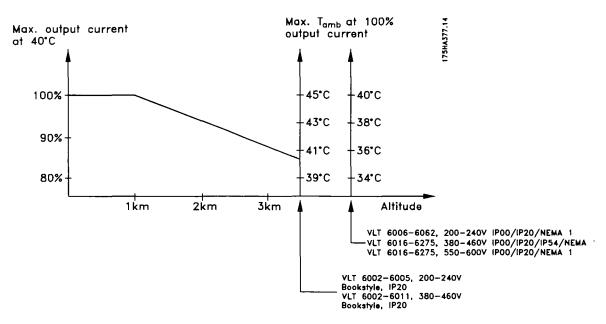


■ Derating for air pressure

Below 1000 m altitude no derating is necessary.

Above 1000 m the ambient temperature (T_{AMB}) or max. output current ($I_{NLT,MAX}$) must be derated in accordance with the diagram below:

- 1) Derating of output current versus altitude at $T_{AMB} = max. 45^{\circ}C$
- 2) Derating of max. T_{AMB} versus altitude at 100% output current.





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■ Derating for running at low speed

When a centrifugal pump or a fan is controlled by a VLT 6000 HVAC frequency converter, it is not necessary to reduce the output current at low speed because the load characterstic of the centrifugal pumps/fans, automatically ensures the necessary reduction.

Derating for long motor cables or cables with larger cross-section

VLT 6000 HVAC has been tested using 300 m unscreened/unarmoured cable and 150 m screened/armoured cable.

VLT 6000 HVAC has been designed to work using a motor cable with a rated cross-section. If a cable with a larger cross-section is to be used, it is recommended to reduce the output current by 5% for every step the cross-section is increased. (Increased cable cross-section leads to increased capacity to earth, and thus an increased earth leakage current).

■ Derating for high switching frequency

A higher switching frequency (to be set in parameter 407, Switching frequency) leads to higher losses in the electronics of the VLT frequency converter.

VLT 6000 HVAC has a pulse pattern in which it is possible to set the switching frequency from 3.0-10.0/14.0 kHz.

The VLT frequency converter will automatically derate the rated output current IVLEN, when the switching frequency exceeds 4.5 kHz.

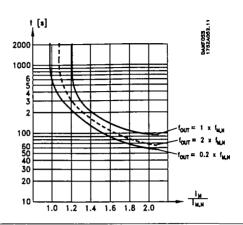
In both cases, the reduction is carried out linearly, down to 60% of lyurn.

The table gives the min., max. and factory-set switching frequencies for VLT 6000 HVAC units.

Switching frequency [kHz]	Min.	Max.	Fact.
VLT 6002-6005, 200 V	3.0	10.0	4.5
VLT 6006-6032, 200 V	3.0	14.0	4.5
VLT 6002-6011, 460 V	3.0	10.0	4.5
VLT 6016-6072, 460 V	3.0	14.0	4.5
VLT 6042-6062, 200 V	3.0	4.5	4.5
VLT 6075-6550, 460 V	3.0	4.5	4.5
VLT 6002-6011, 600 V	4.5	7.0	4.5
VLT 6016-6032, 600 V	3.0	14.0	4.5
VLT 6042-6062, 600 V	3.0	10.0	4.5
VLT 6072-6275 600 V	3.0	4.5	4.5

■ Motor thermal protection

The motor temperature is calculated on the basis of motor current, output frequency and time. See parameter 117, Motor thermal protection.



I Vibration and shock

VLT 6000 HVAC has been tested according to a procedure based on the following standards:

IEC 68-2-6: Vibration (sinusoidal) - 1970 Random vibration broad-band IEC 68-2-34: general requirements IEC 68-2-35: Random vibration broad-band - high reproducibility

> Random vibration broad-band - medium reproducibility

VLT 6000 HVAC complies with requirements that correspond to conditions when the unit is mounted on the walls and floors of production premises, as well as in panels bolted to walls or floors.

Air humidity

IEC 68-2-36:

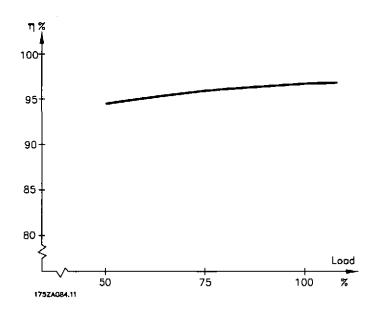
VLT 6000 HVAC has been designed to meet the IEC 68-2-3 standard, EN 50178 pkt. 9.4.2.2/DIN 40040, class E, at 40°C.

See specifications under General technical data.



■ Efficiency

To reduce energy consumption it is very important to optimize the efficiency of a system. The efficiency of each single element in the system should be as high as possible.



Efficiency of VLT 6000 HVAC (nut)

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

The efficiency declines a little when the switching frequency is set to a value of above 4 kHz (parameter 407 Switching frequency). The rate of efficiency will also be slightly reduced if the mains voltage is 460 V, or if the motor cable is longer than 30 m.

Efficiency of the motor (η_{мотов})

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

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

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

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

Efficiency of the system (η_{SYSTEM})

To calculate the system efficiency, the efficiency of VLT 6000 HVAC (η_{NLT}) is multiplied by the efficiency of the motor (η_{MOTOR}):

 $\eta_{\text{SYSTEM}} = \eta_{\text{VLT}} \, \times \eta_{\text{MOTOR}}$

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





■ Mains supply interference/harmonics

A frequency converter takes up a non-sinusoidal current from mains, which increases the input current I_{RMS} . A non-sinusoidal current can be transformed by means of a Fourier analysis and split up into sine wave currents with different frequencies, i.e. different harmonic currents I_{N} with 50 Hz as the basic frequency:

Harmonic curren	ts I ₁	l ₅	l ₇	
Hz	50 Hz	250 Hz	350 Hz	

The harmonics do not affect the power consumption directly, but increase the heat losses in the installation (transformer, cables). Consequently, in plants with a rather high percentage of rectifier load, it is important to maintain harmonic currents at a low level to avoid overload of the transformer and high temperature in the cables.

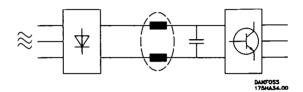
Harmonic currents compared to the RMS input current:

	Input current	
I _{RMS}	1.0	
l ₁	0.9	
l ₅	0.4	
l ₇	0.3	
11-49	< 0.1	

To ensure low, harmonic currents, VLT 6000 HVAC has intermediate circuit coils as standard. This normally reduces the input current I_{RMS} by 40%.

Some of the harmonic currents might disturb communication equipment connected to the same transformer or cause resonance in connection with power-factor correction batteries. VLT 6000 HVAC has been designed in accordance with the following standards:

- IEC 1000-3-2
- IEEE 519-1992
- IEC 22G/WG4
- EN 50178
- VDE 160, 5.3.1.1.2



The voltage distortion on the mains supply depends on the size of the harmonic currents multiplied by the mains impedance for the frequency in question. The total voltage distortion THD is calculated on the basis of the individual voltage harmonics using the following formula:

THD% =
$$\sqrt{U_5^2 + U_7^2 + \cdots U_N^2}$$
 (U_N% of U)

■ Power factor

The power factor is the relation between l_i and l_{RMS} .

The power factor for 3-phase control

$$= \frac{\sqrt{3} \times U \times I_1 \times \cos \phi_1}{\sqrt{3} \times U \times I_{RMS}}$$

Power factor =
$$\frac{I_1 \times \cos \phi_1}{I_{RMS}} = \frac{I_1}{I_{RMS}}$$
 since $\cos \phi = 1$

The power factor indicates the extent to which the frequency converter imposes a load on the mains supply.

The lower the power factor, the higher the I_{RMS} for the same kW performance.

In addition, a high power factor indicates that the different harmonic currents are low.

$$I_{RMS} = \sqrt{I_1^2 + I_5^2 + I_7^2 + \dots + I_n^2}$$

Emission

accordance with the section on electrical installation.

converter system, the motor cables should be as short as possible and the screen ends should be made in In order to minimise the conducted noise to the mains supply and the radiated noise from the frequency

EMC test results (Emission, Immunity)

The following test results have been obtained using a system with a VLT frequency converter (with options if relevant), a screened control cable, a control box with potentiometer, as well as a motor and motor cable.

VLT 6002-6005/200-240V	Environment	Industria	Industrial environment		Housing, trades and light industries		
	Basic standard	EN 55011	EN 55011 Class A1		EN 55011 Class B1		
Setup	Motor cable	Conducted	Radiated	Conducted	Radiated	Conducted/radiated	
		150 kHz-30 MHz	30 MHz-1 GHz	150 kHz-30 MHz	30 MHz-1 GHz	150 kHz-30 MHz	
	300 m unscreened/						
	unarmoured	Yes 1)	No	No	No	Yes/No	
VLT 6000 with	50 m br. screened/						
RFI filter option	armoured (Bookstyle 20m)	Yes	Yes	Yes	No	Yes/Yes	
	150m br. screened/						
	armoured	Yes	Yes	No	No	Yes/Yes	
VLT 6000	300 m unscreened/						
with	unarmoured	Yes	No No	No	No	Yes/No	
RFI-filter	50 m br. screened/				,		
(+ LC-module)	armoured	Yes	Yes	Yes	No	Yes/Yes	
	150m br. screened/						
	armoured	Yes	Yes	No	No	Yes/Yes	
1) Depending on installation conditions							
VLT 6016-6550/380-460 V		Emission					
WTennesenes/smissing	Environment	Industrial enviro	nment	Housing trades a	nd light industries	2	

VLT 6016-6550/380-460 V	Emission						
VLT 6006-6062/200-240 V	Environment	Industrial enviror	nment	Housing, trades ar	nd light industries		
	Basic standard	EN 55011 Clas	s A1	EN 55011 Cla	ass B1		
Setup	Motor cable	Conducted	Radiated	Conducted	Radiated		
		150 kHz-30 MHz	30 MHz-1 GHz	150 kHz-30 MHz	30 MHz-1 GHz		
	300 unscreened/						
VLT 6000 w/o	unarmoured	No	No	No	No		
RFI filter option	150 m br. screened/						
	armoured	No	Yes	No	No		
VLT 6000	300 m unscreened/						
with RFI-module	unarmoured	Yes 1.2)	No	No	No		
	50 m br. screened/		•				
	armoured	Yes	Yes	Yes ^{1, 3)}	No		
	150 m br. screened/						
	armoured	Yes	Yes	l No	No		

1) Does not apply to VLT 6350 - 6550

VLT 6002-6011/380-460V

2) Depending on installation conditions 3) VLT 6100-6125, 380-460 V and VLT 6042-6062, 200-240 V with 176F1818, VLT 6150-6275, 380-460 V with 176F1819





■ EMC Immunity

In order to confirm immunity against interference from electrical phenomena, the following immunity test has been made on a system consisting of a VLT frequency converter (with options, if relevant), a screened/armoured control cable and control box with potentiometer, motor cable and motor.

The tests were made in accordance with the following basic standards:

- EN 61000-4-2 (IEC 1000-4-2): Electrostatic discharges (ESD) Simulation of electrostatic discharges from human beings.
- EN 61000-4-3 (IEC 1000-4-3): Incoming electromagnetic field radiation, amplitude modulated Simulation of the effects of radar and radio communication equipment as well as mobile communications equipment.
- EN 61000-4-4 (IEC 1000-4-4): Burst transients
 Simulation of interference brought about by switching with a contactor, relays or similar devices.
- EN 61000-4-5 (IEC 1000-4-5): Surge transients
 Simulation of transients brought about e.g. by lightning that strikes near installations.
- *ENV 50204:* Incoming electromagnetic field, pulse modulated Simulation of the impact from GSM telephones.
- ENV 61000-4-6: Cable-borne HF
 Simulation of the effect of radio transmission equipment connected to supply cables.
- VDE 0160 class W2 test pulse: Mains transients
 Simulation of high-energy transients brought about by main fuse breakage, switching of power factor-correction capacitors, etc.



Immunity, continued

VLT 6002-6550 380-	460 V, VLT 6002-6	6027 200-240 V					
Basic standard	Burst IEC 1000-4-4	Surge IEC 1000-4-5	ESD 1000-4-2	Radiated electro- magnetic field IEC 1000-4-3	distortion	RF common mode voltage ENV 50141	Radiated radio freq.elect.field ENV 50140
Acceptance criterion	В	В	В	Α		Α	A
Port connection	СМ	DM CM		DM	СМ	DM	
Line	OK	OK OK		-	OK	OK	-
Motor	OK		-	-	-	-	-
Control lines	OK	- OK			-	_ ok	-
PROFIBUS option	OK	- OK	-	- "- "-	- :		-
Signal Interface<3 m	OK			•	-		-
Enclosure			OK	OK OK	<u></u>		OK
Load sharing	OK		-	-	-	OK	-
Standard bus	OK	- OK		-		_ OK	-
Basic specifications							
Line	4 kV/5kHz/DCN	2 kV/2Ω 4 kV/12Ω		-	2,3 x U _{N 2)}	10 V _{BMS}	-
Motor	4 kV/5kHz/CCC		_	-	-	10 V _{RMS}	-
Control lines	2 kV/5kHz/CCC	- 2 kV/2Ω ¹			-	10 V _{RMS}	-
PROFIBUS option	2 kV/5kHz/CCC	- 2 kV/2Ω ¹		·		10 V _{RMS}	-
Signal interface<3 m	1 kV/5kHz/CCC			-	-	10 V _{RMS}	-
Enclosure	-		8 kV AD 6 kV CD	10 V/m	-	-	-
Load sharing	4 kV/5kHz/CCC	-	-	-		10 V _{RMS}	
Standard bus	2 kV/5kHz/CCC	- 4 kV/2Ω ⁻¹	_	-	-	10 V _{RMS}	-

DM: Differential mode CM: Common mode

CCC: Capacitive clamp coupling DCN: Direct coupling network

1) Injection on cable shield 2) 2.3 x U_N: max. test pulse 380 V_{AC}: Class 2/1250 V_{PEAK}, 415 V_{AC}: Class 1/1350 V_{PEAK}



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■ Definitions

Definitions are given in alphabetical order.

Analogue inputs:

The analogue inputs can be used for controlling various functions of the VLT frequency converter. There are two types of analogue inputs:

Current input, 0-20 mA

Voltage input, 0-10 V DC.

Analogue ref.

A signal transmitted to input 53, 54 or 60. Can be voltage or current.

Analogue outputs:

There are two analogue outputs, which are able to supply a signal of 0-20 mA, 4-20 mA or a digital signal.

Automatic motor adjustment, AMA:

Automatic motor adjustment algorithm, which determines the electrical parameters for the connected motor, at standstill.

AWG:

Means American Wire Gauge, i.e. the American measuring unit for cable cross-section.

Control command:

By means of the control unit and the digital inputs, it is possible to start and stop the connected motor. Functions are divided into two groups, with the following priorities:

Group 1 Reset, Coasting stop, Reset and Coasting stop, DC braking, Stop and the [OFF/STOP] key.

Group 2 Start, Pulse start, Reversing, Start reversing, Jog and Freeze output

Group 1 functions are called Start-disable commands. The difference between group 1 and group 2 is that in group 1 all stop signals must be cancelled for the motor to start. The motor can then be started by means of a single start signal in group 2.

A stop command given as a group 1 command results in the display indication STOP.

A missing stop command given as a group 2

command results in the display indication STAND BY.

Digital inputs:

The digital inputs can be used for controlling various functions of the VLT frequency converter.

Digital outputs:

There are four digital outputs, two of which activate a relay switch. The outputs are able to supply a 24 V DC (max. 40 mA) signal.

f_{JOG}

The output frequency from the VLT frequency converter transmitted to the motor when the jog function is activated (via digital terminals or serial communication).

Í٨

The output frequency from the VLT frequency converter transmitted to the motor.

<u>f_{м.N}</u>

The rated motor frequency (nameplate data).

f_{MAX}

Maximum output frequency transmitted to the motor.

<u>f</u>MIN

Minimum output frequency transmitted to the motor.

 I_{M}

The current transmitted to the motor.

M.N

The rated motor current (nameplate data).

Initializing:

If initializing is carried out (see parameter 620 Operating mode), the VLT frequency converter returns to the factory setting.

VLT.MAX

The maximum output current.

VLT.N

The rated output current supplied by the VLT frequency converter.

LCP:

The control panel, which makes up a complete interface for control and programming of VLT 6000 HVAC. The control panel is detachable and may, as an alternative, be installed up to 3 metres away from the VLT frequency converter, i.e. in a front panel, by means of the installation kit option.

LSB:

Least significant bit.

Used in serial communication.

MCM:

Stands for Mille Circular Mil, an American measuring unit for cable cross-section.

MSB:

Most significant bit.

Used in serial communication.

$\square_{M,N}$

The rated motor speed (nameplate data).

η_{VLT}

The efficiency of the VLT frequency converter is defined as the ratio between the power output and the power input.

On-line/off-line parameters:

On-line parameters are activated immediately after the data value is changed. Off-line parameters are not activated until OK has been entered on the control unit.

PID:

The PID regulator maintains the desired speed (pressure, temperature, etc.) by adjusting the output frequency to match the varying load.

P_{MN}

The rated power delivered by the motor (nameplate data).

Preset ref.

A permanently defined reference, which can be set from -100% to +100% of the reference range. There are four preset references, which can be selected via the digital terminals.

Ref_{MAX}

The maximum value which the reference signal may have. Set in parameter 205 *Maximum reference*, *Ref_{Max}*.

<u>Ref_{MIN}</u>

The smallest value which the reference signal may have. Set in parameter 204 *Minimum reference*, Ref_{MIN} .

Setup:

There are four Setups, in which it is possible to save parameter settings. It is possible to change between the four parameter Setups and to edit one Setup, while another Setup is active.

Start-disable command:

A stop command that belongs to group 1 of the control commands - see this group.

Stop command:

See Control commands.

Thermistor:

A temperature-dependent resistor placed where the temperature is to be monitored (VLT or motor).

Trip:

A state which occurs in different situations, e.g. if the VLT frequency converter is subjected to an over-temperature. A trip can be cancelled by pressing reset or, in some cases, automatically.

Trip locked:

A state which occurs in different situations, e.g. if the VLT frequency converter is subject to an overtemperature. A locked trip can be cancelled by cutting off mains and restarting the VLT frequency converter.

U_{M}

The voltage transmitted to the motor.

$abla_{M'}$

The rated motor voltage (nameplate data).

U_{VLT. MAX}

The maximum output voltage.

VT characteristics:

Variable torque characteristics, used for pumps and fans.



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■ Factory settings

PNU .	Parameter	Factory setting	_	hange g ope		Conversion index	Data type
001	description Language	English	duliii	Yes	No	0	5
002	Active Setup	Setup 1		Yes	No	0	 5
003	Copying of Setups	No copying		No	No	0	 5
004	LCP copy	No copying		No	No	0	_ 5
005	Max value of user-defined readout	The state of the s	0 - 999.999,99	Yes	Yes	-2	4
006	Unit for user-defined readout	No unit	000.000,000_	Yes	Yes	0	5
007	Big display readout	Frequency, Hz		Yes	Yes	- 0'	5
008	Small display readout 1.1	Reference , Unit		Yes	Yes	0	- 5
009	Small display readout 1.2	Motor current, A		Yes	Yes	0	5
010	Small display readout 1.3	Power, kW		Yes	Yes	0	5
011	Unit of local reference	Hz		Yes	Yes	0	5
012	Hand start on LCP	Enable		Yes	Yes	.0	5
013	OFF/STOP on LCP	Enable		Yes	Yes	0	5
014	Auto start on LCP	Enable		Yes	Yes	0	5
015	Reset on LCP	Enable		Yes	Yes	.0.	5
01.6	Lock for data change	Not locked		Yes	Yes	l Ò i	- 5
017	Operating state at power-up,	Auto restart		Yes	Yes	0	5
	local control						
100	Configuration	Open loop		No	Yes	0	5
1015	Torque characteristics	Automatic Energy Optimisation		No	Yes	0	5
102	Motor power, P _{M,N}	Depends on the unit	0.25-500 kW	No	Yes	1	6
103	Motor voltage, U _{M,N}	Depends on the unit,	200 - 575 V	No	Yes	0	6
104	Motor frequency, f _{M,N}	50 Hz	24-1000 Hz	No	Yes	0	6
105	Motor current, I _{M,N}	Depends on the unit	0.01 - I _{VLT,MAX}	No	Yes	-2	7
106	Rated motor speed, n _{M,N}	Depends on		No	Yes	0	6
7.08° i		par. 102 Motor power					
107	Automatic motor adaptation, AMA	Optimisation disable		No	No	0	5
108	Start voltage of parallel motors	Depends on par 103		Yes	Yes	1-1	6
109	Resonance dampening	100%	0 - 500 %	Yes	Yes	0	6
110	High break-away torque	OEF	0.0 - 0.5 sec.	Yes	Yes	-1	5
111	Start delay	0.0 sec.		Yes	Yes	-1	6
112	Motor preheater	Disable		Yes	Yes	0	5
113	Motor preheater DC current	50 %		Yes	Yes	0	6
114	DC braking current	50 %	0 - 100 %	Yes	Yes	0	6
1.15.	DC braking time	OFF.	0.0 - 60.0 sec.	Yes	Yes	-1	6
116	DC brake cut-in frequency	OFF , A A A A A A A A A A A A A A A A A A	0.0-par. 202	Yes	Yes	-1	6
117	Motor thermal protection	ETR Trip 1 - 1 - 1 - 1 - 1 - 1		Yes	Yes	0	5



■ Factory settings

PNU	Parameter	Factory setting	Range C	hange	s 4-Setup	Conversion	Data
#	description		during	oper	ation	index	type
200	Output frequency range	0 -120 Hž	0 - 1000 Hz	No	Yes	0,	5
201	Output frequency low limit, f _{MIN}	0.0 Hz	0.0 - I _{MAX}	Yes	Yes	-1 ***	6
202	Output frequency high limit, fwax	50 Hz	f _{min} - par. 200	Yes	Yes	-1-	6
203	Reference site	Hand/Auto linked reference		Yes	Yes	0.	5
204	Minimum reference, Ref _{MIN}	0.000	0.000-par. 100	Yes	Yes	-3	4
205	Maximum reference, Ref _{MAX}	50.000	par. 100-999.999,999	Yes	Yes	-3	4
206	Ramp-up time	Depends on the unit	1 - 3600	Yes	Yes	0	7
207	Ramp-down time	Depends on the unit	1 - 3600	Yes	Yes	.0	7
208	Automatic ramp-up/down	Enable		Yes	Yes	.0	5
209	Jog frequency	10.0 Hz	0.0 - par. 100	Yes	Yes	-1	6
210	Reference type	Sum		Yes	Yes	0.	5
211	Preset reference 1	0.00 %	-100.00 - 100.00 %	Yes	Yes	-2	3
212	Preset reference 2	0.00 %	-100.00 - 100.00 %	Yes	Yes	-2	3
213		0.00%	-100.00 - 100.00 %	Yes	Yes	- / 2.	3
214	Preset reference 4	0.00%	-100,00 - 100,00 %	'Yes	Yes	-2-	3
215	Current limit, IUM	il.Ő x l _{vij} [A]	0,1-1,1 x l _{vltn} [A]	Yes	Yes	-1 s	6
216	Frequency bypass, bandwidth	O Hż	0 - 100 Hz	Yes	Yes	0 .	6
217	Frequency bypass 1	120 Hz	0.0 - par. 200	Yes	Yes	-10	6
218.	Frequency bypass 2		0.0 - par. 200	Yes	Yes	-1	6
219	Frequency bypass 3	120 Hz	0.0 - par. 200	Yes	Yes	71	6
220	Frequency bypass 4	120 Hz	0.0 - par. 200	Yes	Yes	31	6
221	Warning: Low current, ILOW	0.0 A	0.0 - par. 222	Yes	Yes	-1.	6
222	Warning: High current, I _{HIGH}	NIT,MAX	Par. 221 - I _{VLT,MAX}	Yes	Yes	-1/ J	6
223	Warning: Low frequency, fLow	0.0 Hz	0.0 - par. 224	Yes	Yes	-1	6
224	Warning: High frequency, f _{HIGH}	120.0 Hz	Par. 223 - par. 200/202	Yes	Yes	-1	6
225	Warning: Low reference, Ref _{Low}	999,999,999	-999,999.999 - par. 226	Yes	Yes	-3,	4
226	Warning: High reference, Ref _{High}	999,999 999	Par. 2 25 - 999,999.999	Yes	Yes	-3	4
227	Warning: Low feedback, FB _{LOW}	999,999.999	-999,999.999 - par. 228	Yes	Yes	-3	4
228	Warning: High feedback, FB _{HGH}	999,999 999	Par. 227 - 999,999.999	Yes	Yes	-3*-	4

Changes during operation:

"Yes" means that the parameter can be changed, while the VLT frequency converter is in operation.
"No" means that the VLT frequency converter must be stopped before a change can be made.

4-Setup:

"Yes" means that the parameter can be programmed individually in each of the four setups, i.e. the same parameter can have four different data values. "No" means that the data value will be the same in all four setups.

Conversion index:

This number refers to a conversion figure to be used when writing or reading to or from a VLT frequency converter by means of serial communication.

Conversion index	Conversion factor
74	0.1
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001

Data type:

Data type shows the type and length of the telegram.					
Data type	Description				
3	Integer 16				
4	Integer 32				
5	Unsigned 8				
6	Unsigned 16				
7	Unsigned 32				
9	_Text string				

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■ Factory settings

PNU	Parameter	Factory setting	Range	Changes 4-9	Setup Conversi	on Data
#	description			during operation	, index	- type
300	Terminal 16 Digital input	Reset		Yes	Yes 0	5
301	Terminal 17 Digital input	Freeze output		Yes	Yes 0	5
302	Terminal 18 Digital input	Start "		Yes `	Yes 0	5
303	Terminal 19 Digital input	Reversing		Yes	Yes 0	5
304:	Terminal 27 Digital input	Coasting stop, inverse		Yes `	Yes 0	5
305	Terminal 29 Digital input	Jog		Yes	Yes 0	5
306	Terminal 32 Digital input	No operation		Yes	Yes 0	5
307	Terminal 33 Digital input	No operation		Yes	Yes 0	5
308	Terminal 53, analogue			1	2	
11/4	input voltage	Reference			Yes 0	5
309	Terminal 53, min. scaling	0.0 V	0.0 - 10.0 V	Yes	Yes -1	5
310	Terminal 53, max. scaling		0.0 - 10.0 V	Yes	Yes -1	5
311	Terminal 54, analogue					
33.6	input voltage	No operation		Yes	Yes 0	5
312	Terminal 54, min. scaling	0.0 V	0.0 - 10.0 V	Yes	Yes -1	5
313	Terminal 54, max. scaling	10:01V	0.0 - 10.0 V	Yes	Yes -1'	5
314:	Terminal 60, analogue input					
1	current	Reference		Yes	Yes 0	5
315	Terminal 60, min. scaling	4.0 mA	0.0 - 20.0 mA	Yes '	Yes -4	5
316	Terminal 60, max. scaling	20.0 mA	0.0 - 20.0 mA	Yes Y	Yes -4	5
317	Time out	10,sec.	1 - 99 sec.	1 , 1	Yes 0	5
318	Function after time out	On the second second		Yes .	Yes 40	5
319	Terminal 42, output	0 - I _{MAX} ⇒ 0-20 mA			Yes 0	5
320	Terminal 42, output,					
1 2	pulse scaling	5000 Hz	1 - 32000 Hz	Yes `	Yes 0	6
321	Terminal 45, output	0 = f _{Max} ⇒ 0-20 mÅ		Yes `	_{Yes} 0	5
322	Terminal 45, output,					
30	pulse scaling	5000 Hz	1 - 32000 Hz	Yes	yes 0	6
323	Relay 1, output function			Yes	Yes 0	5
324	Relay 01, ON delay	0.00 sec	0 - 6 00 sec.	Yes	Yes 7.0	6
325	Relay 01, OFF delay	0.00 sec.	0 - 600 sec.	Yes	Yes 0	6
326	Relay 2, output function	Running			Yes 0,	5
327	Pulse reference,	5000 Hz	Depends on	1	Yes 0	6
	max. frequency		input terminal		30.0	
328		25000 Hz			Yes . 0	6

Changes	مرينام	an aration.
Unandes	aurina	operation:

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4-Setup:

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"Yes" means that the parameter can be programmed individually in each of the four setups, i.e. the same parameter can have four different data values. "No" means that the data value will be the same in all four setups.

Conversion index:

This number refers to a conversion figure to be used when writing or reading to or from a VLT frequency converter by means of serial communication.

Conversion index	Conversion factor
74	0.1
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001

Data type:

Data type shows the	type and length of the telegram.
Data type	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string



■ Factory settings

PNU	Parameter	Factory setting	Range Cl	nange	s 4-Setup	Conversion	n Data
#	description		during	oper	ation	index	type
400	Reset function	Manual reset		Yes	Yes	0	5
401	Automatic restart time	10 sec.	0 - 600 sec.	Yes	Yes	.0	6
402	Flying start	Disable		Yes	Yes	-1	5
403	Sleep mode timer	Off	0 - 300 sec.	Yes	Yes	0]	6
404	Sleep frequency	0 Hz	f _{min} - Par. 405	Yes	Yes	-1	6
405	Wake up frequency	50 Hz	Par. 404 - f _{max}	Yes '	Yes	÷1,	6
406	Boost setpoint	100%	1 - 200 %	Yes	Yes	0	6
407	Switching frequency	Depends on the unit	3.0 - 14.0 kHz	Yes	Yes	2	5
408	Interference reduction method	ASFM		Yes	Yes	0	5
409	Function in case of no load	Warning		Yes.	Yes	0	5
410	Function at mains failure	Trip		Yes	Yes	0	5
411	Function at overtemperature	Trip		Yes	Yes	0	5
412°	Trip delay overcurrent, I _{UM}	60 sec	0 - 60 sec.	Yes	Yes	.0	5
4.13.	Minimum feedback, FB _{MIN}	0.000	-999,999.999 - FB _{мін}	Yes	Yes	-3	4
414	Maximum feedback, FB _{MAX}	100.000	FB _{MIN} - 999,999.999	Yes	Yes	-3	4
415	Units relating to closed loop	%		Yes	Yes	113	5
416	Feedback conversion	Einear		Yes.	Yes	0	5
417	Feedback calculation	Maximum		Yes	Yes	0	5
418	Setpoint 1	.0.000	FB _{MIN} - FB _{MAX}	Yes	Yes	-3	4
419	Setpoint 2	0.000	FB _{MIN} - FB _{MAX}	Yes	Yes	3	4
420	PID normal/inverse control	Normal		Yes	Yes	0.1	5
421	PID anti windup	On		Yes	Yes	-0	5
422	PID start-up frequency	0 Hz	fmin - fmax	{	•	-1	6
423	PID proportional gain	0.01	0.00 - 10.00	Yes	Yes	-2	6
424	PID integration time	Off	0.01 - 9999.00 s. (Off)	Yes	Yes	-2	7
425	PID differentiation time	Off Control	0.0 (Off) - 10.00 sec.	Yes	Yes	-2	6
426	PID differentiator gain	5:0 3:5 3:4	5.0 - 50.0	Yes	Yes	-1	6
· 1	limit	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1		"			
427	PID lowpass filter time	0.01 *	0.01 - 10.00	Yes	Yes	-2	6



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■ Factory settings

5	- D	C	D	han==	4 Cotton 1	Conversion	Data
PNU		Factory setting	- ·			Conversion index	type
#. 500	description Protocol	FC protocol	during	opera Yes	Yes	0	, type 5
1		1	Dangards on par 500	Yes	No	0	6
501 502	Address Baudrate	1 9600 Baud	Depends on par. 500	Yes	No No	0,0	5
1		1		Yes	Yes	0	
503	Coasting	Logic or		1 . 1	Yes	0.	<u>5</u>
504 505	DC-brake	Logic or		Yes	Yes	Ŏ	
506	Start Direction of rotation	Logic or	<u> </u>	Yes	Yes	0	5
507		Logic or		Yes	Yes	0	5
508	Selection of Setup Selection of preset reference	Logic or Logic or		Yes	Yes	Ö	5
509		Logic or	1	No	No	-1	3
510	Data read-out: Reference % Data read-out: Reference unit			No	No	-3	4
511.				No		-3	4
512	Data read-out: Frequency		-	7	No.	-1	6
513	Data read-out: Frequency User defined read-out			No.	No No	-2	7
		- 1		1		-2	
514	Data read-out: Current			No	No	1 3 3	
515	Data read-out: Power, kW			No .	No	1 1	7
516	Data read-out: Power, HP			No	No	-2	6
517	Data read-out: Motor voltage			No	No No	-1	6
518	Data read-out: DC link voltage			No	No	0	5
519	Data read-out: Motor temp.			INo	No	10.	
520	Data read-out: VLT temp.			No	No No	0	5
521	Data read-out: Digital input	 		No	No	0 1	
522	Data read-out: Terminal 53, analogue			No -	No_	1-1-	3
523	Data read-out: Terminal 54, analogue	1 * * * * * * * * * * * * * * * * * * *	_	lNo .	No No	4	3
524	Data read-out: Terminal 60, analogue		£	No	No No	-	3
525				No	No	-1:	7
526	Data read-out: External reference %			No	No	-1	3
527				No	No	0	6
528	Data read-out: Heat sink temperature			No	No	1 31	5
529	Data read-out: Alarm word, hex			No	No	0	7
530	Data read-out: Control word, hex			No .	No	0 .	6
531	Data read-out: Warning word, hex		· !	No:	No	0	7
532	Data read-out: Extended status word, hex	(No	No	0	7
533	Display text 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	, s	No	No	.0.	9
534	Display text 2	1 2 5 7 4 6 1 Mg/2	1	No	No	0	9
535	Busfeedback 1	* * * * * * * * * * * * * * * * * * *	; ;	No	No	0	3
536	Busfeedback 2			No	No_	0.	3
537	Data read-out: Relay status			No	No	0	5
555	Bus time interval	II SEC.	1 - 99 sec.	Yes	Yes	0.	5
556	Bus time interval function	OFF		Yes	Yes	0	5
560	N2 Override release time	ÖFF	1 - 65534 sec.	Yes	No	-0	6
565	FLN Bus time interval	60 sec.	1 - 65534 sec.	Yes	Yes	0.	6
566	FLN Bus time interval function	OFF .	1	Yes	Yes	0	5



■ Factory settings

PNU	Parameter	Factory setting	Range Chang	es 4-Setup	Convérsio	n Data
# .	description		during ope	eration	index	type
600	Operating data: Operating hours		No	No_	74	7
601	Operating data: Hours run	خم ر ر	No	No	₀ 74	7
602	Operating data: kWh counter		No	No	3	7
603	Operating data: No. of cut-ins		No	No	0	6
604	Operating data: No. of overtemps		No	No	0	6
605	Operating data: No. of overvoltages	6	No	No.	0	6
606	Data log: Digital input		No	No	0	5
607	Data log: Control word	Sparse of	No	No	0	6
608	Data log: Status word		No	No	0	6
609	Data log: Reference		No	No	-1	3
610	Data log: Feedback		No	No	-3	4
61.1	Data log: Output frequency		No	No	7-17	3
612	Data log: Output voltage	153	No	No	-1	6
613	Data log: Output current	Hay I St. Brigh	No	No	-2	3
614	Data log: DC link voltage	10-24-16-3	No	No	0	6
615	Fault log: Error code		No	No	1.0	5
616	Fault log: Time	E martit the mil	No	No	.0	7
617	Fault log: Value		-No	No	0	3
618	Reset of kWh counter	No reset	Yes	No	Ö	5
619	Reset of hours-run counter	No reset	Yes	No	0	5
620	Operating mode	Normal function	Yes	No	.0;	5
621	Nameplate: Unit type		No	No	0	9
622	Nameplate: Power component	- 1 / 2	No	No	0	9
623	Nameplate: VLT ordering no.		No	No	0	9
624	Nameplate: Software version no.	# 35	No	No	.0.	9
625	Nameplate: LCP identification no.		No	No	0.	9
626.	Nameplate: Database identification no.		No	No	-2	9
627	Nameplate: Power component		1			
* * * * * * * * * * * * * * * * * * * *	identification no.		No.	. No	0	9
628	Nameplate: Application option type	Constitution of the	No	No	0	9
629	Nameplate: Application option ordering no.		No	No	0	9
630	Nameplate: Communication option type	and a second second	·No	No	0	9
631 %	Nameplate: Communication option	en de la companya de la companya de la companya de la companya de la companya de la companya de la companya de		į		
	ordering no.		No	. No	0	9
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Conversion index:

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Conversion factor
0.1
100
10
1
0.1
0.01
0.001
0.0001

Data type.	
Data type shows the type	and length of the telegram.
Data type	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string

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Data tuna:



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TECHNICAL DATA SHEET

For

SPS 296

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Surge Diverter

Location:

Main Incomer

Model Numbers:

TDS-180S-277

Manufacturer:

Critec

Supplier:

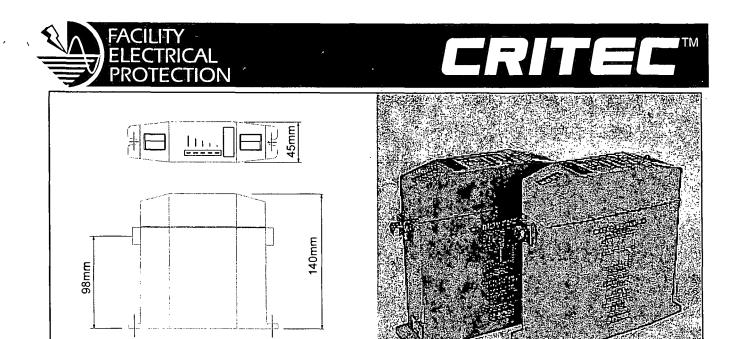
SCA Distributors

178 Wecker Road

MANSFIELD QLD 4122

Ph: 07 3849 5077

Fx: 07 3849 7035



Detailed Specifications for ERICO's TDS-MOVTEC SURGE DIVERTER TDS-MT-277

Applications

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

140mm

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

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

Since 75% of all lightning strikes comprise multiple strokes through the one air to ground channel, often as little as 30 milliseconds apart, conventional MOVs can rapidly accumulate heat and self destruct just when they are most needed. TDS-MOVTECs are high capacity surge diverters and are the most advanced surge protection devices currently in place to offer low let through levels at sites with poor voltage regulation. Internal electronics continuously monitor TDS-MOVTEC protection, and their status is displayed on a 5-segment LED bar graph. Alarm contacts are provided which may be used to shut down the system or activate an external warning if the internal surge material is below optimum condition.

Features

- Robust against abnormal over-voltage
- UL1449 Edition 2 compliant (pending)
- Single phase primary protection for extremly high exposure sites and pointof-entry protection applications
- Single mode protection, configurable to Ph-N, Ph-E or N-E protection
- Small foot print for more effective use of realestate.
- Fail safe voltage free alarm contacts
- 5 segment electronic status indication ideal for poorly illuminated locations
- · Long Service life
- Lug terminals for connection of large cables



TDS-MOVTEC SURGE DIVERTER TDS-MT-277

SPECIFICATIONS

Operation:

Nominal input voltage 220 -277 Vrms

> Input frequency 50/60 Hz

Max. permissible abnormal over-voltage

480 Vrms TN-C, TN-S, TN-C-S (MEN), TT

Power systems Earth leakage current

Protection:

Ph-N, Ph-E or N-E Modes

Let through voltage @ 3kA 8/20µs <740V

Let through voltage @ 20kA 8/20µs <970V

Surge rating 8/20µs

Surge rating 10/350µs 20kA

> Energy rating 4800J

Multipulse™ capability Yes

Aggregate surge material

Alarms and Indicators:

200kA 8/20µs

Protection status indication

5-segment LED bar graph

User configurable alarm contacts

Voltage free relay contact (NO)

Breakdown isolation

MOVTEC alarm actuation point ≤60% status (two LEDs off)

Physicals:

Operating conditions

Enclosure style

-35 to +55°C, 0-90% humidity

Proprietry

Dimensions (W x D x H)

45 x 140 x 140mm

Weight 600g (approx.)

Encapsulation Shockguard

Enclosure material Flame Retardent UL94V-0

Surface finish Highly Polished

Wiring terminals M6 Swift Thread and Bolt

Warranty 5 years

Test standards:

UL1449 Edition 2 (pending) Approvals

AS 3260, IEC 950

C-Tick

Certificate of suitability,

Electricity Regulator

Surge rated to meet

ANSI/IEEE C62.41-1991 Cat A, Cat B, Cat C.

ANSI/IEEE C62.45-1987 Life cycle testing.

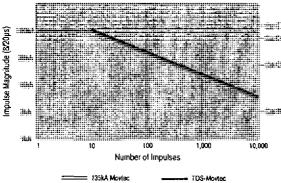
AS/NZS 1768-1991 Cat A, Cat.B, Cat C.

BS 6651:1992 Cat A, Cat B.

IEC801-5 Installation Class 5.

IEC 61643-1

Estimated Life of MOVTEC and TDS-MOVTEC



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

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Description

TDS-MT-277

TDS MOVTEC 220-277V 100KA

Hobart Sydney Melbourne

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fax:+61 3 6273-0399 fax:+61 2 9980-5092 fax:+61 3 9894-3216

Adelaide Pedh Singapore

ph:+61 8 8386-6555 ph:+61 8 9358-1233 ph:+ 65-763-2477

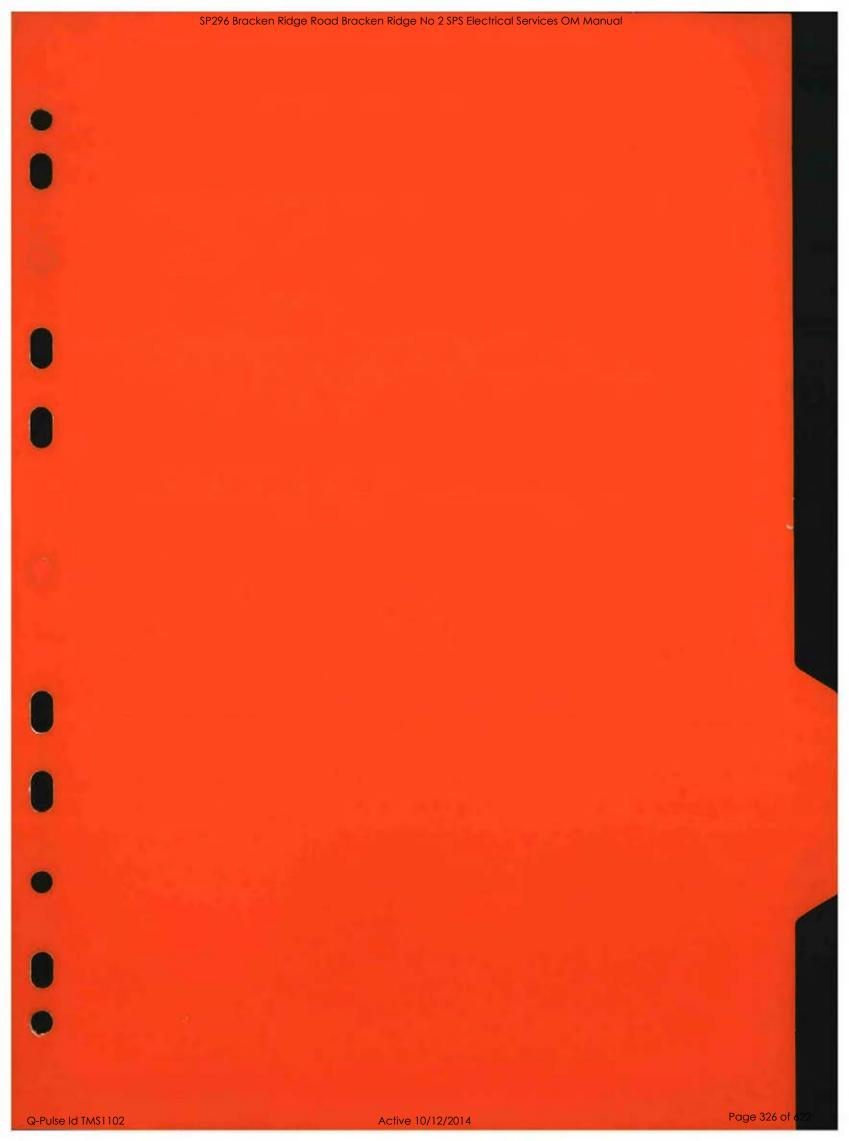
fax:+61 8 8366-6556 fax:+61.8.9358-1404 fax:+ 65 763-2397



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SP296 Bracken Ridge Road Bracken Ridge No 2 SPS Electrical Services OM Manual Page 325 of Q-Pulse Id TMS1102 Active 10/12/2014





For

SPS 296

Equipment Type: Surge Diverter

PLC/RTU Cubicle Location:

Model Numbers: TDF-10A-240V

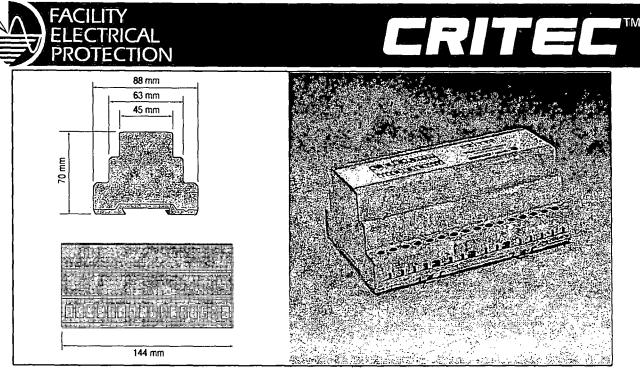
Manufacturer: Critec

Supplier: **SCA Distributors**

178 Wecker Road

MANSFIELD QLD 4122

Ph: 07 3849 5077 Fx: 07 3849 7035



Detailed specifications for ERICO's

TRANSIENT DISCRIMINATING FILTER, TDF-10A SERIES

Applications

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

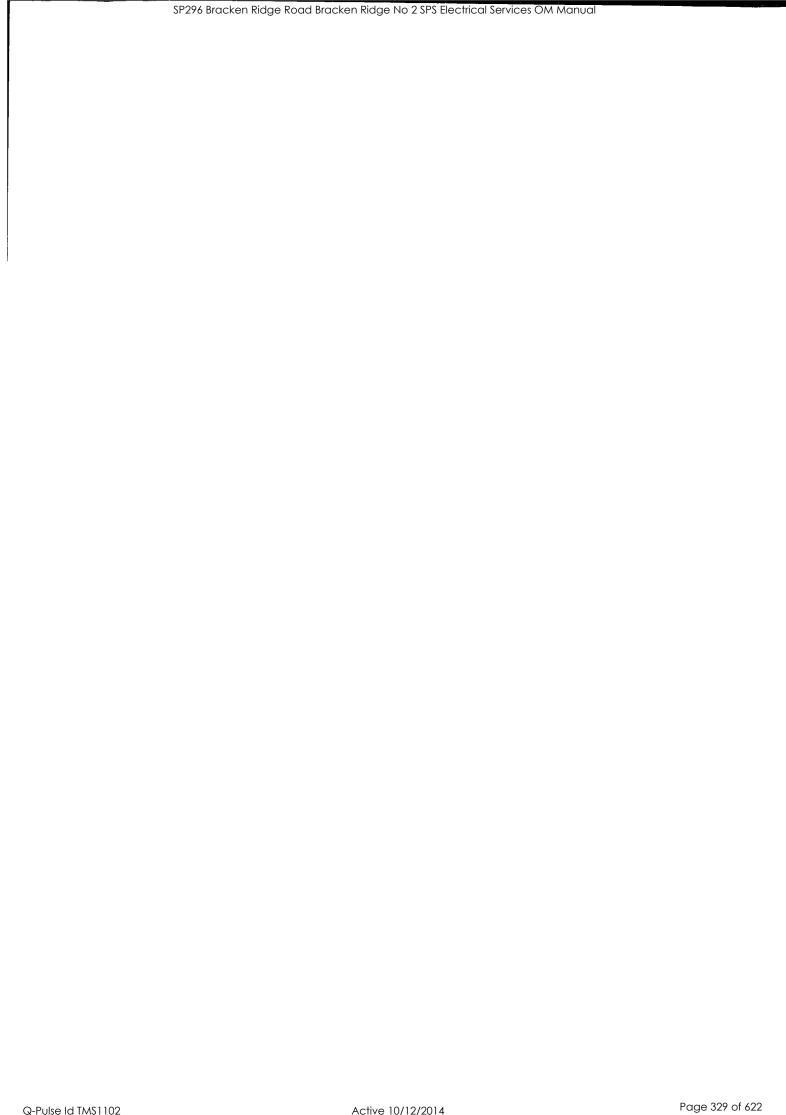
'DF series has been specifically designed for process control applications to protect the switched mode power supply units on devices such as PLC controllers, SCADA systems and motor controllers. Units are available for 3A, 10A and 20A loads and in a range of clamping voltages ncluding 30V, 150V, 275V.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

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

Features

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





PROCESS CONTROL TVSS PROTECTION

SPECIFICATIONS

Operation:

Models available TDF-10A-120V 120VAC/125VDC TDF-10A-240V 240VAC

340Vrms

Nominal line voltage Max Continuous Operating Voltage MCOV

170Vrms

Max Load Current 10A

Input frequency 50/60Hz

Earth leakage current <0.2mA

Protection:

Max aggregate surge rating 50kA 8/20µs

Protection modes L-N, L-G and N-G

Max surge current/mode L-N 20kA 8/20µs

> L-G 20kA 8/20µs

> N-G 10kA 8/20us

SPD circuit description Series low pass LC filter

Transient Discriminating Technology

Thermal fusing

Filter:

Inductor Ferrite cored

Capacitor type X & Y grade interference suppression

polypropylene film

Attenuation @100kHz L-N 65dB

Performance:

UL1449 SVR L-N 500V 700V

ANSI/IEEE C62.41 Cat B3 - 500A ringwave

22V

28V

Cat C1 - 3kA, 8/20µs

262V

481V

Alarms and Indicators:

Protection status indication

Red LED, On = OK. Opto-isolated output

Physical Data:

Dimensions($W \times D \times H$)

144mm x 88mm x x70mm 750g (approx)

Weight

Enclosure material Flame Retardant UL94V-O

Connection means Screw terminals

Wire size 1.0mm² - 6.0mm²

Mounting method DIN T35 Rail

Enclosure style DIN 43880

Environmental rating IP20

Opearting temperature -30°C to +55°C

Humidity 0-90%

Surface finish Spark eroded finish

Warranty

Test standards: Approvals

UL1449 Ed 2, UL1283 recognised, CSA22.2

C-Tick AS3260

Surge rated to meet ANSI/IEEE C62.41 Cat A, Cat B, Cat C

AS/NZS 1768-1991 Cat A, B, C

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Part Number Description

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

Sydney Melbourne ph:+61 3 6237-3200 ph:+61 2 9479-8500 ph:+61 3 9894-2677

fax:+61 3 6273-0399 fax:+61 2 9980-5092 fax+61 3 9894-3216 fax:+61 2 6257-3127

CAITEC

TDF 104 24M

Perth Singapore

ph:+61 8 8366-6555 ph:+61 8 9358-1233 ph:+ 65-763-2477 ph:+ 662 627-9037-8

fax:+61.8.8366-6556 fax:+61 8 9358-1404 fax:+ 65 763-2397 fax:+662 627-9168



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For

SPS 296

Equipment Type: Surge Diverter

Location: Main Incomer

Model Numbers: TDS-AR

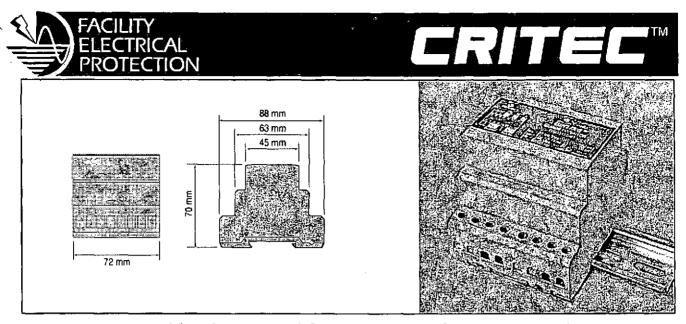
Manufacturer: Critec

Supplier: SCA Distributors 178 Wecker Road

MANSFIELD QLD 4122

Ph: 07 3849 5077

Fx: 07 3849 7035



Detailed Specifications for ERICO's TDS-DINLINE ALARM RELAY TDS-AR

Applications

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

The TDS-DINLINE products provide internal monitoring and visual indication of their protection status. Because it is important that the status protection be monitored to ensure that optimum protection is being provided, the indication circuit also provides a low voltage optocoupler alarm output circuit. The TDS-AR connects to the TDS-DINLINE opto-coupler outputs and provides a fully isolated potential free change-over alarm contact.

For installations not readily accessible, or for remote or unattended locations, it is recommended that the status of the TDS-DINLINE units be monitored via the TDS-AR Alarm Relay. This will allow prompt detection if optimum protection is not being provided at that site. Only the TDS-AR should be used for remote monitoring of TDS-DINLINE products, as use of other interfaces may cause damage to the diverters or connected circuits.

One TDS-AR can be used with up to 20 opto-coupler outputs. Opto-coupler outputs can be connected in series to the one TDS-AR to provide a common output. This allows for one TDS-AR unit to monitor an entire three phase TDS-DINLINE protection system. It is recommended that the TDS-AR unit be powered from the downstream power circuit that feeds to the units being monitored. However it can be supplied from other circuits. The wide input range of the TDS-AR power supply (100-480Vrms) allows it to be used on many distribution systems.

Features

- Retrofittable TDS Alarm Relay for Transient Discriminating DINLINE Surge Diverters
- UL1449 Edition 2 compliant
- For use with external alarm and monitoring systems
- · Potential free change over contacts
- 4000V isolation
- 35mm DIN rail mount, DIN 43 880 profile matches common MCBs
- 72mm width compact design fits into most switch and distribution boards
- Electronic indicators ideal for poorly illuminated locations
- For use with up to 20 DINLINE opto coupler outputs
- 100-480Vrms operating range

The TDS-AR can also be used with standard technology DINLINE

CADUELD* CRITEC* ERITECH*
WELDED ELECTRICAL CONNECTIONS SURGE PROTECTION DEVICES LIGHTHING PROTECTION/GROWNING

TDS DINLINE ALARM RELAY TDS-AR

SPECIFICATIONS

Operation: Input voltage

Power systems

100V-480Vrms

Max. operating voltage

480Vrms

TN-C, TN-S, TN-C-S (MEN), TT

Surge immunity:

Power supply

3kA 8/20µs, Cat B AS-1768

Output contacts:

Contact types

Change over 2A, 30VDC

Nominal switching capacity Maximum switching power

60W, 125VA

Maximum switching voltage Maximum switching current 220VDC, 250VAC

Isolation to other circuits

Physicals:

Environmental rating IP20

Operating conditions

-35 to +55°C, 0-90% humidity

Enclosure style DIN 43880

Dimensions (W x D x H)

72 x 88 x 70mm

Weight 350g (approx.)

Shockguard

Encapsulation

Enclosure material Flame Retardent UL94V-0

Surface finish Spark eroded finish

Wiring terminals Accepts up to 6mm² Warranty

5 years

Test standards:

Approvals

AS 3260, IEC 950

C Tick

ACA TS001

Certificate of suitability, Electricity Regulator

	Number of Opto	-couplers:
	One DAR-275V	One TDS-AR
Product	can support	can support
DSD140-2S/DSD155-2T		
DSF-10A-XXX/DSF-20A-XXX	1-8	1-20
DSD180-4S/DSD1110-4T	1-4	1-10
DSD1160-8S/DSD1220-8T	1-2	1-5
DSD355-8T	1-2	1-6
TDS140-XXX	- 1	1-20
TDS180-XXX	-	1-10
TDS1160-XXX		1-5

Note: For specifications on other DINLINE products, refer to relevant Specifications Sheet.

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Description

TDS-AR

TDS ALARM RELAY

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fax:+61 3 6273-0399 fax:+81 2 9980-5092 fax:+61 3 9894-3216

ph:+61 8 8366-6555 Perth ph:+61 8 9358-1233 Singapore ph:+ 65-763-2477 ph:+ 662 627-9037-8

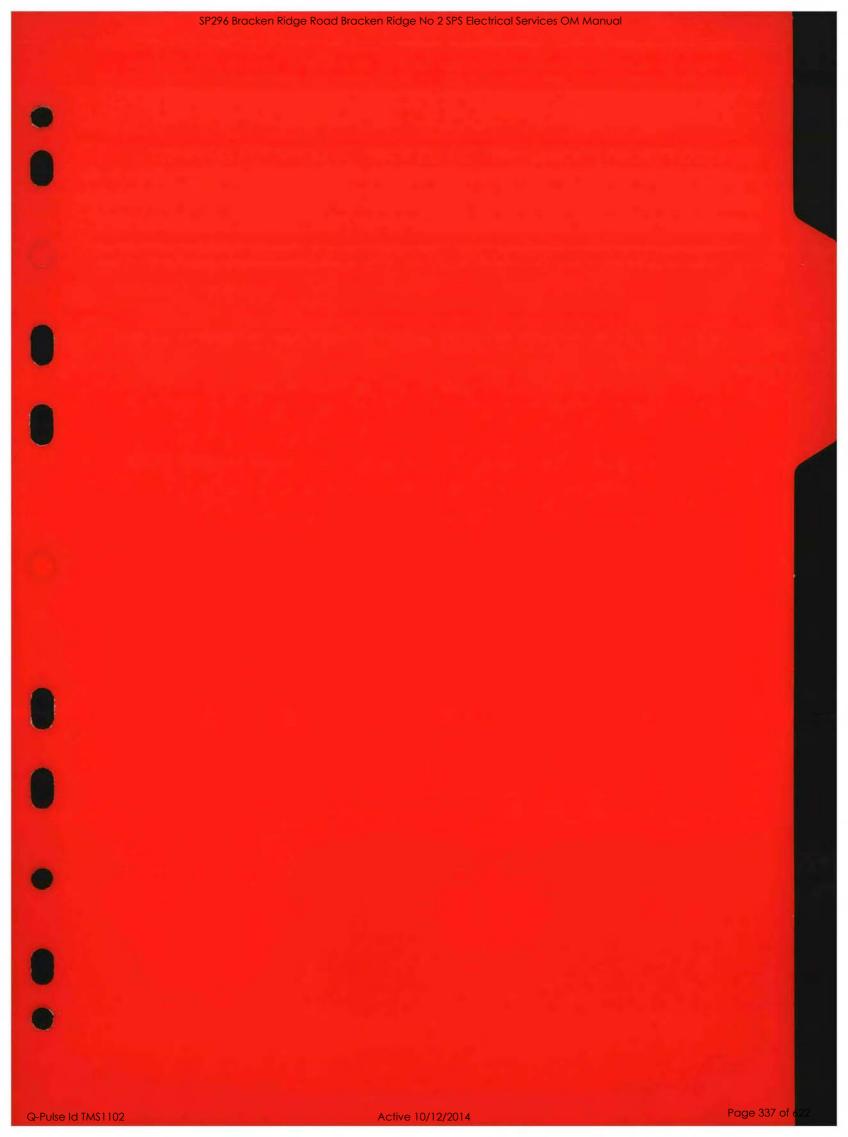
(ax+61 8 9358-1404 fax:+ 65 763-2397 fax:+662 627-9168

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Q-Pulse Id TMS1102 Active 10/12/2014 Page 336 of 622





For

SPS 296

Equipment Type:

Phase Failure Relay

Location:

Common Control

Model Numbers:

252-PS

Manufacturer:

Crompton

Supplier:

Alstrom.

3/7 Miller Street

Murrarie QLD 4172

Ph: 07 3890 4412 Fx: 07 3890 4413

Q-Pulse Id TM\$1102 Active 10/12/2014 Page 338 of 622

50PMSH Edition 4 April 1997

Thermistor Trip, Speed Sensing, Phase Angle Protector Relay Installation Instructions



Models Covered

252-PMM 252-PMT 252-PSF 252-PSG 253-PH3 252-PMM 252-PMT

Introduction

Thermistor Trip Relay (252-PMM & 252-PMT)

Tip inputs are monitored within settable limits. In the event of the input moving outside these limits, the unit will initiate a trip signal via a double pole changeover relay. An illuminated green LED indicates when the thermistor temperature is within normal working limits.

The unit is designed such that the alarm relay is energised at normal temperatures is reached, until manual intervention occurs.

el 252-PMM has the facility for manual resetting, so that rip condition remains after normal operating temperature is reached, until manual intervention occurs.

Installation

The Protector should be installed in a dry position, not in direct sunlight and where the ambient temperature is reasonably stable and will not be outside the range 0 to 60 degrees Celsius. Mounting will normally be on a vertical surface but other positions will not affect the operation and vibrations should be kept to a minimum. The Protectors are designed for mounting on a 35mm rail to DIN 46277. Alternatively they may be screw fixed, a special adaptor can be supplied to mount 252 types.

To mount a protector on a DIN rail, the top edge of the cutout on the back is hooked over one edge of the rail and the bottom edge carrying the release clip clicked into place. Check that the unit is firmly fixed. Removal or repositioning may be achieved by levering down the release clip and lifting the unit up and off the rail.

ase Balance Relay (252-PSF & 252-PSG)

Trip inputs are monitored within settable limits. In the event of the input moving outside these limits, the unit will initiate a trip signal via a double pole changeover relay. An illuminated red LED indicates that the supply is within limits.

Speed Sensing Relay (253-PH3)

Trip inputs are monitored within settable limits. In the event of the input moving outside these limits, the unit will initiate a trip signal. The illuminated red LED's indicates that the single pole output relays are in an energised state and at normal running speed all three relays should be energised. Units are factory adjusted for normal running speed = 0.75mA output. The meter adjust pot on the product front is used for this requirement, which also ensures the trip levels are set to the calibrated values. Terminal 8 is connected to terminal 5 internally. Terminals 15 and 16 give a 0/1mA signal proportion to speed. Terminal 8 is connected to terminal 5 internally.

- No.1 Relay energises on rising speed
 -).2 Relay energises on rising speed
 - 5.3 Relay de-energises on rising speed

This product is designed for use only with magnetic coil inductive sensors.

252-PMM, 252-PMT & 253-PH3

Pick up, input and output leads should be kept separate from any other wiring.

Setting Controls (252-PSF, 252-PSG)

These products have two calibration facilities which can be set to suit operating requirements and they are factory calibrated as follows:-

- % unbalance set points
 Voltages of and below 380 volts L-L are calibrated to 1.0% class index of rated voltage. Voltages above 380 volts L-L are calibrated to 1.5% class index of rated voltage.
- Time Delay For all voltage ranges 10% maximum delay.
- Voltage Withstand
 Continuous overload = 1.35 x rated voltage

Setting Up (all other models)

The calibration marks around the controls are provided as a guide if the installer does not have access to accurate equipment. The maximum error of the calibration marks is typically 10% of the span of the control concerned.

Maintenance

The unit should be inspected to normal standards for this class of equipment. For example remove accumulations of dust and check all connections for tightness and corrosion. In the unlikely event of a repair being necessary it is recommended that the unit is returned to the factory or to the nearest Crompton Instruments Service Centre, (details on page 2). Should repair be attempted then replacement components must be of the same type, rating and tolerance as those used in the original circuit. It is important that should calibration be deemed necessary, say after repair, then this should only be attempted if the required high accuracy equipment is available. With any enquiry please quote the full model number found on the side label. The unit must be recalibrated after repair.

Electromagnetic Compatibility (EMC) Installation Requirements

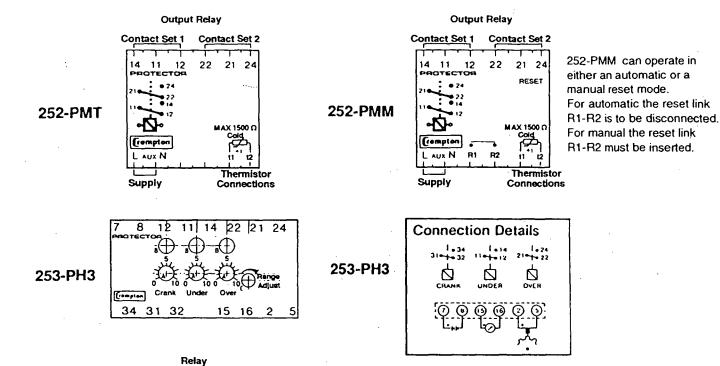
This product range has been designed to meet the certification requirements of the EU Directives when installed to a good code of practice for EMC in industrial environments. e.g.

- 1. Screen output and low signal input leads. In the event of RF fields causing problems where screened leads can not be used, provision for fitting RF suppression components, such as fernite absorbers, line filters Etc., must be made.
- N.B. It is good practice to install sensitive electronic instruments, that are performing critical functions, in EMC enclosures that protect against electrical interference causing a disturbance in function.
- 2. Avoid routing leads alongside cables and products that are, or could be, a source of interference.
- 3. To protect the product against permanent damage, surge transients must be limited to 2kV pk.
- 4. Electro Static Discharge (ESD) precautions must be taken at all times when handling this product.

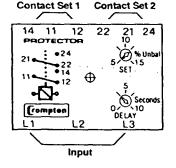
For assistance on protection requirements please contact your local sales office.

IW250PMSH Edition 4 April 1997.

Connection Diagrams



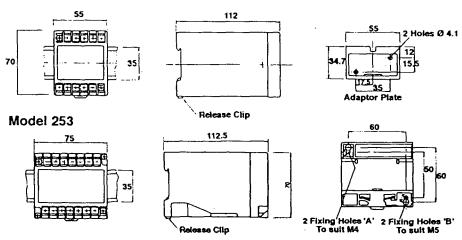
252-PSF 252-PSG



Connection diagrams should carefully followed to ensure correct polarity and phase rotation where applicable. External voltage transformers may be used on 252-PSF and 252-PSG to extend the range. Connection wires should be sized to comply to applicable regulations and codes of practice. These products do not have internal fuses therefore external fuses must be used for safety protection under fault conditions.

Dimensions in mm

Model 252

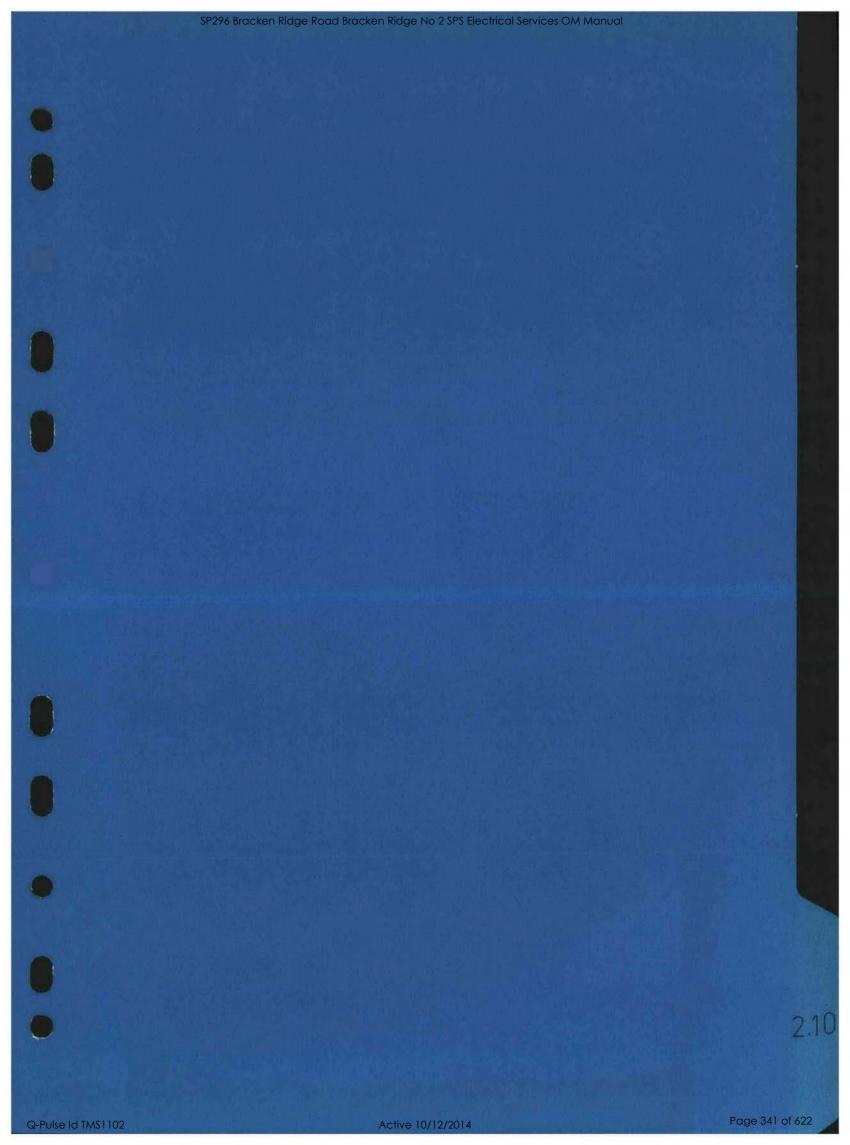


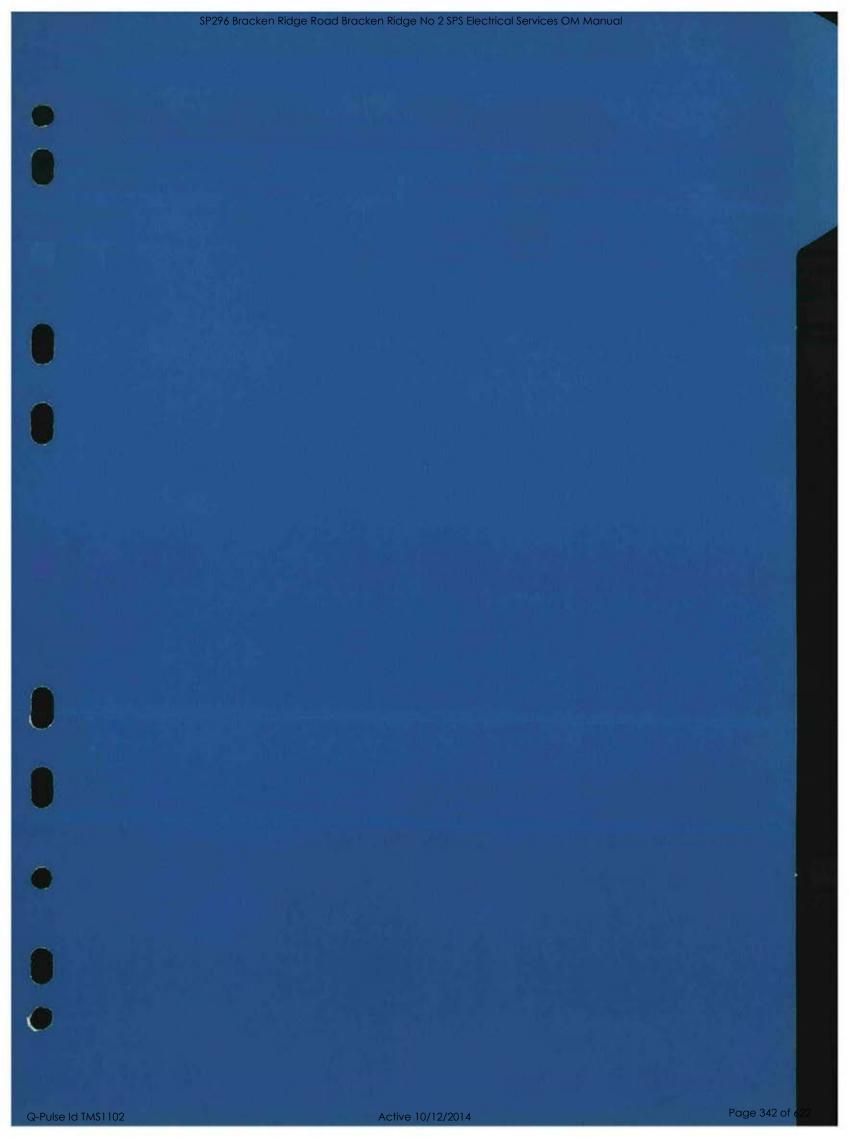
LOW VOLTAGE DIRECTIVE:- This product complies with BSEN61010-1

WARNING
Voltages dangerous to human life may be present at some of the terminals of this unit. Ensure all supplies are de-energised before attempting any connection/disconnection. If it is necessary to make adjustments with the power connected then exercise extreme caution.
This product is manufactured by Crompton Instruments Limited, Freebournes Road, Witham, Essex. CM8 3AH. Telephone 01376 512601, Fax: (01376) 518320.
Our policy is one of continuous development, and although the information is correct at the time of publication, we reserve the right to supply products differing in construction or dimension from those illustrated and

Sales Centres

UNITED KINGDOM South East (Witham) Crompton Instruments Ltd Freebournes Road, Witham, Essex: CM8 3AH Tel: (0)1376 502051 Fax: (0)1376 500860 South West (Abingdon) Crompton Instruments Ltd Tel: (0)1235 521872 Fax: (0)1235 528946 North (Halifax) Crompton Instruments Ltd Tel: (0)1422 246183 Fax: (0)1422 248545 NETHERLANDS (Rotterdam Crompton Instruments BV Tel: 0180 432033 Fax: 0180 425640 GERMANY (Ratingen)
Crompton Messinstrumente GmbH Tel: 02102 94790 Fax: 02102 46001 SINGAPORE Crompton Instruments (SE Asia) Pte Ltd Tel: 481 8866 Fax: 481 8254 HONG KONG Crompton Instruments Ltd (HK) Tel: 852 25520267 Fax: 852 28731476 AUSTRALIA (Sydney) Crompton Instruments Crompton Instruments
(Aust) Pty Ltd
Tel: (0)2 9603 2066
Fax: (0)2 9603 9335
JAPAN (Tokyo)
Hawker Siddely Japan KK
Tel: 03 3987 1421
Fax: 03 3987 1831 CANADA (Toronto) Crompton Instruments Ltd (Canada) Tel: (905) 6712253 Fax: (905) 6/12 USA (Atlanta) (905) 6712617 Crompton Instruments Inc Tel: (770) 425 8903 Fax: (770) 423 7194







For

SPS 296

Level Relay **Equipment Type:**

Location: **RTU Section**

Model Numbers:

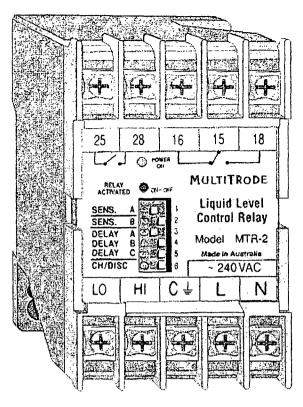
Multirode Manufacturer:

Multirode Pty Ltd Supplier:

130 Kinston Road

Underwood. Qld 4119

Ph. 07 9808 4011



Controls either one pump, alarm or solenoid.

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

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

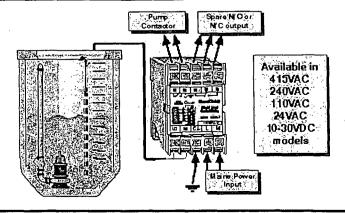
The MTR relay offers many features found in several discrete devices such as latching and time delay relays. Normally all of these devices must be installed individually. MultiTrode's MTR includes all of these features in one compact case, simplifying installation and reducing labour costs.

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

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

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

SAMPLE MTR APPLICATION



MULTITRODE

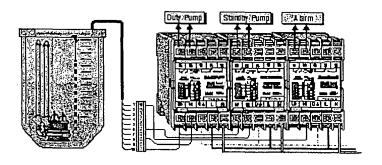
More information and Data-sheets on our complete range of products are available at www.multitrode.com

Level Control Relay

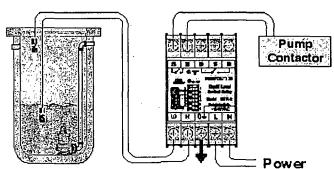
Page 2

MULTITRODE

IPLE MTR APPLICATION



SAMPLE APPLICATION



DIP SWITCH SETTINGS

WIRING DIAGRAM?

16



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

Sw 3, 4 & 5 Activation delays:

0, 2.5, 5, 10, 20, 40, 80, 160 sec

Pump Contactor

25

28

Sw 6 Mode settings: Charge & Discharge

PRODUCT, SPECIFICATIONS

Mode of operation:

MTR

Charge/Discharge (Fill or Empty)

Probe Inputs:

Sensor inputs Sensor voltage Sensor current MTR: 2 / MTRA: 3 10/12VAC Nominal 0.8mA max. (per sensor)

1k, 4k, 20k, 80k

Relay Outputs:

Sensitivity

MTR relay output MTR Output delay Relay contact rating 2 contact sets: I N/O & I C/O 0, 2.5, 5, 10, 20, 40, 80, 160 sec

250 VAC

Relay contact life Terminal size

5A Resistive, 2A Inductive 105 Operations 2 x 2.5mm2, #13

Display LEDs:

MTR

Power On Pump Green Red

<u>Alarm</u>

Physical Product:

Dimensions (mm) Mounting

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

Power Supply:

Enclosure

Supply Voltage AC **Power Consumption**

24, 110, 240, 415VAC* - 50/60Hz 3.5 Watts max *(MTR only)

Supply Voltage DC 12 or 24VDC. **Power Consumption** 3 watts max

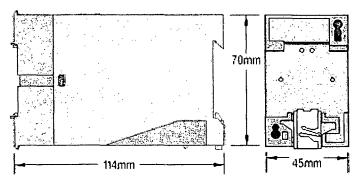
Environmental Range:

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



PHYSICAL DIMENSIONS

15



Ordering Information & Example VAILABLE MODELS MTRI 🕸 n/a : MTR2

Model **MTRA** Voltage 2

This order code is for a 240VAC MTRA.

All MultiTrode Products carry a two year warranty

...ultiTrode Pty Ltd Head Office

130 Kingston Road, Underwood Qld 4119 PO Box 2465, Logan City D.C. Qld 4114 Ph:+61 7 3808 4011 Fax:+61 7 3808 0011 sales@multitrode.com.au

MOUTHERODE

Sydney - Australia Tel:+61 2 9774 2433 Fax:+61 2 9774 2566

Melbourne - Australia Tel:+61 3 5978 6900 Fax:+61 3 5978 6932

MultiTrode Inc. - USA 6560 East Rogers Circle, Boca Raton FI 33487 Tel:+1 561 994 8090 Fax:+1 561 994 6282 E-mail: sales@multitrode.net

SP296 Brac	ken Ridge Road Bracken Ridge No 2 SPS Electrical Services OM Manual	
		2.1
MANILLA BRIGHT DIVIDERS 5 TAB A4		
Ref. No. 37100 Made in China 9 312311 371009		
Q-Pulse Id TMS1102	Active 10/12/2014	Page 346 of 622



For

SPS 296

Equipment Type: Signal Isolator

Location: PLC/RTU Section

Model Numbers: ECT/4-20mA/4-20mA 12-24vdc

Manufacturer: Moore Industries

Supplier: Pacific Controls

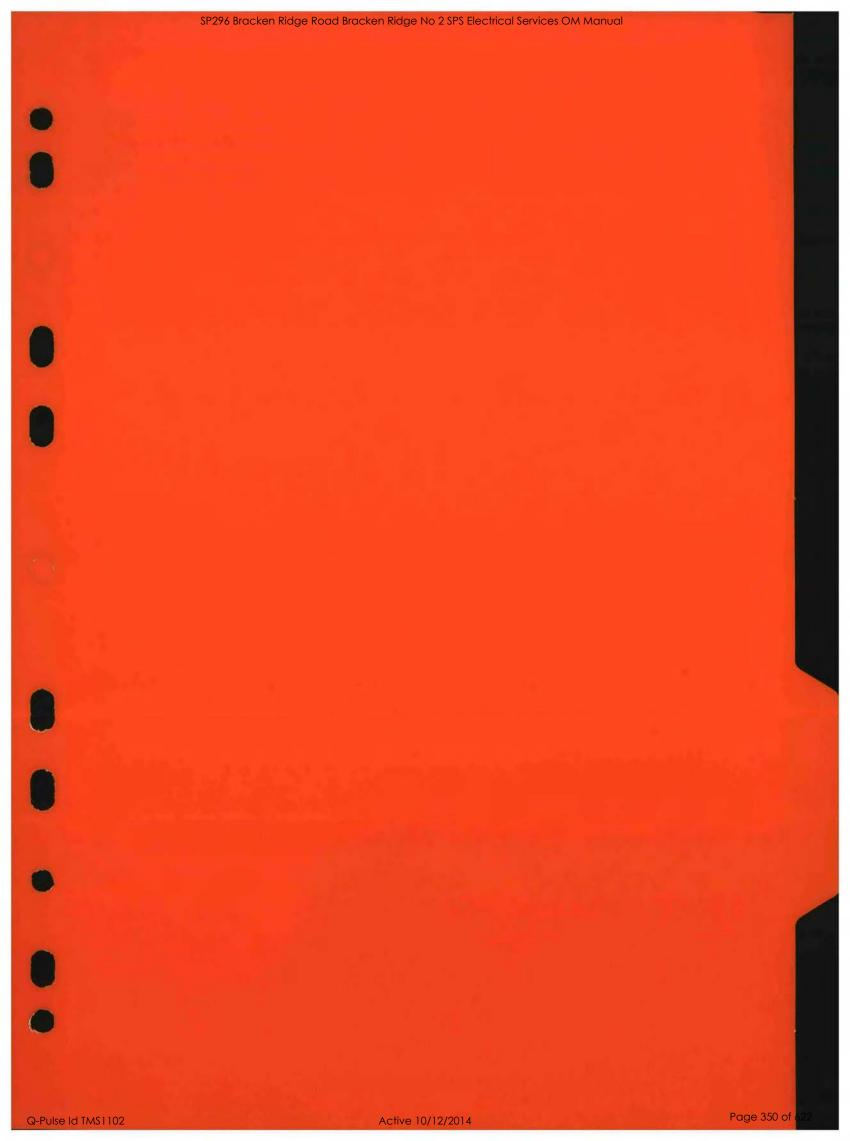
32 Container Street Tingalpa Qld 4173 Ph. 07 3907 9200

Fx. 07 3890 7612

Q-Pulse Id TM\$1102 Active 10/12/2014 Page 348 of 622

SP296 Bracken Ridge Road Bracken Ridge No 2 SPS Electrical Services OM Manual

Q-Pulse Id TM\$1102 Active 10/12/2014 Page 349 of 6





For

SPS 296

Equipment Type: Pressure Transducer

Location: RTU Section/Valve Pit

Model Numbers: D84XGG412FC3LC

DIS12.XBXW

Manufacturer: Vega

Supplier: Vega

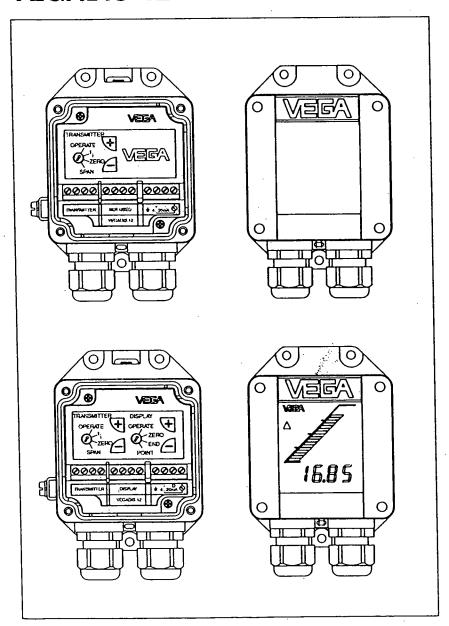
398 The Boulevarde Kirrawee NSW 2232 Ph. 02 9542 6662

Fx. 02 9542 6665



OrderNo: 1109544_5

Operating Instructions VEGADIS 12





\$-Pulse Id TM\$1102



Safety information, Note Ex area

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



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	4.2	Adjustment and indicating elements (version with display)
		Adjustment of the transmitter
	4.4	Scaling of the indication
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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.

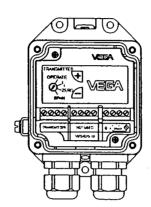
VEGADIS 12 has the following functions:

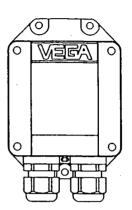
- adjustment of zero, span and ti
- atmospheric pressure compensation for the pressure transmitter
- measured value display (optional).

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.

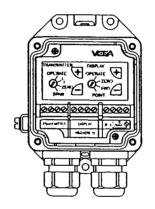
1.2 Types and versions

VEGADIS 12 without display





VEGADIS 12 with display





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Product description



1.3 Technical data

Standard data

Materials	and	weig	ıht
marchai2	anu	MCIC	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,

Housing Ground terminal Display window

Breather facility

Weight

high-resistance plastic PBT (Polyester)

stainless steel 1.4305

Lexan

PTFE filter element 1)

approx. 0.5 kg

Adjustment and indicating elements

Adjustment elements

2 keys, 1 rotary switch

Adjustment elements with display

Display (option)

2 x 2 keys, 2 x 1 rotary switch LC multifunctional display with - bar graph (20 segments)

- digital value (4 digits)

- tendency indicator for rising or falling values

Connection

Cable entry Screw terminals M20 x 1.5 (for cable ø 5 ... 9 mm) for wire cross-section up to 2.5 mm²

Adjustment circuit

Connection to

VEGAWELL 72 - 4 ... 20 mA/HART®. VEGABAR 74 or VEGABAR 75

or 3-wire standard cable

connection cable

VEGA special cable with breather capillaries

Cable length

max. 200 m

1) air permeable and humidity blocking

Q-Pulse Id TMS1102



Supply and signal circuit (analogue transmission, 4 ... 20 mA)

Supply voltage via pressure transmitter in conjunction with VEGADIS 12

- without display

with display

Max. input current

Range of the current signal

Max. permissible load

12 ... 36 V DC

17 ... 36 V DC

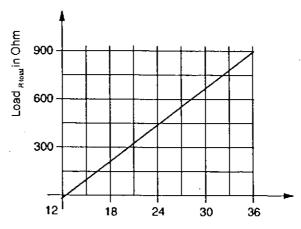
150 mA

3.5 ... 22 mA

depending on the supply voltage

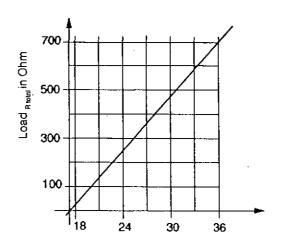
(see load diagrams)

Load diagram without display



Voltage of the external energy U_H in Volt

Load diagram with display



Voltage of the external energy U_H in Volt

Protective measures

Housing	IP 65 ¹
Protection class	
Overvoltage category	111

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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Product description



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 C€

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

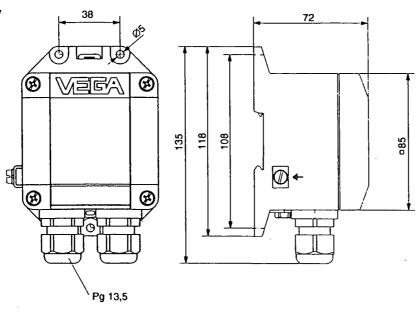
NAMUR regulations

Full compliance with NAMUR regulations NE21, May 1993.

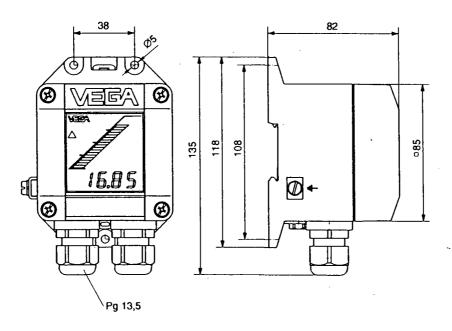


1.5 Dimensions

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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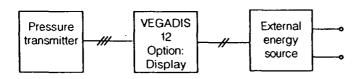


3 Electrical connection

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.

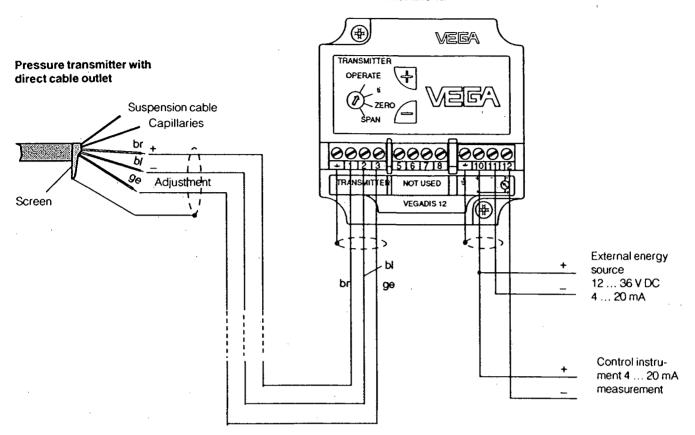
Q-Pulse Id TMS1102



3.2 Wiring plan

VEGADIS 12 without display

VEGADIS 12

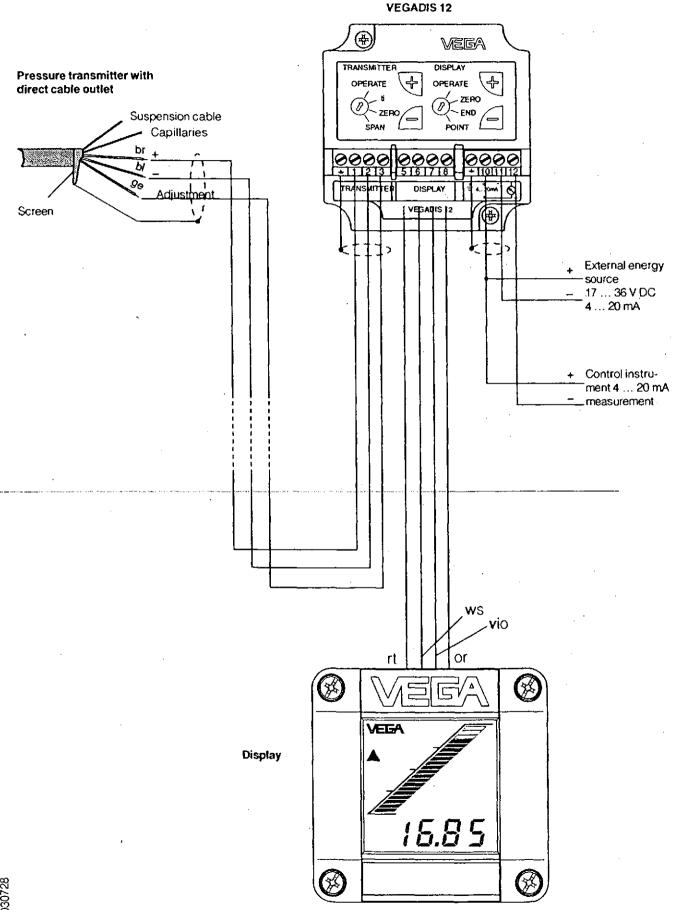


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Electrical connection



VEGADIS 12 with display

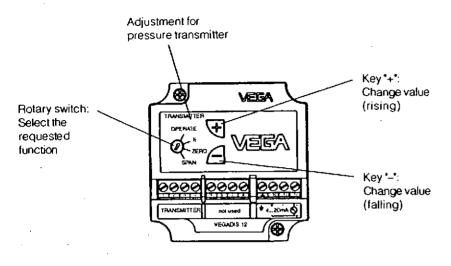


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4 Setup

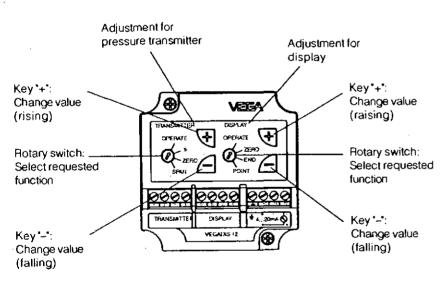
4.1 Adjustment elements



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)

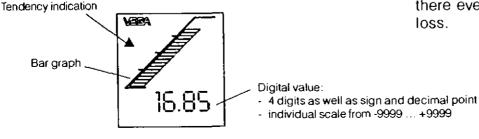


Adjustment system (transmitter)

(see section 4.1)

Adjustment system (display)

- With the rotary switch you choose the requested func-
- 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.



individual scale from -9999 ... +9999

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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.
- 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.

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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

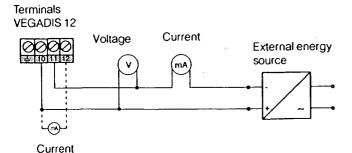
First of all open the housing cover. The indicated measured value must not change. However, if the indicated value changes nevertheless, the compensation of the atmospheric pressure is not ensured. Please therefore check:

- 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

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VEGA Grieshaber KG Am Hohenstein 113 77761 Schiltach Germany Phone (0 78 36) 50 - 0 Fax (0 78 36) 50 - 201 E-mail info@de.vega.com www.vega.com

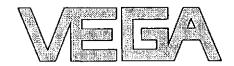






All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and processing systems correspond to the latest information at the time of printing.

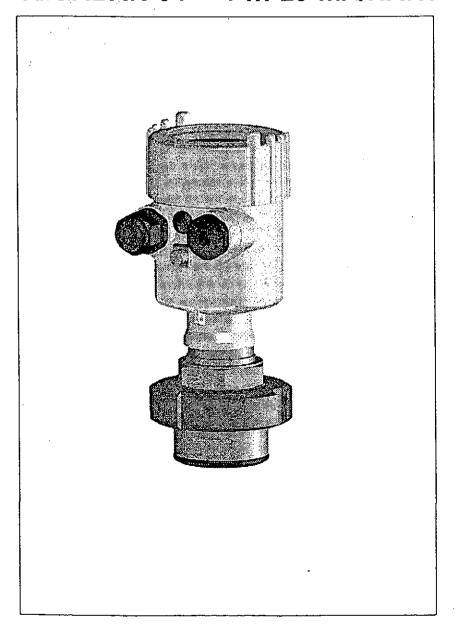
Technical data subject to alterations



OrderNo: 1109544_1

Operating Instructions VEGABAR 64 – 4 ... 20 mA/HART®









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1 About this document

1.1 Function

This operating instructions manual has all the information you need for quick set-up and safe operation of VEGABAR 64. Please read this manual before you start set-up.

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

This symbol informs you of a dangerous situation that could occur. Ignoring this cautionary note can impair the person and/or the instrument.



Ex applications

This symbol indicates special instructions for Ex applications.

FEN-030601

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About this document

• 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.



2 For your safety

2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained and authorised personnel. For safety and warranty reasons, any internal work on the instruments must be carried out only by VEGA personnel.

2.2 Appropriate use

VEGABAR 64 is a pressure transmitter for level and pressure measurements.

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 setting.

2.4 General safety instructions

VEGABAR 64 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 (e.g. the VDE regulations in Germany) as well as all prevailing safety regulations and accident prevention rules.



2.5 CE conformity

VEGABAR 64 pressure transmitter is in CE conformity with EMC (89/336/EWG) and NSR (73/23/EWG) and fulfils the Namur recommendations NE 21. Conformity has been judged acc. to the following standards:

- EMC
 - Emission EN 61326: 1997 (class B)
 - Susceptibility EN 61326: 1997/A1: 1998
- NSR EN 61010-1: 2001.

VEGABAR 64 is not subject to the pressure device guideline 1).

2.6 Safety instructions for Ex areas

Take note of the Ex specific safety instructions for Ex applications. These are part of the operating instructions manual and come with Ex approved instruments.

2.7 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 acc. to DIN EN ISO 14001.

Please help us fulfil this obligation by observing the environmental instructions in this manual:

- Chapter 3.4 Storage and transport
- Chapter 9.2 Disposal.

Due to the flush diaphragm, no additional pressure compartment is formed.



3 Product description

3.1 Configuration

Scope of delivery

The scope of delivery encompasses:

- VEGABAR 64 pressure transmitter
- documentation
 - this operating instructions manual
 - test protocol
 - Ex-specific safety instructions (with Ex versions) and, if necessary, further certificates.

Components

VEGABAR 64 consists of the following components:

- process connection with measuring cell
- housing with electronics
- housing cover with indicating/adjustment module (optional)

The components are available in different versions.

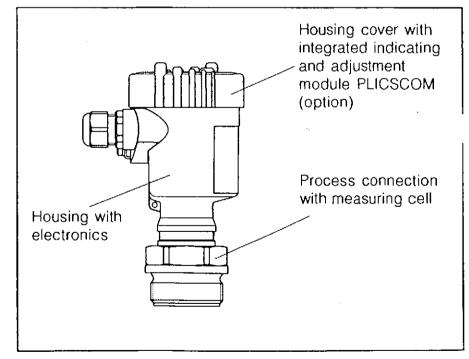


Fig. 1: Example of a VEGABAR 64 with process fitting G1½A and plastic housing



3.2 Principle of operation

Area of application

VEGABAR 64 is a pressure transmitter for use in the paper, food processing and pharmaceutical industry as well as in water/waste water applications. Dependent on the version, it is used for measurement of the level, the gauge pressure, the absolute pressure or the vacuum. Measured products are gases, vapours and liquids, also those with abrasive constituents.

Physical principle

The actual sensor element is the CERTEC® measuring cell with a flush, abrasion resistant ceramic diaphragm. The hydrostatic pressure of the product or the process pressure effects via the ceramic diaphragm a capacitance change in the measuring cell. This capacitance change is converted into a 4 ... 20 mA/HART® signal.

Power supply

VEGABAR 64 has a two-wire 4 ... 20 mA/HART® electronics requiring supply voltage:

- 12 ... 36 V DC (non Ex instrument)
- 12 ... 30 V DC (EEx ia instrument)
- 18 ... 36 V DC (Ex d instrument).

3.3 Adjustment

VEGABAR 64 can be adjusted with three different media:

- with the indicating and adjustment module PLICSCOM
- with the PC and an adjustment software acc. to FDT/DTM standard, e.g. PACTware™
- with a HART® handheld.

The entered parameters are generally saved in VEGABAR 64, when adjusting with PACTware™ and PC, also optionally in the PC.



3.4 Storage and transport

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test acc. to DIN 55439.

The packaging consists of environment-friendly, recyclable cardboard. Dispose of the packing material via specialised recycling companies.

Storage and transport temperature

- Storage and transport temperature -40°C up to ¹⁾
- Relative humidity 20 ... 85 %.



4 Mounting

4.1 Mounting procedure

Select installation position

VEGABAR 64 functions in any installation position¹⁾. Select an installation position that lets you reach the instrument easily during mounting and connecting as well as later retrofitting of an adjustment module. When carrying out these operations, the housing can be rotated by 330° without the use of any tools.

"/eld the socket

To mount VEGABAR, a welded socket is necessary (dependent on the process fitting). Use components from the line of VEGA accessories:

- welded socket G1A, article no. 2.27867
- welded socket G1½A, article no. 2.21993
- welded socket Tri-Clamp 1", article no. 2.24711
- welded socket Tri-Clamp 1½", article no. 2.14140
- welded socket Tri-Clamp 2", article no. 2.10974
- welded socket, hygienic fitting with groove nut F40, article no. 2.23898
- welded socket DN 40 DIN 11851, article no. 2.10955
- welded socket DN 50 DIN 11851, article no. 2.4177
- welded socket DN 50 DIN 11864, article no. 2.25290
- welded socket DRD, article no. 2.10500.
- welded socket M44x1.25, article no. 2.15986
- welded socket cone 2.1, nut M64x2, article no. 2.9875
- -> Take note of the applicable welding standards (segmental welding procedure).

¹⁾ In case of position correction, see 6.4 "Set-up procedure".



Sealing/Screwing in

- 1 Use the seal attached to the appropriate process fitting:
- thread G1A: Viton, article no. 2.28172; seal behind the thread
- thread G1½A: Klingersil 48 x 55 x 2, article no.
 2.4191; seal behind the thread
- Tri-Clamp 1": EPDM, article no. 2.24710
- Tri-Clamp 11/2": EPDM, article no. 2.14141
- Tri-Clamp 2": EPDM, article no. 2.10975
- hygienic connection with groove nut: EPDM 40x5, article no. 2.17682
- bolting DIN 11851 DN 40: NBR, article no. 2.10956
- bolting DIN 11851 DN 50: NBR, article no. 2.4178
- bolting DIN 11864 DN 50: article no. 2.19059
- DRD PN 40: PTFE, article no. 2.10360
- thread M44 x 1,25: Viton, article no. 2.10491
- cone 2.1, nut 64x2; EPDM article no. 2.19094

-or-

Seal with a suitable, resistant seal:

flange connections acc. to DIN/ANSI

-or-

Seal the thread with Teflon, hemp or similar resistant seal materials:

- thread 1½ NPT.
- 2 Screw VEGABAR into the welded socket by tightening the hexagon screw on the process fitting with SW 27 (spanner width 27 mm).



Protection against moisture

Protect your VEGABAR against moisture penetration.

- with horizontally installed instruments:
- -> turn the housing so that the cable entry points downwards
- with vertically installed instruments:
- -> lead the connection cable downward in front of the cable entry.

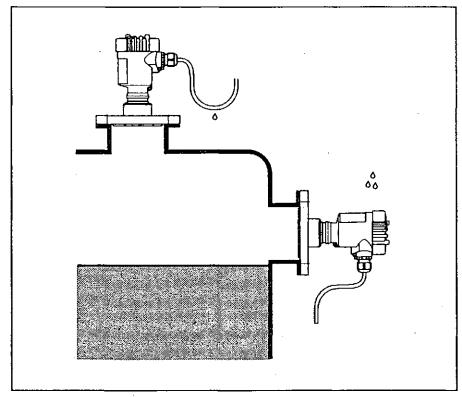


Fig. 2: Measures against moisture penetration

Rain and condensation water can thus drain off. This applies mainly to mounting outdoors, in areas where moisture is expected (e.g. by cleaning processes) or on cooled or heated vessels.



5 Connecting to power supply

5.1 Preparing the connection

Note safety instructions

Always observe the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltages are expected, overvoltage arresters should be installed.



We recommend VEGA overvoltage arresters ÜS-F-LB-I and ÜSB 62-36G.X.

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. The sensors must only be operated on intrinsically safe circuits. The permissible electrical values are stated in the certificate.

Select voltage supply

VEGABAR 64 requires a supply voltage of 12 ... 36 V DC. Power supply and current signal are transmitted via the same two-wire connection cable.

Provide a reliable separation between the supply circuit and the mains circuits acc. to DIN VDE 0106 part 101. The 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 64.

Bear in mind the following factors regarding supply voltage:

- the reduction of output voltage of the power supply unit under nominal load
- the influence of additional instruments in the circuit (see load values in Technical data).

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Select connection cable

VEGABAR 64 is connected with standard two-wire cable. An outer diameter of 5 ... 9 mm ensures the seal effect of the cable entry.

If strong electromagnetic interference is expected, we recommend the use of screened cable. The screen should be grounded on both ends.

Select connection cable for Ex applications



Take note of the corresponding installation regulations for Ex applications.



5.2 Connection procedure

Single/double chamber housing

Proceed as follows:

- 1 Unscrew the housing cover
- 2 Loosen compression nut of the cable entry
- 3 Remove approx. 10 cm of the cable mantle, strip approx. 1 cm insulation from the ends of the individual wires ¹⁾
- 4 Insert the cable into the sensor through the cable entry
- 5 Lift the opening levers of the terminals with a screwdriver
- 6 Insert the wire ends into the open terminals according to the wiring plan

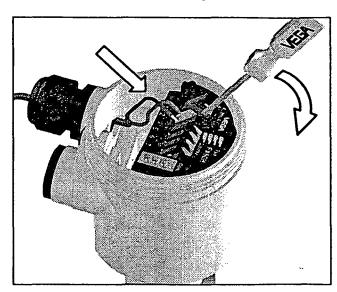


Fig. 3: Connection steps 5 and 6

- 7 Press down the opening levers of the terminals, you will hear the terminal spring closing
- 8 Check the hold of the wires in the terminals by slightly pulling on them
- 9 Tighten the compression nut of the cable entry, the seal ring must completely encircle the cable
- 10 Screw the housing cover back on

The electrical connection is finished.

Use wire end ferrules.



IP 68 version

Proceed as follows:

- 1 Loosen screw on the rear of the plug connector
- 2 Remove plug connector and seal from the remote electronics
- 3 Lift plug insert out of the plug housing

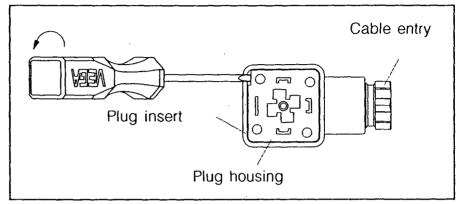


Fig. 4: Loosen the plug insert

- 4 Loop the connection cable¹⁾ through the cable entry into the plug housing
- 5 Connect wire ends to the screw terminals acc. to the wiring plan

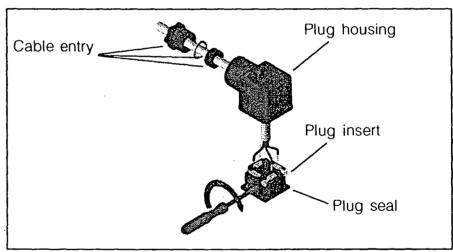


Fig. 5: Connection to screw terminals

- The connection cable is already preconfectioned. If necessary, shorten to the required length, cut the breather capillaries clean. Remove approx. 5 cm of the cable mantle, strip approx. 1 cm insulation from the ends of the wires. After shortening the cable, fasten the type plate again on the cable.
- 6 Snap the plug insert into the plug housing and insert the plug seal.



5.3 Wiring plans

Single chamber housing with cable entry

Overview

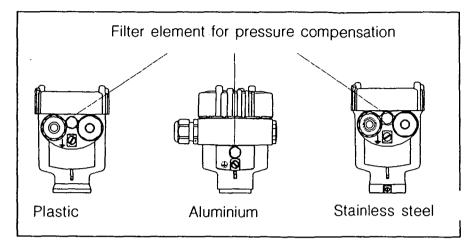


Fig. 6: Overview of the three material versions of the single chamber housing

Top view, electronics and connection compartment

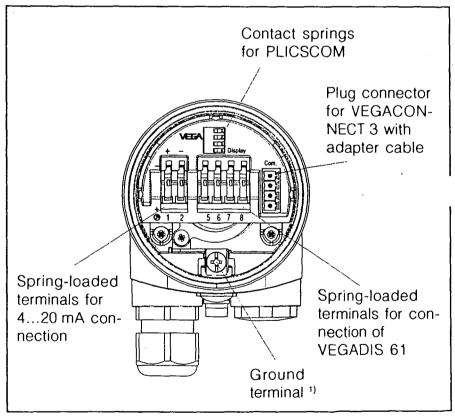


Fig. 7:
Top view of the electronics and connection compartment

Onnect cable screen here, connect ground terminal on the housing exterior to ground as prescribed. The two terminals are galvanically connected.



Wiring plan

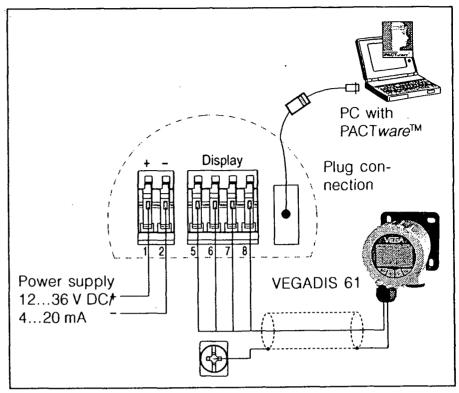


Fig. 8: Wiring plan, single chamber housing

Single chamber housing with M12x1 plug

Overview

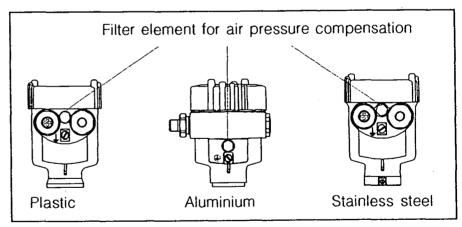


Fig. 9: Overview of the three material versions of the single chamber housing



Top view, electronics and connection compartment

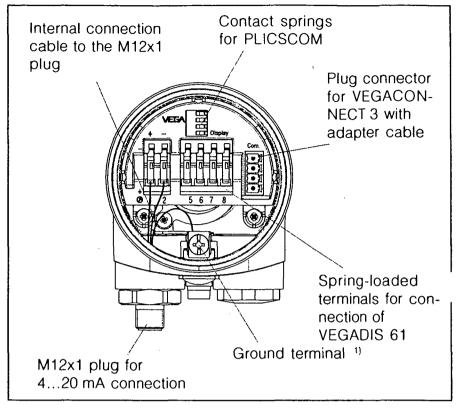
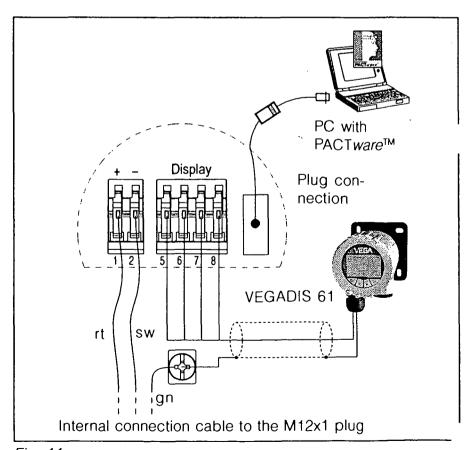


Fig. 10:
Top view of the electronics and connection compartment

Wiring plan



Onnect ground terminal on the housing exterior to ground as prescribed. The two terminals are galvanically connected.

Fig. 11: Wiring plan, single chamber housing



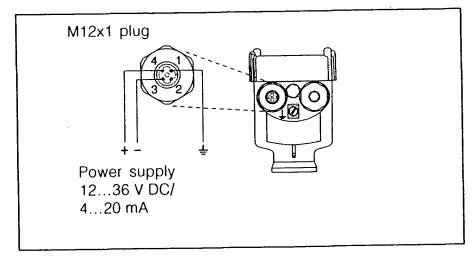


Fig. 12: Wiring plan, single chamber housing, power supply

Double chamber housing with cable entry

Overview

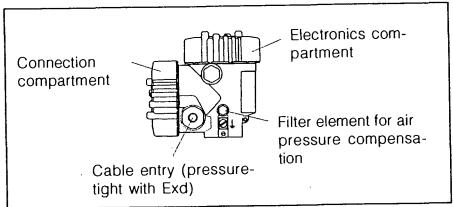


Fig. 13: Double chamber housing, non-Ex instrument or EExia instrument



Top view, electronics compartment

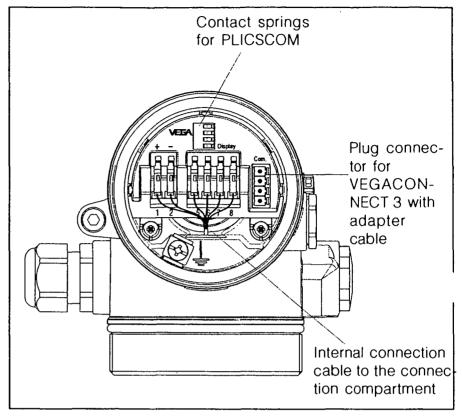
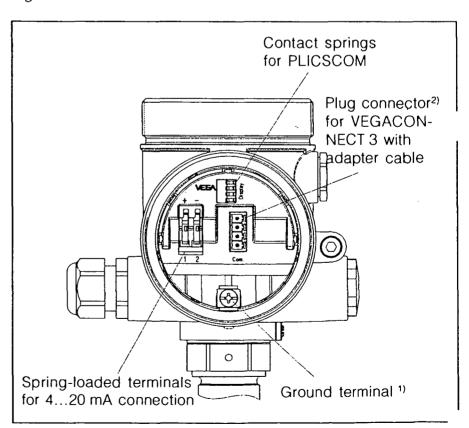


Fig. 14: Top view, electronics compartment with double chamber housing

Top view, connection compartment



Onnect ground terminal on the housing exterior to ground as prescribed. The two terminals are galvanically connected.

2) Not with Exd

Fig. 15: Connection compartment, double chamber housing

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Wiring plan

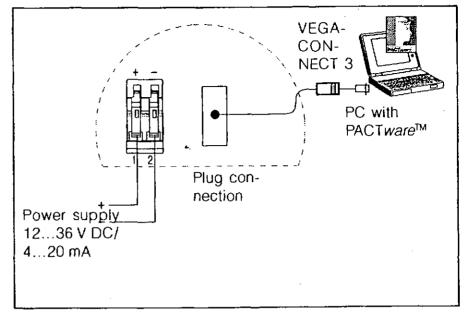


Fig. 16: Wiring plan, double chamber housing

Double chamber housing with M12x1 plug

Overview

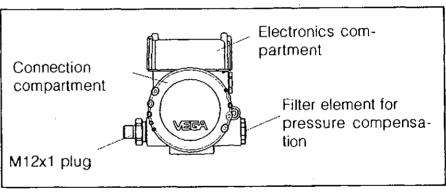


Fig. 17: Double chamber housing, non-Ex instrument or EExia instrument



Top view, electronics compartment

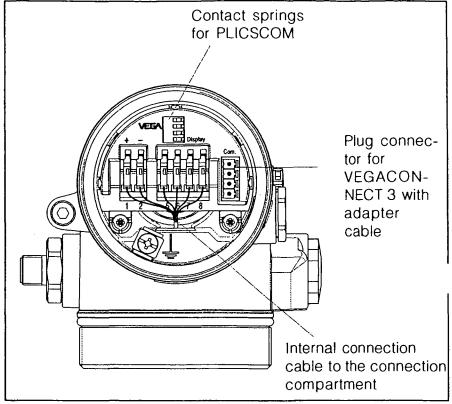
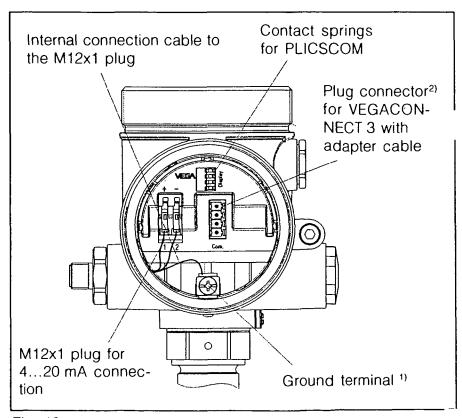


Fig. 18: Top view, electronics compartment of the double chamber housing

Top view, connection compartment



Onnect ground terminal on the housing exterior to ground as prescribed. The two terminals are galvanically connected.

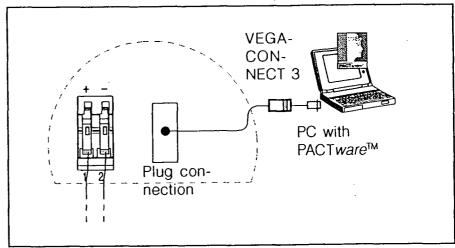
2) Not with Exd

Pulse Id TMS1102

Fig. 19: Connection compartment, double chamber housing Fig. 20:

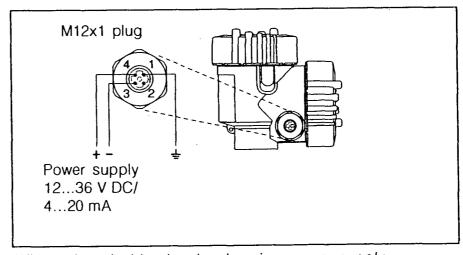


Wiring plan



Wiring plan, double chamber housing, peripheral instruments

Fig. 21:



Wiring plan, double chamber housing, power supply



Overview

Double chamber housing Exd

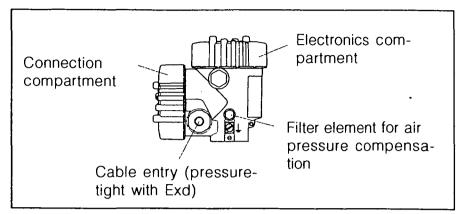


Fig. 22:
Double chamber housing, Exd instrument

Top view, electronics compartment

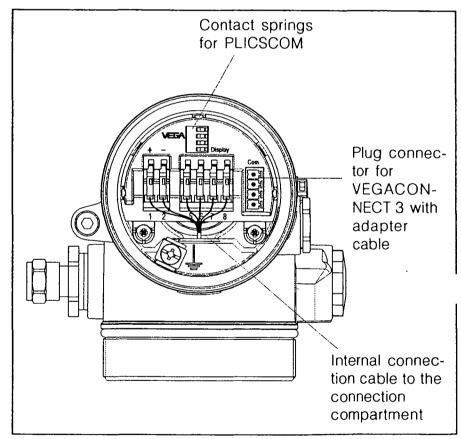


Fig. 23:
Top view of the electronics compartment with double chamber housing ,

Pulse Id TMS1102

Top view connection compartment Exd 1)

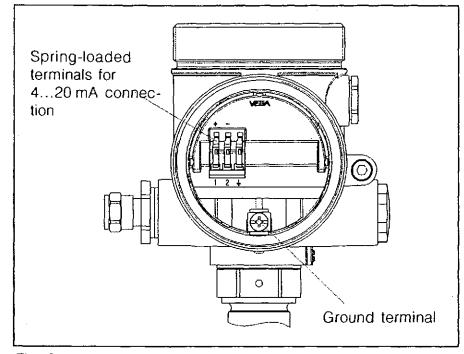


Fig. 24: Connection compartment, double chamber housing Exd

Wiring plan Exd

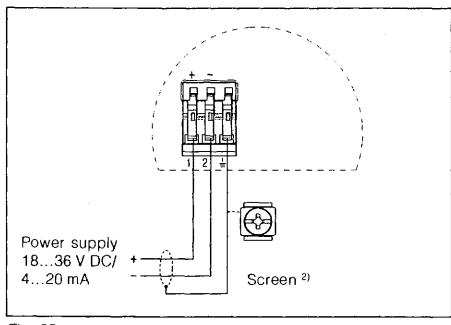


Fig. 25: Wiring plan, double chamber Exd

- In Exd, the indicating and adjustment module PLICSCOM can only be used in the electronics compartment.
- Connect screen to #-terminal or ground terminal. Ground the ground terminal on the outside of the housing acc. to regulations. The terminals are galvanically connected.

Q-Pulse Id TMS1102



IP 68 version with cable entry

Overview

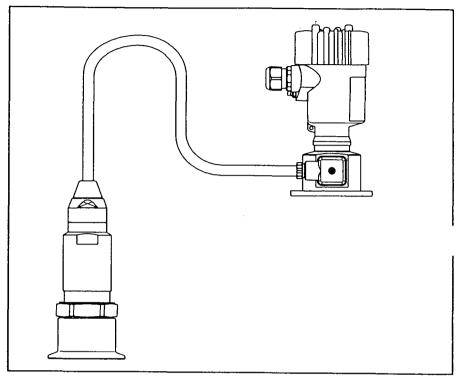


Fig. 26: VEGABAR 64 in IP 68 version and direct cable outlet, remote electronics

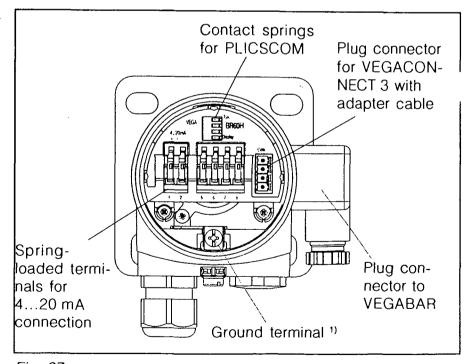


Fig. 27:
Top view to the combined electronics and connection comparment of the remote electronics



Wiring plan, plug connector remote electronics

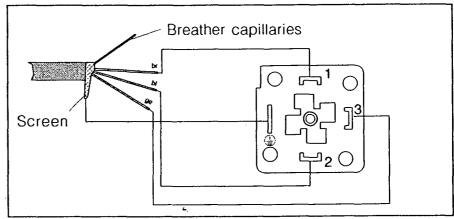


Fig. 28: Wiring plan, plug connector remote electronics

Wiring plan, remote electronics

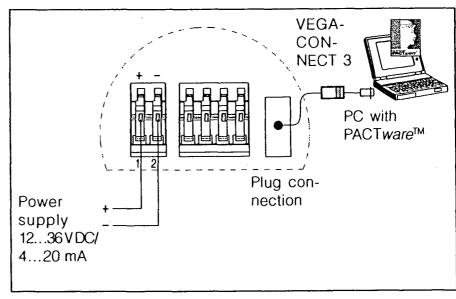


Fig. 29: Wiring plan, remote electronics

Onnect ground terminal on the housing exterior to ground as prescribed. The two terminals are galvanically connected.



Overview

IP 68 version with M12x1 plug

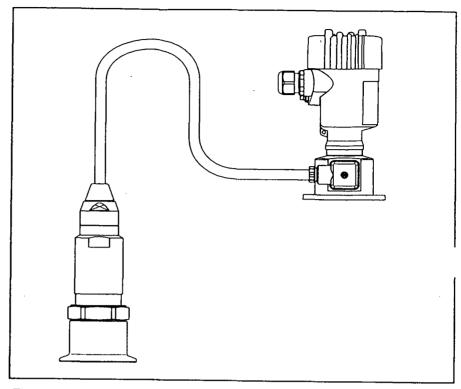
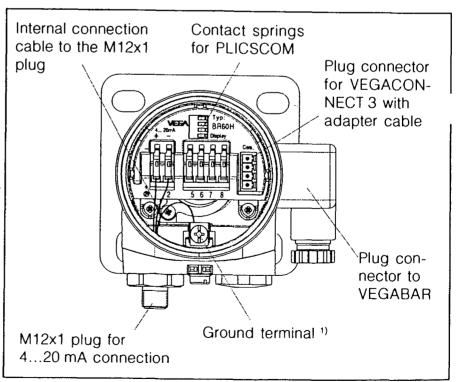


Fig. 30: VEGABAR 64 in IP 68 version and direct cable outlet, remote electronics



1) Connect ground terminal on the housing exterior to ground as prescribed. The two terminals are galvanically connected.

Fig. 31:

Top view of the combined electronics and connection compartment of the remote electronics

Wiring plan, plug connector, remote electronics

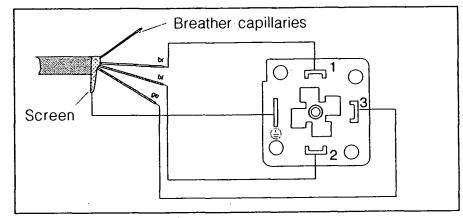


Fig. 32: Wiring plan, plug connector, remote electronics

.Viring plan

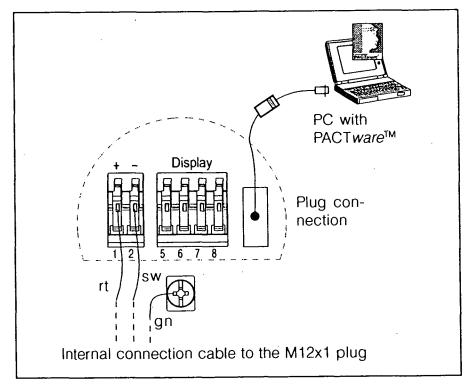


Fig. 33: Wiring plan, remote electronics with M12x1 plug



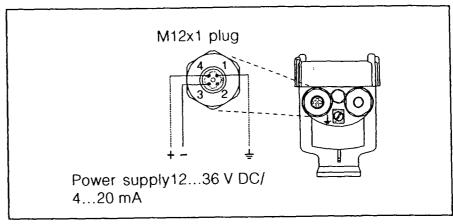


Fig. 34: Wiring plan, single chamber housing, power supply

6 Set-up with the indicating and adjustment module PLICSCOM

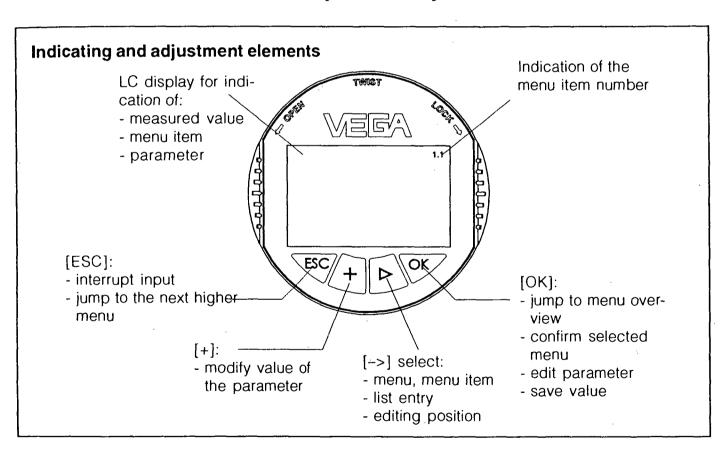
6.1 Short description

Function/Configuration

The indicating and adjustment module PLICSCOM is used for measured value display, adjustment and diagnostics with VEGABAR 64. It is mounted into:

- the single chamber housing or
- the double chamber housing (optionally in electronics or connection compartment) or
- VEGADIS 61.

6.2 Adjustment system





Adjustment system

The sensor is adjusted via the four keys and display of the indicating and adjustment module PLICSCOM. The LC display indicates the individual menu items. The functions are shown in the above illustration. Approx. 10 minutes after the last key is pressed, an automatic reset to measured value display is triggered. The values not confirmed with [OK] will not be saved.

6.3 Set-up procedure, level measurement

Boot phase

After VEGABAR 64 is connected to power supply, the instrument carries out a self-test:

- internal test of the electronics
- indication of the instrument type
- output current jumps to the set fault value (3.6 mA or 22 mA).

The actual measured value is then displayed and the corresponding current value between 4 ... 20 mA is outputted¹⁾.

VEGABAR 64 2 . 5 5 3 bar

Set-up procedure for VEGABAR 64:

- 1 Select unit of measurement/density unit
- 2 Carry out position correction
- 3 Carry out min. adjustment
- 4 Carry out max. adjustment

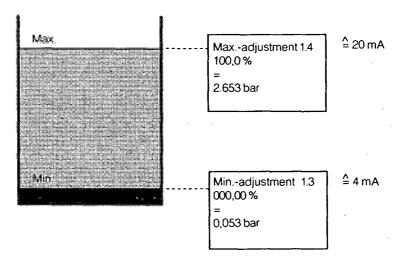
275 4-030601

The values correspond to the actual level as well as the settings already carried out, e.g. default.



In the menu item "units of measurement" you select the physical unit in which the adjustment should be carried out, e.g. mbar, bar, m, mm ...

The position correction compensates the influence of the installation position or a static pressure on the measurement. The position correction does not influence the adjustment values.





These steps are not necessary for instruments which are already adjusted acc. to the customer's request!

These data are stated on the type label of the instrument and in the menu items of the min./max. adjustment.

PLICSCOM enables the adjustment without filling or pressure. You can carry out the settings in the workshop without the instrument having to be installed.

In the menu items min. and max. adjustment, the actual measured value is also displayed.

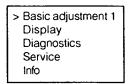
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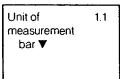
Selecting the adjustment unit/density unit

Proceed as follows when switching over to another adjustment unit¹⁾ (in the example from bar to mbar):

1 Push [OK] in the measured value display, the menu overview will be displayed:



2 Confirm the menu "Basic adjustment" with [OK], the menu item "Unit of measurement" will be displayed:



- 3 Activate the selection with [OK] and select the requested unit (in the example mbar) with [->].
- 4 Confirm with [OK] and move to position correction with [->].

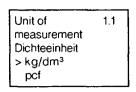
The adjustment unit is now changed from bar to mbar.



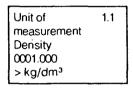
When changing to a height unit (in the example from bar to m), it is also necessary to enter the density. Proceed as follows:

- 1 Push [OK] in the measured value display, the menu overview will be displayed
- 2 Confirm the menu "Basic adjustment" with [OK], the menu item "Units of measurement" will be displayed
- 3 Activate the selection with [OK] and select the requested unit (in the example m) with [->]
- 4 Confirm with [OK], the submenu "Density unit" is displayed
- Options: mbar, bar, psi, Pa, kPa, MPa, inHg, mmHg, inH₂C mmH₂O, m, mm, cm, ft.

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5 Select the requested unit, e.g. kg/dm³ with [->] and confirm with [OK], the submenu "Density" is displayed



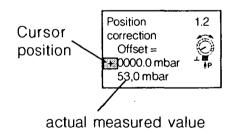
6 Enter the requested density value with [->] and [+], confirm with [OK] and move to position correction with [->].

The adjustment unit is now changed from bar to m.

Carry out position correction

Proceed as follows:

1 Edit the offset value in the menu item "Position correction" with [OK]:



- 2 Set the requested offset value with [->] and [+], e.g. the actual measured value with reciprocal sign
- 3 Confirm with [OK] and move to the min. adjustment with [->].

The actual measured value now incorporates the requested correction (will be in the upper example 0.0 mbar), the position correction is finished.

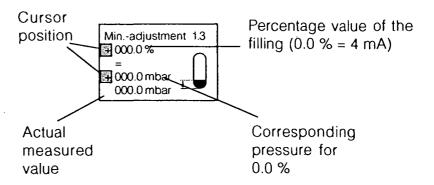
Q-Pulse Id TMS1102



Carrying out min. adjustment

Proceed as follows:

1 Edit the %-value in the menu item "Min. adjustment" and edit with [OK]:



- 2 Set the requested %-value with [+] and [->]
- 3 Confirm with [OK] and edit the requested mbarvalue
- 4 Set the requested mbar-value with [+] and [->]
- 5 Confirm with [OK] and move to the max. adjustment with [->].

The min. adjustment is finished.



To adjust with a filling, you simply enter the displayed actual measured value. VEGABAR automatically calculates from the entered values (e.g. 10.0 % and 100.0 mbar) the current value for 0.0 %. If the adjustment ranges are exceeded the display indicates the message "Outside parameter limits". Editing can be interrupted with [ESC] or the displayed limit value can be accepted with [OK].

Adjustment ranges:

- %-value of -10 % ... 110 %
- pressure value of -50 % ... +150 % of the nominal measuring range.

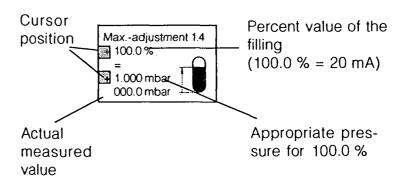
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Carrying out max. adjustment

Proceed as follows:

1 Edit the %-value in the menu item "max. adjustment" with [OK]:



The displayed pressure for 100 % corresponds to the nominal measuring range of the sensor (in the above example 1.0 bar = 1000 mbar).

- 2 Set the requested %-value with [->] and [OK]
- 3 Confirm with [OK] and edit the requested mbarvalue
- 4 Set the requested mbar-value with [+] and [->]
- 5 Confirm with [OK] and move to the menu overview with [ESC].

The max. adjustment is finished.



To adjust with a filling, you simply enter the displayed actual measured value. VEGABAR automatically calculates from the entered values (e.g. 90.0 % and 100.0 mbar) the current value for 100.0 %. If the adjustment ranges are exceeded the display indicates the message "Outside parameter limits". Editing can be interrupted with [ESC] or the displayed limit value can be accepted with [OK].

Adjustment ranges:

- %-value of -10 % ... 110 %
- Pressure value of -50 % ... +150 % of the nominal measuring range.

97595_ENI_03060:

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The set-up of VEGABAR is finished. All other menuitems are described in the separate operating instructions manual PLICSCOM.

6.4 Set-up procedure, process pressure measurement

Boot phase

After VEGABAR 64 is connected to power supply, the instrument carries out a self-test:

- internal test of the electronics
- indication of the instrument type
- output current jumps to the set fault value (3.6 mA or 22 mA).

The actual measured value is then displayed and the corresponding current value between 4 ... 20 mA is outputted¹⁾.

VEGABAR 64 2.653 bar

Set-up procedure for VEGABAR 64:

- 1 Select application "process pressure measurement"
- 2 Select unit of measurement
- 3 Carry out position correction
- 4 Carry out zero adjustment
- 5 Carry out span adjustment.

In the menu item "units of measurement" you select the physical unit in which the adjustment should be carried out, e.g. mbar, bar, psi...

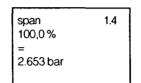
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The values correspond to the actual level as well as the settings already carried out, e.g. default.

The position correction compensates the influence of the installation position or static pressure on the measurement. The position correction does not influence the adjustment values.

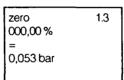
In the menu items "zero" and "span" you determine the measuring span of the sensor.





^≙ 20 mA





≙ 4 mA



These steps are not necessary for instruments which are already adjusted acc. to the customer's request!

These data are stated on the type label of the instrument and in the menu items of the zero/span adjustment.

PLICSCOM enables the adjustment without filling or pressure. You can carry out the settings in the workshop without the instrument having to be installed.

In the menu items "zero" and "span", the actual measured value is also displayed.



Select application "process pressure measurement"

VEGABAR 64 is preset to application "Level measurement". To switch over to application "Process pressure measurement" you have to proceed as follows:

- 1 Push [OK] in the measured value display, the menu overview is displayed
- 2 Select the menu "Service" with [->] and confirm with [OK]

Basic adjustment 4
Display
Diagnostics
> Service
Info

3 Select the menu item "Application" with [->] and edit the selection with [OK]



Note warning: "Output can change".

- 4 Select with [->] "OK" and confirm with [OK]
- 5 Select "Process pressure" from the list and confirm with [OK]

Unit of 4.8 mesurement > Process pressure Level

6 Move to the measured value display by pushing [ESC] twice.

Selecting the adjustment unit

Proceed as follows when switching over to another adjustment unit¹⁾ (in the example from bar to mbar):

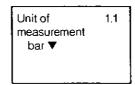
1 Push [OK] in the measured value display, the menu overview will be displayed:

> Basic adjusment 1 Display Diagnostics Service Info

Options: mbar, bar, psi, Pa, kPa, MPa, inHg, mmHg, inH₂O, mmH₂O.

2/5 4-050601

2 Confirm the menu "Basic adjustment" with [OK], the menu item "Unit of measurement" will be displayed:



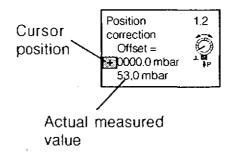
- 3 Activate the selection with [OK] and select the requested unit (in the example mbar) with [->].
- 4 Confirm with [OK] and move to position correction with [->].

The adjustment unit is now changed from bar to mbar.

Carrying out position correction

Proceed as follows:

1 Edit the offset value in the menu item "Position correction" with [OK]:



- 2 Set the requested offset value with [->] and [OK], e.g. the actual measured value with reciprocal sign
- 3 Confirm with [OK] and move to the min. adjustment (zero) with [->].

The actual measured value has now the requested correction (in the above example it is now 0.0 mbar), the position correction is finished.

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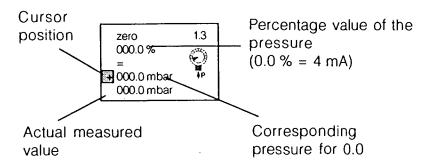
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Carrying out zero adjustment

Proceed as follows:

1 Edit the mbar value in the menu item "zero" with [OK]:



- 2 Set the requested mbar value with [+] and [->]
- 3 Confirm with [OK] and move to span adjustment with [->].

The zero adjustment is finished.

The zero adjustment shifts the value of the span adjustment. The span, i.e. the difference between these values, remains. It can be max. 120 % of the nominal measuring range.



To adjust with a filling, you simply enter the indicated actual measured value. If the adjustment ranges are exceeded, the following message is displayed "Outside parameter limits". The editing can be interrupted with [ESC] or the indicated limit value can be accepted with [OK].

Adjustment range:

 Meas. begin -50 % ... +95 % of the nominal measuring range.

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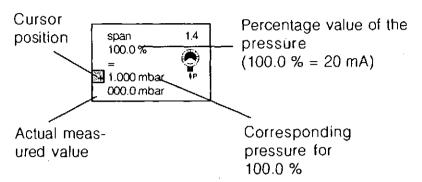
-Pulse Id TMS1102

Set-up with the indicating and adjustment module PLICSCOM

Carrying out span adjustment

Proceed as follows:

1 Edit the mbar value in the menu item "span" with [OK]:



The displayed pressure for 100 % corresponds to the nominal range of the sensor (in the above example 1.0 bar = 1000 mbar).

- 2 Set the requested mbar value with [->] and [OK]
- 3 Confirm with [OK] and move with [ESC] to the menu overview.

The span adjustment is finished.



To adjust with a filling, you simply enter the indicated actual measured value. If the adjustment ranges are exceeded, the following message is displayed "Outside parameter limits". The editing can be interrupted with [ESC] or the indicated limit value can be accepted with [OK].

Adjustment range:

• -120 % ... +120 % of the nominal measuring range.

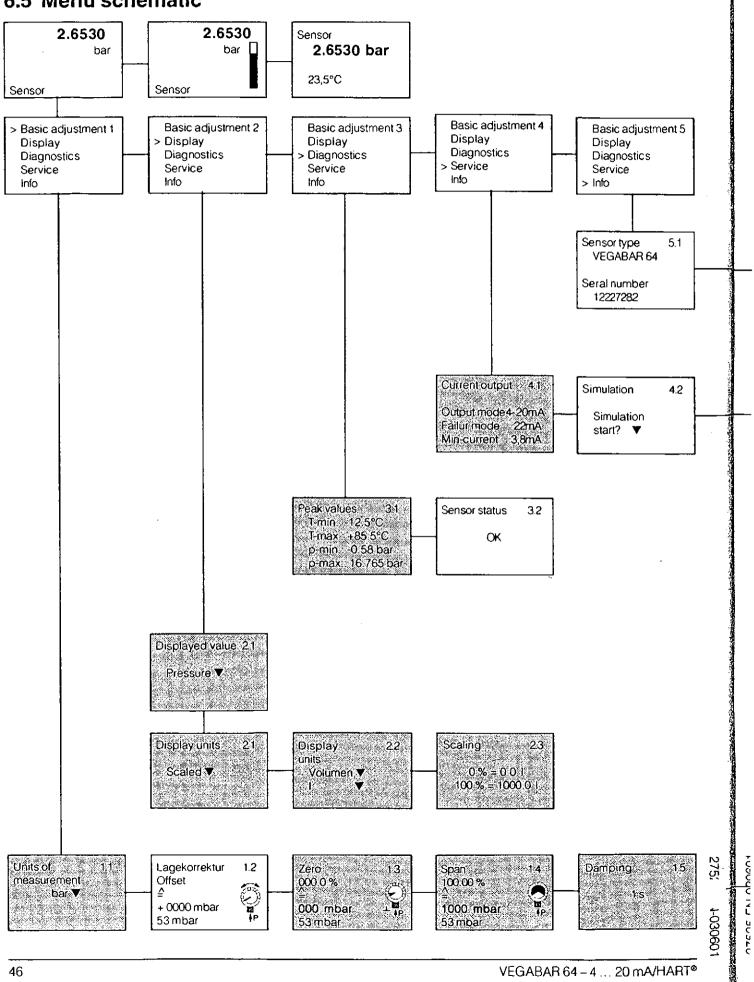
The set-up of VEGABAR for process pressure measurement is finished. The other menu items are described in the separate operating instructions manual of the indicating and adjustment module PLICSCOM.

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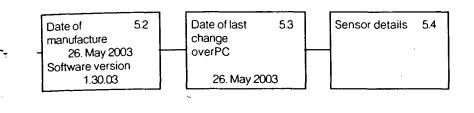


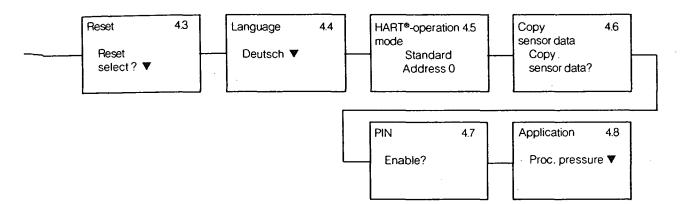
6.5 Menu schematic





Set-up with the indicating and adjustment module PLICSCOM

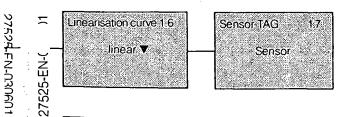




▼ Selection possibility in the menu item



With these keys you move in the menu field



• The parameters in the menu items highlighted in grey are reset to default by activating the reset function.



Set-up with PACTware™ and PC

7.1 Connecting the PC

Connecting the PC directly to the sensor

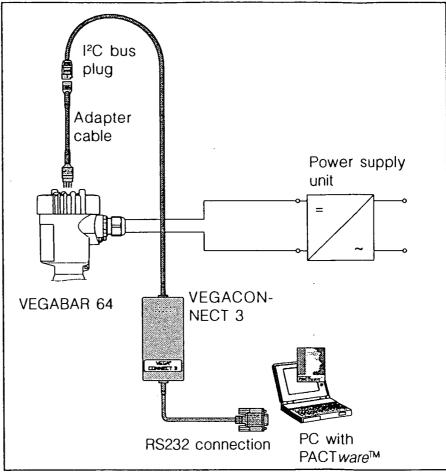


Fig. 35: PC connected directly to the sensor

Necessary components:

- VEGABAR 64
- PC with PACTware™
- VEGACONNECT 3 with I²C bus plug and adapter cable, article no. 2.27323
- power supply unit

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Connecting the PC to the signal cable

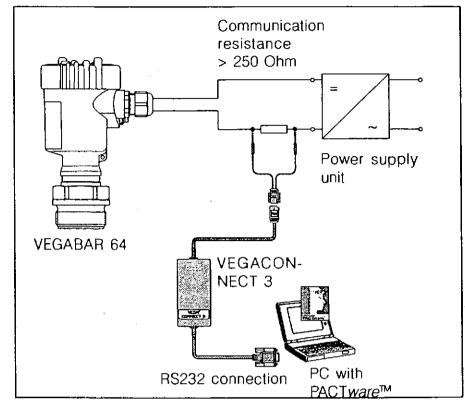


Fig. 36: PC connected to the signal cable

Necessary components:

- VEGABAR 64
- PC with PACTware™
- VEGACONNECT 3 with adapter for HART®
- communication resistance >250 Ohm
- power supply unit

The individual set-up steps are described in the help texts of PACT $ware^{TM}$.



8 Maintenance and fault rectification

8.1 Maintenance

In normal operation, the VEGABAR 64 pressure transmitter is completely maintenance-free.

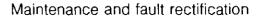
8.2 Fault rectification

Checking the 4 ... 20 mA signal

Connect a hand-multimeter with a suitable measuring range acc. to the wiring plan.

Fault	Possible reason	Rectifying measure
4 20 mA signal not stable	level fluctuations	set integration time via PLICSCOM or PACT <i>ware</i> ™
	no atmospheric pressure compensation	Check pressure compensation in the housing, if necessary clean filter element
4 20 mA signal missing	incorrect connection to power supply	check connection acc. to chapter 5.3 and correct if necessary acc. to chapter 5.2
	no power supply	check cables for line break, repair if necessary
	power supply too low or load resistance too high	check and adapt if necessary
Current signal 22 mA or less than	electronics module or meas. cell defective	exchange instru- ment or return for repair







In Ex applications, the regulations for the wiring of intrinsically safe circuits must be observed.

Fault messages via PLICSCOM

The error message appears as code in the measured value display and in all menu items. The explanatory text is displayed in the menu "Diagnosis" in the menu item "Instrument status".

Code	Explanatory text	Rectifying measure
E013	no measured value available	repair
E017	adjustment span too small	repeat with modified values
E036	no operable sensor software	software update, repair
E041	Hardware error	repair

8.3 Instrument modification

Insert/remove PLICSCOM

PLICSCOM can be inserted or removed at any time. An interruption of the power supply is not necessary.

To install proceed as follows:

- 1 Unscrew housing cover
- 2 Place PLICSCOM in the desired position on the electronics.



You can choose any one of four different positions (each displaced by 90°).

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Q-Pulse Id TMS1102

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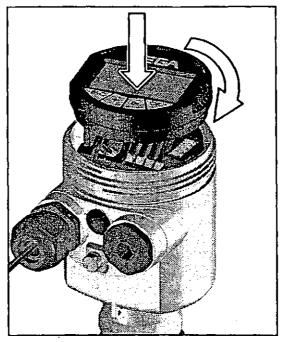


Fig. 37: Installation of PLICSCOM

- 3 Press PLICSCOM lightly onto the electronics and turn it to the right until it snaps in.
- 4 Screw housing cover with inspection window tightly back on

Removal is carried out in reverse order.

PLICSCOM is powered by the sensor, an additional connection is not necessary.

8.4 Repairing the instrument

If it is necessary to repair VEGABAR 64, please send the instrument to the following address:

VEGA Grieshaber KG Repair department Am Hohenstein 113 77761 Schiltach Germany

ò

4-00000



9 Dismounting

9.1 Dismounting procedure

Take note of chapters "4 Mounting" and "5 Connecting to power supply" and carry out the listed steps in reverse order.

9.2 Disposal

VEGABAR 64 consists of materials which can be recycled by specialised recycling companies. We have purposely designed the electronic modules to be easily separable. Mark the instrument as scrap and dispose of it according to government regulations (electronic scrap ordinance, etc.).

Materials: see technical data

If you cannot dispose of the instrument properly, please contact us about disposal methods or return.

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Supplement

Technical data

General data

Materials, wetted parts - process fitting - diaphragm	stainless steel 1.4435, PVDF sapphire-ceramic® (99.9 % oxiEN-ceramic)
- seal	Viton, Kalrez Spectrum, EPDM
Materials, non-wetted parts	
housing	plastic PBT (Polyester),
	Alu-die casting powder-coated,
	stainless steel 1.4435
 seal ring between housing and 	
housing cover	NBR (Alu/stainless steel housing)
	silicone (plastic housing)
 inspection window in housing cover¹⁾ 	Lexan
ground terminal	stainless steel 1.4571/1.4435
 connection cable between IP 68 	
housing and remote electronics	PUR, FEP, PE
Weight	0.8 8 kg (depending on process fitting)

Output variable

Output signal	4 20 mA/HART®
Resolution	1.5 μΑ
Fault signal	22 mA (3.6 mA), adjustable
Current limitation	22 mA
Integration time ²⁾	0 999 s, adjustable
Rise time	150 ms (ti : 0 s, 0 100 %)
Fulfilled Namur recommendation	NE 43

4-03060

¹⁾ Version with PLICSCOM.

The interval required by the output signal to reach 63 % of the actual height after a jump of the input variable. After the triple integration time has passed, the output signal has reached 95 % of the jump height.

Input variable

Adjustment range of the zero/span adjustm	ent:
- zero	begin minus 50 % of the nominal range up to +95 % of the nominal range
- span	-120 ³⁾ +120 % of the nominal range
Adjustment range of the min. adjustment:	
min. %-value	from -10 % 110 % of the nominal
	range
 min. pressure value 	from -50 % 150 % of the nominal
	range
Adjustment range of the max. adjustment:	
max. %-value	from -10 % 110 % of the nominal
	range
 max. pressure value 	from -50 % 150 % of the nominal
	range
Recommended max. turn down	1:30

Nominal range	Gauge pr. resistance ⁴⁾	Low pr. resistance
Gauge pressure		
00.1 bar / 010 kPa	15 bar / 1 500 kPa	-0.2 bar / -20 kPa
00.2 bar / 020 kPa	20 bar / 2 000 kPa	-0.4 bar / -40 kPa
00.4 bar / 040 kPa	30 bar / 3 000 kPa	-0.8 bar / -80 kPa
01.0 bar / 0100 kPa	35 bar / 3 500 kPa	-1.0 bar / -100 kPa
02.5 bar / 0250 kPa	50 bar / 5 000 kPa	-1.0 bar / -100 kPa
-1.00.0 bar / -1000 kPa	35 bar / 3 500 kPa	-1.0 bar / -100 kPa
-1.0+1.5 bar / -100+150 kPa	50 bar /5 000 kPa	-1.0 bar / -100 kPa
	65 bar / 6 500 kPa	-1.0 bar / -100 kPa
-1.0+10.0 bar / -100+1 000 kPa	90 bar / 9 000 kPa	-1.0 bar / -100 kPa
	130 bar / 13 000 kPa	-1.0 bar / -100 kPa
	200 bar / 20 000 kPa	-1.0 bar / -100 kPa
-1.0+60.0 bar / -100+6 000 kPa	300 bar / 30 000 kPa	-1.0 bar / -100 kPa
-0.05+0.05 bar / -5+5 kPa	15 bar / 1 500 kPa	-0.2 bar / -20 kPa
-0.1+0.1 bar / -10+10 kPa	20 bar / 2 000 kPa	-0.4 bar / -40 kPa
-0.2+0.2 bar / -20+20 kPa	30 bar / 3 000 kPa	-0.8 bar / -80 kPa
-0.5+0.5 bar / -50+50 kPa	35 bar / 3 500 kPa	-1.0 bar / -100 kPa
Absolute pressure		
01.0 bar / 0100 kPa	35 bar / 3 500 kPa	
02.5 bar / 0250 kPa	50 bar / 5 000 kPa	
05.0 bar / 0500 kPa	65 bar / 6 500 kPa	
025.0 bar / 02 500 kPa	130 bar / 13 000 kPa	
060.0 bar / 06 000 kPa	300 bar / 30 000 kPa	

- 3) Values less than -1.0 bar cannot be adjusted.4) With process fitting PVDF acc. to nominal pressure stage.

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Accuracy 4)

Reference conditions acc. to IEC 60770-1 - temperature - relative humidity - air pressure	18 30°C 45 75 % 860 1060 mbar (86 106 kPa)
Determination of characteristics Characteristics	limit point adjustment acc. to DIN 16086 linear

Deviation in characteristics 5)

Turn down	Deviation in characteristics
1:1	< 0.1 %
up to 1:5	< 0.1 %
up to 1 : 10	< 0.15 %
Turn down	Deviation in
	characteristics
1:1	< 0.05 %
up to 1 : 5	< 0.05 %
up to 1 : 10	< 0.075 %
	1 : 1 up to 1 : 5 up to 1 : 10 Turn down 1 : 1 up to 1 : 5

Influence of the ambient temperature

Accuracy class 0.1	Turn down	Average temperature coefficient of the zero signal ⁸⁾
	1:1	0.05 %/10 K
	up to 1 : 5	0.1 %/10 K
	up to 1 : 10	0.15 %/10 K

Long-term stability

	0.4.0/ 0 -	
Long-term drift of the zero signal 5)9)	< 0.1 % per 2 years	
Long to the difficult of the Long signal		

Ambient conditions

Ambient, storage and		
transport temperature		
 without PLICSCOM 	-40 +85°C	
with PLICSCOM	-40 +70°C	

- ⁵⁾ Similar to DIN 16086, DINV 19259-1 and IEC 60770-1.
- 6 Relating to the nominal range, incl. hysteresis and repeatability.
- Only with process fitting EV, FT.
- ⁸⁾ In the compensated temperature range between 0°C ... 100°C, reference temperature 20°C.
- Acc. to IEC 60770-1, relating to the nominal range.

—— ?Tø

VEGABAR 64 - 4 ... 20 mA/HART®



Electromechanical data

Cable e	ntrv/p	lua	10)
---------	--------	-----	-----

single chamber housing

double chamber housing

 1 x cable entry M20 x 1.5 (cable-ø 5 ... 9 mm), 1 x blind stopper M20 x 1.5

or:

 1 x closing cap ½ NPT, 1 x blind stopper ½ NPT

or:

1 x plug M12 x 1,

1 x blind stopper M20 x 1.5

 1 x cable entry M20 x 1.5 (cable-ø 5 ... 9 mm),

1 x blind stopper M20 x 1.5

or:

1 x closing cap ½ NPT, 1 x blind stopper ½ NPT

or:

1 x plug M12 x 1,

1 x blind stopper M20 x 1.5

 1 x cable entry M20 x 1.5 (cable-ø 5 ... 9 mm),

1 x blind stopper M20 x 1.5

or:

1 x closing cap ½ NPT, 1 x blind stopper ½ NPT

or:

 1 x plug M12 x 1, 1 x blind stopper M20 x 1.5

 tags for plug connector acc. to DIN 43650

Spring-loaded terminals

remote electronics

for wire cross sections up to 2.5 mm²

Connection cable between IP 68 instrument and remote electronics:

max. length

180 m

min. bending radius

2.5 mm (at 25°C)

diameter

approx. 8 mm

- colour

black

- standard

blue

- Ex version

¹⁰⁾ Depending on the version.



Process conditions

Product temperature, depending on measuring cell seal 11) - Viton - EPDM - Kalrez Spectrum	-20 +120°C -40 +120°C (1 h: +140°C cleaning temperature) -10 +120°C						
Calibration position Influence of the installation position Vibration resistance	upright, diaphragm points downward < 0.2 mbar/20 Pa mechanical vibrations with 4 g and 5 100 Hz ¹²⁾						

Indicating and adjustment module PLICSCOM

Power supply and data transmission	through VEGABAR via sliding contacts (I ² C bus)
Display Adjustment elements	LC display in full dot matrix 4 keys
Protection	IP 20 (mounted in VEGABAR: IP 40)
Materials - housing - inspection window	ABS Polyester foil

Power supply

Supply voltage - non-Ex instrument - EEx ia instrument - Exd instrument	12 36 V DC 12 30 V DC 18 36 V DC
Permissible residual ripple	
- < 100 Hz	$U_{ss} \leq 1 \text{ V}$
– 100 Hz 10 kHz	U s ≤ 10 mV
Load	see diagram
900 -	Voltage limit
675	non-Ex instrument/Exd instru-
VIO	Voltage limit ment
450 HART® load	EEx ia
250	instrument
	► Power supply
12 15 18 21 24 27	30 33 36 V

275

VEGABAR 64 - 4 ... 20 mA/HART®

¹¹⁾ With process fitting PVDF max. +100°C.

¹²⁾ Tested acc. to the regulations of the German Lloyd, GL-directive 2.

Electrical protective measures

Protection

housing

IP 66 or IP 68

 remote electronics (with IP 68 version)

IP 65

Overvoltage category

ill

Protection class

|

Approvals 13)



ATEX II 1G, 1/2G, 2G EEx ia IIC T6, ATEX II 1/2G, 2G EEx d ia IIC T6, WHG, ship approvals

Deviating data with Ex applications: see separate safety instructions.

Dimensions

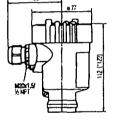
Plastic hous- Stainless ing steel hous- ing

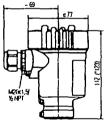
nless Aluminium Aluminium el hous- double chamber housing housing

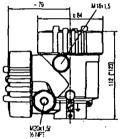
IP 68 version with cable outlet

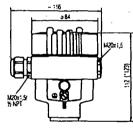
axial

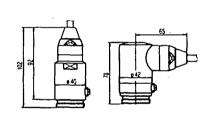
iateral









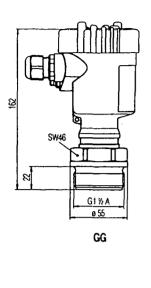


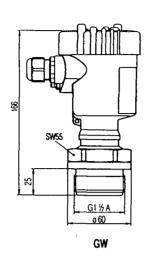
with display

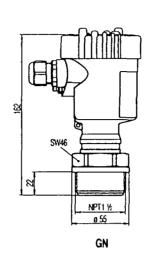
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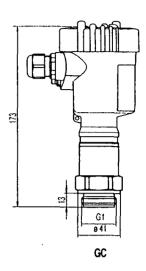


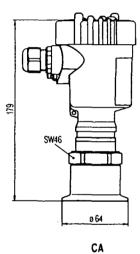
I ruments with screwed connection

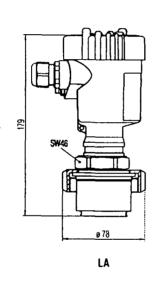


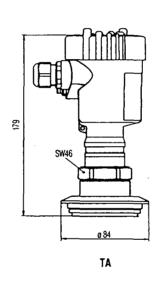


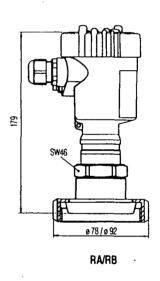


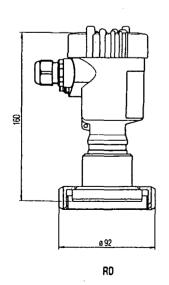


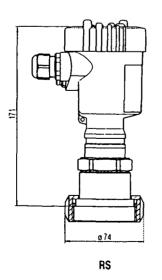


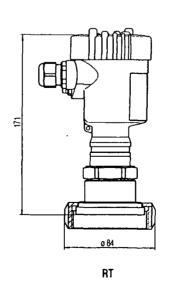


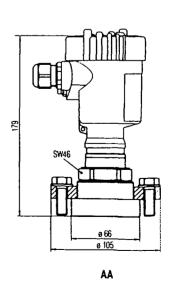




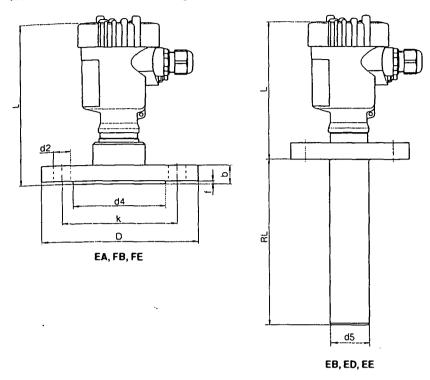








Instruments with flange connection



D = outer flange diameter

b = flange thickness

k = diameter of hole circle

 d_2 = diameter of holes

 d_4 = seal ledge diameter d_5 = extension diameter f = seal ledge strength.

 R_1 = extension length

Flange connection acc. to DIN 2501, seal ledge acc. to DIN 2526 Form D

Order	Flange			Hole			Seal ledge		Extension		Length L	
code	Size	D	b	k	No.	d ₂	d₄	f f	R _L 1)	d _s	without display	with display
EA	DN 40/PN 40	150	18	110	4	18	88	3			156	165
FB	DN 50/PN 40	165	20	125	4	18	102	3			158	167
Æ	DN 80/PN 40	200	24	160	8	18	138	3		i	162	171
EB ·	DN 40/PN 40	150	18	110	4	18	88	3		38	140	149
ED	DN 50/PN 40	165	20	125	8	18	138	3	1	38	142	151
Œ	DN 80/PN 40	200	24	160	8	18	138	3		38	146	155

Flange connection acc. to ANSI B 16.5, seal ledge RF

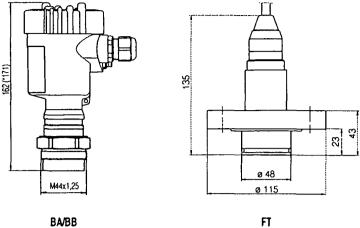
Order Flange			. Holes .				Seal ledge		Extension		Length L	
code	Size	D	b	k	No.	d ₂	d₄	f	R _L 1)	ď	without display	with display
FI FI	2" 150 lbs 3" 150 lbs	152.4 190.5		120.7 152.4	4	19.1 19.1	91.9 127.0	1.6 1.6	_ _	. I	157.1 161.9	166.1 170.9

Order-specific.

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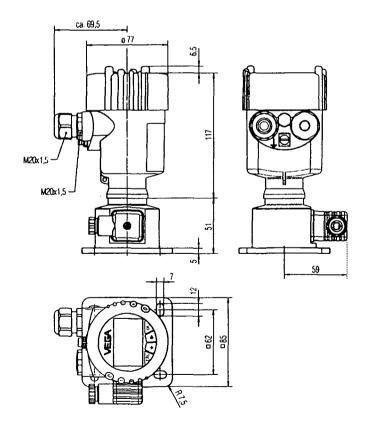
Instruments with connection for the paper industry



FG

* with display

Remote electronics



CE conformity declaration



Konformitätserklärung

Declaration of conformity Déclaration de conformité



VEGA Grieshaber KG Am Hohenstein 113 77761 Schiltach

erklärt in alleiniger Verantwortung, dass das Produkt / declare under our sole responsibility that our product / déclare sous sa seule responsabilité que le produit

VEGABAR 52.X*, 52.C*, 53.X*, 53.C*
VEGABAR 61.X*, 61.C*, 64.X*, 64.C*, 65.X*, 65.C*, 66.X*, 66.C*, 67.X*, 67.C*
mit Elektronik H (4...20.ma HART)

auf das sich diese Erklärung bezieht, mit den folgenden Normen übereinstimmt / to which this declaration relates is in conformity with the following standards / auquel se réfère cette déclaration est conforme aux normes

> EN 61326::1997 / (Klasse B) EN 61326::1997 / A1::1998 EN 61010 - 1::2001

gemäß den Bestimmungen der Richtlinien / following the provision of Directives / conformément aux dispositions des Directives

73/23 EWG 89/336 EWG

Schiltach, 07 11.2002

ppa. J. Fehrwlad

Josef Fehrenbach Entwicklungsleitung

27525-EN-C___11



VEGA Grieshaber KG Am Hohenstein 113 77761 Schiltach Germany

Phone

(07836) 50-0

Fax

(07836) 50-201

E-Mail

info@de.vega.com

www.vega.com







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.

Technical data subject to alterations

27525-EN-030601



TECHNICAL DATA SHEET

For

SPS 296

Equipment Type:

Hydrastatic Level Sensor

Location:

Wet Well

Model Numbers:

BR.64XXGG1SHTMAX

DIS12.XBXW

Manufacturer:

Vega

Supplier:

Vega

398 The Boulevarde Kirrawee NSW 2232 Ph. 02 9542 6662

Fx. 02 9542 6665

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Prüfzertifikat



für Druckmessumformer

Test certificate for pressure transmitters





VEGA bestätigt, dass die zur Qualitätsprüfung des Erzeugnisses eingesetzten Messmittel gültig kalibriert und auf nationale Normale der Physikalischen Technischen Bundesanstalt (PTB) rückführbar sind. VEGA confirms that all instruments used to assure the quality of our products are calibrated and traceable to national standards of PTB (Physikalischen Technischen Bundesanstalt)

VEGA Grieshaber KG, Am Hohenstein 113, 77761 Schiltach, Tel. 0 78 36/50-0, Fax. 0 78 36/50 201

WELL72	Kundennummer	
0 bis/to 0,4 bar rel.	Customer ID	44741
0 bis/to 40 kPa rel.	Auftragsnummer	
13626099	Order number	1109544
4 20mA, HART OHNE	Auftragsposition Order position	4
	0 bis/to 0,4 bar rel. 0 bis/to 40 kPa rel. 13626099 4 20mA, HART	0 bis/to 0,4 bar rel. 0 bis/to 40 kPa rel. 13626099 4 20mA, HART OUNTS Auftragsnummer Order number Auftragsposition

Kennwerte / Characteristics:

0,000 bis/to 0,400 bar rel.

4,006 bis/to 20,003 mA

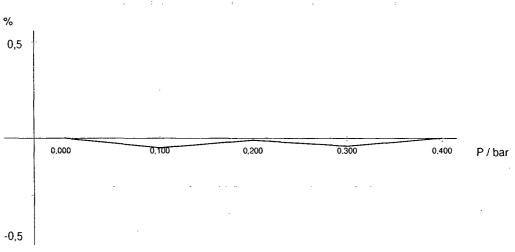
Kennliniencharakteristik / Output characteristics:

max. zul. Abweichung bezogen auf Messbereich:

< 0,25 %

/ Dev. in linearity rel. to measuring range

RefDruck / Ref. pressure [bar]:	0,000	0,100	0,200	0,300	0,400
Soll-Ausgang / Ideal output [mA]:	4,006	8,007	11,999	16,004	20,003
Ist-Ausgang / Real output [mA]:	4,006	7,998	11,998	15,998	20,003
Abweichung / Accuracy [%]:	0,00	-0,05	-0,01	-0,04	0,00

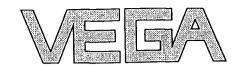


Temperatureinfluss				,		
/ Temperature influence:	Temperatur [°C]	n	20	60	100	
Temperaturfehler bei 0 bar rel.	Temperature		. 20 ! .	00	.	
/ Temperature accuracy at 0 bar rel.	Ist-Ausgang [mA]	4.007	4.006	4,000	3,997	
Bezogen auf den Messbereich / Related to the measuring range	Real output	1,001	; .,,,,,,	1,000		
>zugstemperatur 20 °C / Ref. temperature 20 °C	Abweichung [%] Accuracy	0,01	0,00	-0,04	-0,05	
,	1.002.00)	1				1

Datum / Date: 13.10.2003

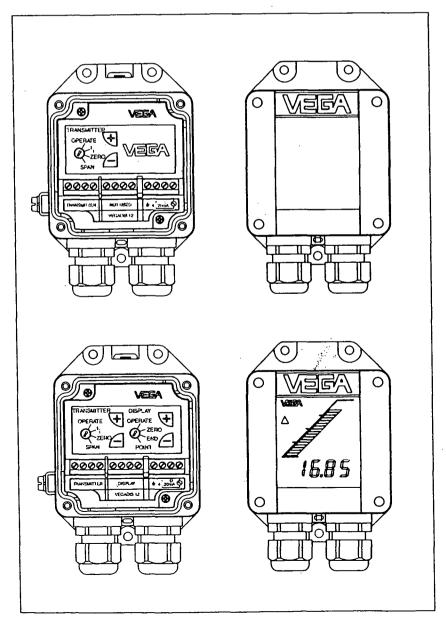
Unterschrift / Signature:

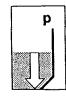
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OrderNo: 1109544_5

Operating Instructions VEGADIS 12







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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Q-Pulse Id TMS1102

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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.

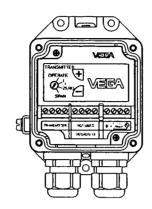
VEGADIS 12 has the following functions:

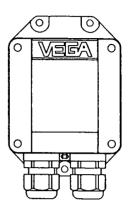
- adjustment of zero, span and ti
- atmospheric pressure compensation for the pressure transmitter
- measured value display (optional).

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.

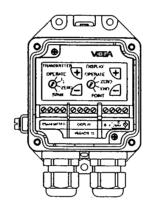
1.2 Types and versions

VEGADIS 12 without display





VEGADIS 12 with display





Product description



1.3 Technical data

Standard data

Materials	and	weight
------------------	-----	--------

Housing Ground terminal

Display window

Breather facility

Weight

high-resistance plastic PBT (Polyester)

stainless steel 1.4305

Lexan

PTFE filter element 1)

approx. 0.5 kg

Adjustment and indicating elements

Adjustment elements

2 keys, 1 rotary switch

Adjustment elements with display

Display (option)

2 x 2 keys, 2 x 1 rotary switch LC multifunctional display with - bar graph (20 segments)

- digital value (4 digits)

- tendency indicator for rising or falling values

Connection

Cable entry Screw terminals

M20 x 1.5 (for cable \emptyset 5 ... 9 mm) 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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Q-Pulse Id TMS1102

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

- with display

Max. input current

Range of the current signal

Max. permissible load

12 ... 36 V DC 17 ... 36 V DC

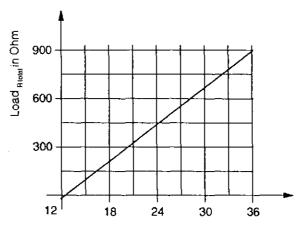
150 mA

3.5 ... 22 mA

depending on the supply voltage

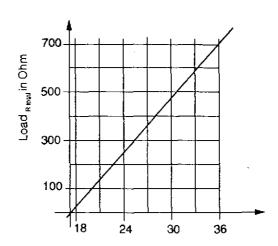
(see load diagrams)

Load diagram without display



Voltage of the external energy U_H in Volt

Load diagram with display



Voltage of the external energy U_H in Volt

Protective measures

Housing	IP 65 ¹
Protection class	Ш
Overvoltage category	ili

Ambient conditions

Ambient temperature -40°C ... +85°C - VEGADIS 12 - VEGADIS 12 with display -20°C ... +70°C -40°C ... +85°C Storage and transport temperature

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¹⁾ Maintaining the housing protection IP 65 requires the use of a seaf in the cable entry fitting to the cable. If the supplied seal does not fit, the customer has to provide a suitable one.

Product description



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 (€

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

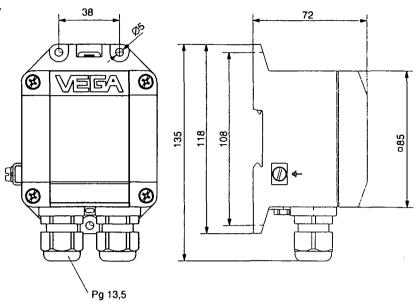
Full compliance with NAMUR regulations NE21, May 1993.

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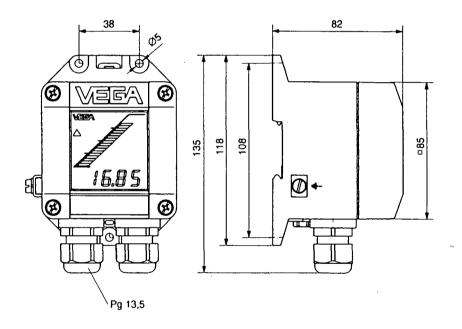


1.5 Dimensions

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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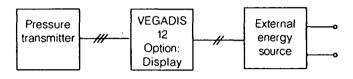


3 Electrical connection

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)

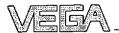
Make sure that the external energy source is reliably separated from the mains circuits acc. to DIN VDE 0106, part 101. The above mentioned VEGA instruments meet this requirement and protection class III is therefore ensured.

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:

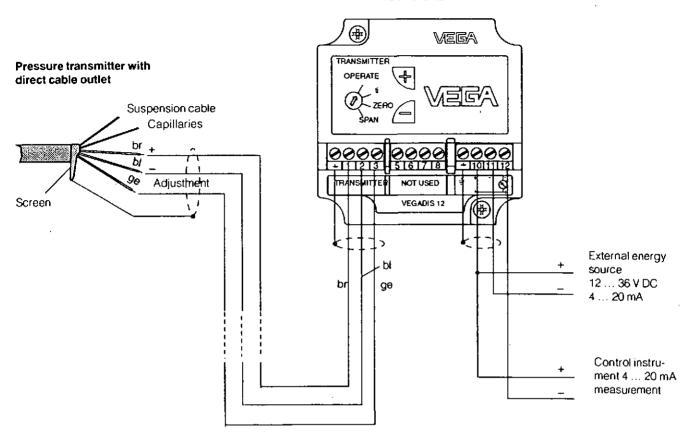
- The connection must be made according to the national installation standards (e.g. in Germany acc. to the VDE regulations).
- To avoid damage of the electronics, the terminal voltage must not exceed 36 V.
- The connection elements have built-in protection against polarity reversal.
- The wiring between 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

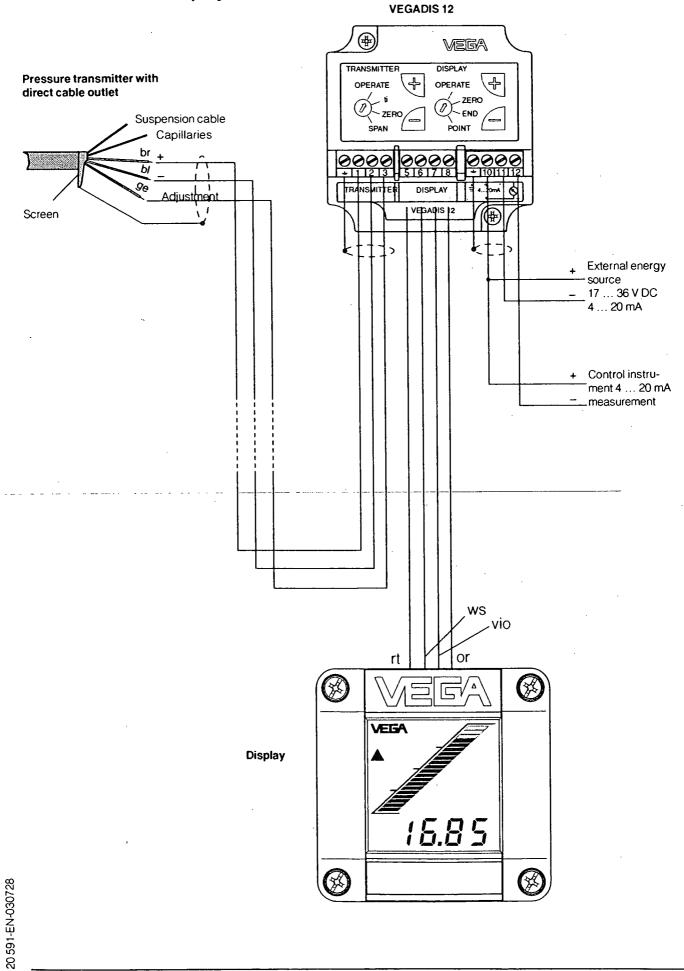
VEGADIS 12



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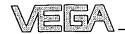


VEGADIS 12 with display



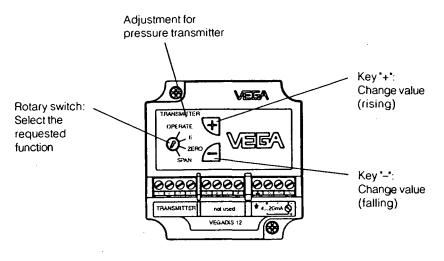
Active 10/12/2014

VEGADIS 12



4 Setup

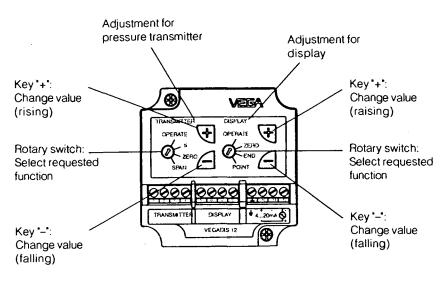
4.1 Adjustment elements



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)

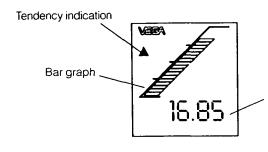


Adjustment system (transmitter)

(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.



Digital value:

- 4 digits as well as sign and decimal point
- individual scale from -9999 ... +9999

-

VEGADIS 12

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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.

Q-Pulse Id TMS1102



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

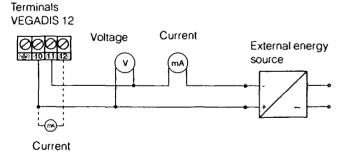
First of all open the housing cover. The indicated measured value must not change. However, if the indicated value changes nevertheless, the compensation of the atmospheric pressure is not ensured. Please therefore check:

- 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

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Notes



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VEGA Grieshaber KG Am Hohenstein 113 77761 Schiltach Germany Phone (0 78 36) 50 - 0 Fax (0 78 36) 50 - 201 E-mail info@de.vega.com www.vega.com

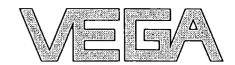






All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and processing systems correspond to the latest information at the time of printing.

Technical data subject to alterations

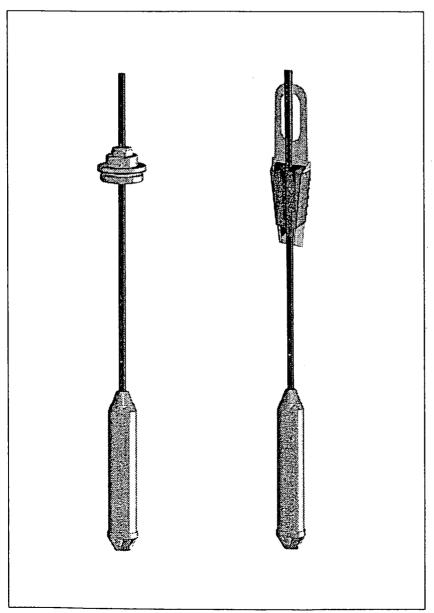


OrderNo: 1109544_4

Operating Instructions

VEGAWELL 72 – 4 ... 20 mA/HART®









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About this document

1.1 Function

This operating instructions manual gives you all the information you need for quick set-up and safe operation of VEGAWELL 72. Please read this manual before you start set-up.

1.2 Target group

This operating instructions manual is addressed to trained specialist staff. The contents of this manual should be made available to this personnel and put into practice by them.

1.3 Symbolism used



Information, tip, note

This symbol indicates helpful additional information.



Caution

This symbol informs you of a possible and dangerous situation. Ignoring this cautionary note can impair the person and/or the instrument.



Ex applications

This symbol indicates special instructions for Ex applications.

• List

The dot put 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.



2 For your safety

2.1 Authorised personnel

All operations described in this operating instructions manual must only be carried out by trained and authorised personnel. For safety and warranty reasons, any internal work on the instruments must only be carried out by qualified VEGA personnel.

2.2 Appropriate use

VEGAWELL 72 is a suspension pressure transmitter for level and gauge measurement.

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 parts by wrong mounting or setting.

2.4 General safety instructions

VEGAWELL 72 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 (e.g. the VDE regulations in Germany) as well as all prevailing safety regulations and accident prevention rules.

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2.5 CE conformity

The VEGAWELL 72 pressure transmitter is CE conform to EMC (89/336/EWG) and NSR (73/23/EWG) and fulfils the Namur recommendation NE 21. Conformity has been judged acc. to the following standards:

- EMC
 - Emission EN 61326: 1997/ A1: 1998 (class B)
 - Susceptibility EN 61326: 1997/A1: 1998
- NSR EN 61010-1: 1993.

2.6 Safety instructions for Ex areas

Take note of the Ex specific safety instructions for Ex applications. These are part of the operating instructions manual and come with Ex approved instruments.

2.7 Environmentally responsible behaviour

Protection of the environment is one of our most important duties. That is why we have introduced an environmental management system that focuses on continuous improvement of company environmental protection. The environmental management system is certified acc. to DIN EN 14001.

Please help us fulfil this obligation by observing the environmental instructions in this manual.



3 Product description

3.1 Configuration

Scope of delivery

The scope of delivery encompasses:

- the VEGAWELL 72 pressure transmitter with suspension cable
- optional straining clamp or screwed connection
- documentation
 - this operating instructions manual
 - test protocol
 - Ex-specific safety instructions (with Ex versions) and if necessary further certificates.

Components

VEGAWELL 72 consists of the following components:

- transmitter
- suspension cable

The components are available in different versions. By combining them in various ways in the order code, manifold instrument versions can be created (see technical data in the supplement).

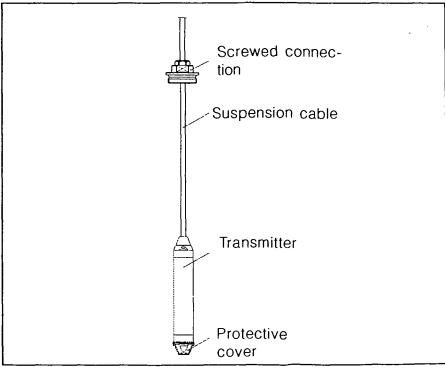


Fig. 1: Example of a VEGAWELL 72 with screwed connection

-EN-030320

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3.2 Principle of operation

Application area

VEGAWELL 72 is used for level and gauge measurement in wells, basins and atmospherically open vessels¹⁾ especially in drinking water and waste water treatment.

Principle of operation

The sensor element is a CERTEC® measuring cell with a flush ceramic diaphragm. The hydrostatic pressure induces a capacitance change in the measuring cell via the ceramic diaphragm. This capacitance change is converted by the integrated digital electronics into a 4 ... 20 mA output signal.

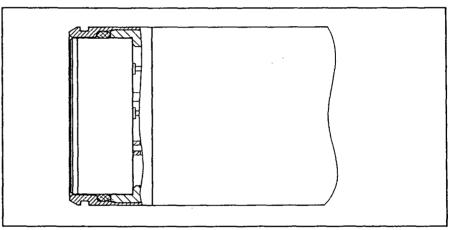


Fig. 2: The CERTEC® measuring cell is flush mounted into the pressure transmitter

Power supply

The VEGAWELL 72 has a two-wire electronics 4 ... 20 mA/HART® for power supply with:

- 12 ... 36 V DC (non-Ex instrument)
- 12 ... 29 V DC (EEx ia instrument).

¹⁾ For use in atmospherically closed vessels under vacuum, VEGAWELL 72 is available with absolute pressure ranges.



3.3 Adjustment

VEGAWELL 72 with 4 ... 20 mA / HART® offers three adjustment options:

- External connection housing VEGADIS 12
- PC with adjustment software VVO
- HART® handheld.

The entered parameters are generally saved in VEGAWELL 72, if you adjust with VVO they can also be saved in the PC.

3.4 Storage and transport

Packing

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test acc. to DIN 55439.

The packaging consists of carton. It is environmental-friendly and recyclable. Dispose of the packing material via specialised recycling companies.

Climatic conditions

- Storage and transport temperature -50°C up to ¹)
- Relative humidity 20 ... 85 %.

-EN-030320

See technical data, product temperature under process conditions.



4 Mounting

4.1 Select installation position

Keep the following points in mind when selecting the installation position:

- Lateral movements of the transmitter can cause measurement errors.
- -> Mount VEGAWELL in a calm area or in a suitable protective tube.
- The suspension cable contains a capillary for atmospheric pressure compensation.
- -> Lead the cable end to a dry environment or into a suitable terminal housing.



VEGA recommends VEGADIS 12 for this purpose. It contains connection terminals and a filter element for pressure compensation. For outdoor mounting, a suitable protective cover is available.

 The measuring cell cover prevents mechanical damage to the measuring cell. It may only be removed when the instrument is used in extremely dirty water.

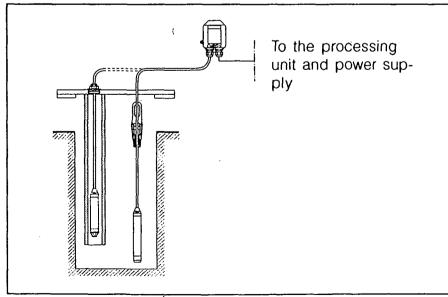


Fig. 3:
Mounting example deep well measurement



4.2 Mounting procedure with straining clamp

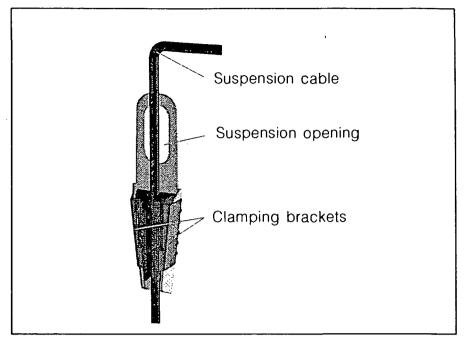


Fig. 4: Straining clamp

Mount VEGAWELL 72 with straining clamp as follows:

- 1 Hang the straining clamp on a suitable wall hook
- 2 Lower VEGAWELL to the requested measuring height
- 3 Move the clamping brackets upward and push the suspension cable between the clamping brackets
- 4 Hold the suspension cable, shift the clamping brackets downward and fix with a light blow

Dismounting is carried out in reverse order.

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4.3 Mounting procedure with screwed connection

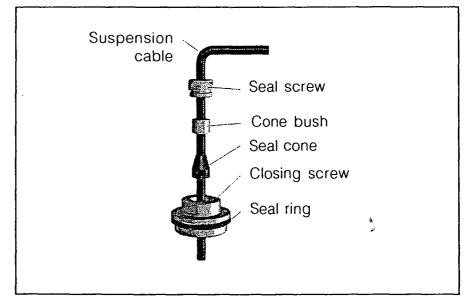


Fig.5: Screwed connection

Mount VEGAWELL 72 with screwed connection as follows:

1 Weld mounting boss G1½A or 1½ NPT into the vessel top



We recommend the following VEGA mounting accessory:

- Mounting boss G1½A of stainless steel 1.4571, article no. 2.21 993.
- 2 Lower VEGAWELL through the mounting boss to the requested height
- 3 Slide the seal ring¹⁾ for the screwed connection over the suspension cable
- 4 Lead the suspension cable from below through the opened screwed connection
- 5 Slide the seal cone and cone bushing over the suspension cable, fasten manually with the seal screw
- 6 Turn the screwed connection into the socket, fasten with SW 30, then fasten seal screw with SW 19

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¹⁾ only with G 1 $\frac{1}{2}$ A



Height correction:

- 1 Loosen seal screw with SW 19
- 2 Slide seal cone and cone bushing over the requested position on the cable
- 3 Fasten seal screw

Dismounting is carried out in reverse order.

^

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5 Connection to power supply

5.1 Prepare connection

Note safety instructions

Always observe the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltages are expected, overvoltage arresters for the power supply side1) should be installed.



We recommend VEGA overvoltage arresters ÜSB 62-36G.X.

Take note of safety instructions for Ex applications

In hazardous areas you should take note of the appropriate regulations and type approval certificates of the sensors and power supply units. The sensors must only be operated on intrinsically safe circuits. The permissible electrical values are stated in the certificate.

Select voltage supply

Provide a reliable separation between the supply circuit and the mains circuits acc. to DIN VDE 0106 part 101. The 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 VEGAWELL 72.

Bear in mind the following factors regarding supply voltage:

- Reduction of the output voltage of the power supply unit under nominal load
- Influence of additional instruments in the circuit (see load values in Technical data).

VEGAWELL 72 has an integrated overvoltage protection.



Select connection cable

VEGAWELL 72 is connected with standard two-wire cable. When connecting to VEGADIS 12, the cable must have an outer diameter of 5 ... 9,mm to ensure the seal effect of the cable entry.

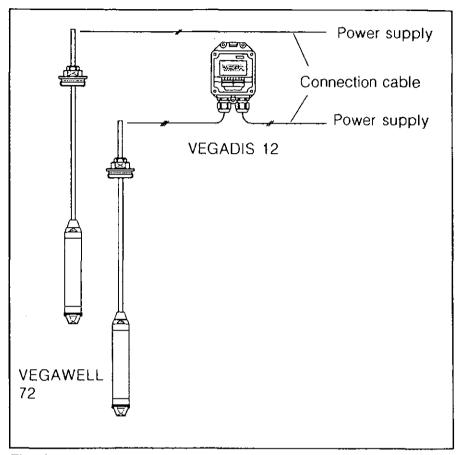


Fig. 6: top: direct connection of VEGAWELL 72 to power supply bottom: connection of VEGAWELL 72 via VEGADIS 12 to power supply

If strong electromagnetic interference is expected, shielded cable is recommended. The screen should be grounded on both ends¹⁾.

Select connection cable for Ex applications



Take note of the corresponding installation regulations for Ex applications.

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Q-Pulse Id TMS 1102

Onnect screen to \(\pm\)-terminal. Earth the ground screen correctly outside on the housing. The two terminals are galvanically connected.



5.2 Connection procedure

Direct connection to power supply

Proceed as follows:

- 1 Lay the suspension cable¹⁾ up to the terminal compartment. The bending radius must have at least 25 mm
- 2 Connect the individual wires to the terminals acc. to the wiring plan

Connection to power supply via VEGADIS 12

Proceed as follows:

- 1 Snap VEGADIS 12 into carrier rail or screw onto mounting plate
- 2 Loosen cover screws and detach cover
- 3 Lead suspension cable through the cable entry into VEGADIS 12
- 4 Loosen terminal screws with a screwdriver
- 5 Insert wire ends into the open terminals acc. to the wiring plan
- 6 Tighten terminal screws with a screwdriver
- 7 Check the hold of the wire ends in the terminals by slightly pulling on them
- 8 Tighten the compression nut of the cable entry, the seal ring must cover the cable completely
- 9 Connect supply cable acc. to steps 3 to 8
- 10 Screw the housing cover back on

The electrical connection is finished.

The suspension cable is prepared and ready for use ex works. If the cable is shortened, fasten the type identification tag with holder back onto the cable.



Direct connection

5.3 Wiring plans

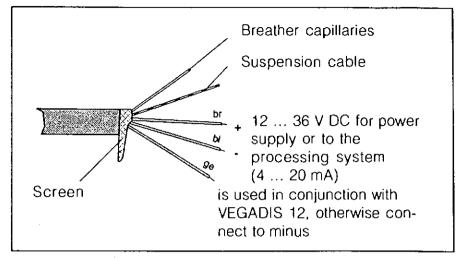


Fig. 7: Wiring suspension cable

Connection via VEGADIS 12

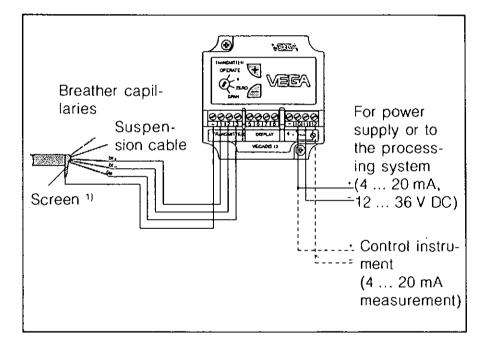


Fig. 8: Terminal assignment VEGADIS 12

N

Onnect screen to *-terminal. Earth ground cable correctly outside on the housing. Both terminals are galvanically connected.



6 Set-up

After mounting and electrical connection, VEGAWELL 72 is ready for operation.

-> Switch on power supply

The electronics carries out a self-test for approx. 2 s. Then VEGAWELL 72 delivers a current of 4 ... 20 mA according to the actual level.

6.1 With VEGADIS 12

Scope of adjustment

- zero begin of the meas, range
- span end of the meas, range
- ti integration time

Adjustment elements

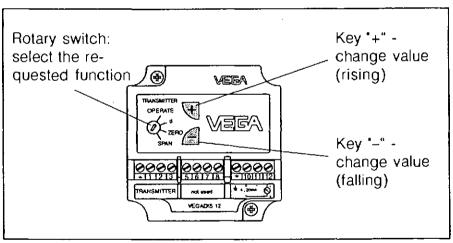


Fig. 9: Adjustment elements of VEGADIS 12



Adjustment system

- Select the requested function with the rotary switch.
- With the [+] and [-] key you set the signal current or the integration time.
- Finally, the rotary switch is set to position "OPER-ATE".

The set values are transferred to the EEPROM memory and remain there even in case of voltage failure.

Set-up procedure

For adjustment with VEGADIS 12 you proceed as follows:

- 1 Open housing cover
- 2 Connect hand-held multimeter to terminals 10 and 12
- 3 Begin of the meas. range: Set rotary switch to "zero"
- 4 Empty the vessel/basin or pull out VEGAWELL completely
- 5 Set a current of 4 mA with the [+] and [-] keys
- 6 End of the meas. range: Set rotary switch to "span"
- 7 Fill the vessel/basin or lower VEGAWELL completely
- 8 Set a current of 20 mA with the [+] and [-] keys
- 9 Operation: Set the rotary switch to "OPERATE"
- 10 Close the housing cover

The adjustment data are effective, the output current 4 ... 20 mA corresponds to the actual level.



6.2 With PC and VVO

Connect the PC

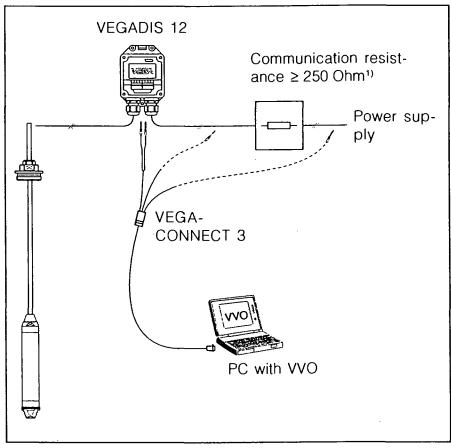


Fig. 10: Connection of the PC to VEGADIS 12 or to the communication resistance

Required components:

- VEGAWELL 72
- PC with VVO
- VEGACONNECT3
- Communication resistance ≥ 250 Ohm
- Power supply, e.g. power supply unit



Take note of the appropriate installation regulations for Ex applications.

The input resistance of the power supply is generally low-resistance. This damps the HART® signal. The communication resistance of ≥ 250 Ohm increases the resistance of the signal circuit and prevents damping.



7 Maintenance and fault rectification

7.1 Maintenance

In standard operation, the VEGAWELL 72 process pressure transmitter is maintenance-free.

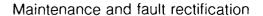
When the instrument is being cleaned externally, care should be taken to avoid mechanical damage, especially to the diaphragm. Cleaning detergents should neither corrode the seal nor other components of VEGAWELL 72.

7.2 Fault rectification

Fault	Possible reason	Rectifying measure
4 20 mA signal not stable	level fluctuations	set integration time via VEGADIS 12 or VVO
	no atmospheric pressure compensation	check capillaries, if necessary cut them clean check pressure compensation of VEGADIS 12, if necessary clean filter element
4 20 mA signal missing	incorrect connection to power supply	check connection acc. to chapter 5.3 and correct if necessary acc. to chapter 5.2
	no power supply	check cables for line break and re pair if necessary
	power supply too low or load resistance too high	check and adapt if necessary

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Fault	Possible reason	Rectifying measure
1	electronics module or meas. cell defective	exchange instru- ment or return for repair



For Ex applications, the regulations for wiring of intrinsically safe circuits must be observed.

7.3 Repairing the instrument

If it is necessary to repair VEGABAR 72, pease send the instrument to the following address:

VEGA Grieshaber KG Repair department Am Hohenstein 113 77761 Schiltach Germany



8 Dismounting

8.1 Dismounting procedure

Take note of chapters "4 Mounting" and "5 Connect power supply" and carry out the listed steps in reverse order.

8.2 Disposal

VEGAWELL 72 consists of materials which can be recycled by specialised recycling companies. We have purposely designed the electronic modules to be easily separable. Mark the instrument as scrap and dispose of it according to government regulations.

Materials: see technical data

If you cannot dispose of the instrument correctly, please contact us concerning disposal methods or return.

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Supplement

Technical data

General data

Instrument name	suspension pressure transmitter VEGAWELL 72
Materials, wetted parts	
transmitter	stainless steel 1.4435
diaphragm	sapphire-ceramic®
	(99.9 % oxide ceramic)
 suspension cable 	PE, FEP, PUR
meas. cell seal	Viton, Kalrez, EPDM
protective cover	PA PA
Materials, non-wetted parts	
straining clamp	stainless steel 1.4301
closing screw	stainless steel 1.4435
 external connection 	
housing VEGADIS 12	plastic PBT (Polyester)
Weights	
basic weight	approx. 0.7 kg
suspension cable	approx. 0.1 kg/m
 straining clamp 	approx. 0.2 kg
 screwed connection 	approx. 0.4 kg

Input variable

Nominal measuring range (gauge/absolu	Gauge pressure resistar	Low pressure resistance
00.1 bar / 010 kPa	15 bar / 1 500 kPa	-0.2 bar / -20 kPa
00.2 bar / 020 kPa	20 bar / 2 000 kPa	-0.4 bar / -40 kPa
00.4 bar / 040 kPa	30 bar / 3 000 kPa	-0.8 bar / -80 kPa
01.0 bar / 0100 kPa	35 bar / 3 500 kPa	-1.0 bar / -100 kPa
02.5 bar / 0250 kPa	50 bar / 5 000 kPa	-1.0 bar / -100 kPa
05.0 bar / 0500 kPa	65 bar / 6 500 kPa	-1.0 bar / -100 kPa
010.0 bar / 01 000 kPa	90 bar / 9 000 kPa	-1.0 bar / -100 kPa
025.0 bar / 02 500 kPa	130 bar / 13 000 kPa	-1.0 bar / -100 kPa

Zero	adjustable between -20 +95 % of nominal range
Span	adjustable between 3.3 +120 % of nominal range



Output variable

Output signal	4 20 mA/HART®
Resolution	6 μA
Fault signal	22 mA, 3.6 mA adjustable
Current limitation without fault	20.5 mA
Integration time ¹⁾	0 10 s, adjustable
Rise time	70 ms (ti : 0 s, 0 63 %)
Fulfilled Namur recommendation	NE 43

Accuracy 2)

Reference conditions acc. to IEC 61298-1	
temperature	18 30°C
 relative moisture 	45 75 %
air pressure	860 1060 mbar (86 106 kPa)
Determination of characteristics	limit point adjustment acc. to DIN 16086
Characteristics	linear

Deviation in characteristics 3)

Accuracy class 0.25	Turn down 1 : 1 up to 1 : 5 up to 1 : 10	Deviation in character. < 0.25 % < 0.3 % < 0.4 %
0.1	1 : 1 up to 1 : 5 up to 1 : 10	< 0.1 % < 0.1 % < 0.2 %

Influence of the ambient temperature

Accuracy class	Turn down	Average temperature coefficient of the zero signal ⁴⁾
0.25	1 : 1 up to 1 : 5 up to 1 : 10	<0.15 %/10 K <0.225% /10 K <0.3 %/10 K
0.1	1 : 1 up to 1 : 5 up to 1 : 10	<0.05 %/10 K 0.075 %/10 K 0.1 %/10 K

The time required by the output signal to reach 63 % of the actual height after a jump. After the triple integration time, the output signal has reached 95 % of the height.

²⁾ Similar to DIN 16086, DIN V 19259-1 and IEC 60770-1.

³⁾ Incl. hysteresis and repeatability relating to the nominal measuring range.

In the compensated temperature range of 0 ... 80°C, reference temperature 20°C.

Acc. to IEC 60770-1, relating to the nominal measuring range.

Λ.

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Supplement

Long-term stability

Long-term drift of the zero signal 5)	< 0.1 % per 2 years	

Ambient conditions

Ambient temperature	-40 +85°C (PE +60°C)
Storage and transport temperature	-40 +100°C
otorage and transport temperature	10 1100 0

Process conditions

Product temperature depending on mate Suspension cable/Meas. cell seal	erial
– PE/Viton	-20 +60°C
- PUR/Viton	-20 +80°C
FEP/Kalrez	-10 +80°C
Calibration position Influence of the installation position Vibration resistance	upright, diaphragm points downward < 0.2 mbar/20 Pa mechanical vibrations with 4 g and 5 100 Hz ⁶⁾

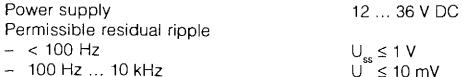
Electromechanical data

Suspension cable	
configuration	four wires, one suspension cable,
	one breather capillary,
	screen braiding, foil, cover
wire cross-section	0.5 mm ²
wire resistance	≤ 0.036 Ohm/m
 tensile load 	≥ 1.200 N
max. length	1000 m (with VEGADIS 12: 200 m)
 min. bending radius 	25 mm (at 25°C)
diameter	approx. 8 mm
- colour	
- PE non-Ex/Ex	black/blue
- PUR non-Ex/Ex	blue/blue
- FEP non-Ex/Ex	blue/blue
Cable entry VEGADIS 12	2 x M20 x 1.5 (cable-ø 5 9 mm)

Tested acc. to the regulation of the German Lloyd, GL directive 2.

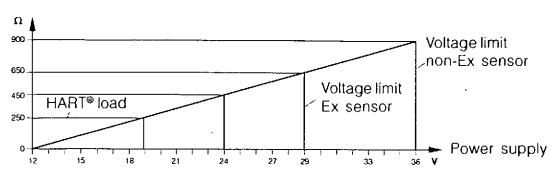


External energy



Load

 $U_{ss} \le 1 \text{ V}$ $U_{ss} \le 10 \text{ mV}$ see diagram



Integrated overvoltage protection

Nominal leakage current (8/20 µS)	10 kA	
riominal loanage barron (o/20 po)	10101	
Min. response time	< 25 ns	

Electrical protective measures

Protection	
transmitter	IP 68 (25 bar)
VEGADIS 12	IP 65
Protection class	III
Overvoltage category	II

Approvals 7)



ATEX II 2G EEx ia IIC T6, ship approval

Deviating data for Ex applications see separate safety instructions.

WEGA

Dimensions

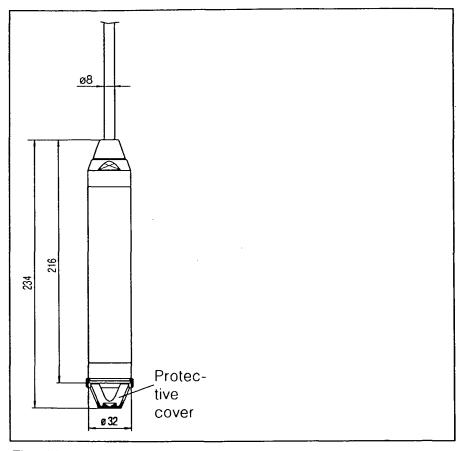


Fig. 11: Dimensions VEGAWELL 72, standard version

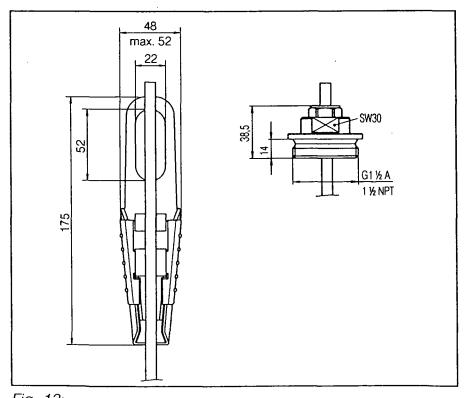


Fig. 12: Dimensions straining clamp and screwed connection



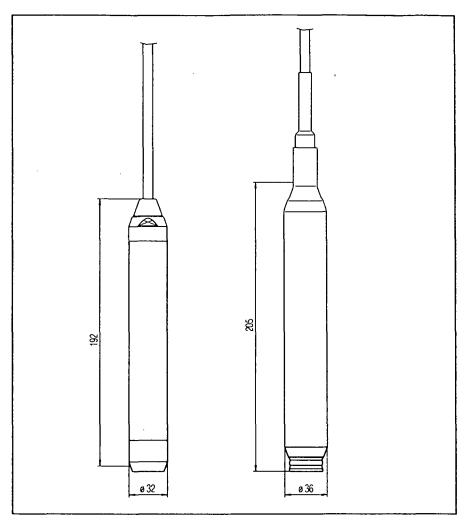


Fig. 13: Dimensions VEGAWELL 72, left: version deep wells, right: version PE coating

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CE conformity declaration



Konformitätserklärung

Declaration of conformity Déclaration de conformité



VEGA Grieshaber KG Am Hohenstein 113 77761 Schiltach

erklärt in alleiniger Verantwortung, daß das Produkt / declare under our sole responsibility that our product / déclare sous sa seule responsabilité que le produit

VEGAWELL 72

auf das sich diese Erklärung bezieht, mit den folgenden Normen übereinstimmt / to which this declaration relates is in conformity with the following standards / auquel se réfère cette déclaration est conforme aux normes

EN 61326 : 1997 / A1 : 1998 (Klasse B) EN 61326 : 1997 / A1 : 1998 EN 61010 - 1 : 1993

gemäß den Bestimmungen der Richtlinien / following the provision of Directives / conformément aux dispositions des Directives

73/23 EWG 89/336 EWG

Schiltach, 16.09.2002

ppa. J. Februliach

Josef Fehrenbach Entwicklungsleitung



VEGA Grieshaber KG Am Hohenstein 113 77761 Schiltach Germany

Phone

07836 50-0

Fax

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E-Mail

info@de.vega.com

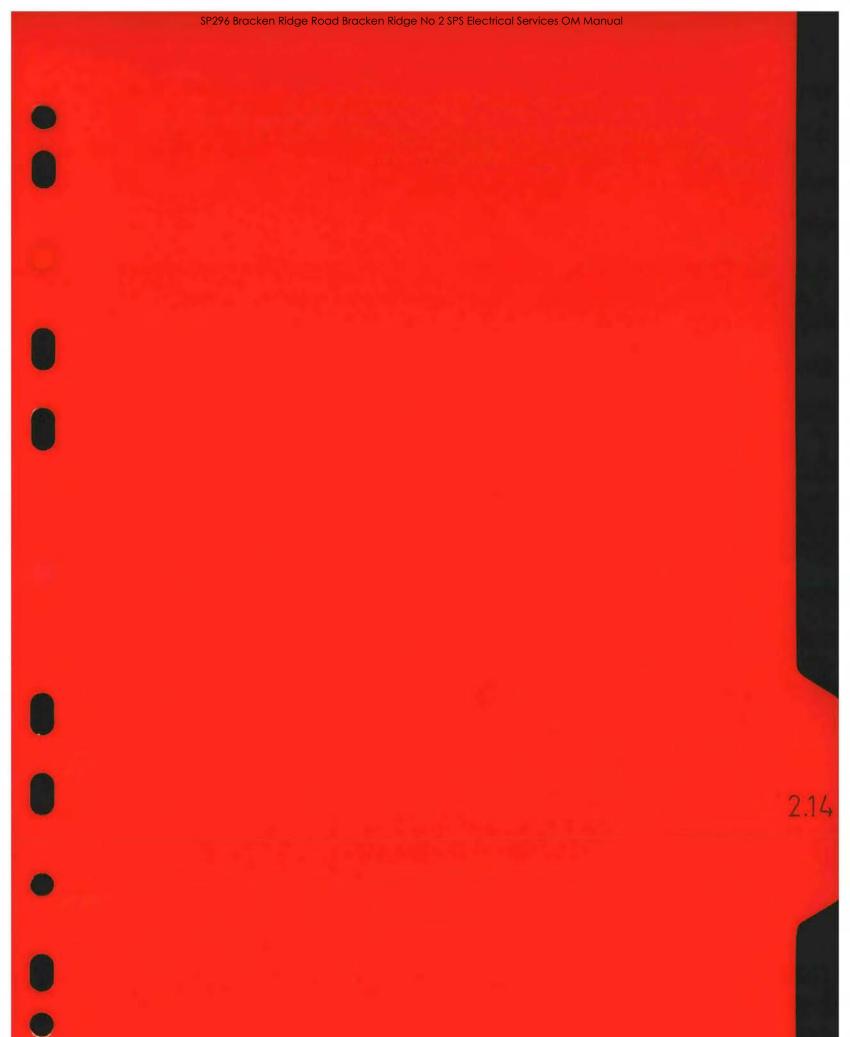
www.vega.com





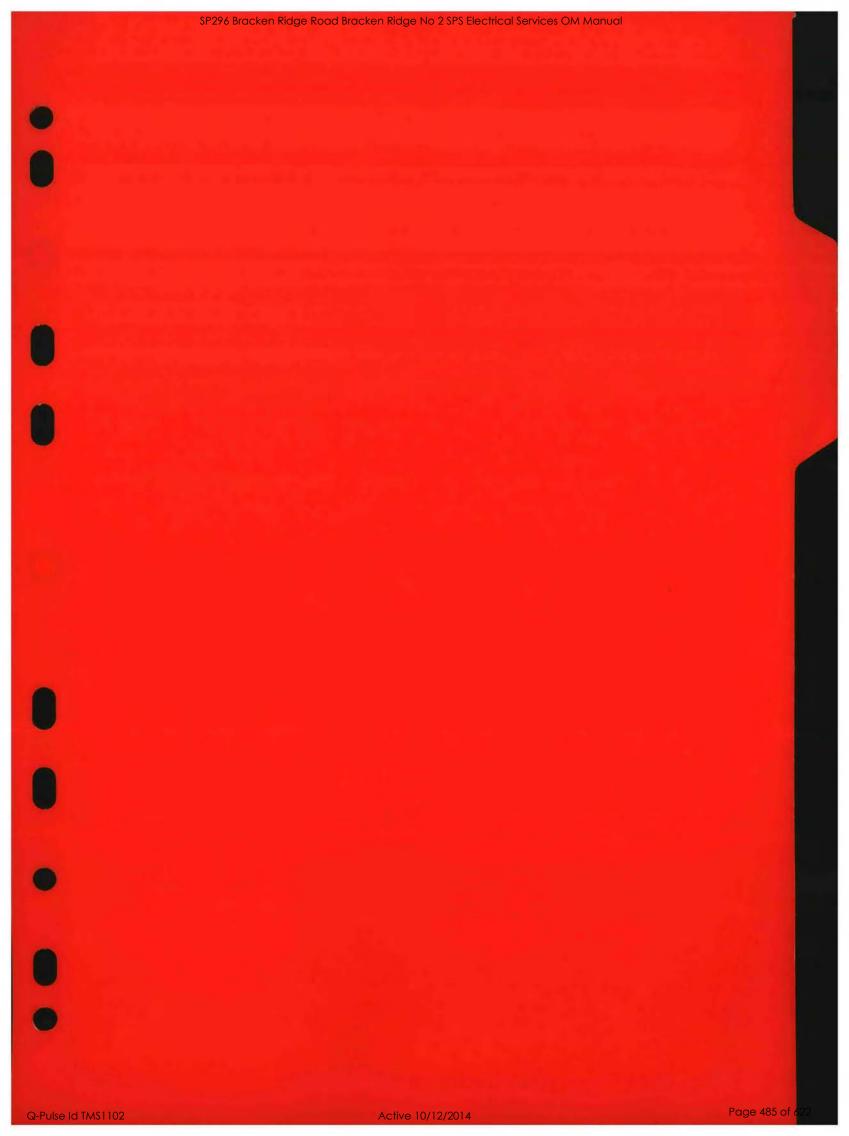


All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and processing systems correspond to the latest information at the time of printing.



Active 10/12/2014

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TECHNICAL DATA SHEET

For

SPS 296

Equipment Type:

Flowmeter

Location:

RTU Section

Model Numbers:

MF/F301X411A005ER1301111

Manufacturer:

ABB Instrumentation

Supplier:

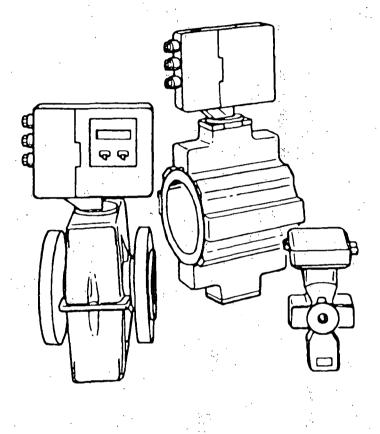
ABB Instrumentation

PO Box 8202

Fairfield Gardens Qld 4103

Ph. 07 3848 6123 Fx. 07 3848 6091

Quick Reference Programming Guide



MagMaster™ Electromagnetic Flowmeters

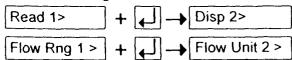
ABB Instrumentation



FUNCTIONS OF KEYS

RETURN (or ENTER, EXE, etc)

• Scrolls through main menu or submenu.



Enters default or confirms existing value.

1 ALPHANUMERIC plus RETURN

• Selects menu (or submenu) item and advances to its first submenu.

Read 1>
$$+$$
 5 \longrightarrow Anlg Fsd 1 > Anlg Fsd 1 > \longrightarrow Anlg Dir Fwd 1 >

Keystrokes can be combined as a shortcut.

Selects submenu and displays current value.
 A'?' indicates current value is configurable.

Enters selected value at '?' prompt.

Note: In some submenus, 1 = select,0 = deselect

Q QUIT plus RETURN

 In main menu, exists system. (Security access reverts to Level 0)

 In submenu, returns to top of main menu, or parent submenu.

ESC ESCAPE

•In any menu or submenu returns to top of main menu.

INTRODUCTION

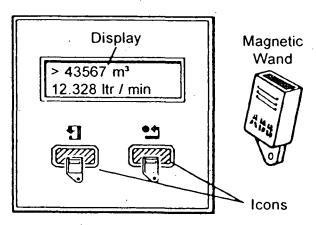
ABB Instrumentation's MagMaster™ provides high precision electromagnetic flowmeters for conductive fluids of >5µs/cm, in sizes of 2.5 to 2200mm (0.1 to 86"). It has state of the art accuracy, repeatability and rangeability.

The MagMaster offers a choice of liners and electrodes, flange or wafer tubes, integral or remote electronics, and an optional keypad display.

Standard outputs include fully programmable analog output (0-21mA), dual pulse (forward and reverse), dual alarm (flow rate, fault conditions, etc.) and a RS-232 connection. Optional outputs include dual analog and RS-422/423.

The MagMaster has been designed to eliminate traditional noisy signals in slurry applications. It has multiple self-monitoring and diagnostic functions, and a comprehensive test mode to test the system without interrupting the process or power.

SIMPLE READ AND RESET



- Top line of display indicates flow totals, velocity,
 % of range and alarm status.
- * Second line shows flow rate.
- Applying wand to the left icon steps the top line display through this sequence:
 - > Forward flow total
 - < Reverse flow total
 - Net flow total

Alm Alarms in sequence ('Alm Clr' when no alarms are activated)

- Vel Flow velocity
- % Flow rate as % of full scale range
- Applying wand to right icon resets the flow total displayed on the top line if parameter 73 (Tot Clr En) is enabled.
- For keypad / display version see separate quick reference quide.

CONFIGURATION PROCEDURE

Main Menu	Submenus	Description	
ABB Kent-Taylor Process # Magmaster V 1.10 17/05/93		Indicates model variant software version, date ‡ or 'Slurry'	
READ			
Read 1>	Read Flow 1>	Flow rate in selected units	
	Read % 2>	Flow rate in % of range	
	Read Fwd 3>	Total in forward totalizer	
	Read Rev 4>	Total in reverse totalizer,	
	Read Net 5>	Net total (fwd minus rev	
	Read Alm 6>	Current active alarms	
ı	** Read Vel 7>	True flow velocity in	
		m/sec, or ft/sec if flow units are in UGal or ft^3	
	‡ Resettable to 0	if Tot ClrEn is set.	
DISPLAY OPTIC			
Disp 2>	Disp Mode 1>	0 = single line display	
		1 = Double line display	
		2 = New line for each	
		update (for printers, etc	
	Disp Res 2>	Resolution of flow	
		display. Enter number of	
	,	decimal places required	
		(max = 6)	
PASSWORDS See information description.	in Security Access s	rection for detailed	
Login 3>	Login En 1>	Current Security level. 0 = default.	
		For default passwords	
		Enter 'user' for Level 1	
		'engineer' for Level 2.	
		Note: enter these pass- words in ALL lower cas	
	** Login Key 2>	Changes Level 1 pass- word	
	** Login Key 3>	Changes Level 2 pass- word	
FLOW MEASUR	REMENT *		
Flow 4>	# Flow Rng 1>	Enter 100% primary range in selected units	
	Flow Unit 2>	Enter '1' ONE place on	
		Ltr 1> Litres	
		m^3 2> Cubic meter	
		IGal 3> Imperial gal	
		UGal 4> U.S. gallons	
	•	ft^3 5> Cubic feet	

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uny, see
7

Main Men	u	Submenus	l	De:	scription
PULSE OUTF	*TU				
Pls 6>	# P	'Is Fact 1>	Enter	out	out pulses pe
	_				ne unit
	P	'Is Cutoff 2>			n % of primar
					low which
					put and
	P	'Is Max 3>	totaliza		
	ľ	12 IAIRY 2>	in Hz	וזוטו	output freq.
	P	ls Hz 4>		ncu	in Hz
		Is Idle 5>			out in idle (of
		Is Size 6>			se width in
					I round up to
			neares	t 1	0 msec). 0 =
			square	e wa	ave
TOTALIZER*					
Tot 7>	T	ot Unit 1 >	See Flo		Unit 2 > for
	T	ot Mult 2>	•		s Mult 3> for
	·	OT WIGHT E	param		
	T	ot CIrEn 3>	•		talizer reset
					from terminal,
			transn	nitte	er display or
			input	con	tact.
ALARMS*					
Alm 8>	A	ılm No1 1>	Any co	omb	oination of
					= Select.
			0 = De	sele	ect.
					Idle state
			En		0 = Disabled 1 = Enabled
			Fault	3>	Measuremen fault
			Fwd		Forward flow
			Rev		Reverse flow
					Pulse output cutoff
					Empty senso
			Hi		High flow
			Lo		Low flow
			Anlg	A>	Analog outpo
			Pls	R>	overrange Pulse ouput
			, 13	<i>-</i>	overrange
	A	lm No2 2>	Same	para	ameters as No
					efault - Rev
			flow e	nat	oled, required
		Nm Trip 3>	ior au Hi		current option High flow tr
	,	mir riip o-	111	, >	point, % rang
			Lo	2>	Low flow trip
			-	-	point, % ran
			Hyst	3>	Hysteresis
			Disp		Enables dis-
					play of Hi ai
					Lo Alarms

Main Menu	Submenus	Description
INPUT CONTAC	CT *	
Input 9>	Input Anlg 1>	Enter '1' to select. Active level selects second analog range
	Inpt Clr 2>	Active level resets all totalizers
	Inpt HId 3>	Active level holds flow- meter flow value
	Inpt Zero 4>	Active level selects downscale drive
•	* Inpt Idle 5>	Enter inactive state of input contact. 1 = Hi normal, 0 = Lo normal
EMPTY PIPE (DETECTION **	
Mtsnsr A>	Mtsnsr Trip 1>	Enter empty pipe detector trip threshold Note: set to zero for a 'slurry MagMaster'.
	Mtsnsr mV 2>	Measured indication used for empty pipe trip. When valve below "trip' threshold then all outputs driven to zero.
SENSOR DATA	AND CALIBRAT	TION **
Snsr B>	Snsr No 1>	Serial number of sensor
	Snsr Tag 2>	Tag number of sensor
	Snsr Size 3>	Calibrated bore (mm)
	Snsr Vel 4>	Present velocity in sensor
	Snsr Fact 5>	1>, 2>, 3>, 4> = cali- bration data. Same as on sensor data label.
SYSTEM TEST	**	
Test C>	Test Mode 1>	If '1', transmitter is in test mode. Self-cancels after 30 min. if no entry made.
;	# Test Flow 2>	Present flow rate. In tes mode, any value may be entered manually.
	Test % 3>	Flow rate in %‡
	Test Hz 4>	Output frequency in Hz.
	Test mA 5>	Output current in mA‡
	Test Vel 6>	Flow velocity in sensor;
	Test Alm 7>	Current active alarms.‡ Clr = none
	Test Txv 8>	Flow velocity, uncorrect ed for sensor calibratio
	‡ Calculated from	n Test Flow 2
* requires Level	1 access	** Requires Level 2 acces

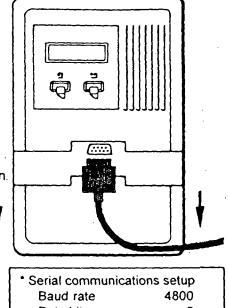
^{*} requires Level 1 access

^{*} Requires Level 2 access

[#] The maximum no. must not exceed 21000. The value entered may display with a small error, e.g. 1.900 may display as 1.899. 1.900 is used in calculation.

CONFIGURATION

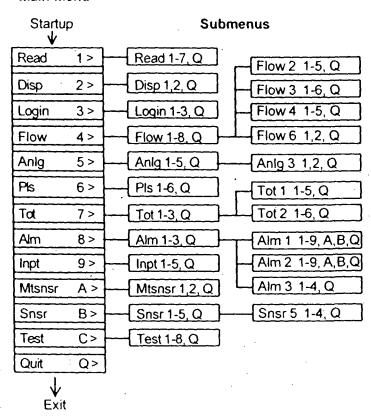
- 1. Set up serial communications* on terminal or PC.
- For PC, use a laplink / null modem cable.
 A cable is available from ABB Instrumentation.
- Connect terminal cable to transmitter's D-connector as shown.
- 4 Press RETURN or equivalent (ENTER, EXE, etc).



* Serial communications setup
Baud rate 4800
Data bits 8
Stop bits 1
Parity None
Handshake None

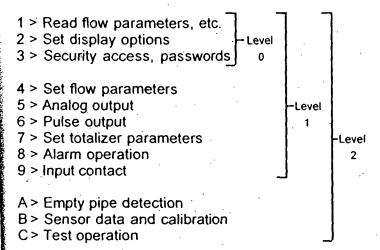
RELATIONSHIP OF MENUS

Main Menu



SECURITY ACCESS

Any of three security levels may be selected. In Levels 0 and 1, operator is restricted to certain menus as listed below. In Level 2, operator has full access to all menus and can change passwords.



ABB

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1175 John Street PO Box 20550 Rochester, New York 14602-0550 USA

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ABB Kent-Taylor SpA.

Via Statale 113 22016 Lenno (Como) Italy

Telephone: +39 (0)344 58111 Telex: 380044 KENTIL I Facsimile: +39 (0)344 56278

> BS 5750 Part 1 : 1987 and EN 29001 1987 Cert. No. Q5907



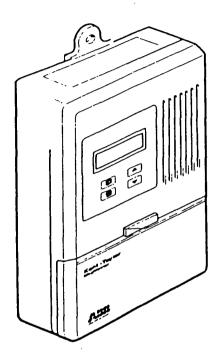
Because ABB Instrumentation constantly seeks to improve product quality, all specifications are subject to change without notice.

IM / MM - QRG2

ISS₂

9/96

Quick Reference Guide



MagMaster™ Electromagnetic Flowmeters

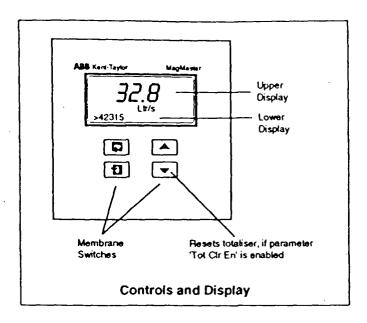
Keypad Version

IM/MM-QRG Iss 1 5/96

ABB Kent-Taylor



CONTROLS AND DISPLAY



Upper display gives continual update of flow rate in selected units.

By pressing the 1 key, the lower display steps through the following sequence:

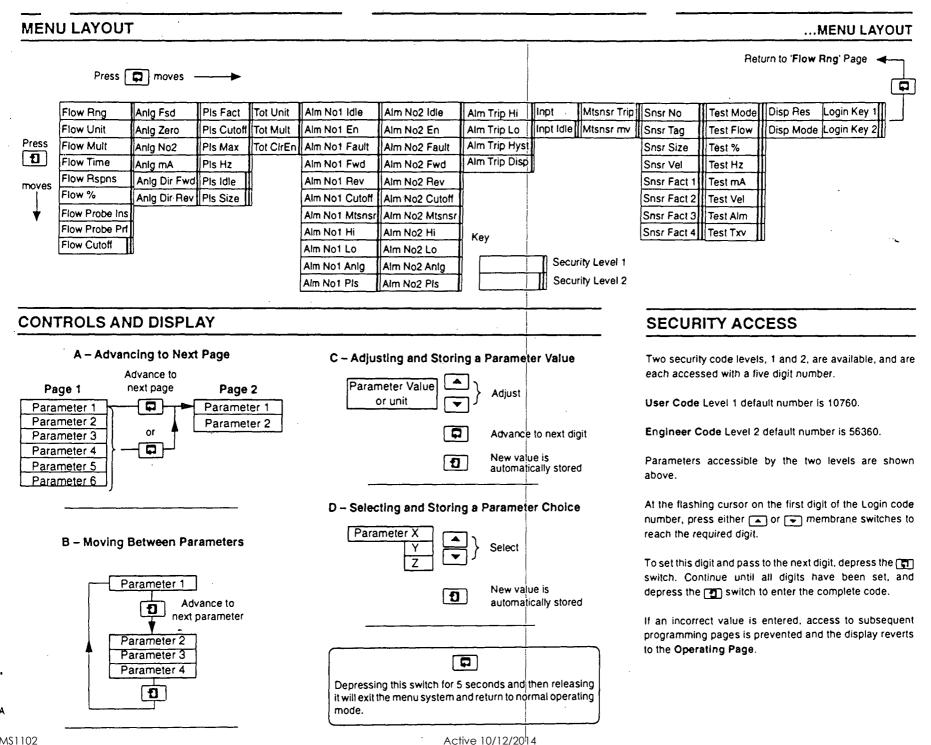
- > Forward flow total value.
- < Reverse flow total value
- Net flow total value
- Alm Active alarms Any alarms are displayed sequentially if more than one alarm is present.

 'Alm Clr' is displayed when no alarms are present.
- Vel Flow Velocity
- % % of Flow Range.

Pressing the key resets the flow total displayed on the upper display, if parameter 'Tot CIr En' is enabled.

Pressing the style key accesses the Login Parameter where it is necessary to enter a security code before any other parameters can be accessed – see SECURITY ACCESS.

Oldends Lane, Stonehouse, Gloucestershire, England GL10 3T Telephone: 01453 826661, Facsimile: 01453 826358



PARAMETER CHANGES

When a parameter is selected, which holds one or more variable units e.g. 'Flow Unit' parameter which can be Liters, Cubic meters, Gallons etc., proceed as follows to change the units: ('Flow Rng' selected).

Slaw Dag	
Flow Rng	\dashv
5.00000	
1	
Flow Unit	
m^3/Hr	

'Flow Unit' selected

Press or switch to change the units.

Note. The existing units will flash at the first depression of the or switch, and further switch depressions will change the type of units displayed.

Depressing the switch will now enter the newly selected units.

This type of action is similar for all variable units.

Where numerical values are to be changed, initial depression of the or switches cause the first of five digits to be highlighted by a flashing cursor. Change the value with the and switches, the particular digit with the switch, and enter the final selection with the switch.

PROGRAMMING

The correct security level MUST be selected – see SECURITY ACCESS.

Select the parameter to read the value, or to change it as necessary. All 'live' data displayed is updated each second.

Use the step key to move between pages.

Use the key to move between parameters.

The and keys change displayed values and units.

The key will accept the chosen value or unit.

FLOW MEASUREMENT

PARAMETER DESCRIPTION

Flow Range Enter main full scale (100%) flow

range (Upper Range Value) in

selected flow units. #

Flow Unit Select Units as required.

Ltr (Liters)

m^3 (Cubic Meters)
iGal (Imp Gals)
UGal (U.S. Gals)
ft^3 (Cubic Feet)

Flow Mult Select multiplier as required.

m (0.001) c (0.01) x1 (1) h (100) k (1000) M (1000000)

Flow Time Select time units as required.

s (Second)
Min (Minute)
Hr (Hour)
Dy (Day)
Wk (Week)

Flow Resp Nominal Time Constant for output.

Enter Display Setting from table below for time constant required.

Display Setting	Seconds
2	3
4	3
5	8
6	15
é	30 60
و ا	120

Flow % Flow Probe Ins Flow Probe Pri

Flow Cutoff

Present flow as % of range. Probe Insertion Factor. Probe Profile Factor

Flow velocity in mm/sec. below

which flow set to 0.

ANALOG OUTPUT

PARAMETER DESCRIPTION Anlg Fsd Enter output current in mA for 100% flow $(0 \le FSD \le 21)$ Anlg Zero Enter output current in mA for 0% flow $(0 \le ZERO \le 21)$ Full scale flow range for 2nd analog Anlg No2 range, as % of main flow range. Anlg mA Present output current (mA) Anlg Dir Fwd Output responds to forward flow if set to '1'. § Anlg Dir Rev Output responds to reverse

flow if set to '1'. §

1

OUTPUT PULSE

PARAMETER	DESCRIPTION
Pis Fact	Enter required output pulses per
	flow volume unit.#
Pls Cutoff	Flow rate (%) below which pulse
	output and totaliser cease to operate.
Pls Max	Maximum output frequency in Hz.
Pls Hz	Display of present output frequency in
	Hz (live value).
Pls Idle	Idle state for Pulse Output with no
	output pulse (e.g. at zero flow).
	0 = Low (output transistor ON)
	1 = High (output transistor OFF)
PIs Size	Enter output pulse width in msecs.
	(Value will be rounded up to nearest
1	10ms). Set to '0' for square wave
	output.

TOTALIZER

PARAMETER	DESCRIPTION
Tot Unit	Select totaliser measurement units.
Tot Mult	Select multiplier units required.
▲ Tot CIrEn	Enter '1' to enable totaliser reset
	function to be used from front panel.
l	(m)



ALAIIIIO	
PARAMETER	DESCRIPTION
Alarm No1 Idle	Idle state for alarm output.
	With no alarm active:
	0 = Low (O/P transistor ON)
	1 = High (O/P transistor OFF)
Alm No1 En	0 = Alarm output disabled (set to
	idle state).
	1 = Alarm output enabled.
Alm No1 Fault	Alarm occurs for System fault.
Alm No1 Fwd	Alarm occurs for forward flow.
Alm No1 Rev	Alarm occurs for reverse flow.
Alm No1 Cutoff	Alarm occurs for Pulse Output
	Cutoff.
Alm No1 Mtsnsr	Alarm occurs for empty sensor.
Alm No1 Hi	Alarm occurs for Flow ≥ 'Alm Trip Hi'.
Alm No1 Lo	Alarm occurs for Flow ≤ 'Alm Trip Lo'.
Alm No1 Anlg	Alarm occurs for Analogue Output
•	over range.
Alm No1 Pls	Alarm occurs for Pulse Output over
	range.
1	-

ALARMS (CONTD.)

PARAMETER

DESCRIPTION

Alarm No2 Idle

Identical to, but independent of

Alarm No1 above.

▲Alarm No2 Pls

Alarm occurs for Pulse Output over range.

PARAMETER

DESCRIPTION

Alarm trip Hi

High flow alarm trip point as % of

range.

Alarm Trip Lo

Low flow alarm trip point as % of

range.

Alm Trip Hyst

Enter hysteresis for alarms as % of

range.

Alm Trip Disp

Set to '1' if Hi/Lo Alarms are to be

displayed.

INPUT CONTACT

PARAMETER

Inpt Idle

DESCRIPTION

Inpt

Set up external logic input function:

'Zero' sets flowrate output to zero. 'Hid' holds flowmeter output value.

'CIr' resets all totalizers.

'Anig' selects Anig No2 Range.

Enter inactive state of input contact: '1' for Hi normal

'0' for Lo normal.

[1]

EMPTY PIPE DETECTION

PARAMETER

DESCRIPTION

Mtsnsr Trip

Set empty pipe detector trip

threshold.

∲Mtsnsr mV

Measured value related to fluid

conductivity.

SENSOR CALIBRATION

PARAMETER

DESCRIPTION

Snsr No

Serial No. (Up to 13 characters)

Snsr Tag

Tag No. (If required).

Snsr Size

Sensor calibrated bore (mm).

Snsr Vel

Display of present velocity.

Snsr Fact 1

Snsr Fact 2

Sensor calibration data -

Snsr Fact 3

should agree with sensor data label

Snsr Fact 4

TEST MODE	•
PARAMETER	DESCRIPTION
Test Mode	Set to '1' to enable.
Test Flow	Displays present flowrate.
	If in 'Test Mode', any value may be
	entered manually, ‡
Test %	Flowrate as a percentage
Test Hz	Output Frequency
Test mA	Output Current
Test Vel	Flow Velocity in sensor
Test Alm	Shows present active alarms
	sequentially. ('Clr' indicates no
	alarms are active). Ø
▲Test Txv	Live flow velocity (uncorrected for
	sensor calibration).

 $\varphi_{i,j} = \varphi_{i,j}^{i,j} \wedge \varphi_{i,j}^{i,j}$

DISPLAY RESOLUTION

PARAMETER
Disp Res
Enter number of decimal places required on flow display (0 to 5).

Disp Mode
Serial Communication display mode (Read Only) – attempts to edit this parameter result in display of 'Keypad Version No.' with eventual return to normal

operation.

SECURITY PASSWORD

Caution. Access is NOT possible without the correct password. 'Lost' passwords can ONLY be reset by the Service Engineer.

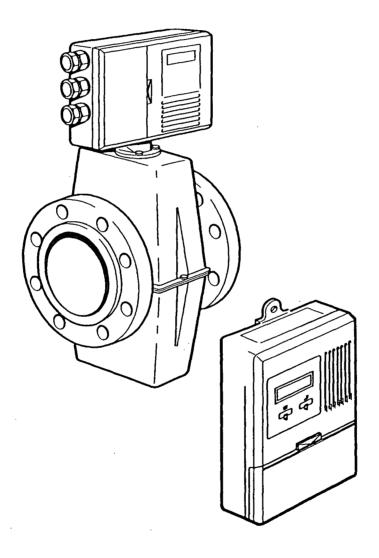
Login Key 1 Set Level 1 security password.

Login Key 2 Set Level 2 security password.

- # The maximum which can be entered must not exceed 21000. The value entered may be displayed with a small error in the decimal digits e.g. 1.900 may be displayed as 1.899. This is a display characteristic and the value 1.900 will be used by the MagMaster.
- § Select both parameters for bidirectional operation (e.g. when dual current output is fitted). If both are zero, then lour is always 0%.
- ‡ On performing a Rapid Reset/Escape to return to 'Operation' level, 'Test Mode' is automatically cancelled.
- Ø If the sensor is empty or disconnected, the alarms 'MtSnsr' and 'Coil' will be displayed as appropriate.

MagMaster Electromagnetic Flowmeters

Instruction Manual





ABB

The Company

ABB is an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

The NAMAS Calibration Laboratory (No. 0255) is just one of ten flow calibration plants operated by the Company, and is indicative of ABB's dedication to quality and accuracy.

BS EN ISO 9001



St Neots, U.K. – Cert. No. Q5907 Stonehouse, U.K. – Cert. No. FM 21106

EN 29001 (ISO 9001)



Lenno, Italy - Cert. No. 9/90A



Stonehouse, U.K.

Use of Instructions



Warning.

An instruction that draws attention to the risk of injury or death.



Note.

Clarification of an instruction or additional information.



Caution.

An instruction that draws attention to the risk of damage to the product, process or surroundings.



Information.

Further reference for more detailed information or technical details.

Although Warning hazards are related to personal injury, and Caution hazards are associated with equipment or property damage, it must be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance leading to personal injury or death. Therefore, comply fully with all Warning and Caution notices.

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of Marketing Communications Department, ABB.

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

- 1. The relevant sections of these instructions must be read carefully before proceeding.
- 2. Warning labels on containers and packages must be observed.
- 3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
- Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
- 6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

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1 INTRODUCTION

MagMaster™ is a range of high performance electromagnetic flowmeters for the measurement of electrically conductive fluids and slurries, and is normally supplied as a calibrated system, with the transmitter, factory configured, to a supplied full-bore or insertion probe sensor.

A wide range of options is available to suit most applications, including:

Integral or remote transmitter.

Glass loaded polypropylene

transmitter housing.

Flanged or wafer style sensors.

Insertion Probes.

Approved Versions, including:

Hazardous area operation.

Hygienic.

HART™ communication protocol.



Warning.

For MagMaster Approved /Hazardous Versions see the full installation manual.

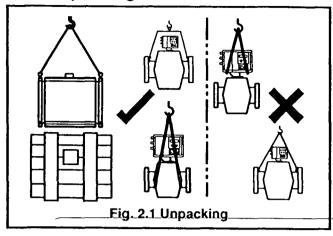


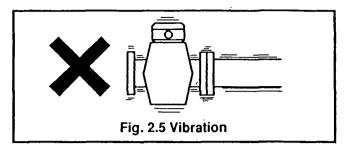
Warning.

- Installation and maintenance must only be carried out by suitably trained personnel.
- All relevant sections of this manual must be read before selecting a location.
- Safety requirements of this equipment, any associated equipment and the local environment must be taken into consideration.
- The installation and use of this equipment must be in accordance with relevant national and local standards.

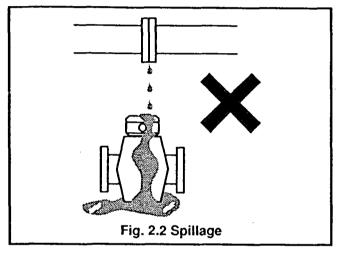
MECHANICAL INSTALLATION

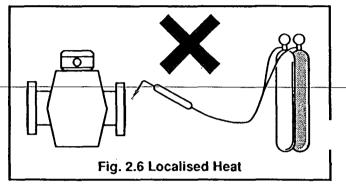
2.1 Unpacking

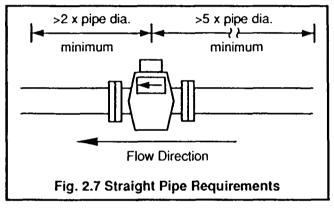


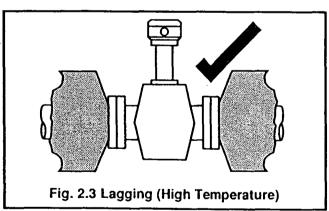


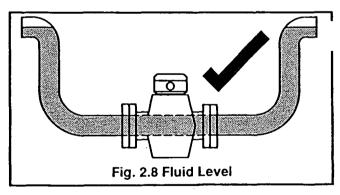
2.2 Installation Conditions

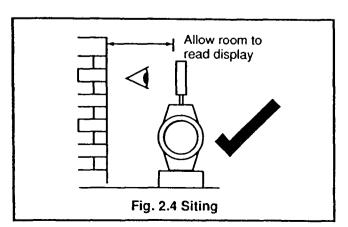


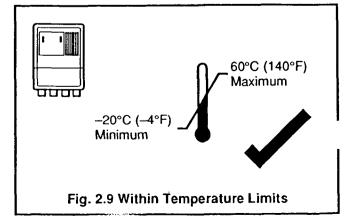




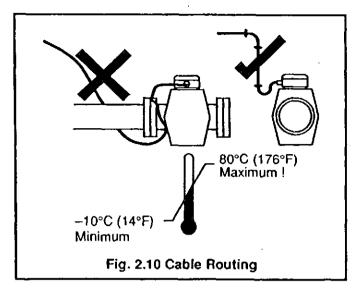


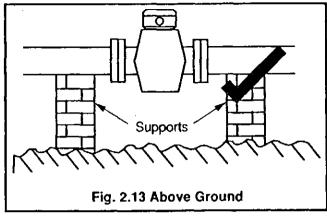


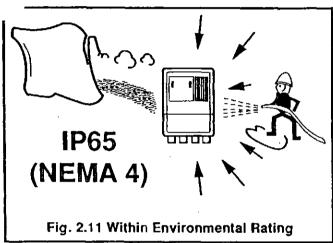


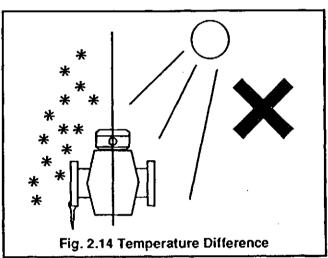


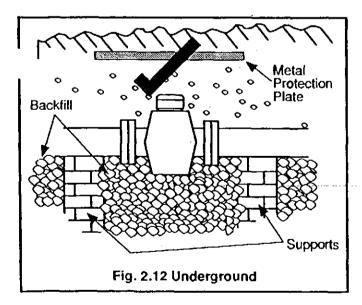
2 MECHANICAL INSTALLATION...

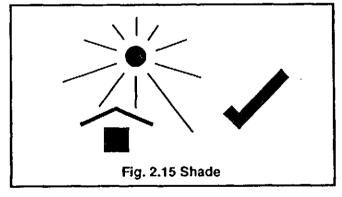








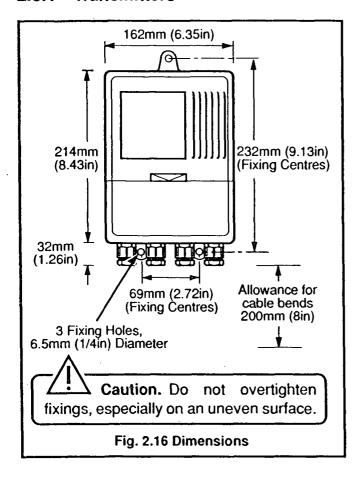




MECHANICAL INSTALLATION ...2

2.3 **Mechanical Installation**

2.3.1 **Transmitters**

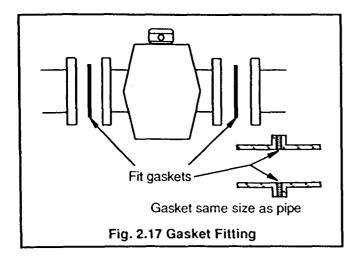


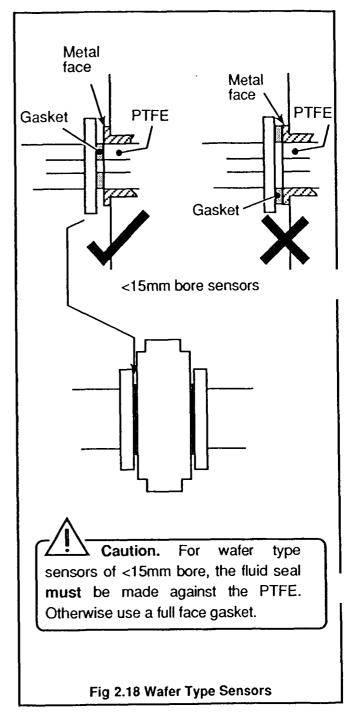
2.3.2 Sensors



Caution

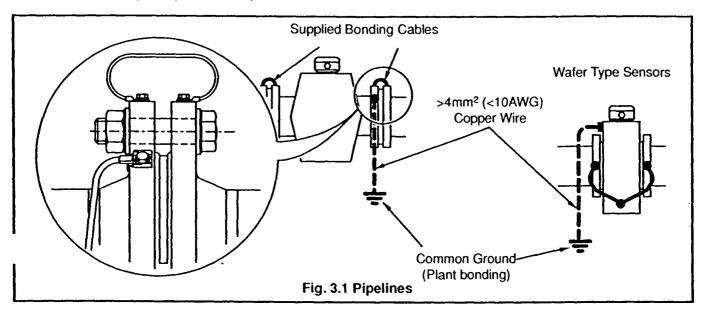
- Do NOT exceed the maximum working pressure marked on the equipment.
- Use stainless steel (austenitic) bolts, studs and nuts for flanged sensors below 200mm.

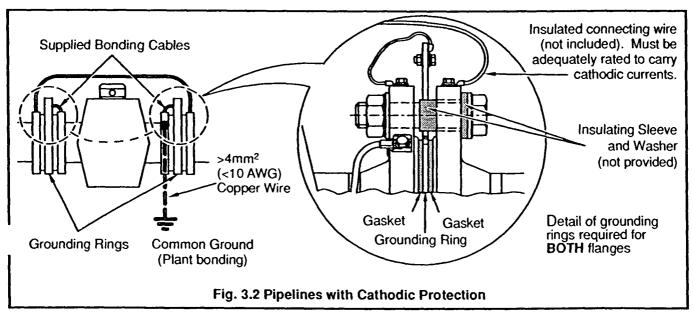




3 ELECTRICAL INSTALLATION...

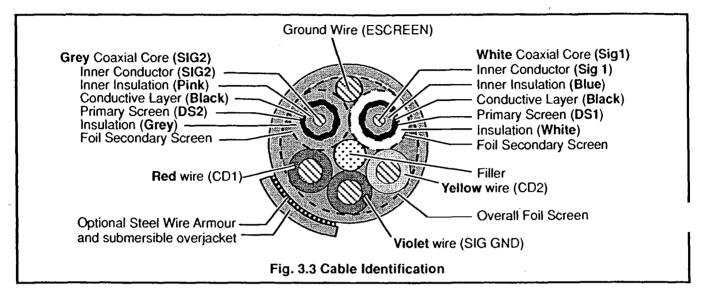
3.1 Grounding (Fig. 3.1, 3.2)

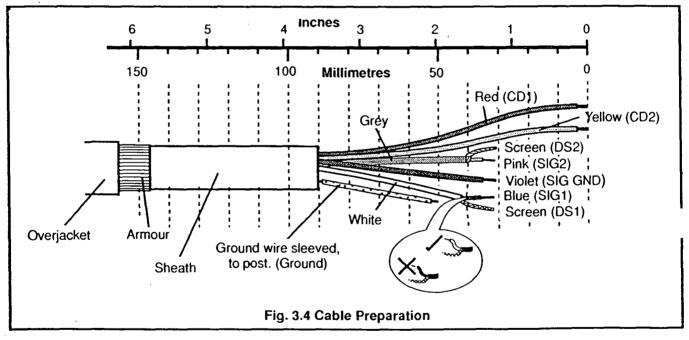




3.2 Cables

3.2.1 Cable (Remote Versions only)



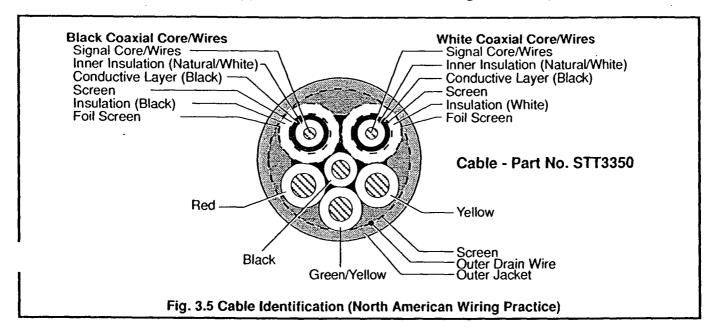


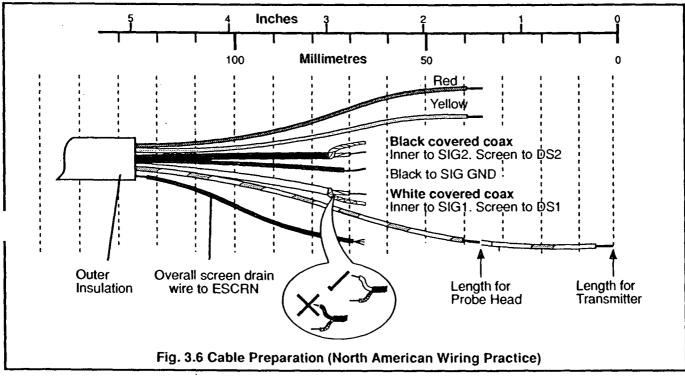
6 Q-Pulse Id TMS1.102

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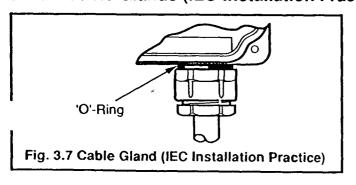
3 ELECTRICAL INSTALLATION...

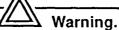
3.2.2 Cable (Alternative Type – North American Wiring Practice)





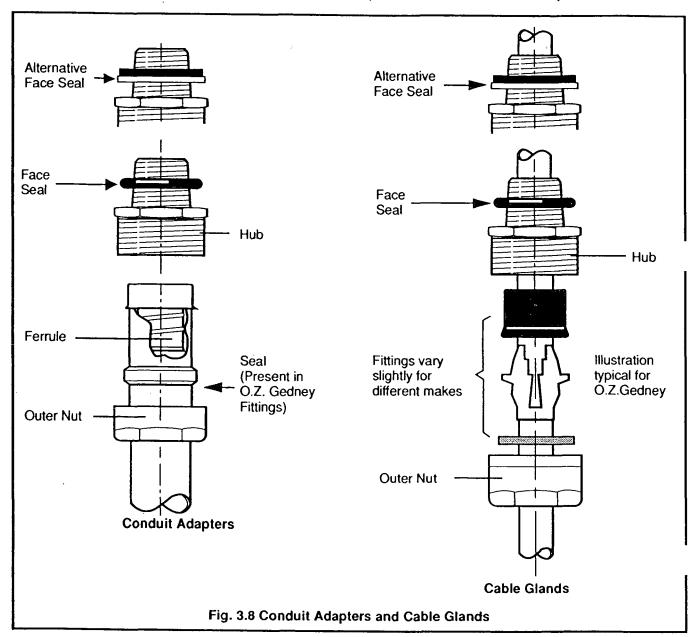
3.2.3 Cable Glands (IEC Installation Practice)

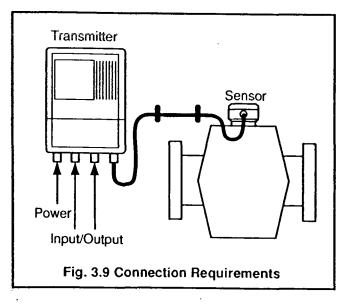




- Rigid conduit must not be fitted to the transmitter.
- Transmitter conduit adaptors must incorporate a face seal.

3.2.4 Conduit Adapters and Cable Glands (North American – 0.5in)





3.3 Connection Requirements

The transmitter and sensor are supplied as a matched system. Check serial numbers to ensure they are matched.

3.3.1 Sensors

Remote sensors are usually supplied with an integral cable and potted connections. If the sensor has been supplied unpotted, connections must also be made to the sensor terminal box and then potted on completion with the supplie potting material — See Appendix A.

3 ELECTRICAL INSTALLATION...

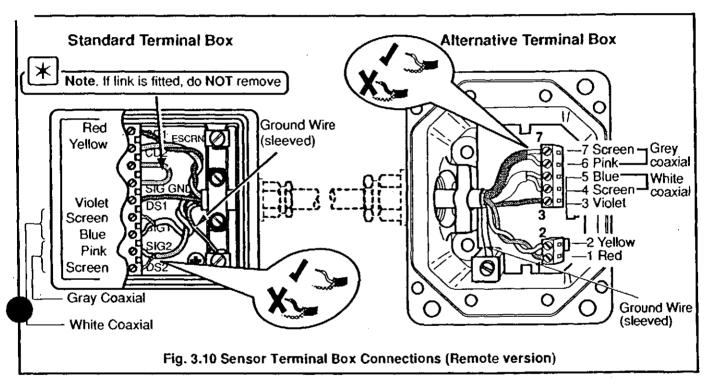


Caution. (Remote versions)

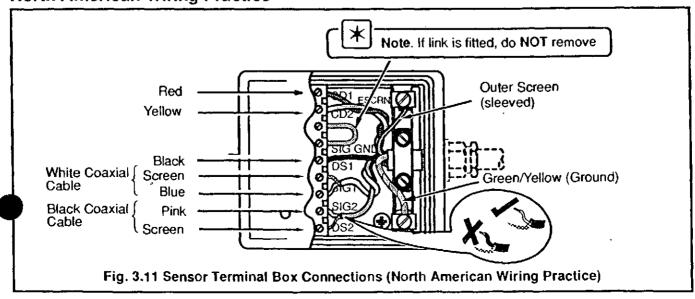
- Remove any exposed black conductive layer from under coaxial screens.
- Make connections only as shown.
- Sleeve all bare wiring.
- Twist RED and YELLOW cores lightly together.
- Twist WHITE and GREY coaxial cables lightly together.
- Maintain Environmental Protection at all times.
- Conduit connections must provide cable entry sealing.
- [i]

Information. (Remote versions)

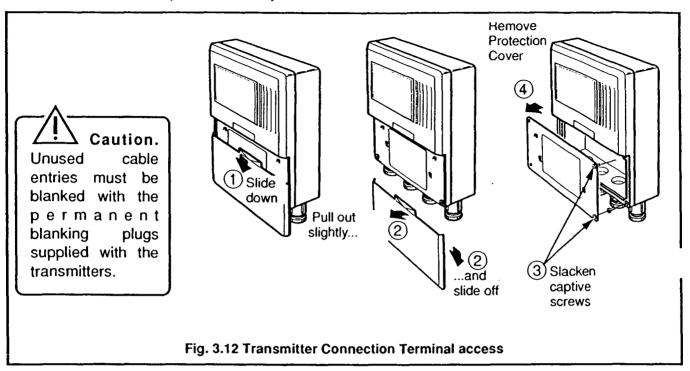
- Refer to ENVIRONMENTAL PROTECTION (Appendix A).
- Internal appearance of Terminal Box may vary from that shown.



North American Wiring Practice



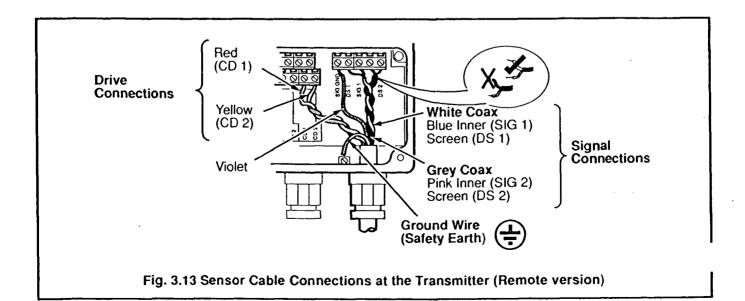
3.3.2 Transmitters (All versions)



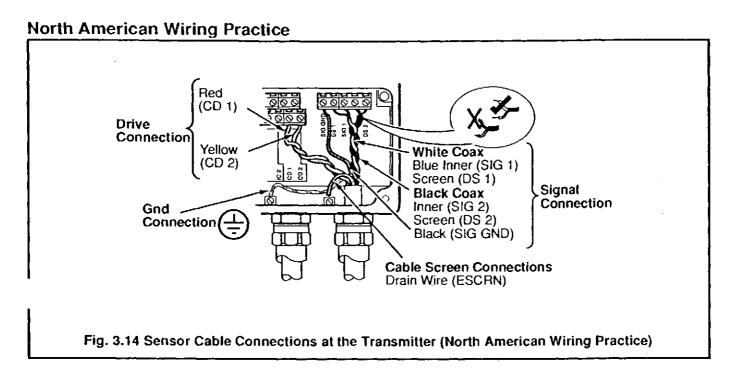


Caution.

- Remove any exposed black conductive layer from the inner insulation of both coaxial cables.
- Substitute sensor cable of any kind is not acceptable.
- Do not make connections except as shown.
- Twist cable pairs together as shown.
- Sleeve ALL bare wires.
- Sensor cable may only be joined using company supplied junction box available separately.



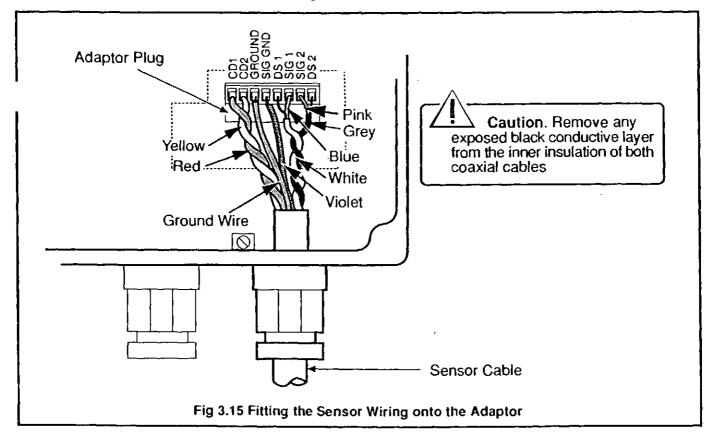
3 ELECTRICAL INSTALLATION...



3.3.3 MagMaster-CalMaster Adapter

When a MagMaster Transmitter is fitted with an adaptor board for use with a CalMaster Verification Unit, wiring from the sensor to this adaptor board is shown in the following diagram.

To wire the adaptor plug, carefully pull off the plug from the adaptor board, connect the wires, using only a screwdriver with a 2.5mm blade to tighten the terminal screws, and replace the plug.



3.4 Input/Output Connections

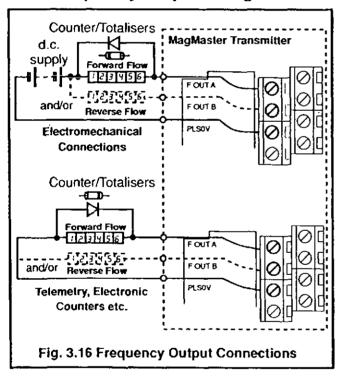


Caution.

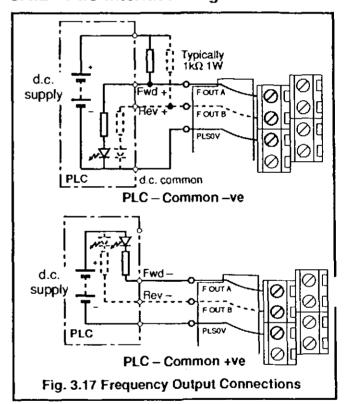
- Refer to SPECIFICATION SHEET for Input/Output ratings.
- Inductive loads must be suppressed or clamped to limit voltage swings
- Capacitive loads must be inrush current limited.
- Hazardous area requirements are not considered in the following pages.

Note. The connection terminal markings in the metal housed transmitter are identical to those in the standard transmitter as shown in this section. However, the supply connection in the former is made using a non-reversible plug (provided).

3.4.1 Frequency Outputs - Fig. 3.16



3.4.2 PLC Interface - Fig. 3.17

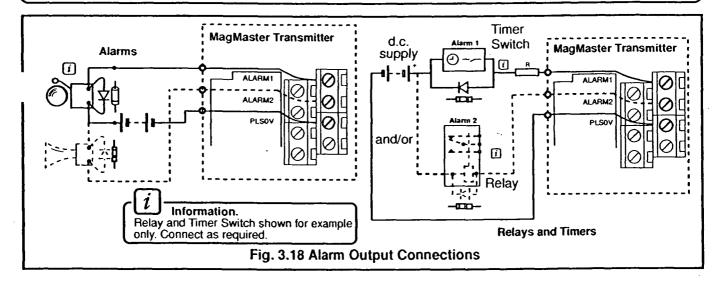


3 ELECTRICAL INSTALLATION...

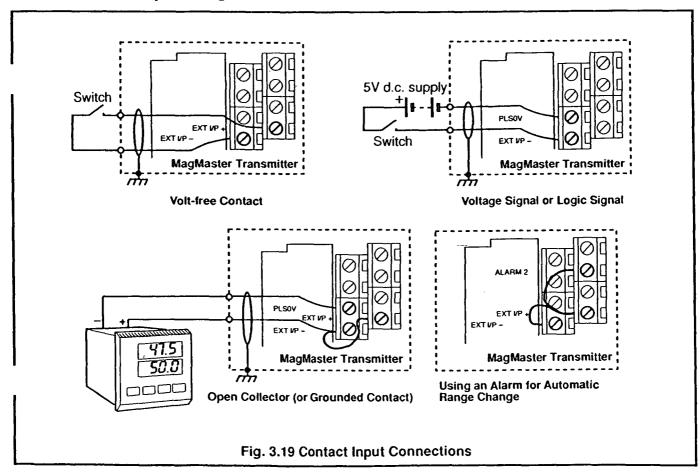
3.4.3 Alarm Outputs – Fig. 3.18

Information.

- Inductive loads may be suppressed by diodes (D) 1N4004 or similar.
- Inrush currents are limited to 1 Amp by resistor R e.g. 27Ω 1W for 24V systems.
- Operation of outputs is programmable see Configuration Manual for details.
- · Frequency and Alarm outputs share a common return with contact input.
- External isolators not normally required, as the pulse, alarm and contact circuits are electrically separated from all other Magmaster connections.

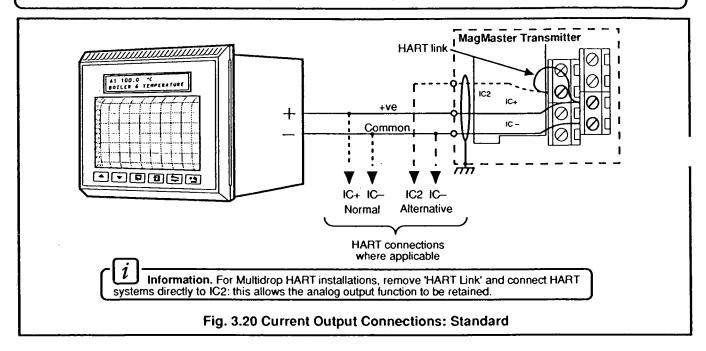


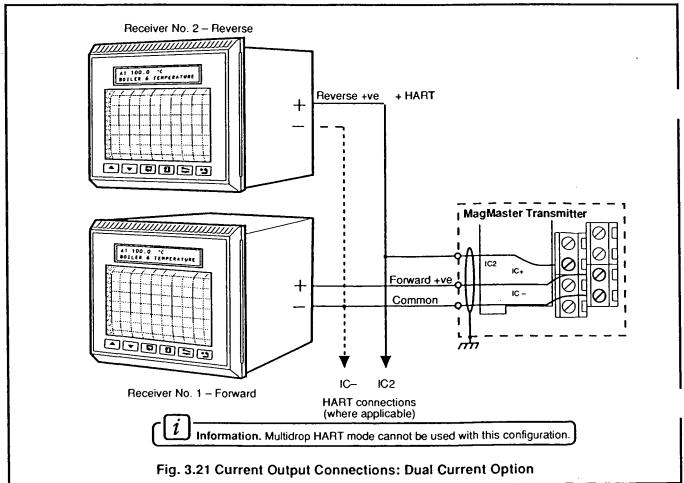
3.4.4 Contact Input - Fig 3.19



3.4.5 Current Output - Fig. 3.20 and 3.21

- Information.
- Output is fully programmable see Programming Guide.
- Output is electrically separated from all other MagMaster connections.
- External isolators are not normally required and may significantly limit accuracy if used.

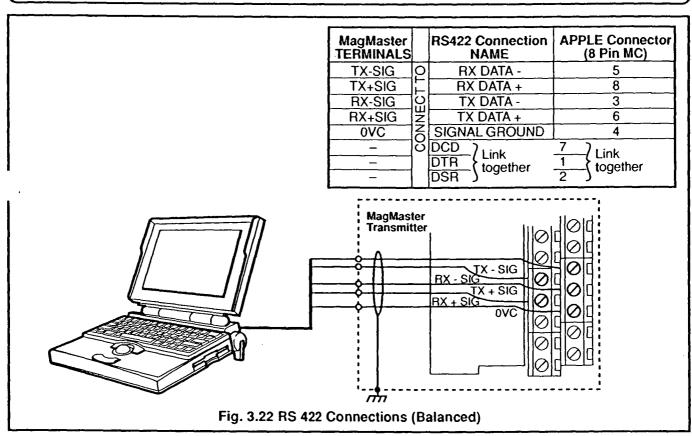


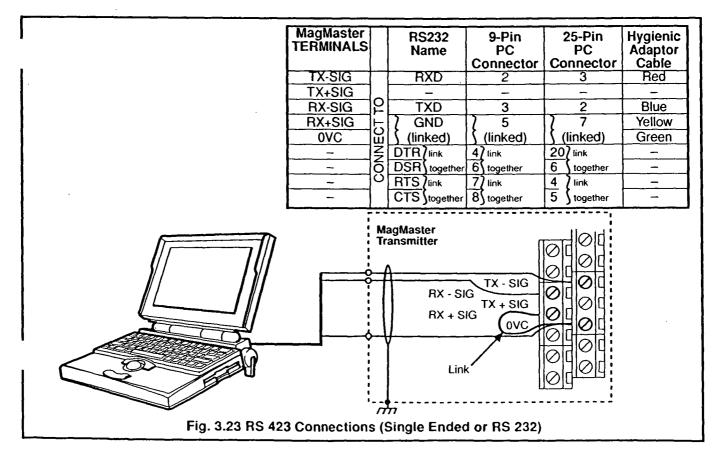


3 ELECTRICAL INSTALLATION...

3.4.6 Computer Connection – Fig. 3.22 and 3.23

Information. RS422/423 option is electrically isolated from all other MagMaster connections.





3.4.7 Power Supply Connections – Fig. 3.24 and 3.25



Warning.

- DISCONNECT THE SUPPLY FROM ANY CABLES BEING TERMINATED ON THE TRANSMITTER.
- Electrical installation and earthing (grounding) must be in accordance with relevant national and local standards.
- Ensure that the cover of the metal housed transmitter is never cross threaded. The threads are greased (as supplied).
- Ensure that the grease is in good condition when fitting the cover, and replenish as required with a grease suitable for aluminium threads.

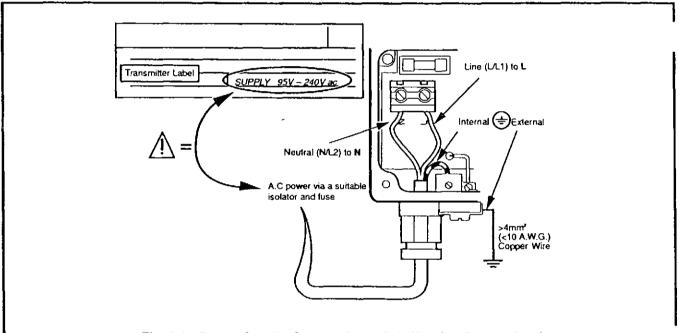
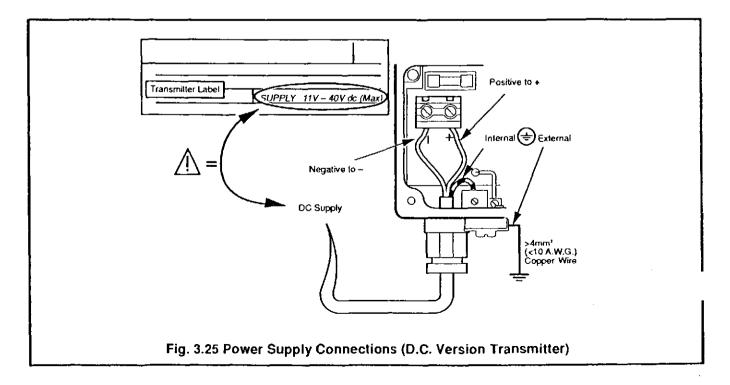


Fig. 3.24 Power Supply Connections (A.C. Version Transmitter)



4 STARTUP AND OPERATION

4 STARTUP AND OPERATION...



∆ Warning.

- Ensure Plant Safety while configuring, at all times.
- The 9-way D-Type Serial Link is not isolated. Ensure that it is NOT connected to power earth (ground), with cathodically protected systems.

4.1 Startup

Switch on the power supply to the flowmeter, and if a transmitter with display has been ordered, the flow rate will be shown on the display as shown in E.g. 4.1 or 4.2.

Sequential application of the provided magnetic wand to the left hand icon in the transmitter display area, or by pressing the 1 button on the keypad versions or the remote display, steps the display through the following sequence:

- % (Flow Rate % of Range)
- > (Forward flow total value)
- < (Reverse flow total value)
- * (Net flow total value)

Alm(Active alarms)

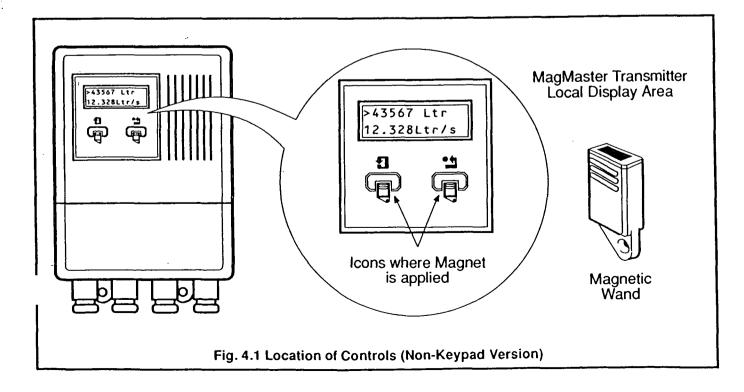
Vel (Flow Velocity in m/s or ft/s)

Any alarms are displayed sequentially if more than one alarm is present.

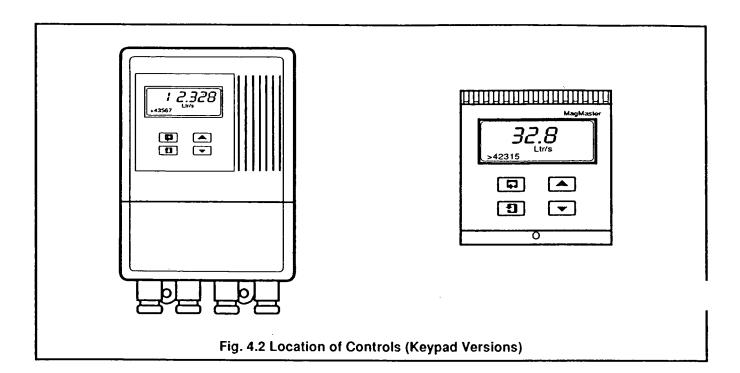
Application of the wand to the right hand icon, or pressing the keypad button, resets the totaliser display, if this facility is enabled.

iInformation.

- For the use of local or remote serial communication, and configuration, see the Quick Reference Programming Guide or the main MagMaster manual.
- For all versions supporting HART[™], see the main MagMaster manual.



...4 STARTUP AND OPERATION



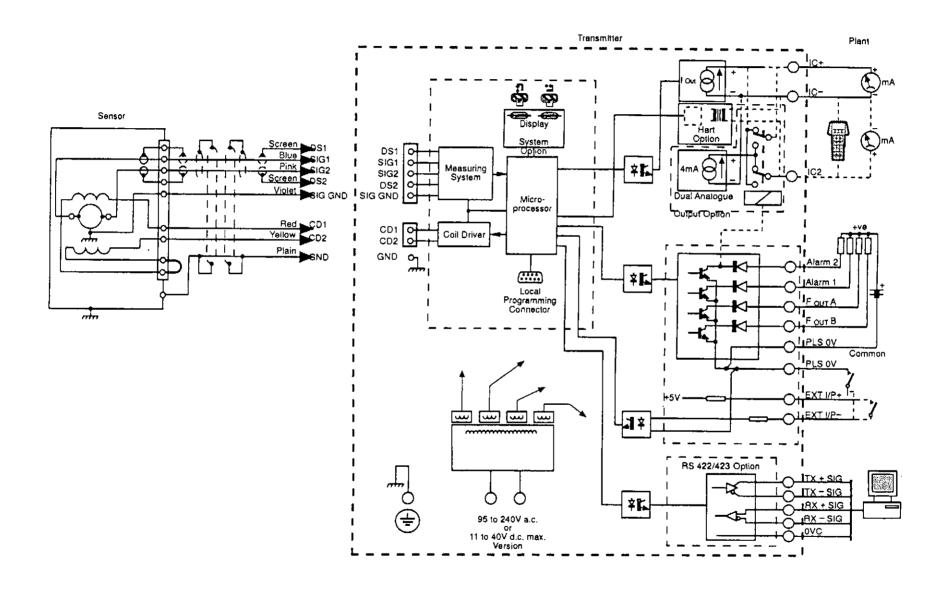
APPENDIX A - ENVIRONMENTAL PROTECTION



Warning.

- Potting materials are toxic use suitable safety precautions.
- Read the manufacturers instructions carefully before preparing the potting material.
- The remote sensor terminal box connections must be potted immediately on completion to prevent the ingress of moisture.
- Check all connections before potting see ELECTRICAL INSTALLATION.
- Do not overfill the terminal box or allow the potting material to come into contact with the 'O' ring or groove.
- Do not let potting material enter conduit, if used.

APPENDIX B - MAGMASTER BLOCK DIAGRAM



PRODUCTS & CUSTOMER SUPPORT

Products

Automation Systems

- · for the following industries:
 - Chemical & Pharmaceutical
 - Food & Beverage
 - Manufacturino
 - Metals and Minerals
 - Oil, Gas & Petrochemical
 - Pulp and Paper

Drives and Motors

- AC and DC Drives, AC and DC Machines, AC motors to 1kV
- Drive systems
- Force Measurement
- Servo Drives

Controllers & Recorders

- Single and Multi-loop Controllers
- Circular Chart , Strip Chart and Paperless Recorders
- Paperless Recorders
- Process Indicators

Flexible Automation

Industrial Robots and Robot Systems

Flow Measurement

- · Electromagnetic Magnetic Flowmeters
- Mass Flow Meters
- Turbine Flowmeters
- Wedge Flow Elements

Marine Systems & Turbochargers

- Electrical Systems
- Marine Equipment
- Offshore Retrofit and Referbishment

Process Analytics

- Process Gas Analysis
- Systems Integration

Transmitters

- Pressure
- Temperature
- Level
- Interlace Modules

Valves, Actuators and Positioners

- Control Valves
- Actuators
- Positioners

Water, Gas & Industrial Analytics Instrumentation

- pH, conductivity, and dissolved oxygen transmitters and sensors
- ammonia, nitrate, phosphate, silica, sodium, chloride, fluoride, dissolved oxygen and hydrazine analyzers.
- Zirconia oxygen analyzers, katharometers, hydrogen purity and purge-gas monitors, thermal conductivity.

Customer Support

ABB provides a comprehensive after sales service via our Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

United Kingdom

ABB Automation Limited Tel: +44 (0)1480 475321 Fax: +44 (0)1480 470787

United States of America

ABB Automation Inc. Instrumentation Division

Tel: +1 215-674-6000 Fax: +1 215-674-7183

Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification. Periodic checks must be made on the equipment's condition.

In the event of a failure under warranty, the following documentation must be provided as substantiation:

- A listing evidencing process operation and alarm logs at time of failure.
- Copies of operating and maintenance records relating to the alleged faulty unit.



The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice.

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DRAWINGS

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19 Elliot Street, Albion Qld 4010

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Email: mail@sjelectric.com.au

SJ ELECTRIC (NSW) PTY LTD

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25 Lidco Street, Arndell Park NSW 2148

Phone: (02) 9672 7922 Fax: (02) 9672 7252 Email: graemec@sjelectricnsw.com.au

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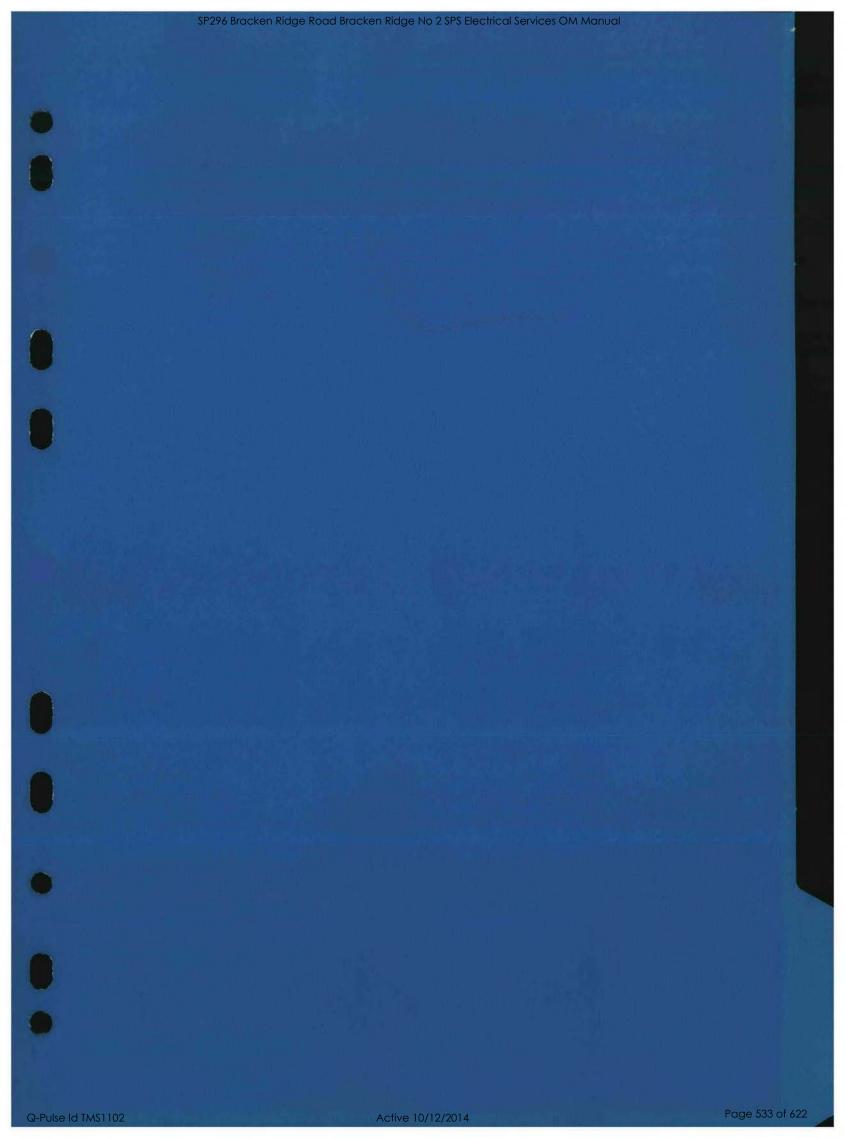
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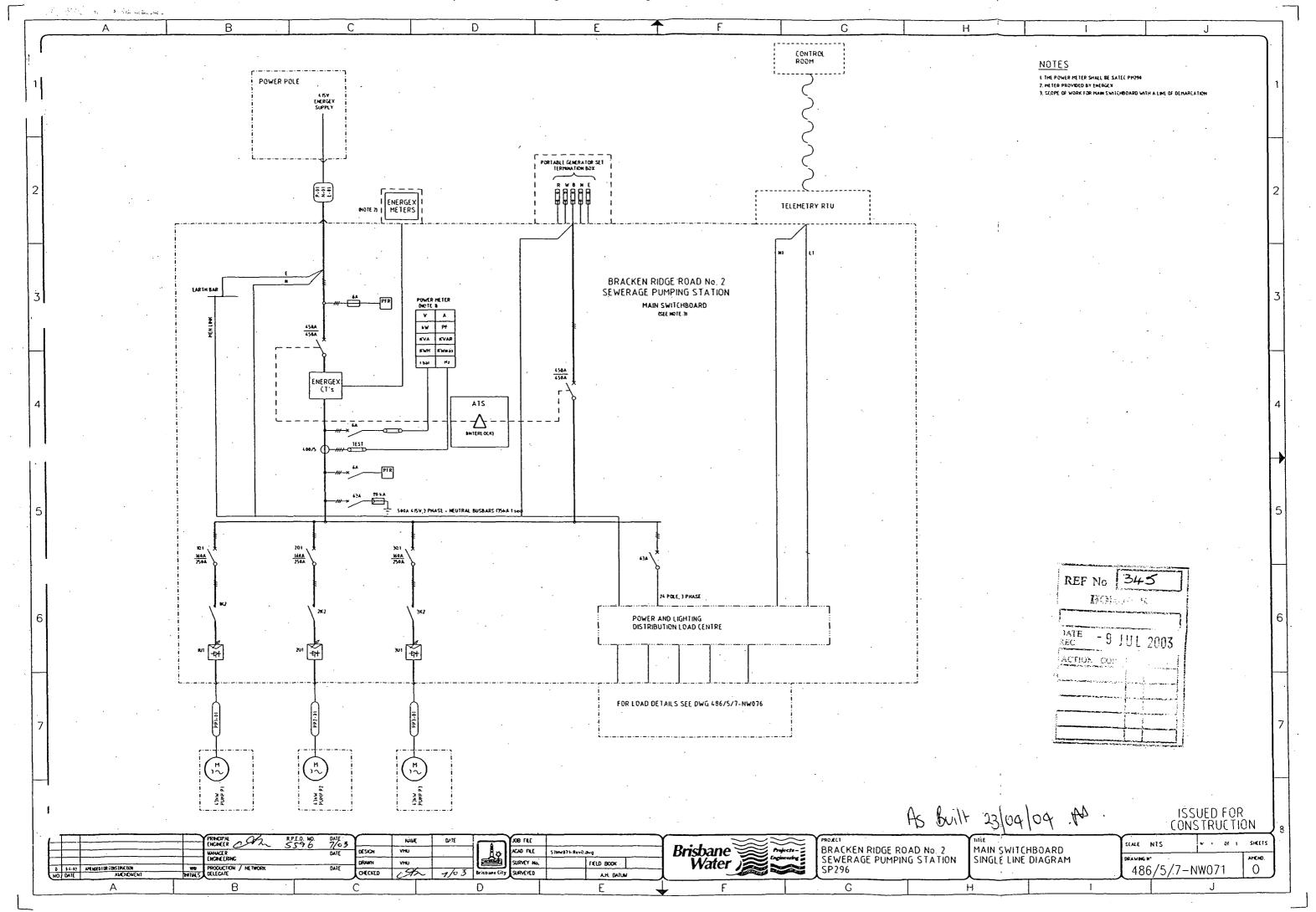
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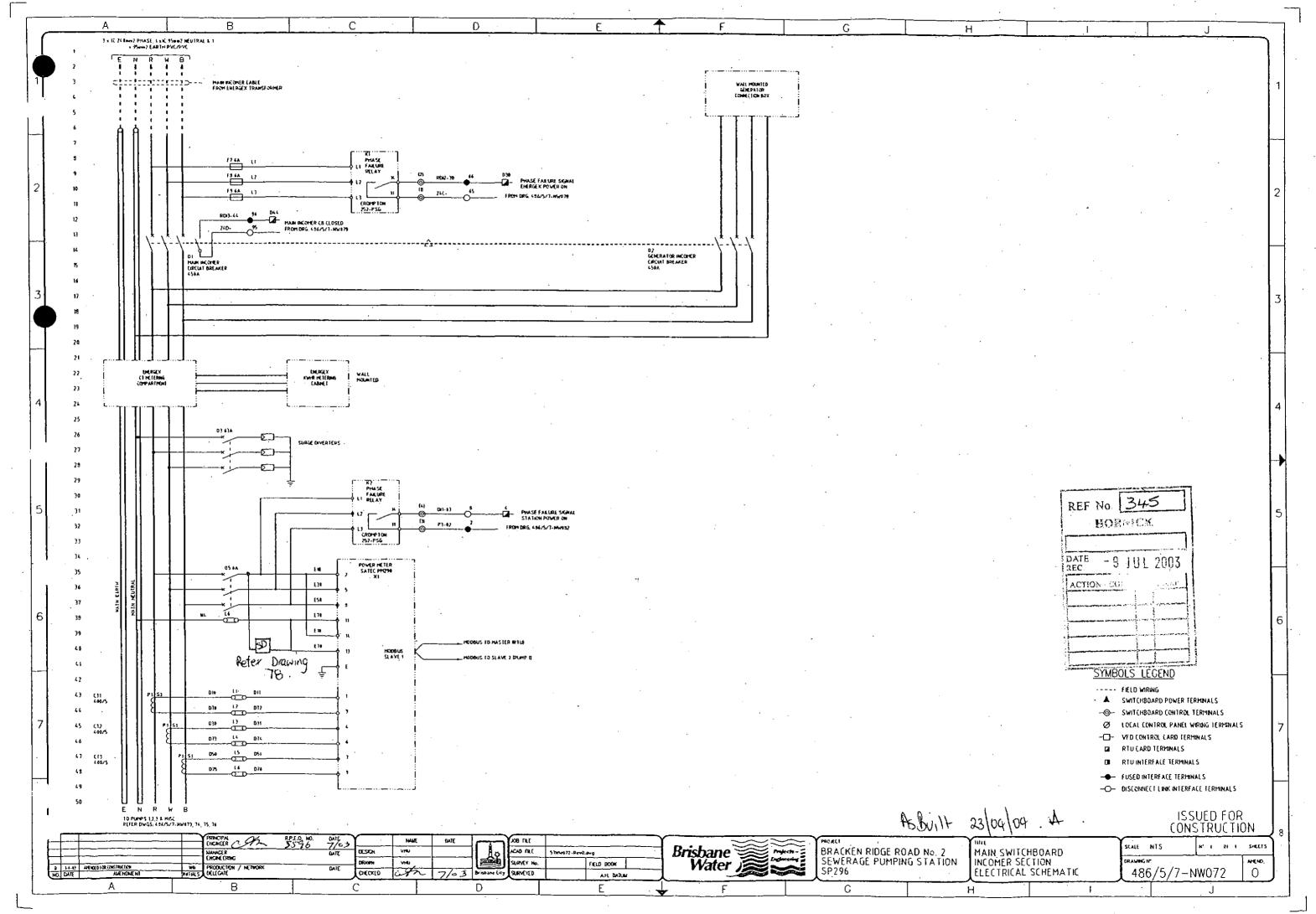
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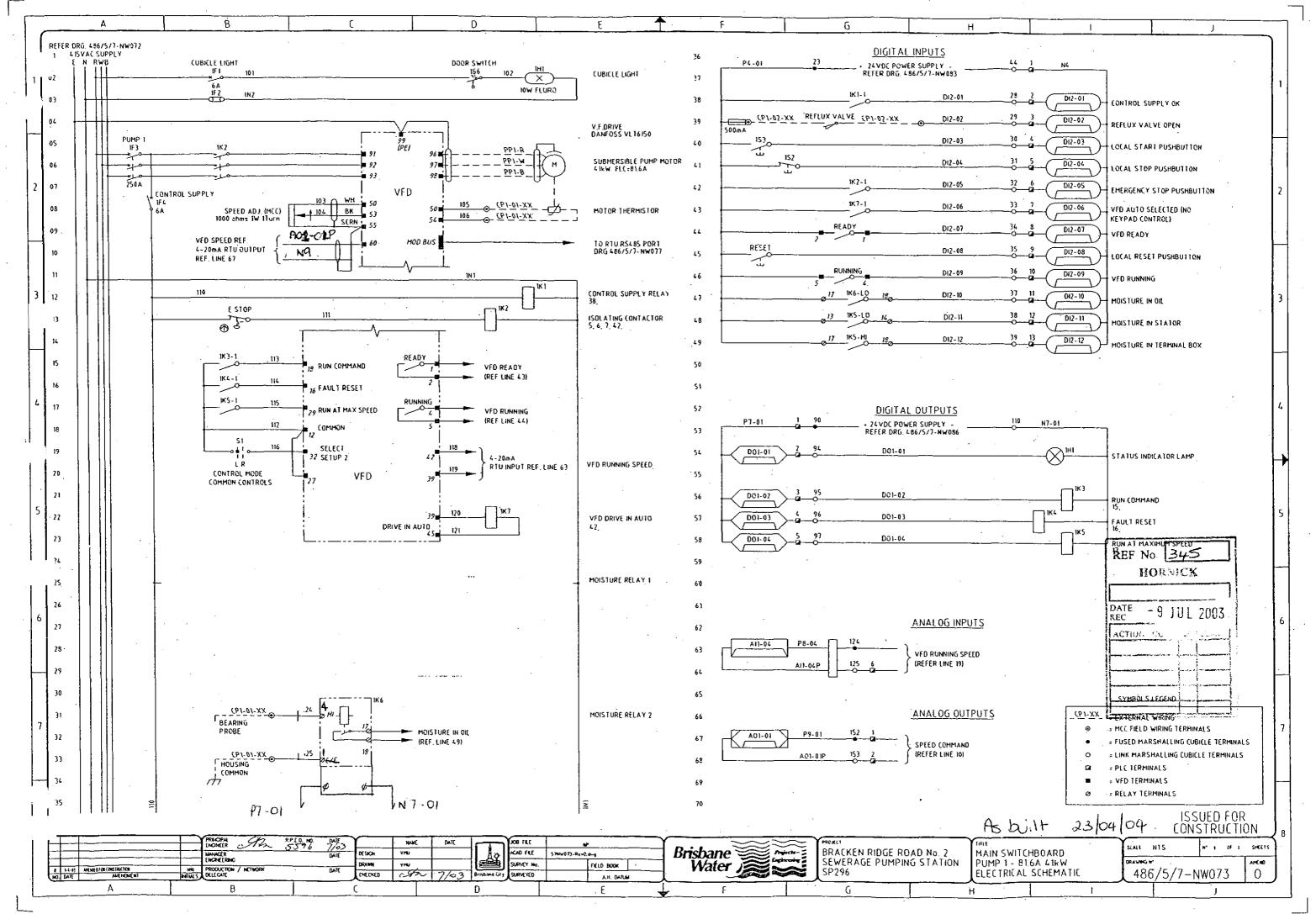
Phone: (08) 9470 4292 Fax: (08) 9470 4787 Email: sjwa@bigpond.com

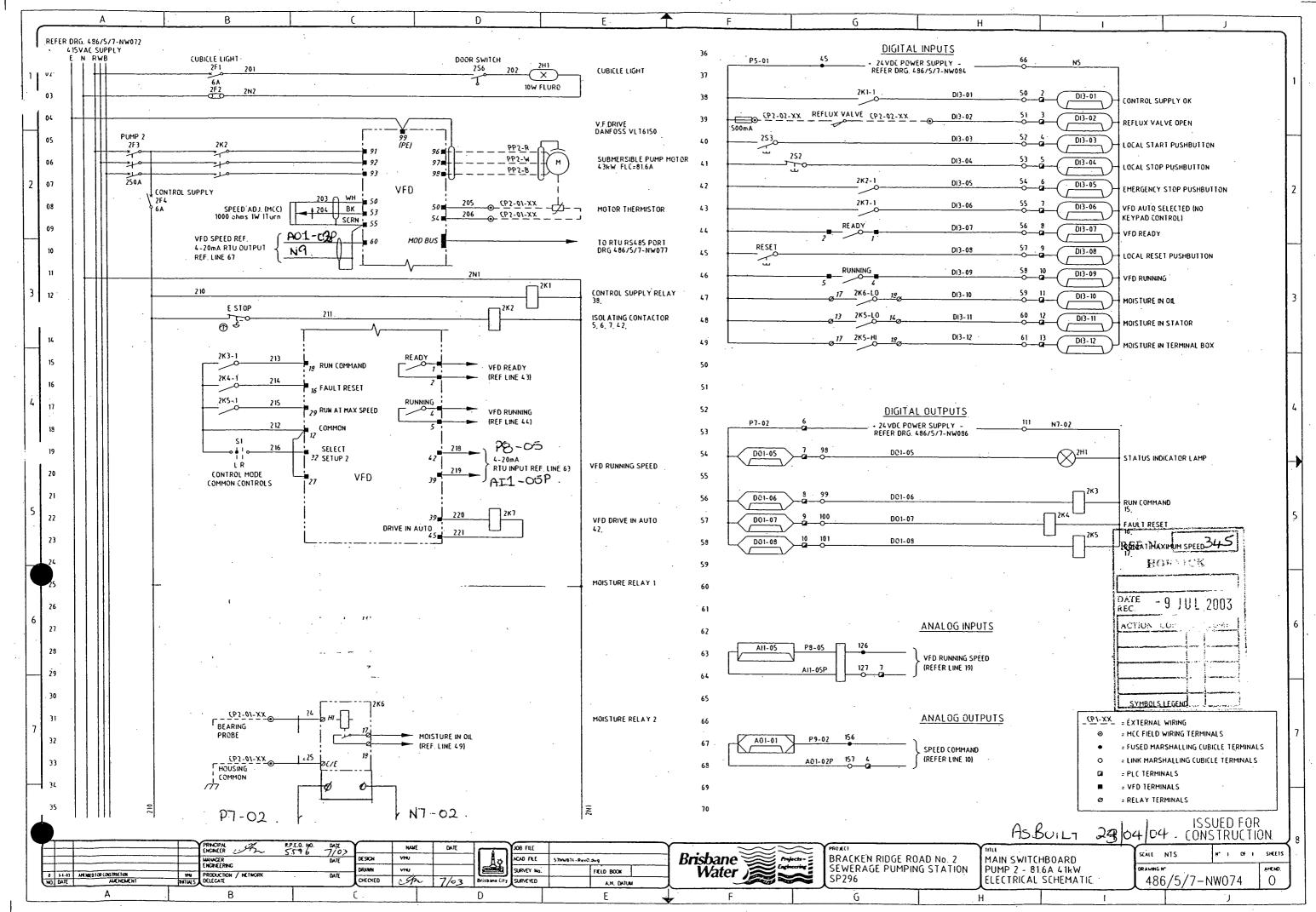
ELECTRICAL ENGINEERS, CONTRACTORS & SWITCHBOARD MANUFACTURERS

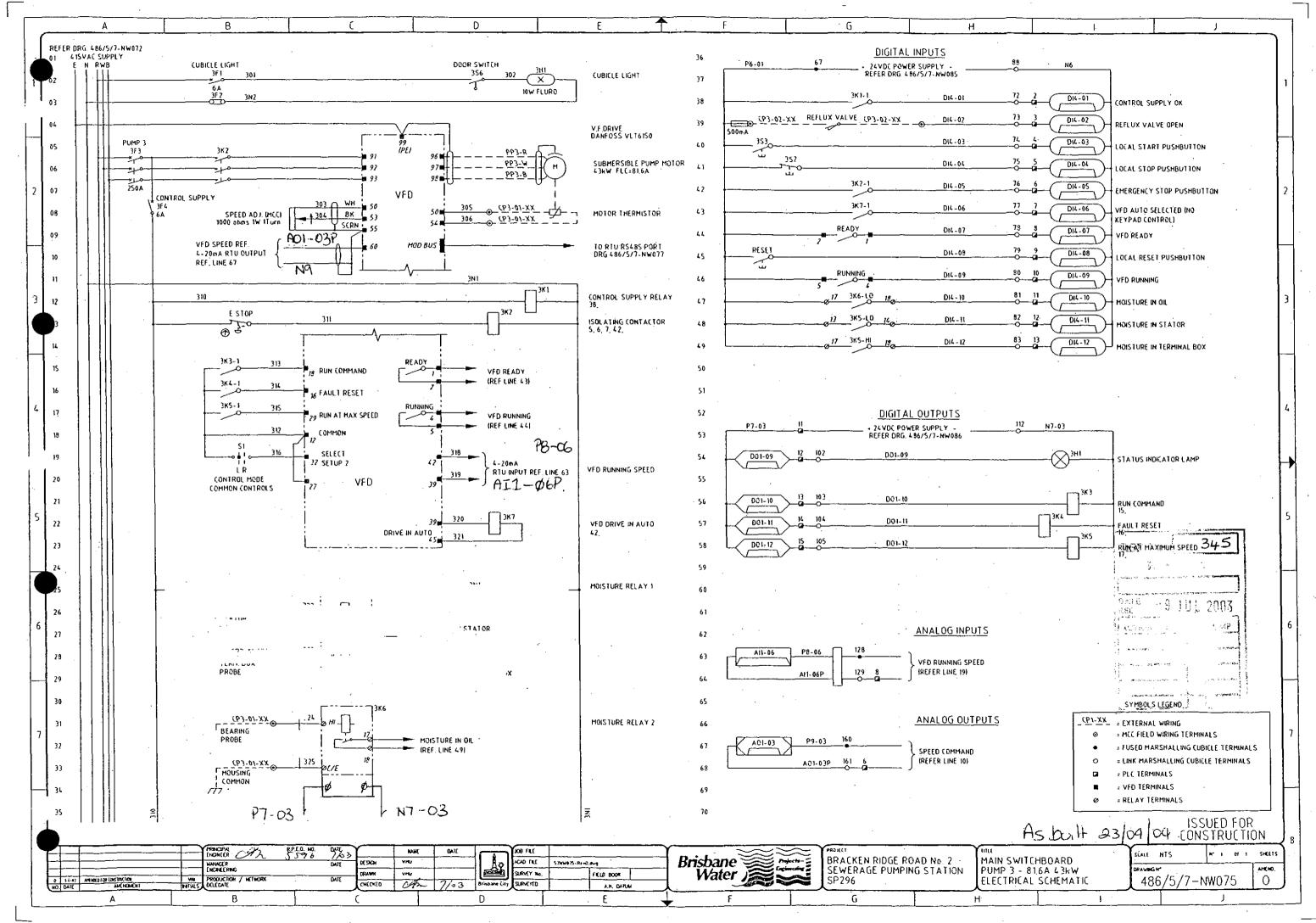




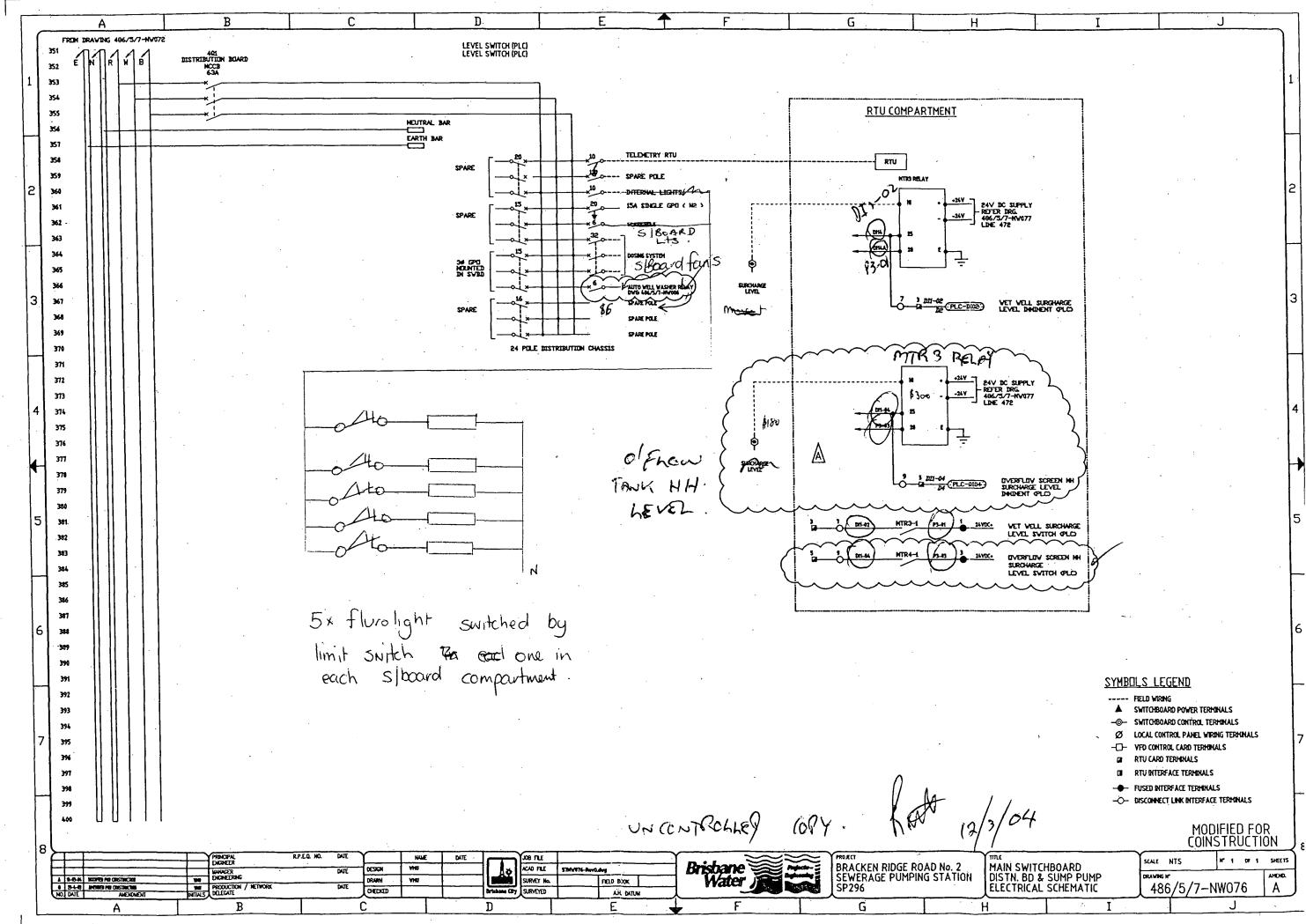


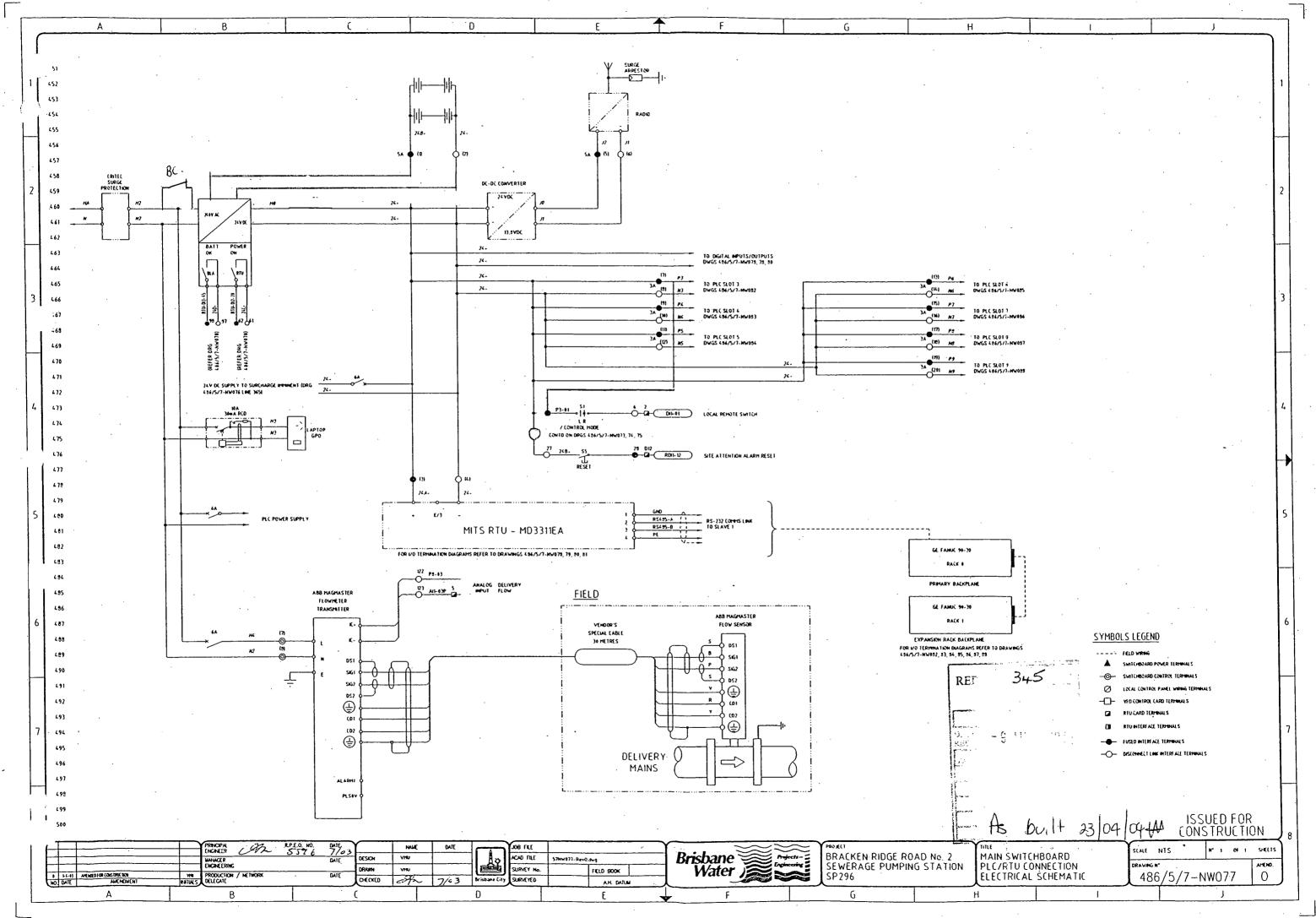


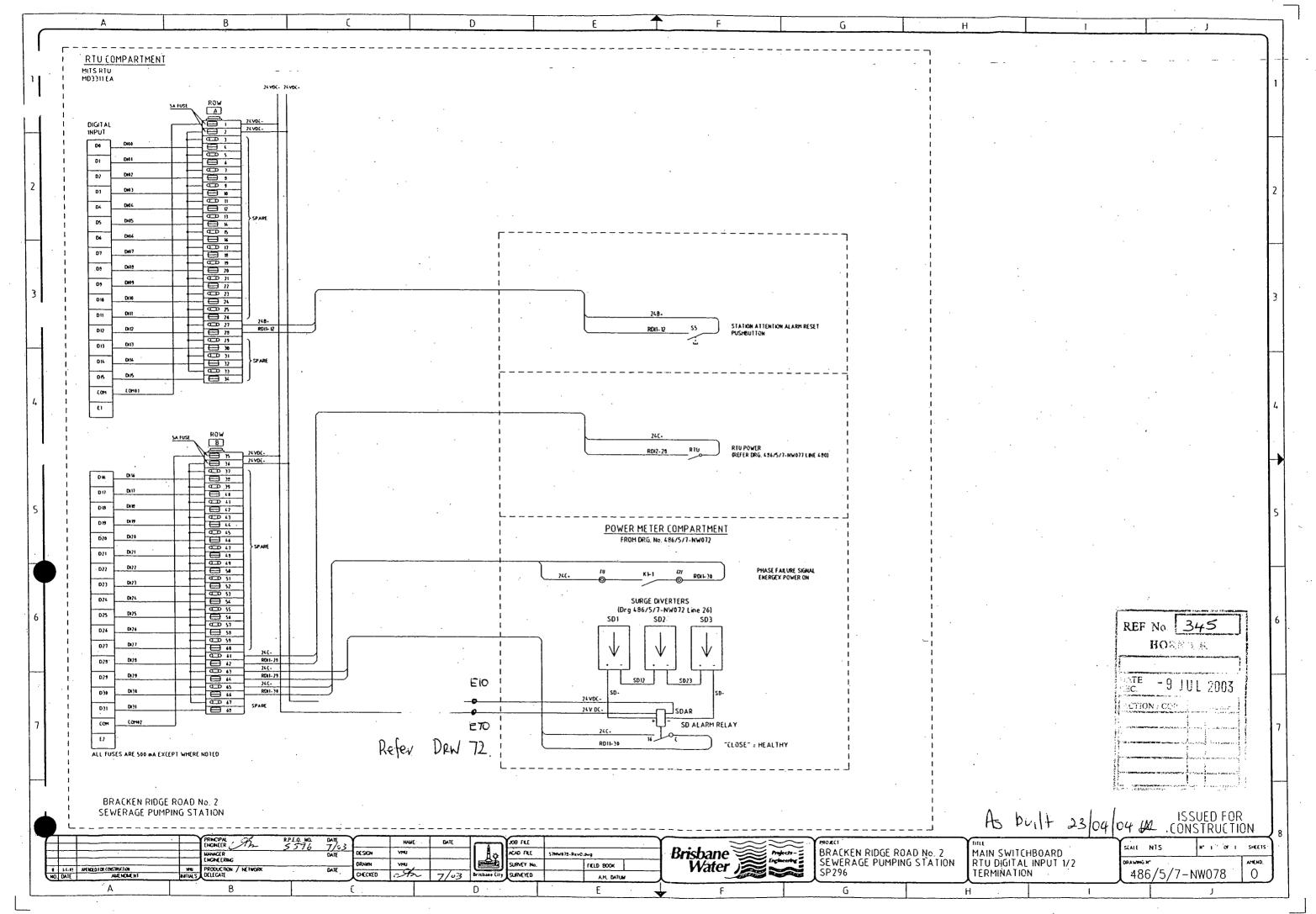


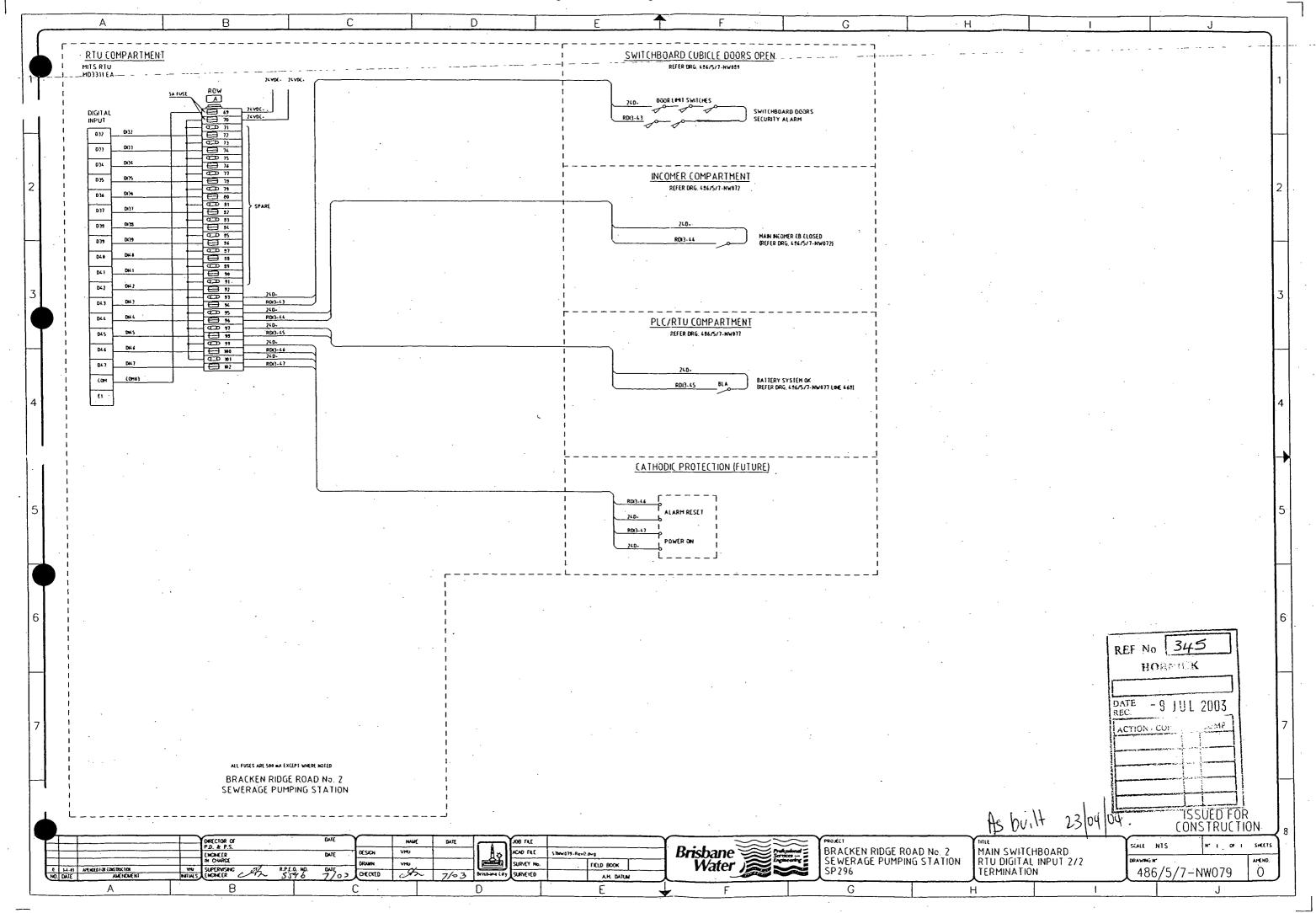


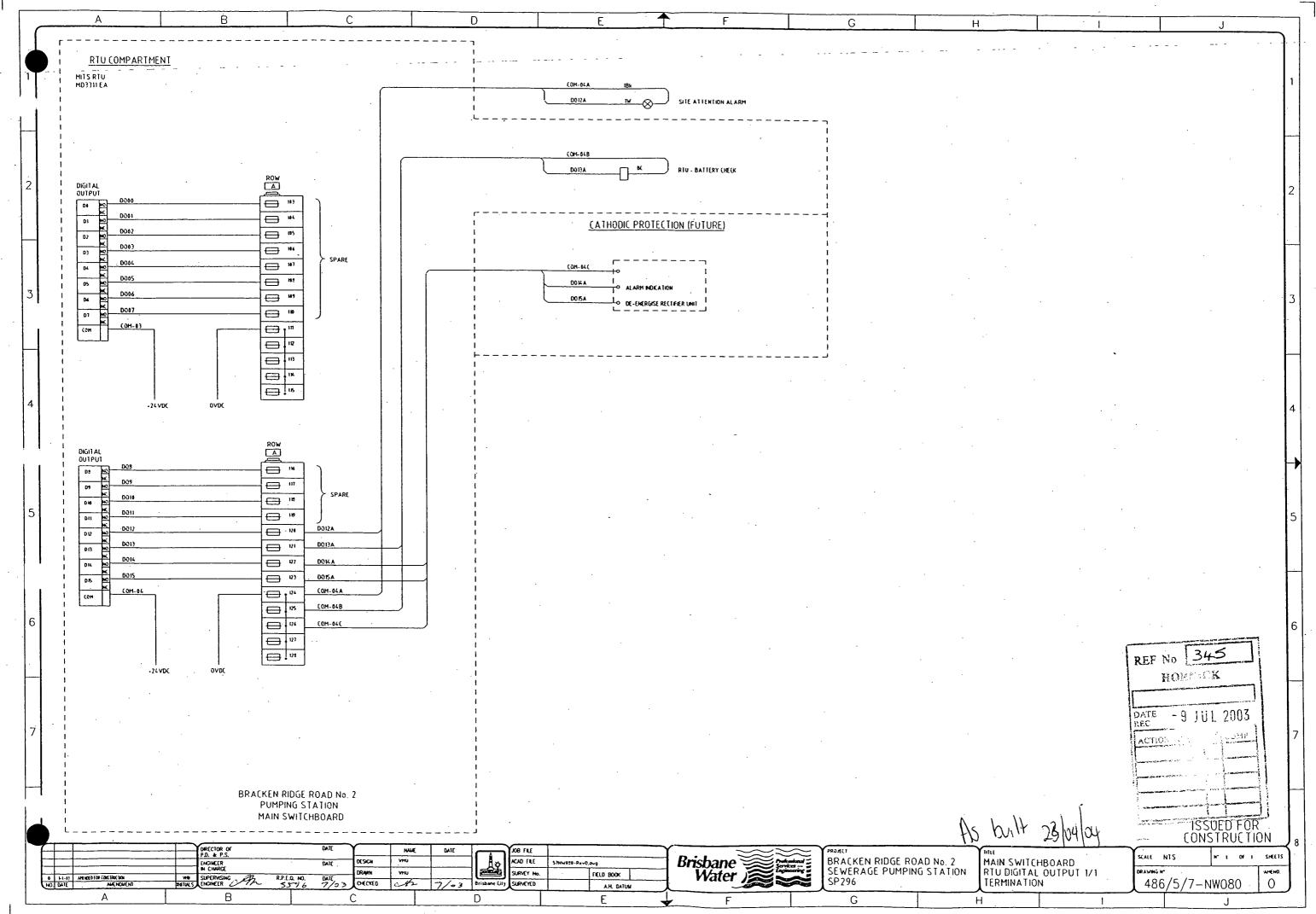


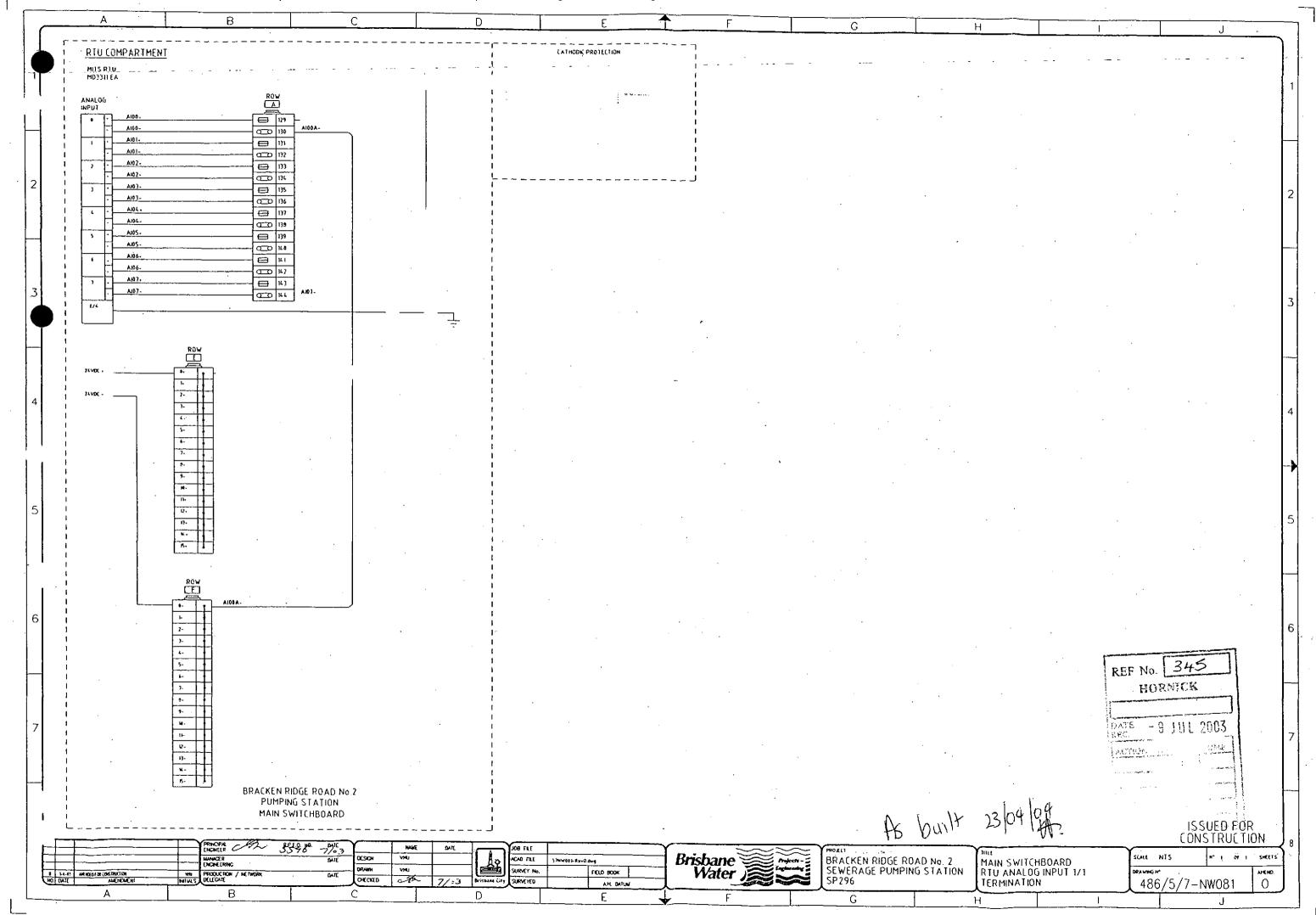


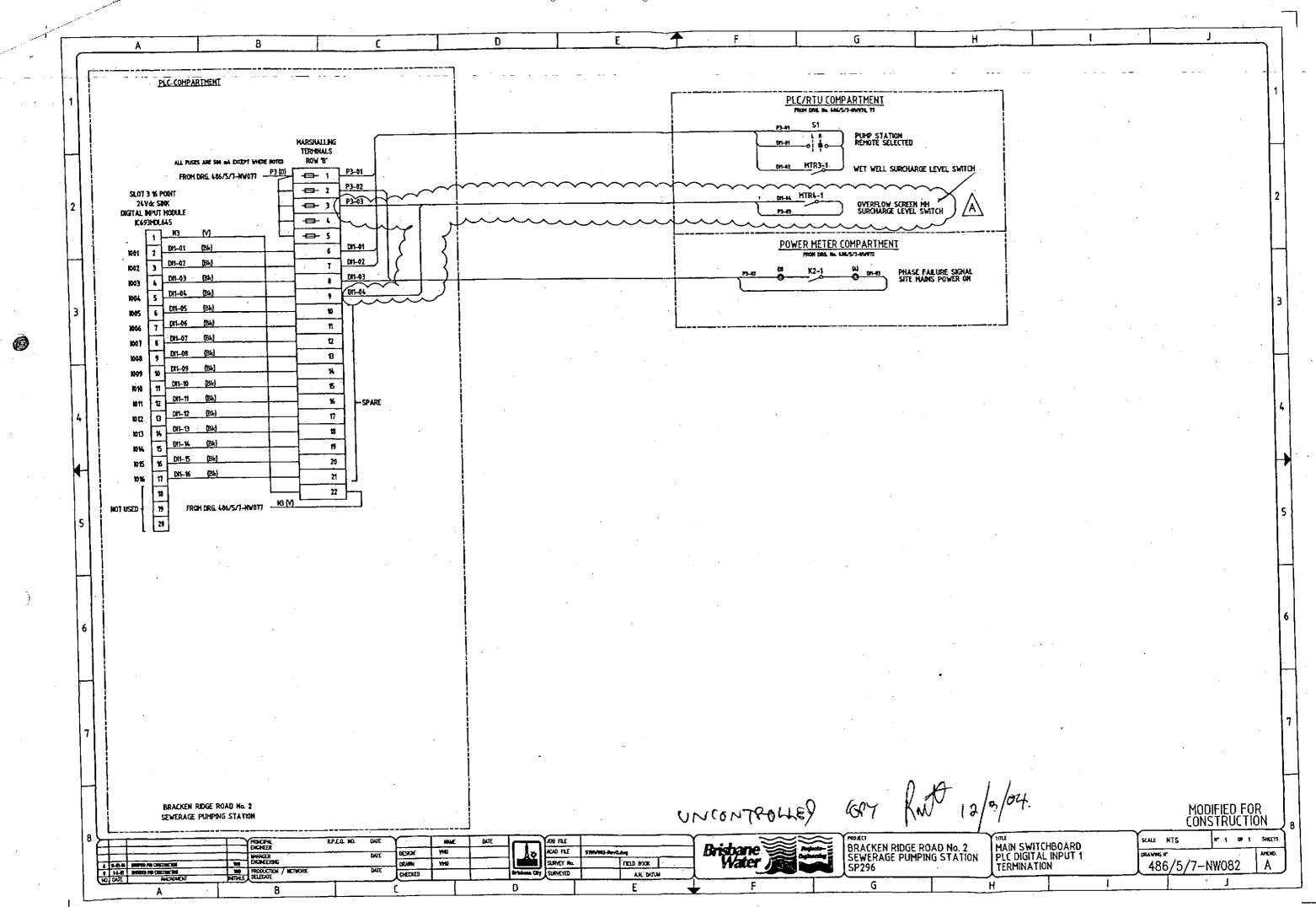


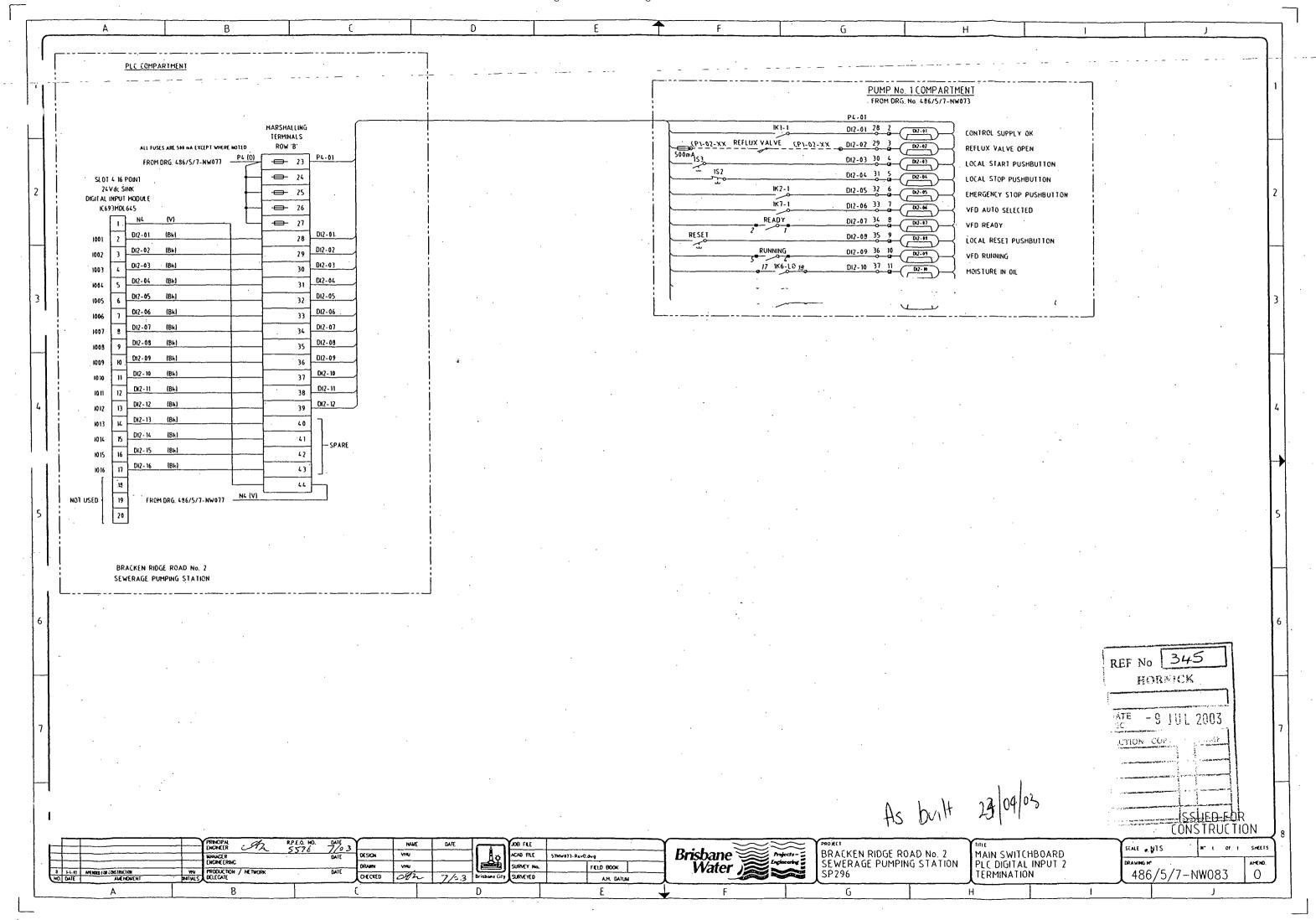


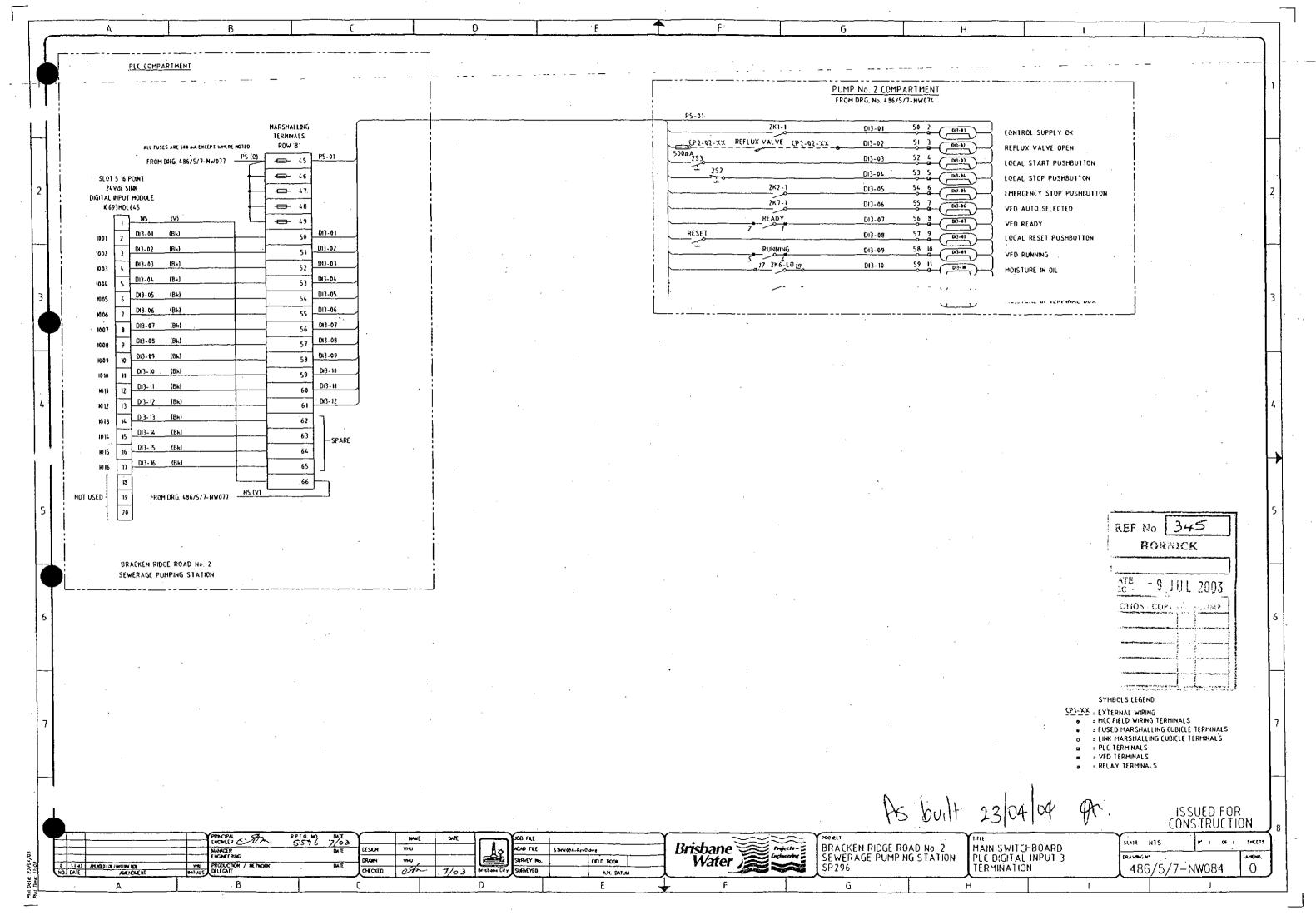


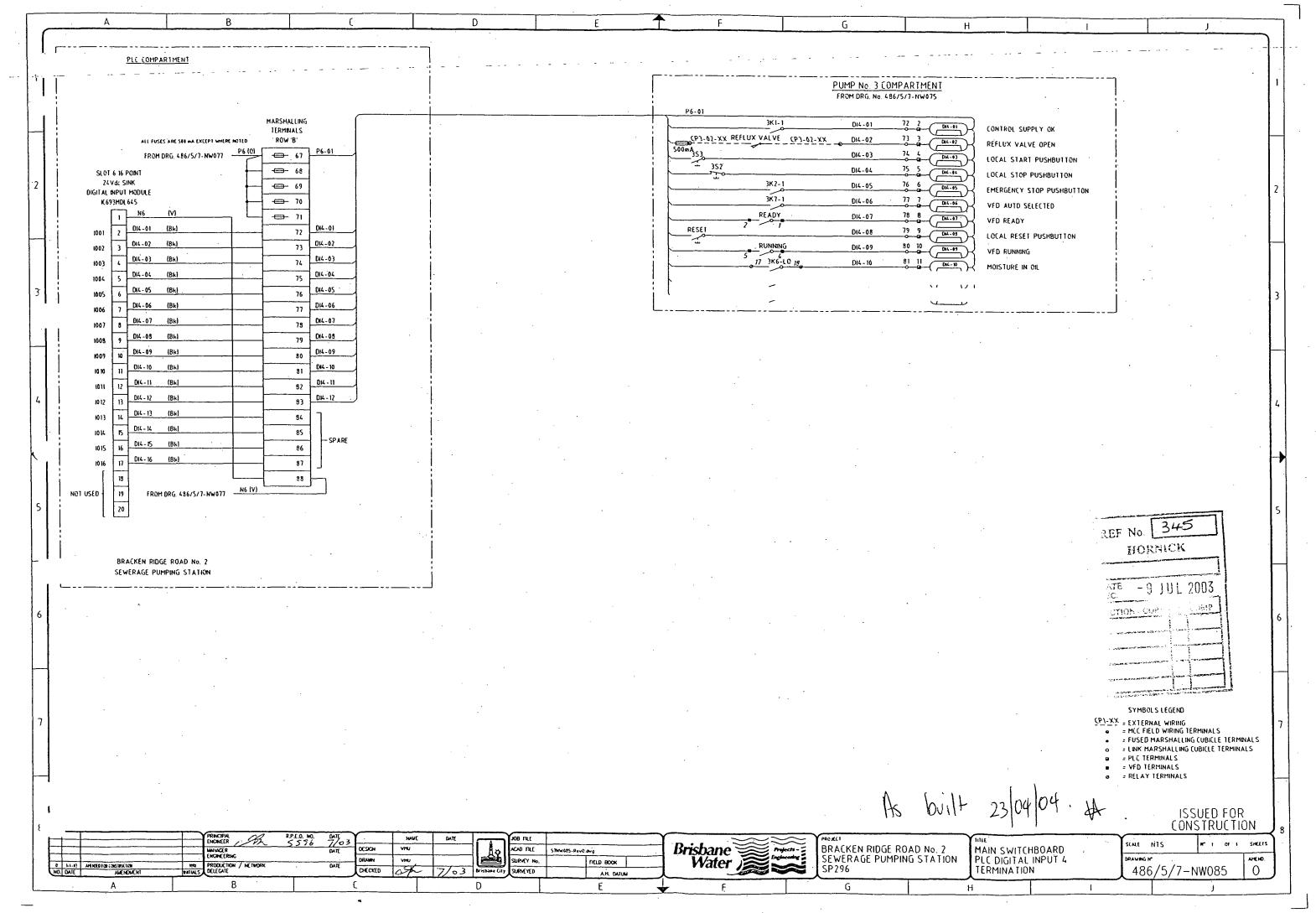


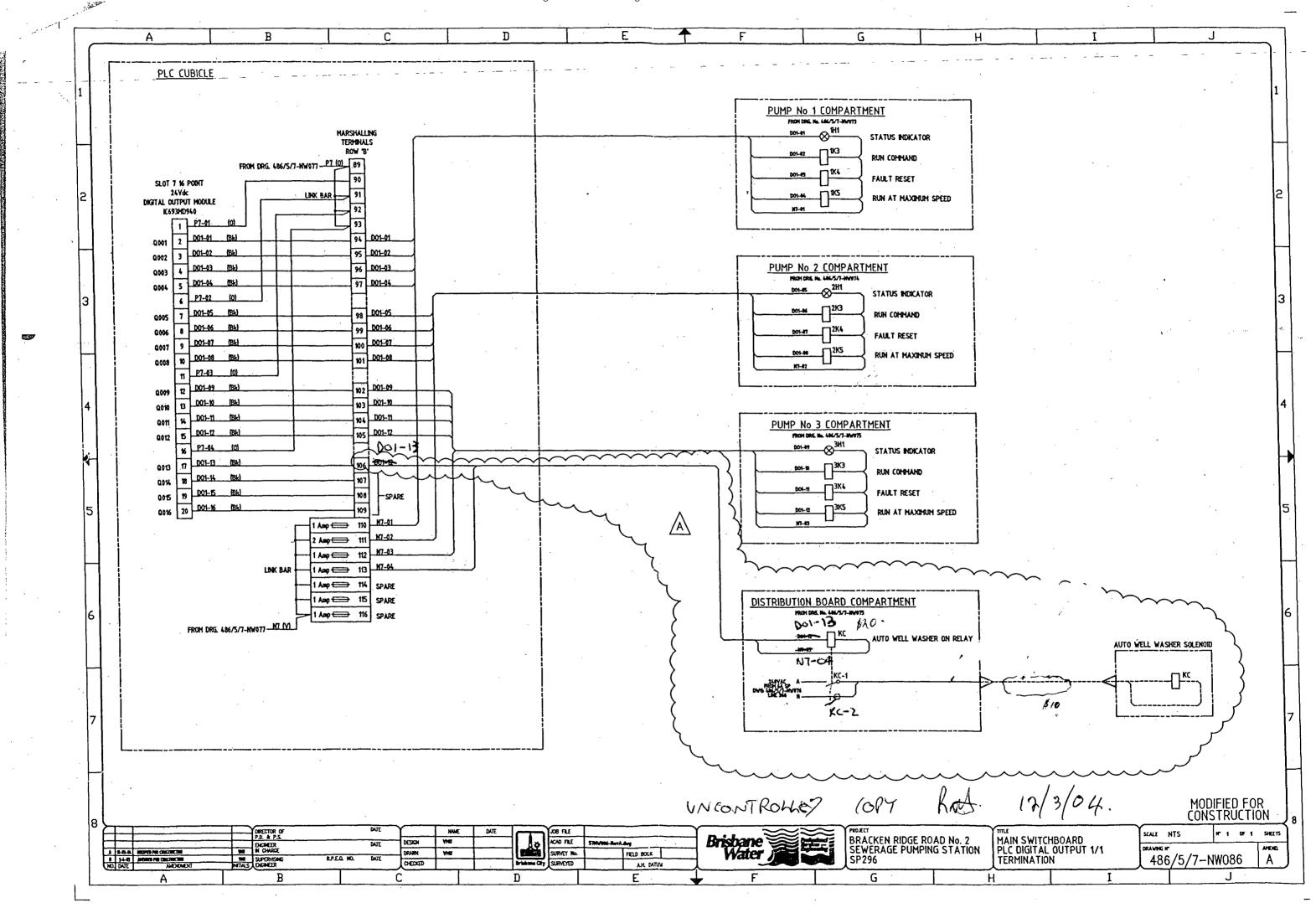


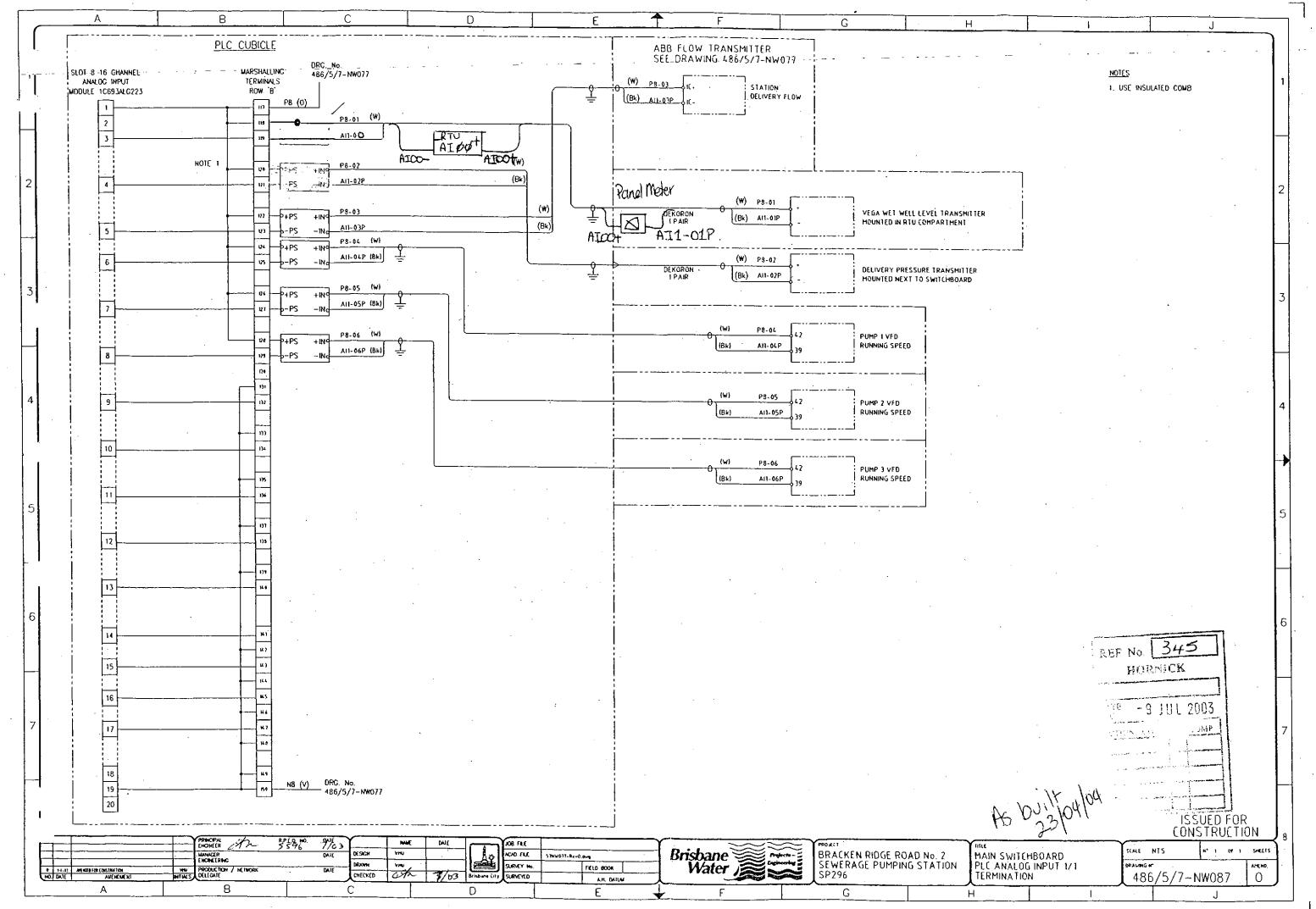


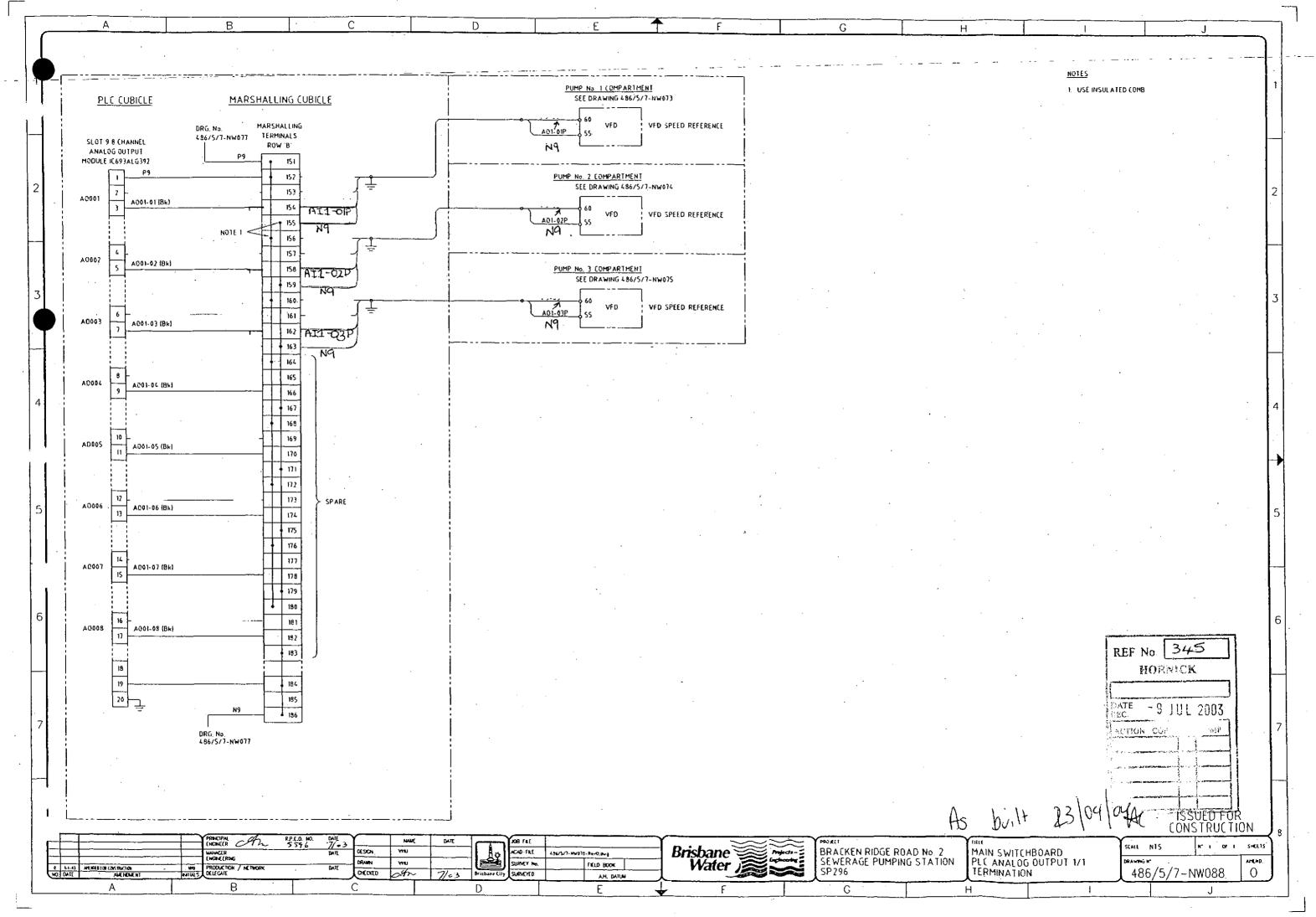


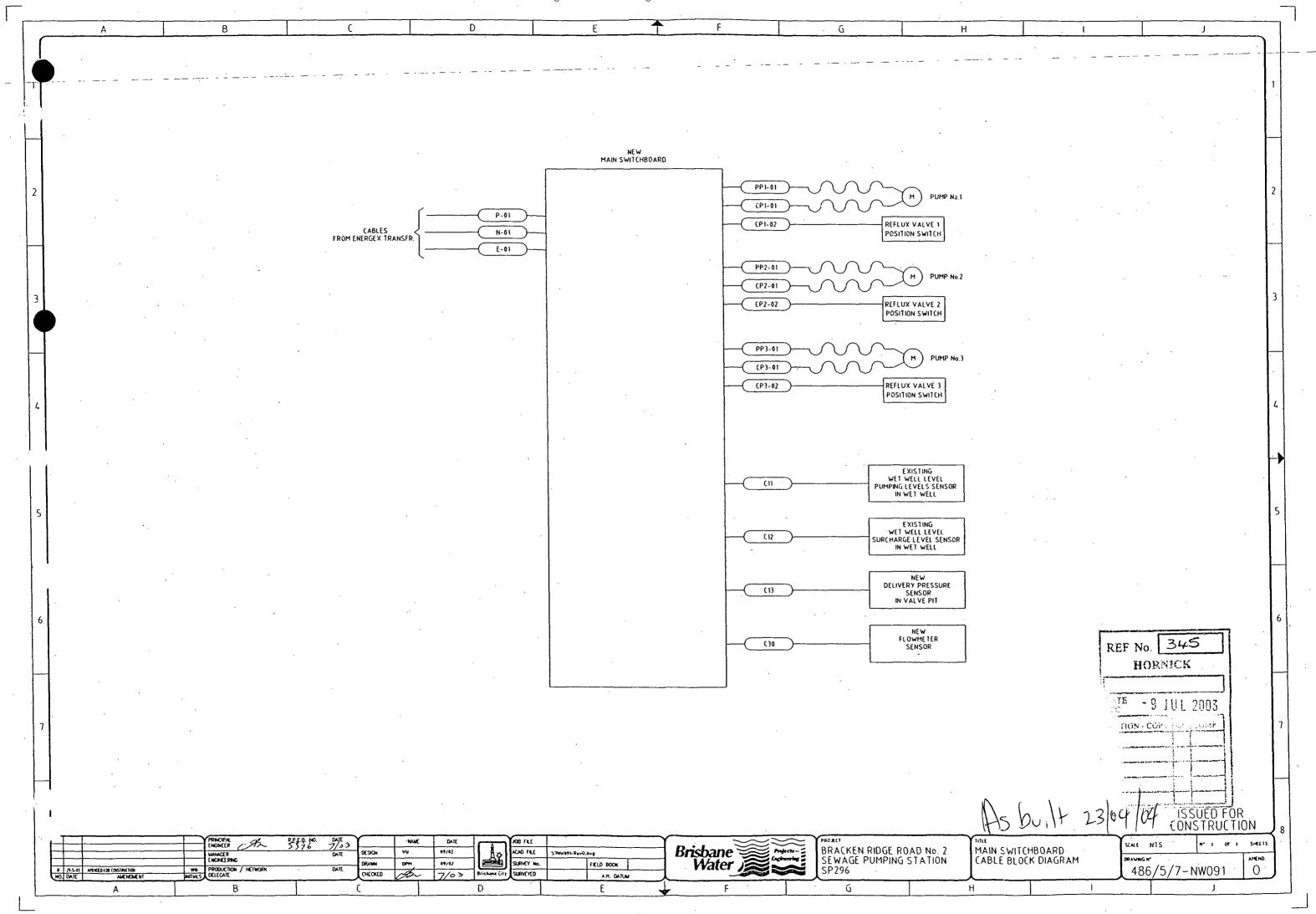




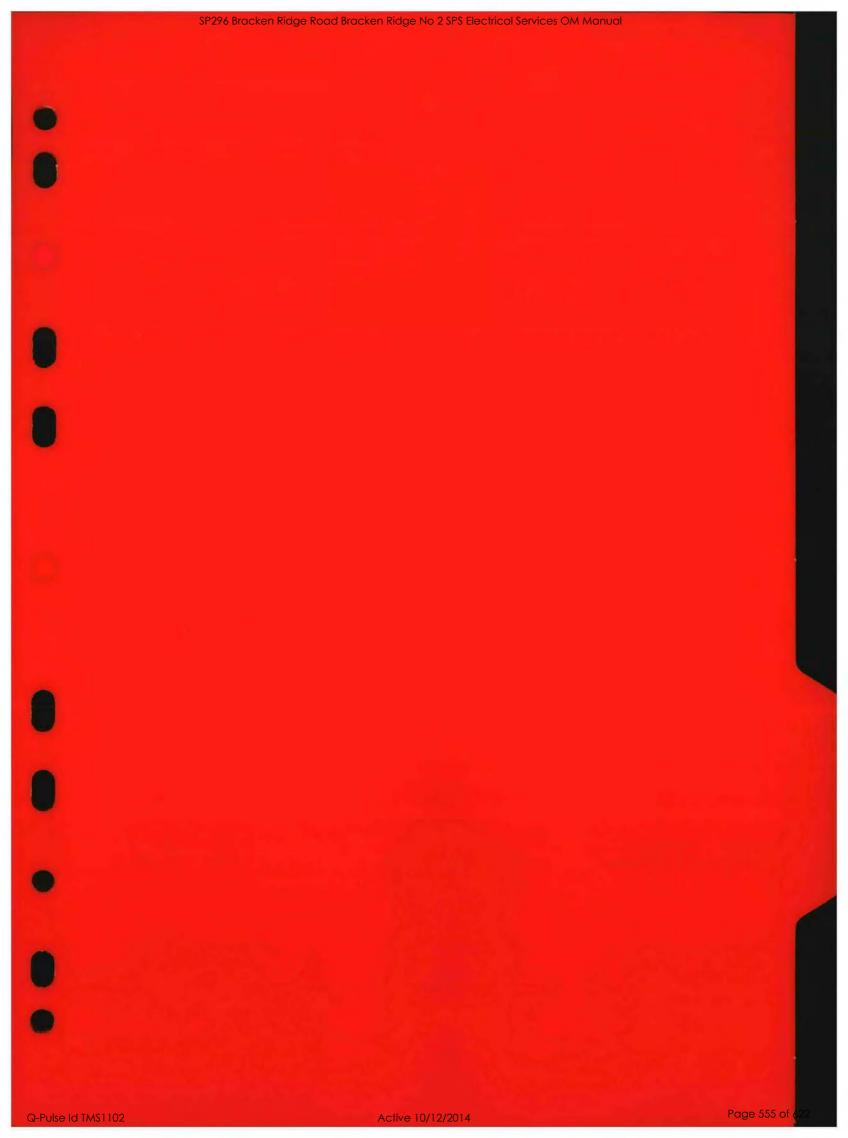








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INSPECTION & TEST RESULTS

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ELECTRICAL ENGINEERS, CONTRACTORS & SWITCHBOARD MANUFACTURERS



ST BEFORE YOU TOUCH



CUST	OMERS	ADDI	RESS:	S WATTER HORNICK SLACKEN R.OGE CIRCUIT DESCRIPTION	RR								JOB No	o.:
C/B NO.	CABLE SIZE	C/B SIZE	N NO.	CIRCUIT DESCRIPTION	VISUAL INSPECTION	CORRECT CIRCUIT CONNECTION	EARTH CONT.	A - E MΩ	N - E M Ω	A - E VOLTS	A - N VOLTS	Ø - Ø VOLTS	RCD mA	TEST mS
M/5				MAINS		1	0	50	50				_	-
GEN M/S	95x2	630	6/N	GEN SUPPLY	1		0	100	1-800				-	-
Pi	16×2	160	_	PUMP1			0.05	00					-	_
P7	16x2			Pumpe			0.05	0					-	_
PZ	16×2		_	PUMP3	\sim		0.05	0						_
LZZ,	1.5	6	22	& WASHWATER SOLEWOLD	✓		0.1	P	0					
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ELECTRIC

QUALITY PLAN: J07002 CHECK LIST NO: QA3CH - 020 ISSUE NO: 3 PAGE 1 OF 1

SWITCHBOARD AND CONTROL PANEL FUNCTIONAL TEST

CUSTOMER: Hornick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRACT NO:BW.30077-02/03

PLANT:	TEST EQPT:
LOCATION / AREA:	TYPE:
DRG NO:	SERIAL NO:

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

CHECKED BY: SEAL CAUST SIGNATURE: Land DATE: 10/12/03 ELECTRICAL LICENCE NO: 5379/	APPROVED BY: SIGNATURE:	DATE: 284/CC

All the above signatories certify that the Electrical switchboard work listed has been checked and tested in accordance with the prescribed procedure and that such work complies in every respect with the requirements of the Electricity Act 1994, AS3000 1991 and AS3008.1 1989.



QUALITY PLAN: J07002 CHECK LIST NO: QA3CH-005 ISSUE NO: 3 PAGE 1 OF 2

SWITCHBOARD AND CONTROL PANEL SWITCHGEAR ASSEMBLY

CUSTOMER: Hornick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRACT NO:BW.30077-02/03

PLANT: 5/ 296 TEST EQPT: VISUAL LOCATION / AREA: TYPE: DRG NO: SERIAL NO: **ITEM ACTIVITY DESCRIPTION** CHECKED Comment NO (TICK) Engraving Labels level 1 2 Legible (letter height as per specification) 3 4 Material as per specification Duct/din rail 5 Level 6 Fixing Earth and Neutral Bars 7 Neutral no. of holes 8 Earth no. of holes 9 Neutral bar no. screws 10 Earth bar no screws 11 Neutral bar hole size 12 Neutral bar hole size Equipment **Equipment Layout** 13 14 Correct Equipment Equipment level 15 16 Equipment fix CHECKED BY: APPROVED BY: 8/12/03 DATE: SIGNATURE: F. LA SIGNATURE: ELECTRICAL LICENCE NO: 53771

All the above signatories certify that the Electrical switchboard work listed has been checked and tested in accordance with the prescribed procedure and that such work complies in every respect with the requirements of the Electricity Act 1994, AS3000 1991 and AS3008.1 1989.



QUALITY PLAN: J07002 CHECK LIST NO: QA3CH - 005 ISSUE NO: 3 PAGE 2 OF 2

SWITCHBOARD AND CONTROL PANEL SWITCHGEAR ASSEMBLY

CUSTOMER: Hornick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRACT NO:BW.30077-02/03

PLANT: LOCATION DRG NO	SP296 ON/AREA: 0:	TEST EQPT: TYPE: SERIAL NO:			
ITEM NO	ACTIVITY DESCRIP	TION	CHECKED (TICK)	Comment	
17 18 19 20 21 22 23 24 25 26 27 28 29 30	Wiring Wire size and temperature rating is of Wire colour Wire number system as per specification wire numbers Isolators are correct size Fuses are correct size Contact/o/load are correct size Terminals (allow spares as per specification of the correct size) Looms Supported Protected Cable off steel edges (allow bushing) Cable lugs Cable crimp	ation ification)	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	Ass	
SIGNAT	CHECKED BY: PETEL CRUST SIGNATURE: DATE:8/1/2 SIGNATURE: DATE:0/6/CK				

All the above signatories certify that the Electrical switchboard work listed has been checked and tested in accordance with the prescribed procedure and that such work complies in every respect with the requirements of the Electricity Act 1994, AS3000 1991 and AS3008.1 1989.



QUALITY PLAN: J07002 CHECK LIST NO: QA3CH - 020 ISSUE NO: 3 PAGE 1 OF 1

SWITCHBOARD AND CONTROL PANEL FUNCTIONAL TEST

CUSTOMER: Hornick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRACT NO:BW.30077-02/03

PLANT: LOCATION DRG NO	SP 296 ON / AREA: BRACKEN KIOGE.			
ITEM NO	ACTIVITY DESCRIPT	ION	CHECKED (TICK)	Comment
1	Prior to Supply Connection Do a point to point test on all cables schematic drawings.	as per the	(4)	
2	Check no crossed voltages 24/240.		(~)	
3	Ensure cable colour coding as per sp	(1)		
4	Check analog inputs/outputs have shielded cable.		(~	
5	Check all cables are numbered.		(5	
6	Ensure indicator lights have right col	our lenses.	(1)	
7	Check all CT's are earthed.		(5	
8	Ensure relays are switching correctly	/ .	(4)	
9	Check push buttons work correctly.		(5)	
10	Check selector switches work correct	tly.	()	
11	Ensure signal inputs/outputs are cor	rect.	(/)	
12	Connect Supply Test operations step by step following procedure.	ng specified	(5	

All the above signatories certify that the Electrical switchboard work listed has been checked and tested in accordance with the prescribed procedure and that such work complies in every respect with the requirements of the Electricity Act 1994, AS3000 1991 and AS3008.1 1989.

ELECTRICAL ENGINEERS, CONTRACTORS & SWITCHBOARD MANUFACTURERS



QUALITY PLAN: J07002 CHECK LIST NO: QA3CH - 025 ISSUE NO: 3 PAGE 1 OF 1

EARTHING

CUSTOMER: Hornick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRACT NO:BW.30077-02/03

PLANT: LOCATION/AREA: BRACKEN RIGGE. DRG NO:	TEST EQPT: VISUAL TYPE: SERIAL NO:
--	------------------------------------

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	TEST RESULTS
1	Check earth conductors and earth electrodes are of correct size as per construction drawings.	5	
2	Check earth conductors are supported as per AS3000 and specification.	(1	
3	Check earth conductors are protected against mechanical damage.	(1	
4	Ensure correct lug/connector and fixing bolts/screws are used for termination as per AS 1882.	(1)	
5	Check earth pits are provided with warning label.	(3	
6	Ensure that the top level of the earth pit in respect to finished ground level complies with the construction drawing.	(8	
7	Check joints are electrically and mechanically sound	(4	
8	Ensure anti-corrosion measures are taken.	(4	
9	Ensure that the removal of covers or part of equipment will not disturb or reduce effectiveness of earthing connection.	(1	
10	Check spare terminals kept on earthing bar (if applicable) and each connection to earth bar identified by label.	(5)	

CHECKED BY: MICK FRANKS
SIGNATURE: 14/4/01

APPROVED BY SIGNATURE:

DATE: 28/4/C4

All applicable items have been checked - YEŞ/NO



QUALITY PLAN: J07002 CHECK LIST NO: QA3CH - 001 ISSUE NO 3 PAGE 1 OF 1

TRENCHING

CUSTOMER: Hornick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRACT NO:BW.30077-02/03

	TEST EQPT: VISUAL TAPE MEASURE TYPE: SERIAL NO:
--	---

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	TEST RESULTS
1	Check construction drawing for other underground services and obstacles.	(1)	
2	Check availability of access.	(2)	
3	Check trenching for correct depth and width.	(8	
4	Check level for future finished ground level.	(5	
5	Check bedding sand is correct grade, as per specification and construction drawing.	(4)	
	<u>,</u>		

CHECKED BY DATE: 14/4/04 SIGNATURE: ELECTRICAL LICENCE NO. 38985

APPROVED BY: SIGNATURE: <

ELECTRICAL LICENCE NO:

All the above signatories certify that the Electrical switchboard work listed has been checked and tested in accordance with the prescribed procedure and that such work complies in every respect with the requirements of the Electricity Act 1994, AS3000 1991 and AS3008.1 1989.



QUALITY PLAN: J07002 CHECK LIST NO: QA3CH - 040 ISSUE NO: 3 PAGE 1 OF 1

CABLE INSTALLATION (in conduit)

CUSTOMER: Homick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRACT NO:BW.30077-02/03

PLANT: SP 796
LOCATION / AREA: SPACKEN RIDGE.
DRG NO:

TEST EQPT: V15VAL
TYPE:
SERIAL NO:

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	TEST RESULTS
1	Check approved cable schedule and cable layout drawing.	(4	
2	Check cable drum is identified and IR value recorded.	(/)	
3	Ensure correct cable type, size and rating.	(<	
4	Check actual length against length indicated on the cable schedule.	(4)	
5	Check conduit is internally clean, prior to cable installation.	(/)	
6	Check handling facility is adequate for cable installation.	(4)	
7	Ensure cable is feed into conduit without twists and sheath/insulation is not getting damaged during pulling.	(8	
8	Check that approved means of protection is provided to underground cables emerging from the ground.	(1	
9	Ensure number of cables in conduit as per AS3000 and AS30081.	(5	
10	Check correct length of cables is left on both ends for termination.	(%)	

CHECKED BY:

SIGNATURE:

DATE: 17/3/4 SIGNATURE:

DATE: 25/4/C4

All applicable items have been checked - YES/NO



DRG NO:

QUALITY PLAN: J07002 CHECK LIST NO: QA3CH - 050 ISSUE NO: 3 PAGE 1 OF 1

CONDUIT CABLE SYSTEM

CUSTOMER: Hornick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRACT NO:BW.30077-02/03

PLANT: 3P296 LOCATION/AREA: BASIKEN LIDGE.

TEST EQPT: VISUAL

TYPE:

SERIAL NO:

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	TEST RESULTS
1	Check anti-corrosion coating on conduits are used for installation exposed to weather/corrosive atmosphere.	(-)	
2	Check all damaged surface coating including threads are restored.	(\sqrt_1	
3	Check internal wall of conduit are free from projections, sharp corners etc.	(\(\sigma \)	
4	Check normal bends and inspection tees/elbows provide as per approved construction drawing.	(🗸)	
5	Check conduit joins are done with suitable coupling and fittings.	(/)	
6	Check conduit support spacing as per AS3000.	(</td <td></td>	
7	Check flexible conduit terminated at motor is anchored near motor terminal box where unsupported length exceeds 1.5m.	(🗸)	
8	Check maximum support spacing for flexible conduit not likely to be disturbed is 1.00m and 2.00m for horizontal and vertical run respectively.	(1)	
9	Ensure that conduits (metallic or non-metallic) installed is spaced at least 150mm away from gas pipe/s containing hot fluids and should not be installed above and parallel to hot pipes.	()	
10	Check and confirm that cast-in conduits tend to become bunched, eg. at switchboard positions, are spaced to the approval of the structural engineer.	(1/)	

All applicable items have been checked - YES/NO

CHECKED BY:

Q-Pulse Id TMS1102

Active 10/12/2014

APPROVED BY: SIGNATURE:

Page 567 of 622



QUALITY PLAN: J07002 CHECK LIST NO: QA3CH - 055 ISSUE NO: 3 PAGE 1 OF 1

CABLE TERMINATIONS (LV/Control/Instrumentation)

CUSTOMER: Hornick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRACT NO:BW.30077-02/03

PLANT:	TEST EQPT: VISUAL
LOCATION / AREA: BASINEW RIBGER	TYPE:
DRG NO:	SERIAL NO:

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	TEST RESULTS
1	Check cubicle/panel/equipment and both ends of cable are electrically isolated and danger tags have been fitted to all isolation points.	(1	
2	Check gland plates (if provided) have been correctly fitted and spare holes have been sealed and are specified type.	(1	
3	Check cable screens have been earthed as per specified requirements.	()	
4	Check cable cores have not been damaged during stripping of sheath.	(<)	·
5	Check cable cores are loomed and supported as per specified requirements.	(/)	
6	Check wire number ferrules are the specified type and wire number corresponds with allocated cable core number/colour.		,
7	Check lugs are specified type, correct size and properly crimped.	()	
8	Check terminations are as per wiring schedule/diagram.	(1)	
9	Check spare cores are installed, secured and identified as per specified requirements.		
10	Check all terminal; covers fitted and cable off-cuts and other rubbish removed.	(/)	
11	Check all danger tags have been removed.	(/)	

CHECKED BY: MICK FRANKS SIGNATURE: 14/4/04 DATE:

APPROVED BY: SIGNATURE:

All applicable items have been checked - YES/NO



QUALITY PLAN: J07002 CHECK LIST NO: QA3CH - 070 ISSUE NO: 3 PAGE 1 OF 2

LIGHTING AND GENERAL POWER (Fit off)

CUSTOMER: Hornick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRACT NO:BW.30077-02/03

TEST EQPT: VISUAL. TYPE: SERIAL NO:
T

ACTIVITY DESCRIPTION	CHECKED (TICK)	TEST RESULTS
Check wiring and sockets location as per approved construction drawing.	(1)	
Check cables are of correct size, type and voltage rating.	()	
Ensure lighting fixtures, socket outlet types, rating as per approved construction drawing.	()	
Check lighting supports/fixtures as per approved construction drawing.	()	
Check lighting fittings are complete - with correct ballast, reflectors etc.	(1)	
Check emergency lighting circuit and fittings are identified.	WA	
Ensure socket outlets of correct rating installed at locations as per approved construction drawing.	(1)	
Check cables terminated at light fittings and switches as per circuit arrangement on approved construction drawing.	(1)	
Check cables are properly fixed and terminated.	(8)	
Ensure all unused conduit entries are sealed.	(5)	
Check all field changes are approved and incorporated in "as-built" drawing.	(\(\)	
	Check wiring and sockets location as per approved construction drawing. Check cables are of correct size, type and voltage rating. Ensure lighting fixtures, socket outlet types, rating as per approved construction drawing. Check lighting supports/fixtures as per approved construction drawing. Check lighting fittings are complete - with correct ballast, reflectors etc. Check emergency lighting circuit and fittings are identified. Ensure socket outlets of correct rating installed at locations as per approved construction drawing. Check cables terminated at light fittings and switches as per circuit arrangement on approved construction drawing. Check cables are properly fixed and terminated. Ensure all unused conduit entries are sealed. Check all field changes are approved and incorporated	Check wiring and sockets location as per approved construction drawing. Check cables are of correct size, type and voltage rating. Ensure lighting fixtures, socket outlet types, rating as per approved construction drawing. Check lighting supports/fixtures as per approved construction drawing. Check lighting fittings are complete - with correct ballast, reflectors etc. Check emergency lighting circuit and fittings are identified. Ensure socket outlets of correct rating installed at locations as per approved construction drawing. Check cables terminated at light fittings and switches as per circuit arrangement on approved construction drawing. Check cables are properly fixed and terminated. Ensure all unused conduit entries are sealed. Check all field changes are approved and incorporated

CHECKED BY: APPROVED BY: SIGNATURE: SIGNATURE:

All applicable items have been checked - YES/NO





QUALITY PLAN: J07002 CHECK LIST NO: QA3CH - 075 ISSUE NO: 3 PAGE 1 OF 1

CONDUIT INSTALLATION (in ground)

SERIAL NO:

CUSTOMER: Homick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRACT NO:BW.30077-02/03

PLANT: 5P 296
LOCATION / AREA: BRAKEN RIDGEN
DRG NO:

TEST EQPT: VISUAL
TYPE:

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	TEST RESULTS
1	Check approved construction drawing for size and number of conduits required.	(1/)	
2	Check trench excavation for correct width and depth.		
3	Check bedding sand is correct grade, as per specification and approved construction drawing.	(/)	
4	Layer of bedding sand in trench prior to conduit laying.	(\(\sigma \)	
5	Arrange layers of conduit in bedding sand as per specification and approved construction drawings.	(\(\sigma \)	
6	Place danger indicator tape above conduit (300mm) or as required by the specification and approved construction drawing.	(\(\sigma \)	
7	Backfill and tamp soil as per specification and approved construction drawing.		
8	Ensure cable pits are constructed as per specification and approved construction drawing.	(\	
9	Ensure conduit entry into pits allow for minimum radius requirements for the size of cables being installed.		
10	Check installation area cleaned and made good.	(4)	

All applicable items have been checked - YES/NO

CHECKED BY:

APPROVED BY: SIGNATURE:



QUALITY PLAN: J07002 CHECK LIST NO: QA3CH - 100 ISSUE NO: 3 PAGE 1 OF 1

ON SITE **Functional Checks**

CUSTOMER: Hornick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRA	CT NO:BW.30077-02/03				
PLANT: LOCATIO DRG NO:	SP296 NIAREA: BARCHEN LIDGÓ.		TEST EQF TYPE: SERIAL N		
ITEM NO	ACTIVITY DESCRIPTIO	Ν		CHECKED (TICK)	TEST RESULTS
1	Prior to supply connection Do a point to point test on all cables as schematic drawings.	s per the		(4)	
2	Check no cross voltages 24/240.			(/)	
3	Check all cables are numbered as per	cable so	chedule.		
4	Check all analog inputs\ outputs have	shielded	I cable.	(<	
5	Check all overload settings are correct	t.		()	
6	Operations Check motor current - do not exceed e	each mot	or FLC.	()	
7	Confirm each motor functions correctly station control and field isolator operat		n field	()	
8	Check ammeters for correct readings of	of load c	urrent.	()	
9	Check motor direction is correct.			()	
			-1		
CHECKE SIGNATI	IDE DATE I !	APPROVE BIGNATU		MATE: 1	J efan
					

All applicable items have been checked - YES/NO

SJ ⊨iectric (Qld) Pty. Ltd.

FACTORY ACCEPTANCE TEST SHEET 6:

PROJECT:

Bracken Ridge Pump Stations

Client:

Hornick Constructions

Job No.

J07002

Equipment:

SPS 296 Switchboard

Section:

Pump No. 3

Drawing:

486/5/7-NW075 Amend 0

	Process Operation	Reference/ Acceptance Criteria	
1.	Ensure Insulation test as per QA3CH-15 have been completed	SJ QA3CH-15 AS 3000 Insulation resistance greater than 1 megohm ph to earth Hi pot test 2.5 kv ph-eth for 1 minute	V NA
2.	Ensure Checks 1 to 11 as per QA3CH-020 have been completed	SJ QA3CH-020 Point to Point check of schematics. Visual Check of wiring.	o mo
3.	Check voltage is available on line side of motor circuit breaker 3F3.	Drawing 486/5/7-NW075 415 vac ph to ph	19/3/8
4.	Ensure control circuit breaker 3F4 is "OFF" and emergency stop is operated, close circuit breaker 3F3 and confirm voltage is available on line side of circuit breaker 3F3.	Drawing 486/5/7-NW075 415 vac ph to ph	
5.	Check voltage is available on line side of control circuit breaker 3F4, close circuit breaker and ensure: 1 K1 Control Supply Relay is operating correctly. Voltage is available to 3K5 and 3K6.	Drawing 486/5/7-NW075 240 vac ph to n	
6.	Release emergency stop and confirm operation of isolating contactor 3K2 and confirm voltage is available to VSD.	Drawing 486/5/7-NW075 415 vac ph to ph	

SJ :tric (Qld) Pty. Ltd.

7.	Confirm operation of Pump 3 Digital Inputs.	Drawing 486/5/7-NW075	
8.	Confirm Operation of Pump 3 Digital Outputs	Drawing 486/5/7-NW075	
9.	Confirm Operation of Pump 3 Analog I/O	Drawing 486/5/7-NW075	

Tests Completed By	Witnessed By	Accepted By
Date	Date	Date 10 12 03
Comments:		
Instruments Used:	1	

SJ Fiectric (Qld) Pty. Ltd.

FACTORY ACCEPTANCE TEST SHEET 5:

PROJECT:

Bracken Ridge Pump Stations

Client:

Hornick Constructions

Job No.

J07002

Equipment:

SPS 296 Switchboard

Section:

Pump No. 2

Drawing:

486/5/7-NW074 Amend 0

	Process Operation	Reference/ Acceptance Criteria	·
1.	Ensure Insulation test as per QA3CH-15 have been completed	SJ QA3CH-15 AS 3000 Insulation resistance greater than 1 megohm ph to earth Hi pot test 2.5 kv ph-eth for 1 minute	h. A
2.	Ensure Checks 1 to 11 as per QA3CH-020 have been completed	SJ QA3CH-020 Point to Point check of schematics. Visual Check of wiring.	1000
3.	Check voltage is available on line side of motor circuit breaker 2F3.	Drawing 486/5/7-NW074 415 vac ph to ph	13 (12)
4.	Ensure control circuit breaker 2F4 is "OFF" and emergency stop is operated, close circuit breaker 2F3 and confirm voltage is available on line side of circuit breaker 2F3.	Drawing 486/5/7-NW074 415 vac ph to ph	
5.	Check voltage is available on line side of control circuit breaker 2F4, close circuit breaker and ensure: 1 K1 Control Supply Relay is operating correctly. Voltage is available to 2K5 and 2K6.	Drawing 486/5/7-NW074 240 vac ph to n	
6.	Release emergency stop and confirm operation of isolating contactor 2K2 and confirm voltage is available to VSD.	Drawing 486/5/7-NW074 415 vac ph to ph	

SJ Electric (Qld) Pty. Ltd.

7.	Confirm operation of Pump 2 Digital Inputs.	Drawing 486/5/7-NW074	
8.	Confirm Operation of Pump 2 Digital Outputs	Drawing 486/5/7-NW074	
9.	Confirm Operation of Pump 2 Analog I/O	Drawing 486/5/7-NW074	

Tests Completed By	Witnessed By	Accepted By	(Da)
Date	Date	Data 10	1/22
Comments:	Date	Date (D)	4031
Instruments Used:			

FACTORY ACCEPTANCE TEST SHEET 4:

PROJECT:

Bracken Ridge Pump Stations

Client:

Hornick Constructions

Job No.

J07002

Equipment:

SPS 296 Switchboard

Section:

Pump No. 1

Drawing:

486/5/7-NW073 Amend 0

	Process Operation	Reference/ Acceptance Criteria	Passed	Date
1.	Ensure Insulation test as per QA3CH-15 have been completed	SJ QA3CH-15 AS 3000 Insulation resistance greater than 1 megohm ph to earth Hi pot test 2.5 kv ph-eth for 1 minute		RAP
2.	Ensure Checks 1 to 11 as per QA3CH-020 have been completed	SJ QA3CH-020 Point to Point check of schematics. Visual Check of wiring.		10/12
3.	Check voltage is available on line side of motor circuit breaker 1F3.	Drawing 486/5/7-NW073 415 vac ph to ph		
4.	Ensure control circuit breaker 1F4 is "OFF" and emergency stop is operated, close circuit breaker 1F3 and confirm voltage is available on line side of circuit breaker 1F3.	Drawing 486/5/7-NW073 415 vac ph to ph		
5.	Check voltage is available on line side of control circuit breaker 1F4, close circuit breaker and ensure: 1 K1 Control Supply Relay is operating correctly. Voltage is available to 1K5 and 1K6.	Drawing 486/5/7-NW073 240 vac ph to n		
6.	Release emergency stop and confirm operation of isolating contactor 1K2 and confirm voltage is available to VSD.	Drawing 486/5/7-NW073 415 vac ph to ph		

7.	Confirm operation of Pump 1 Digital Inputs.	Drawing 486/5/7-NW073	
8.	Confirm Operation of Pump 1 Digital Outputs	Drawing 486/5/7-NW073	
9.	Confirm Operation of Pump 1 Analog I/O	Drawing 486/5/7-NW073	

Tests Completed By	Witnessed By	Accepted By
		76/19/23
Date	Date	Date Date
Comments:		
Instruments Used:		

FACTORY ACCEPTANCE TEST SHEET 3:

PROJECT:

Bracken Ridge Pump Stations

Client:

Hornick Constructions

Job No.

J07002

Equipment:

SPS 296 Switchboard

Section:

PLC/RTU Connection

Drawing:

486/5/7-NW077 Amend 0

	Process Operation	Reference/ Acceptance Criteria	Passed	Date
1.	Ensure Insulation test as per QA3CH-15 have been completed	SJ QA3CH-15 AS 3000 Insulation resistance greater than 1 megohm ph to earth Hi pot test 2.5 kv ph-eth for 1 minute		le Co
2.	Ensure Checks 1 to 11 as per QA3CH-020 have been completed	SJ QA3CH-020 Point to Point check of schematics. Visual Check of wiring.		
3.	Ensure Laptop GPO, PLC and Flowmeter circuit breakers are "OFF" and operate RTU circuit breaker on DB Chassis and ensure: RTU Power Supplies are operating correctly.	Drawing 486/5/7-NW077 240 vac ph to n on power supply input. 24 vdc on power supply output		
4.	Close Laptop GPO Circuit Breaker and: Check GPO polarity. Check GPO switch is functioning. Check operation of RCD device.	Drawing 486/5/7-NW077		
5.	Close Flowmeter circuit breaker and ensure transmitter power is correct.	Drawing 486/5/7-NW077 240 vac to transmitter aux power terminals		
6.	Close PLC circuit breaker and ensure PLC power supply is functioning correctly.	Drawing 486/5/7-NW077 240 vac to PLC aux power terminals		,

7.	Confirm operation of door switches.	Drawing 486/5/7-NW077	6

Comments:	59
Instruments Used:	
Instruments Used:	
Instruments Used:	

FACTORY ACCEPTANCE TEST SHEET 2:

PROJECT:

Bracken Ridge Pump Stations

Client:

Hornick Constructions

Job No.

J07002

Equipment:

SPS 296 Switchboard

Section:

DB

Drawing:

486/5/7-NW076 Amend 0

	Process Operation	Reference/ Acceptance Criteria	Passed	Date
1.	Ensure Insulation test as per QA3CH-15 have been completed	SJ QA3CH-15 AS 3000 Insulation resistance greater than 1 megohm ph to earth Hi pot test 2.5 kv ph-eth for 1 minute		Mila
2.	Ensure Checks 1 to 11 as per QA3CH-020 have been completed	SJ QA3CH-020 Point to Point check of schematics. Visual Check of wiring.		
3.	Ensure all distribution circuit breakers are "OFF" and operate circuit breaker 4Q1 and confirm voltage is available to distribution chassis.	Drawing 486/5/7-NW076 415 vac ph to ph. 240 vac ph to n 240 vac ph to eth		
4.	Confirm Operation of Bay Well Flooded Alarm relay by simulating level probes.	Drawing 486/5/7-NW076		

Tests Completed By	Witnessed By	Accepted	By More	MARU
Date	Date	Date	10/12/	02
Comments:				
Instruments Used:				
mstraments osea.				

Page 582 of 622



QUALITY PLAN: J07002 CHECK LIST NO: QA3CH - 015 ISSUE NO: 3 PAGE 1 OF 1

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

CUSTOMER: Hornick Constructions

PROJECT: Bracken Ridge Sewerage Pump Station

CONTRACT NO:BW.30077-02/03

	8P296 DN/AREA:	TYPE: 🗡	PT: MELGER 10175U 0: 50308	S2.
ITEM NO	ACTIVITY DESCRIPTION		CHECKED (TICK)	Comment
1 2 3 4 5 6 7 8 9	Note: 1. 500v applied prior to 2.5kv 2. Ensure all electronics are disconnect to testing Rated insulation voltage Disconnect control circuits and all electronics Insulation test - volts Insulation test - Red to White. Insulation test - Red to Blue. Insulation test - Blue to White Insulation test - Red to Earth. Insulation test - Red to Neutral. Insulation test - White to Earth. Insulation test - White to Neutral.	ted prior	V V X X X X X X X X X X X X X X X X X X	8 8 8 8 8 8 8 8
	·			∞
11	Insulation test - Blue to Earth.	٠.		∞
13	Insulation test - Blue to Neutral. 2.5 KV Insulation test - Earth to Neutral with MEN dis	connected.		
∥ SIGNAT	ED BY: PETEL CLUST / APPROV URE: PLT DATE: 8/12/03 SIGNATURICAL LICENCE NO: \$2 74		DATE:	

All the above signatories certify that the Electrical switchboard work listed has been checked and tested in accordance with the prescribed procedure and that such work complies in every respect with the requirements of the Electricity Act 1994, AS3000 1991 and AS3008.1 1989.

FACTORY ACCEPTANCE TEST SHEET 1:

PROJECT:

Bracken Ridge Pump Stations

Client:

Hornick Constructions

Job No.

J07002

Equipment:

SPS 296 Switchboard

Section:

Incomer

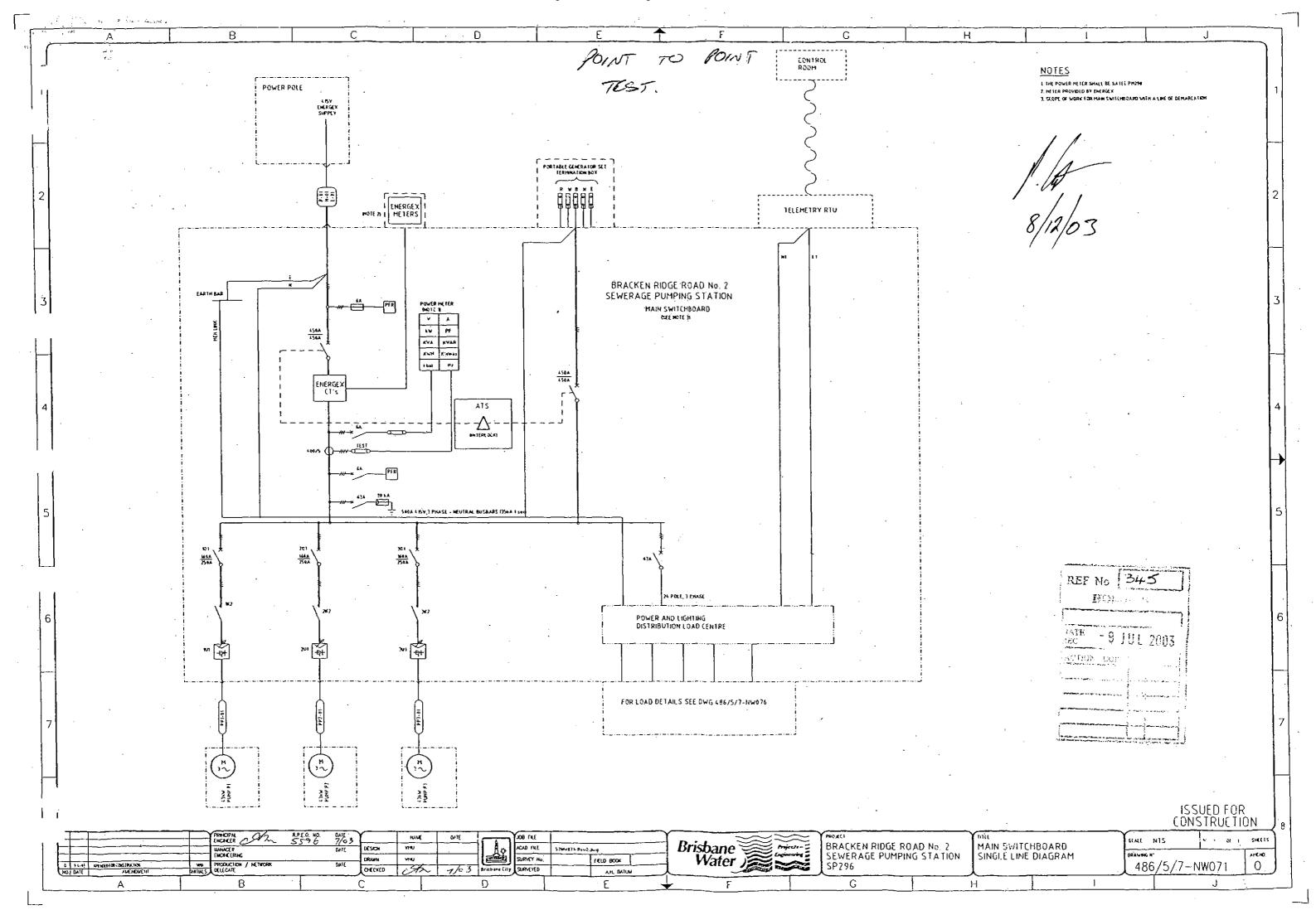
Drawing:

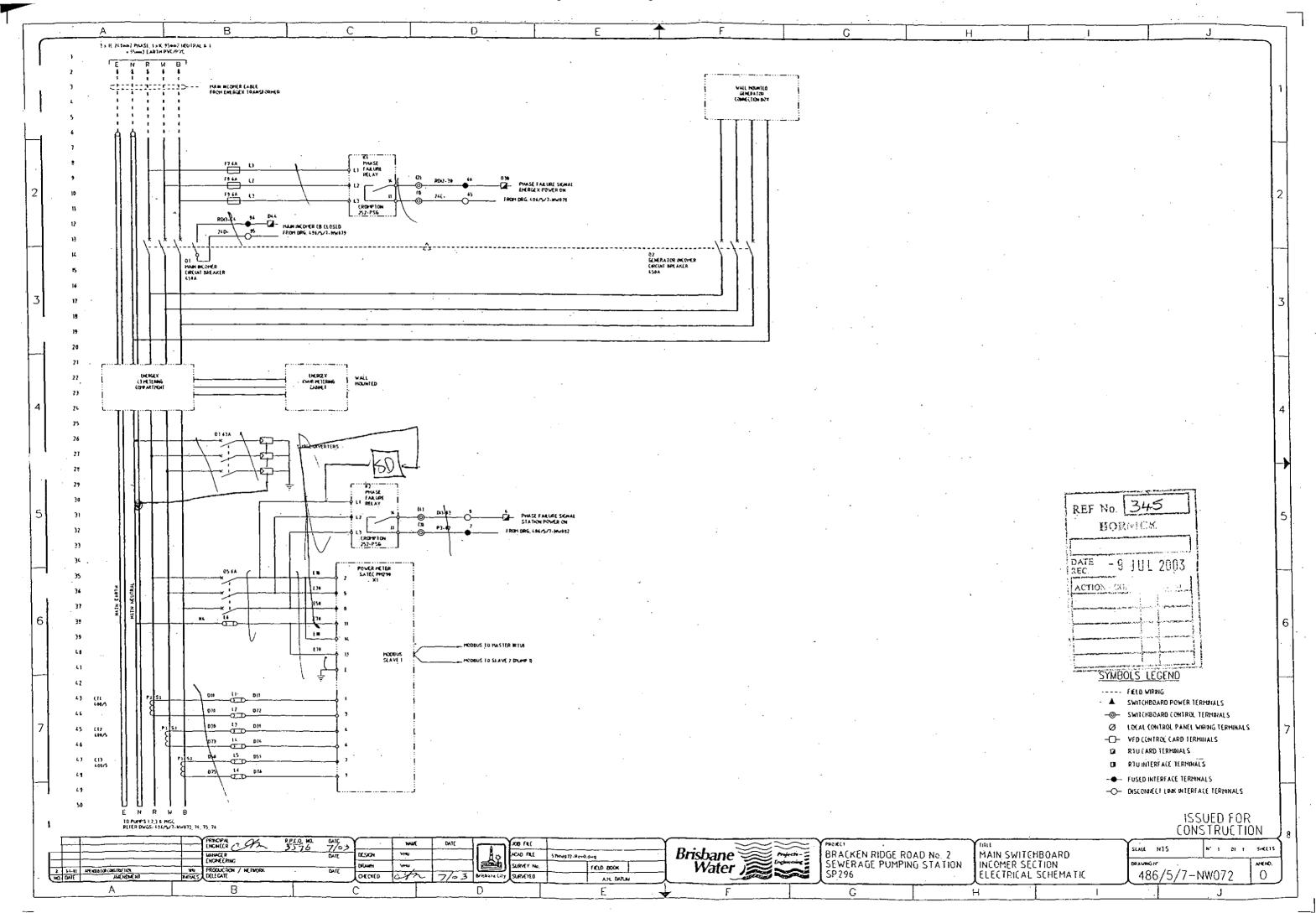
486/5/7-NW072 Amend 0

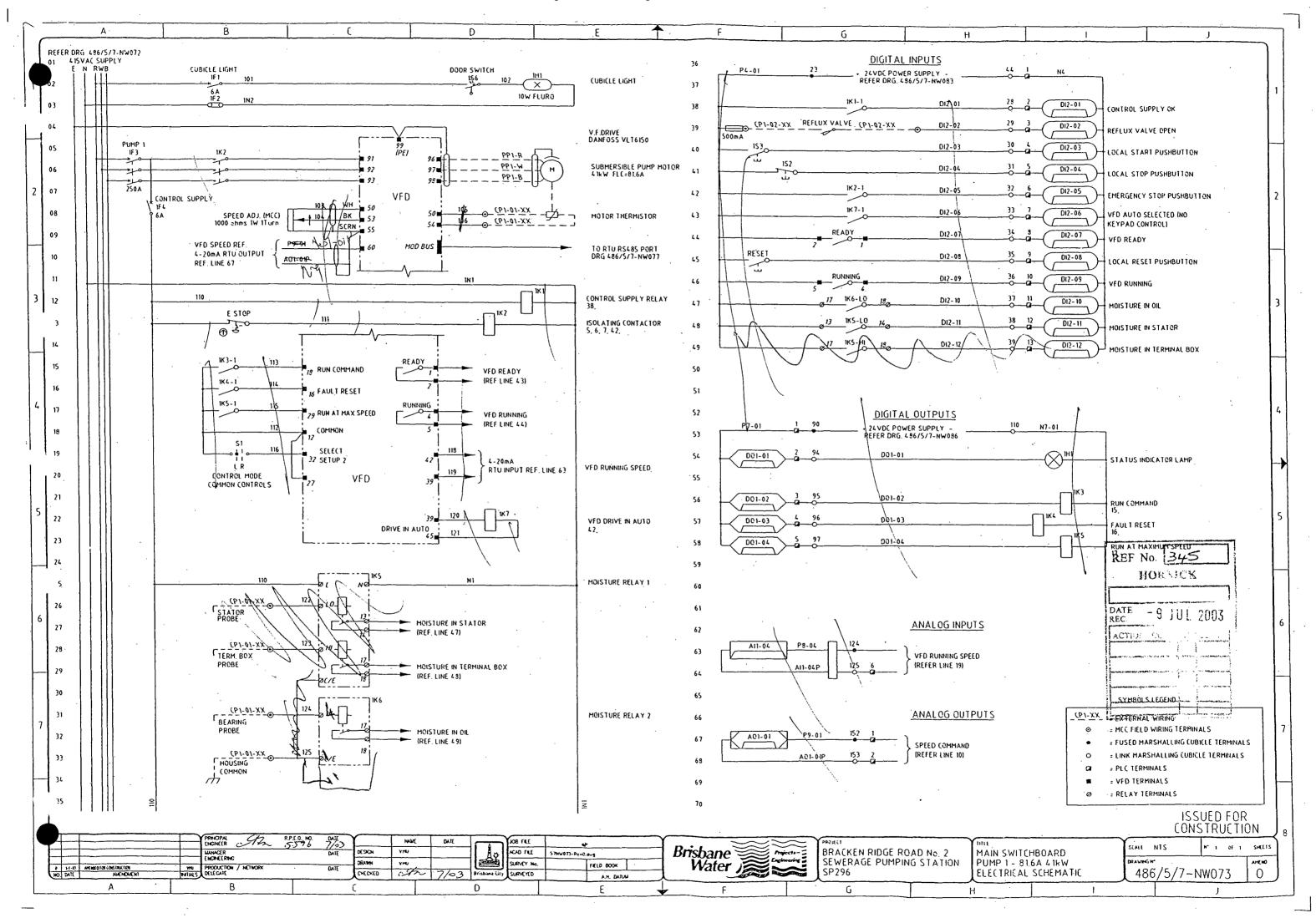
	Process Operation	Reference/ Acceptance Criteria	Passed	Date
1.	Ensure Insulation test as per QA3CH-15 have been completed	SJ QA3CH-15 AS 3000 Insulation resistance greater than 1 megohm ph to earth Hi pot test 2.5 kv ph-eth for 1 minute		JAN 121
2.	Ensure Checks 1 to 11 as per QA3CH-020 have been completed	SJ QA3CH-020 Point to Point check of schematics. Visual Check of wiring.		101
3.	Check Incomer and Generator circuit breaker mechanical interlock is functioning.	Drawing 486/5/7-NW072		
4.	Check operation of Energex Power On phase failure relay K1 and correct signal is being received by RTU	Drawing 486/5/7-NW072 Remove one phase from relay sensing circuit to simulate loss of power.		
5.	Check operation of Main Incomer circuit breaker auxiliary switch and correct signal is being received by RTU.	Drawing 486/5/7-NW072		
6.	Check operation of Station Power On phase failure relay K2 and correct signal is being received by RTO ALC	Drawing 486/5/7-NW072 Remove one phase from relay sensing circuit to simulate loss of power.		
7.	Check correct voltage is being received at Power Monitor voltage terminals and ensure power monitor readout is functioning correctly. Note further programming of this unit will be required.	Drawing 486/5/7-NW072 415 VAC to Voltage sensing terminals. 240 VAC to Aux Power terminals.		

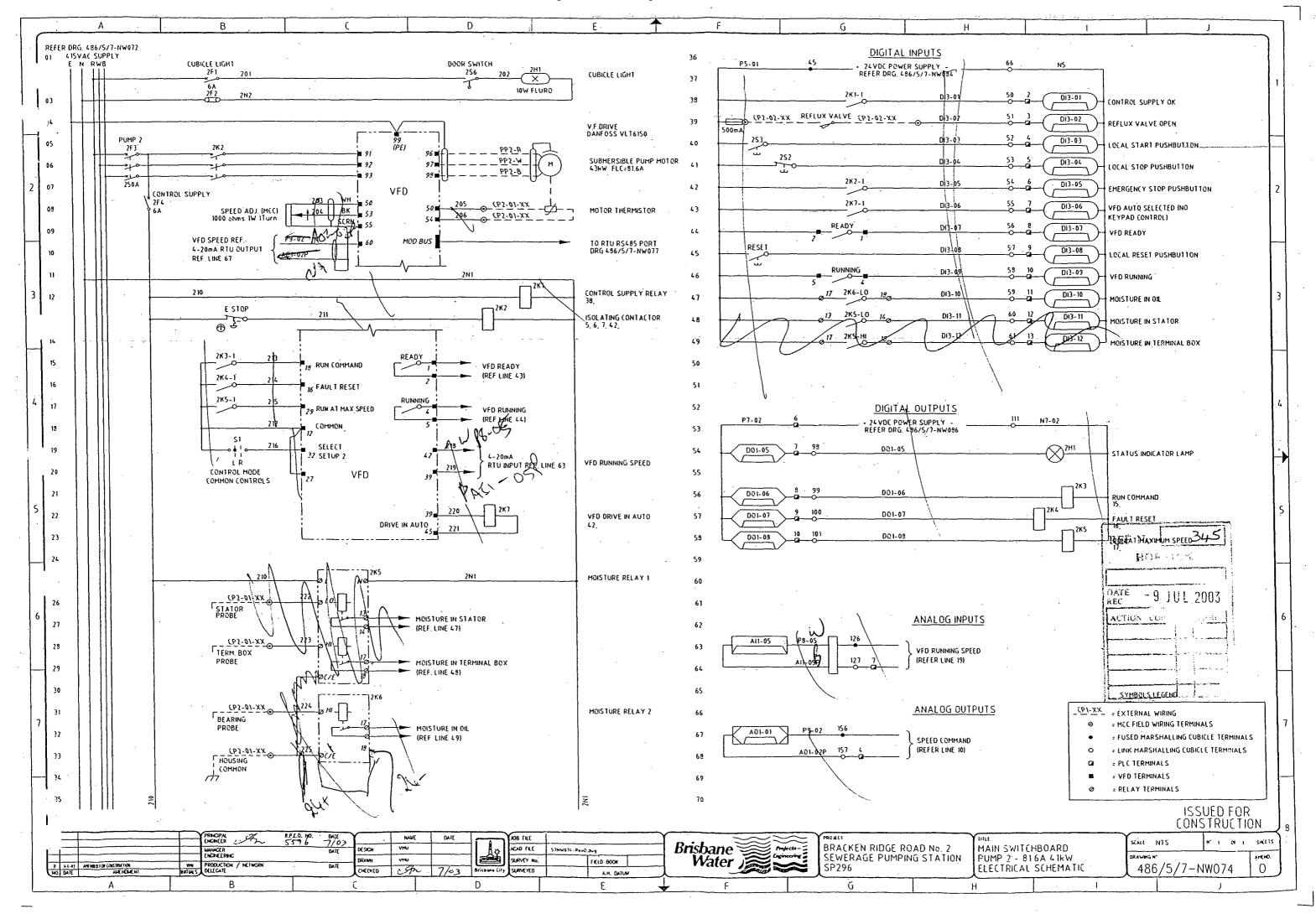
Tests Completed By	Witnessed By	Accepted By	
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Date	Date	Date 10/12/	
Comments:		7 7	
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Instruments Used:			
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FACTORY CEPTANCE TEST SHEET 1 SPS 296 IC - .doc

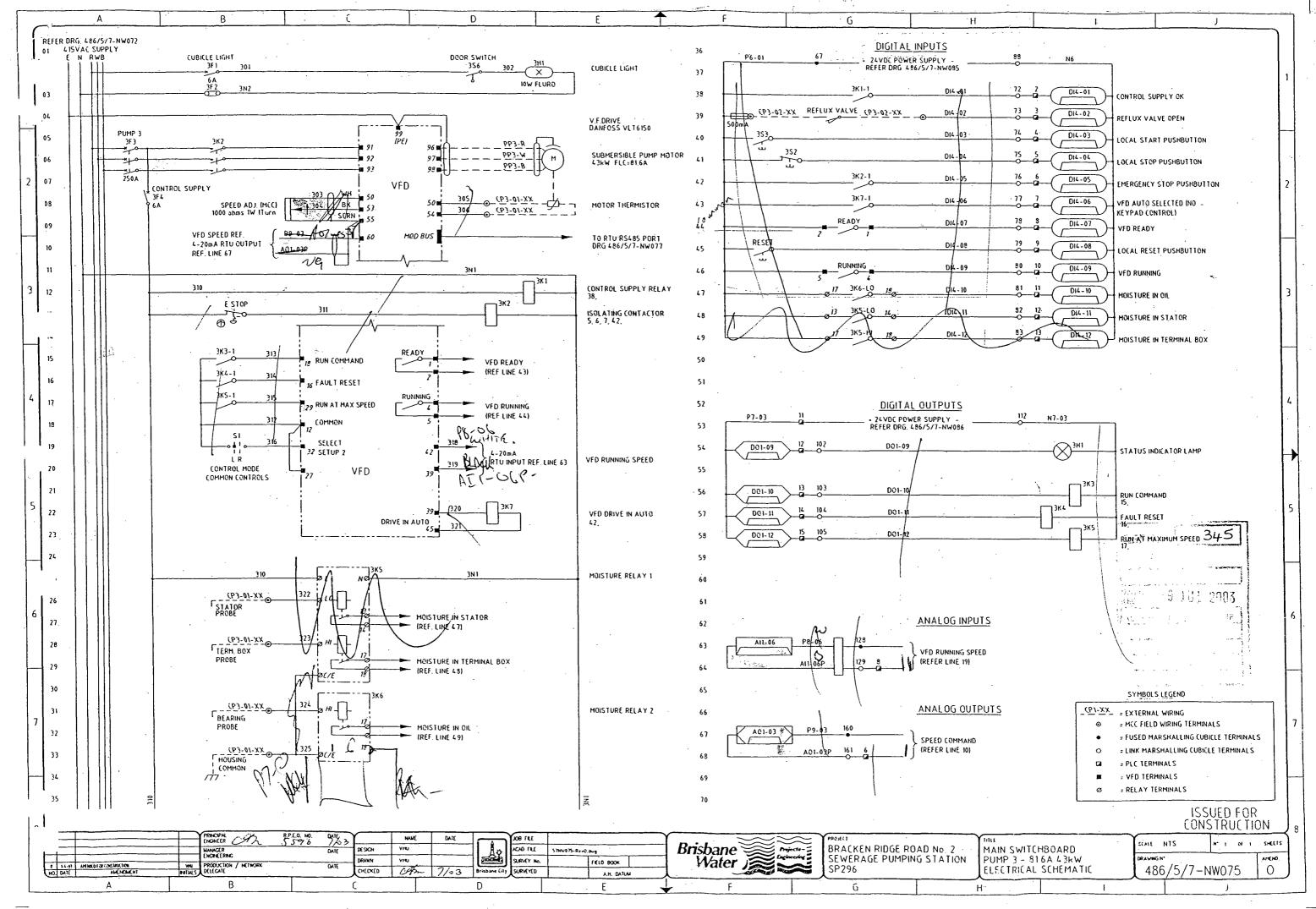


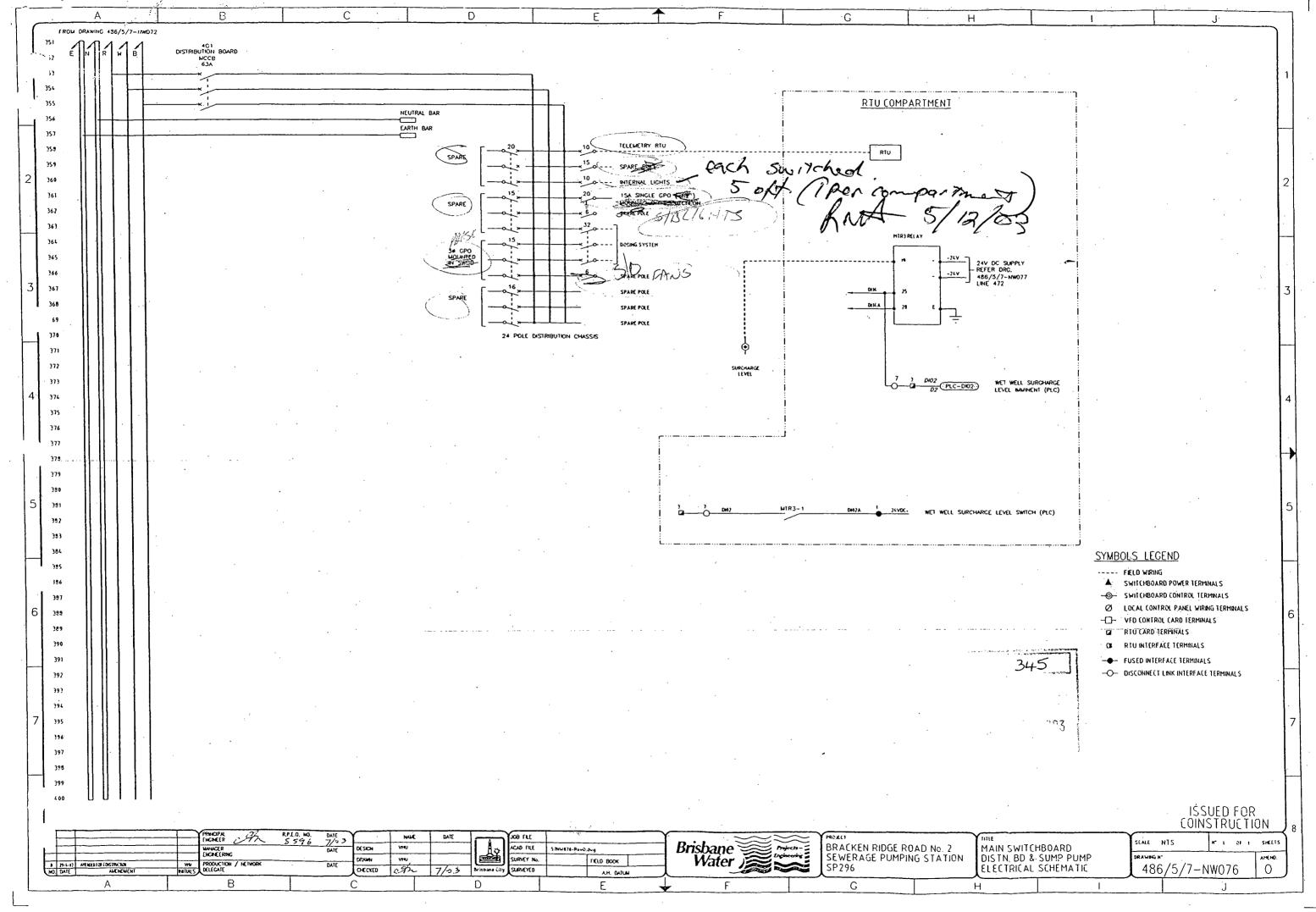


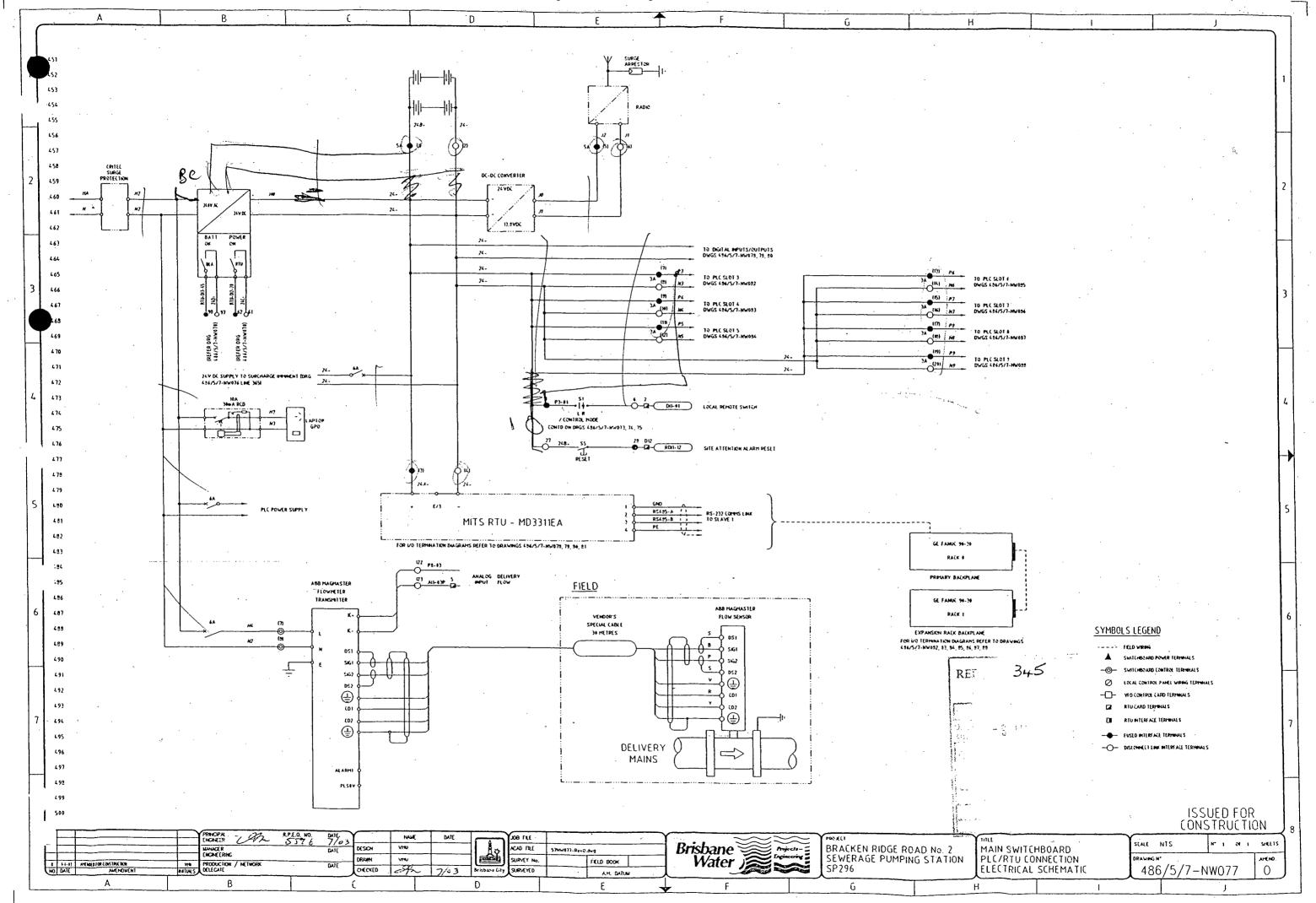




Active 10/12/2014







MAIN SWITCHBOARD RTU DIGITAL INPUT 1/2 TERMINATION DRAWING HT 486/5/7-NW078 Page 601 of 622

STALE NTS"

6 PC-63 NENGELOR GREATMENT ON ONE N

PRINCIPAL (NCHECH)

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CHECKED

MANACER .
[INCHEERING
PRODUCTION / NETWORK
DELECATE

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Brisbane Water

BRACKEN RIDGE ROAD No. 2 SEWERAGE PUMPING STATION SP296

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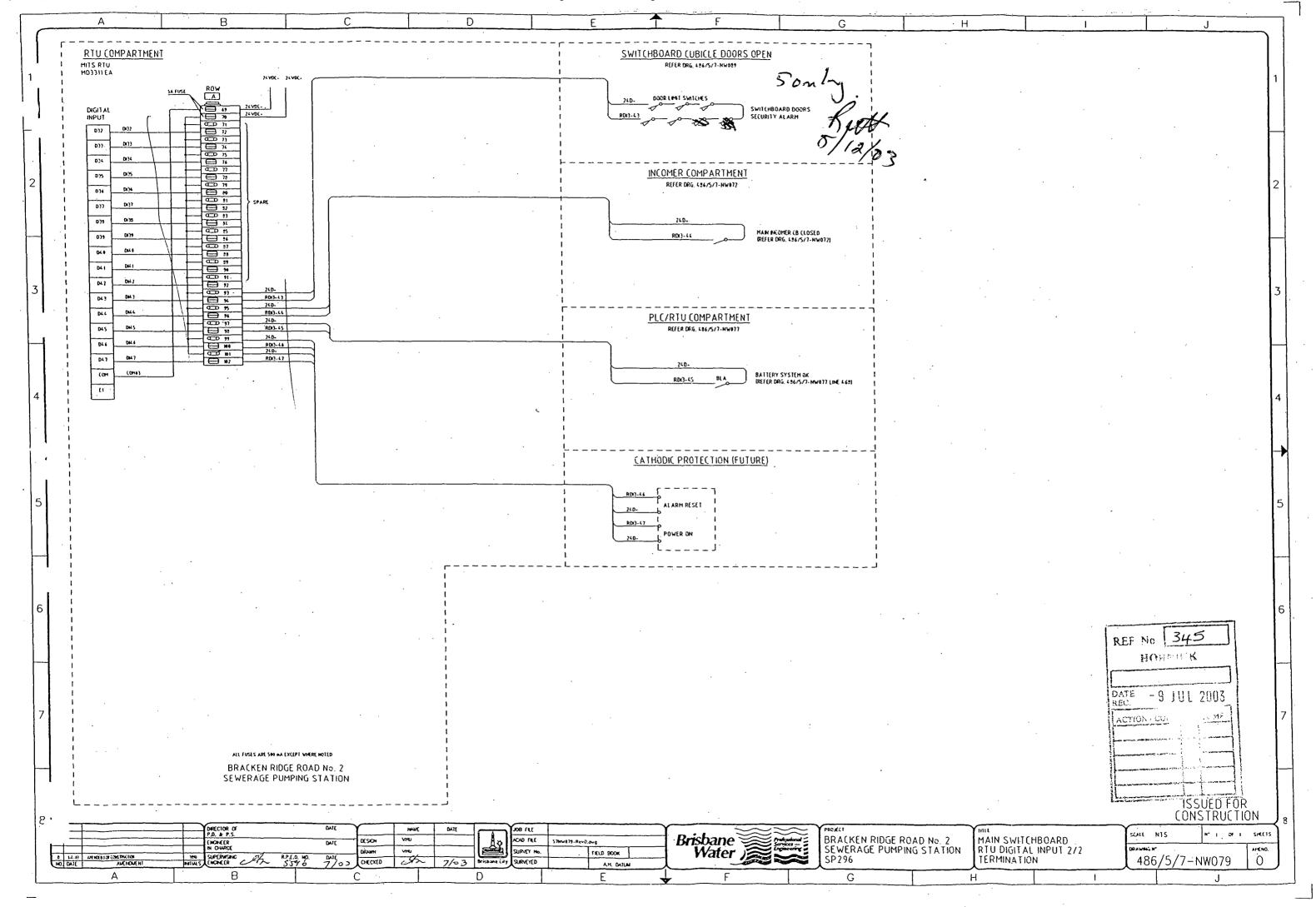
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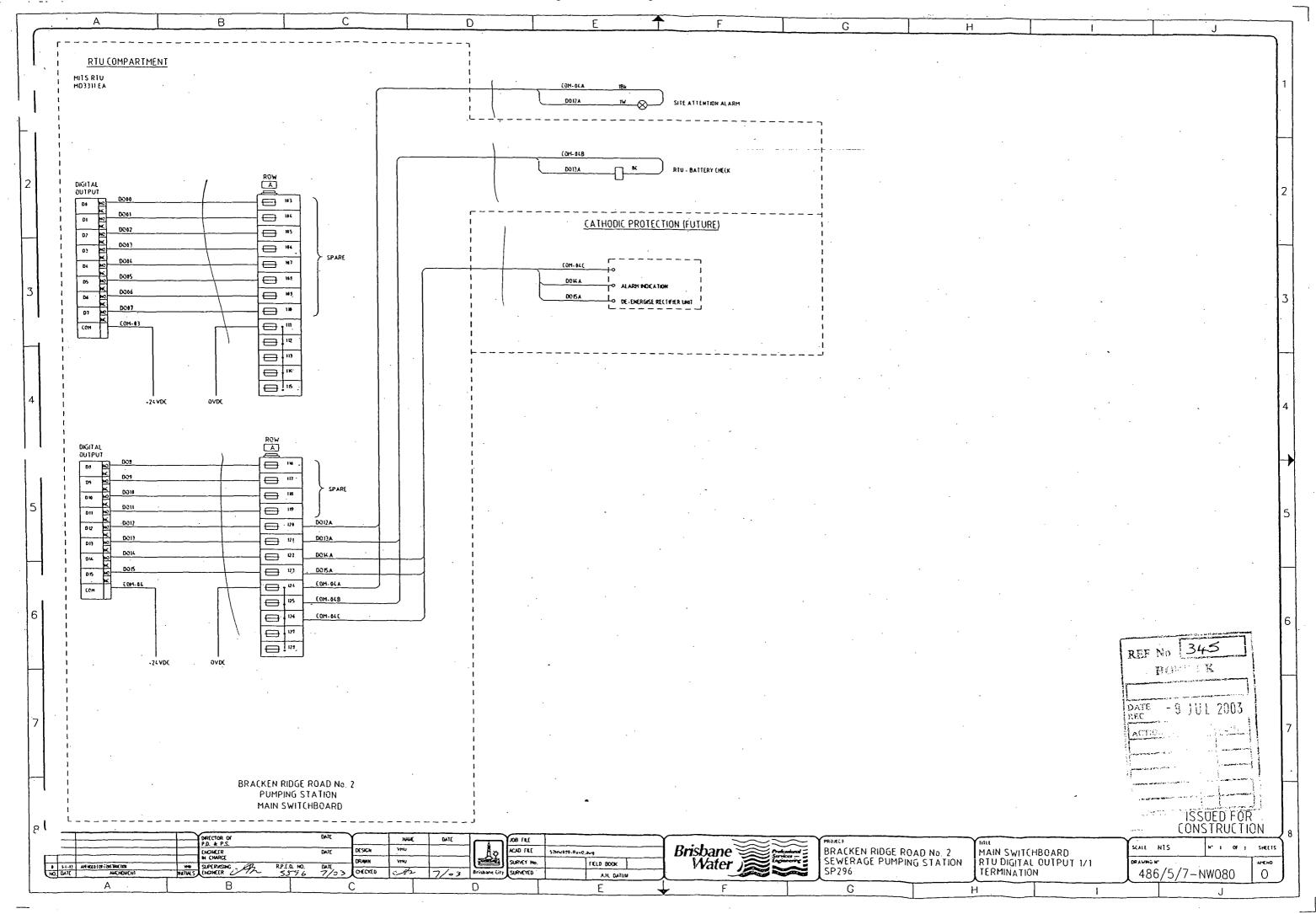
Brisbane City SURVEYED

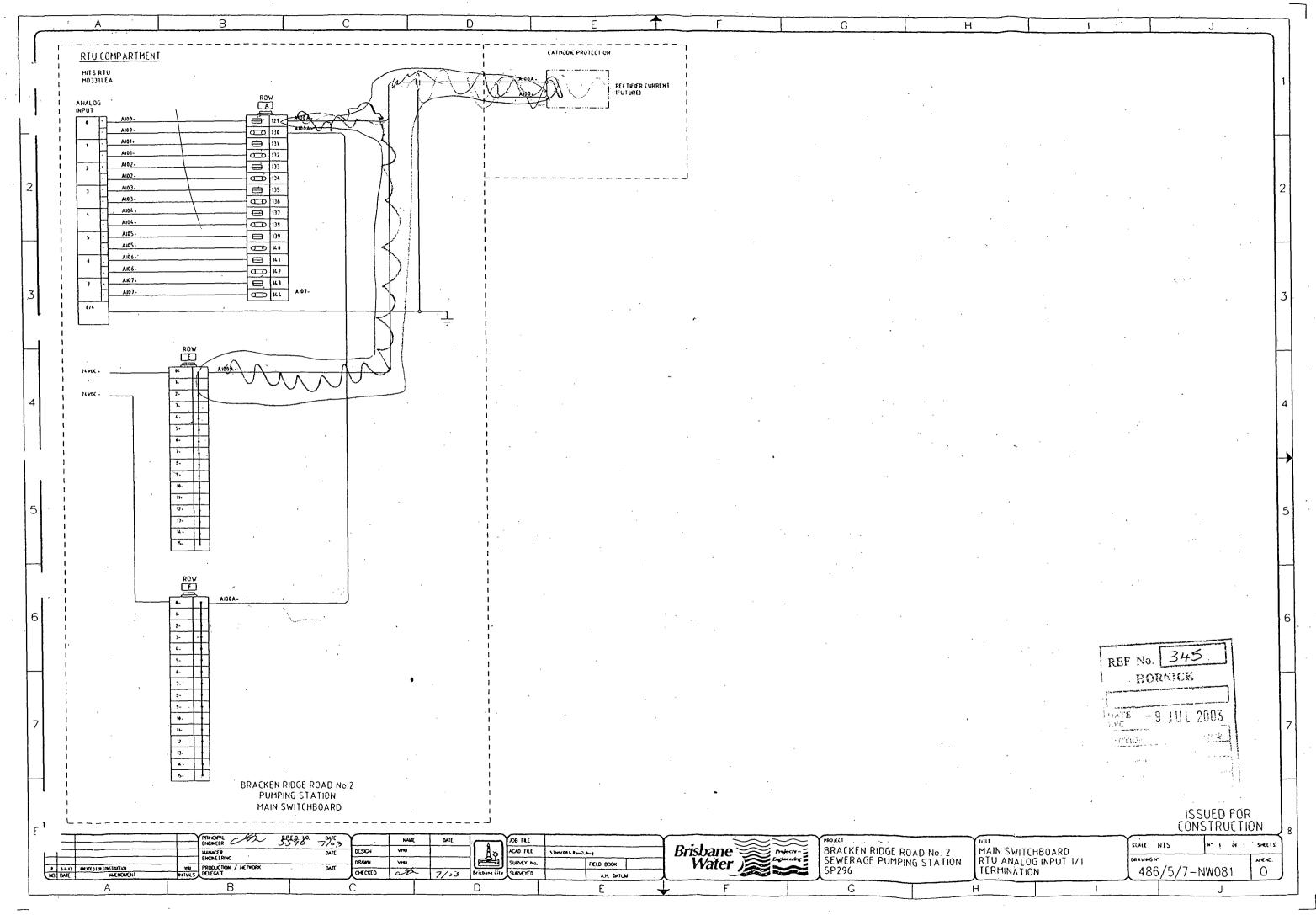
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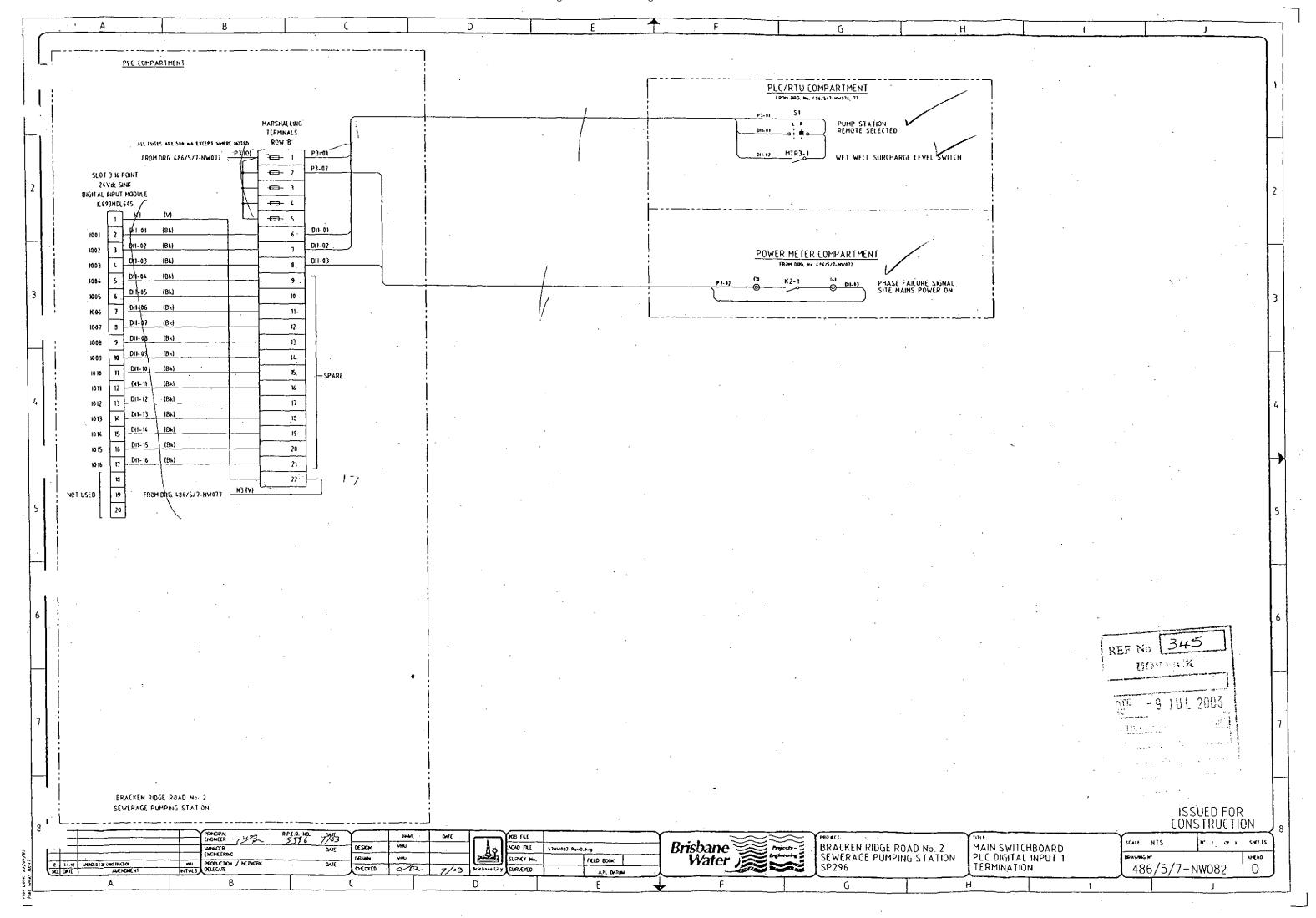
LETO BOOK

AH. DATUM









Q-Pulse Id TM\$1102

PRINCIPAL STA

DESIGN

DRAWN VMU CHECKED CF2 SURMEY No.

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LEFT BOOK

AH, DATUM

MANAGER
ENCHETRING

HILL PRODUCTION / NETWORK
MINUS DELECATE

Brisbane Water

BRACKEN RIDGE ROAD No. 2 SEWERAGE PUMPING STATION SP296

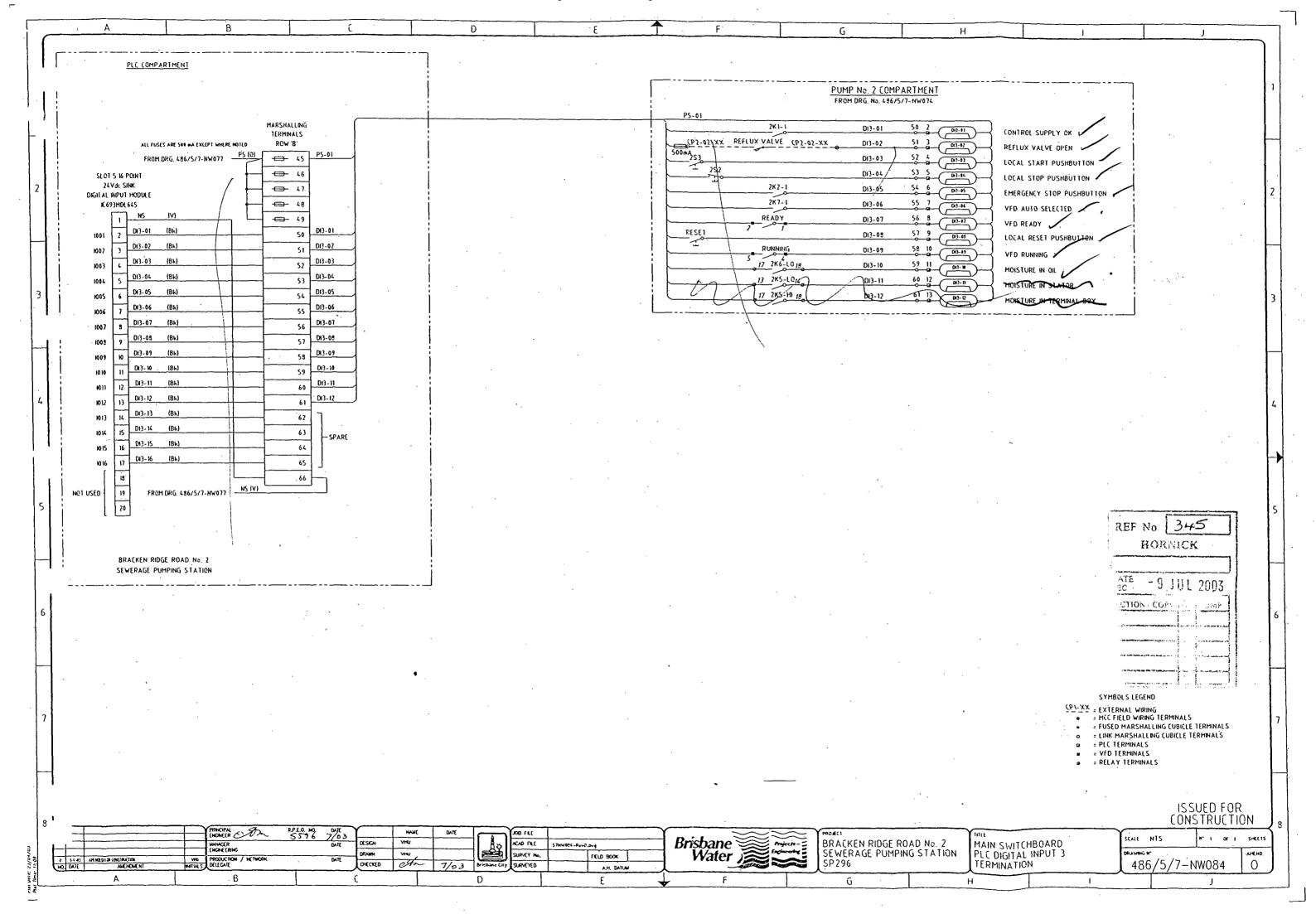
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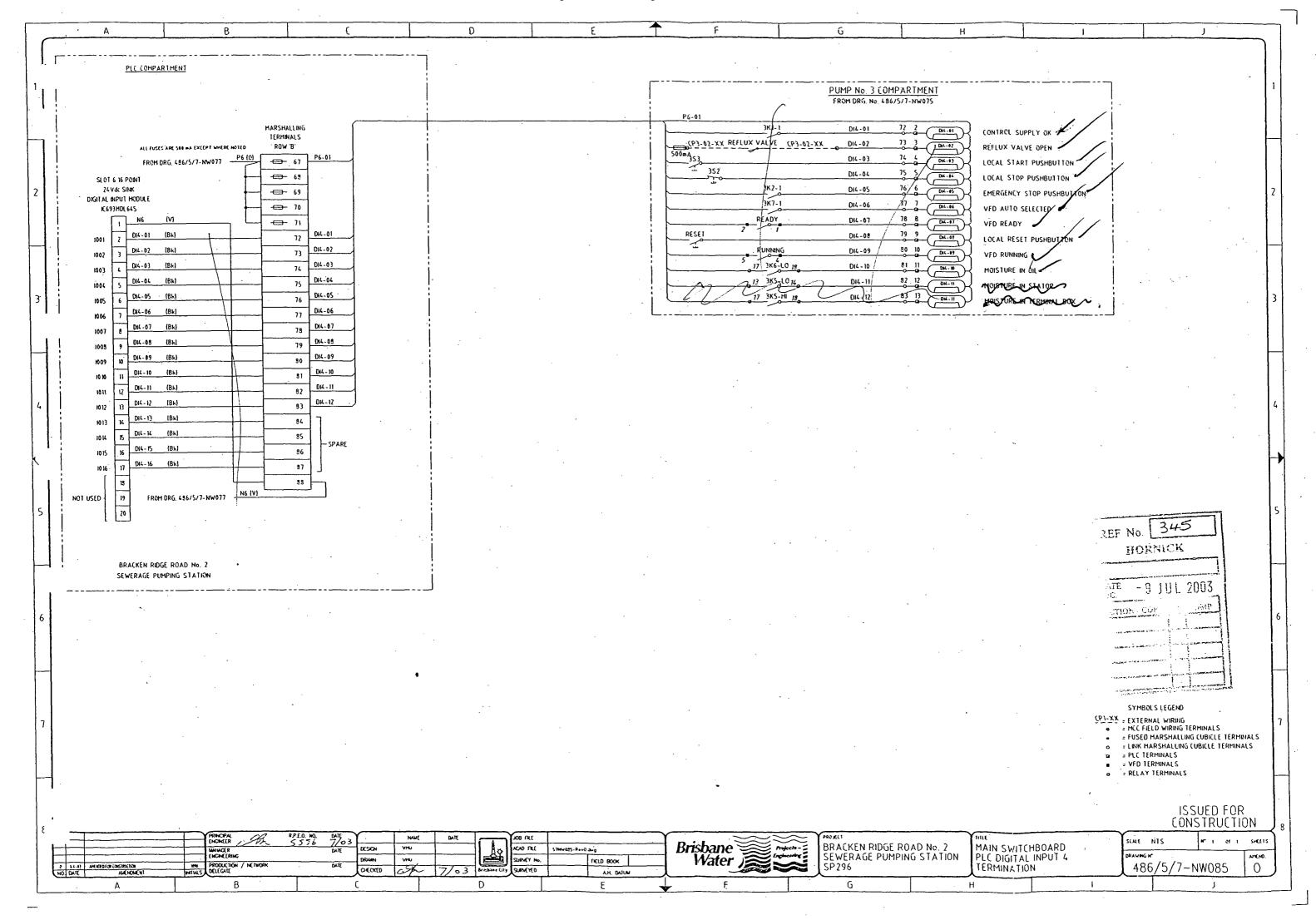
STALE NTS

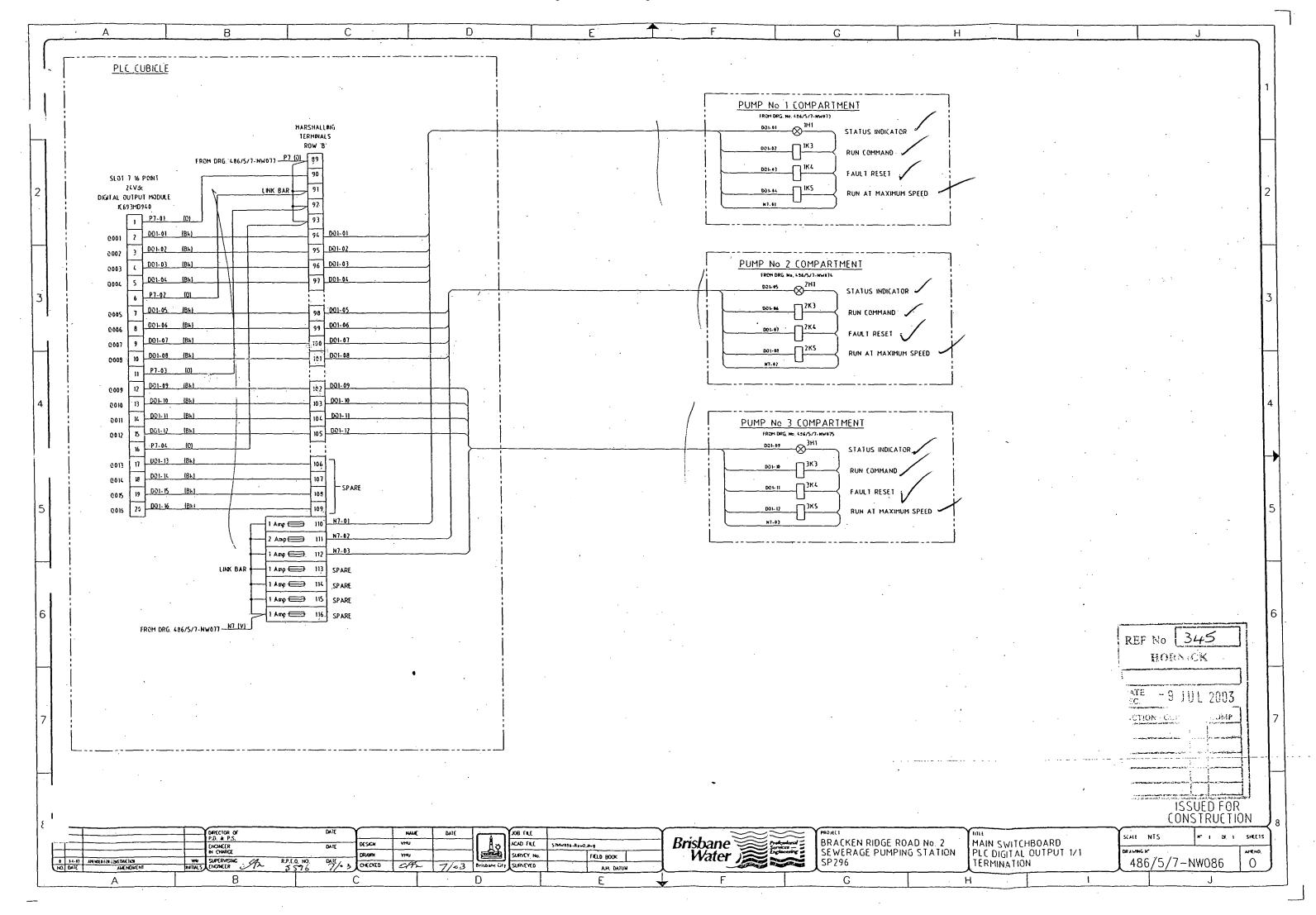
486/5/7-NW083

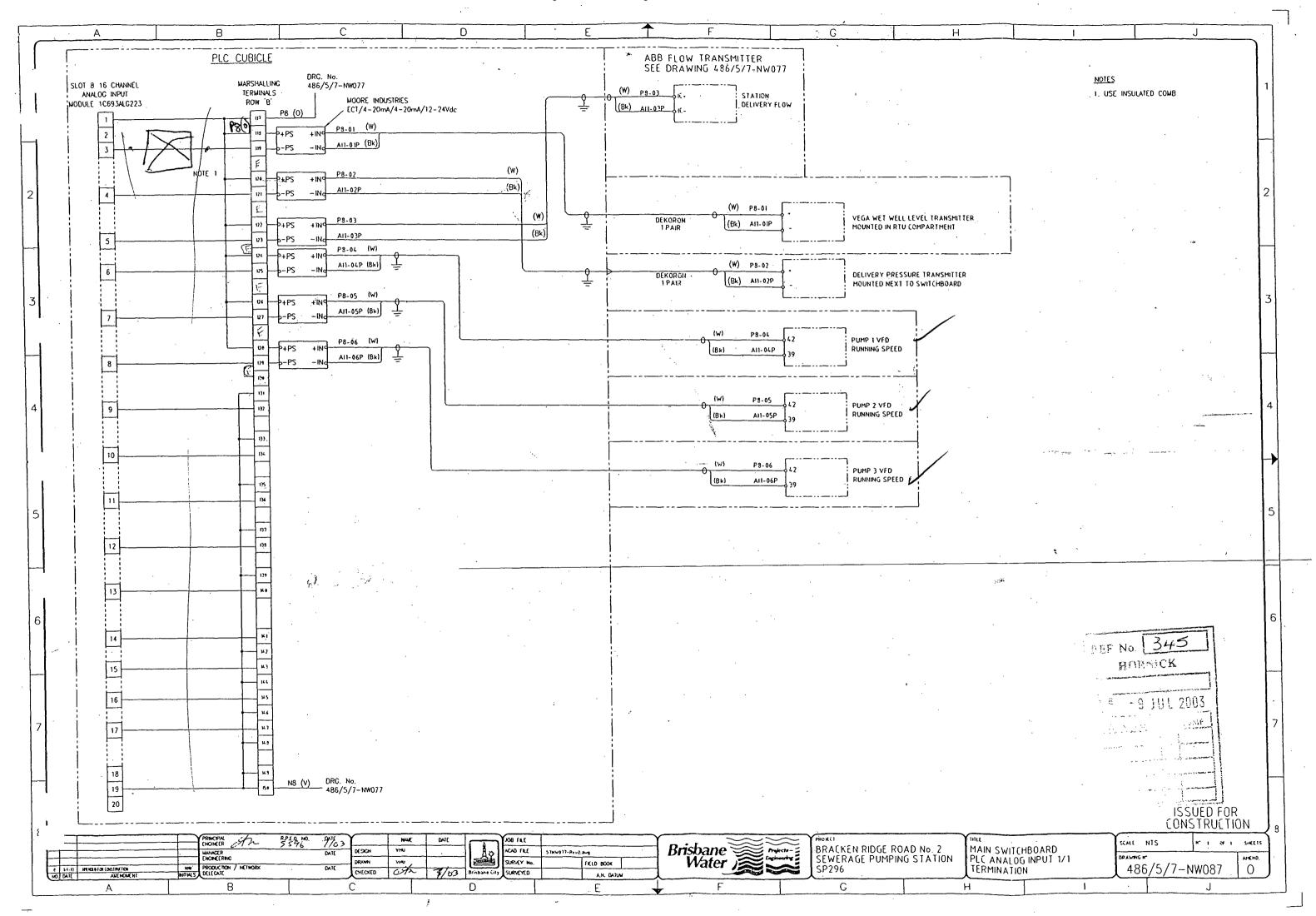
DRAWING N°

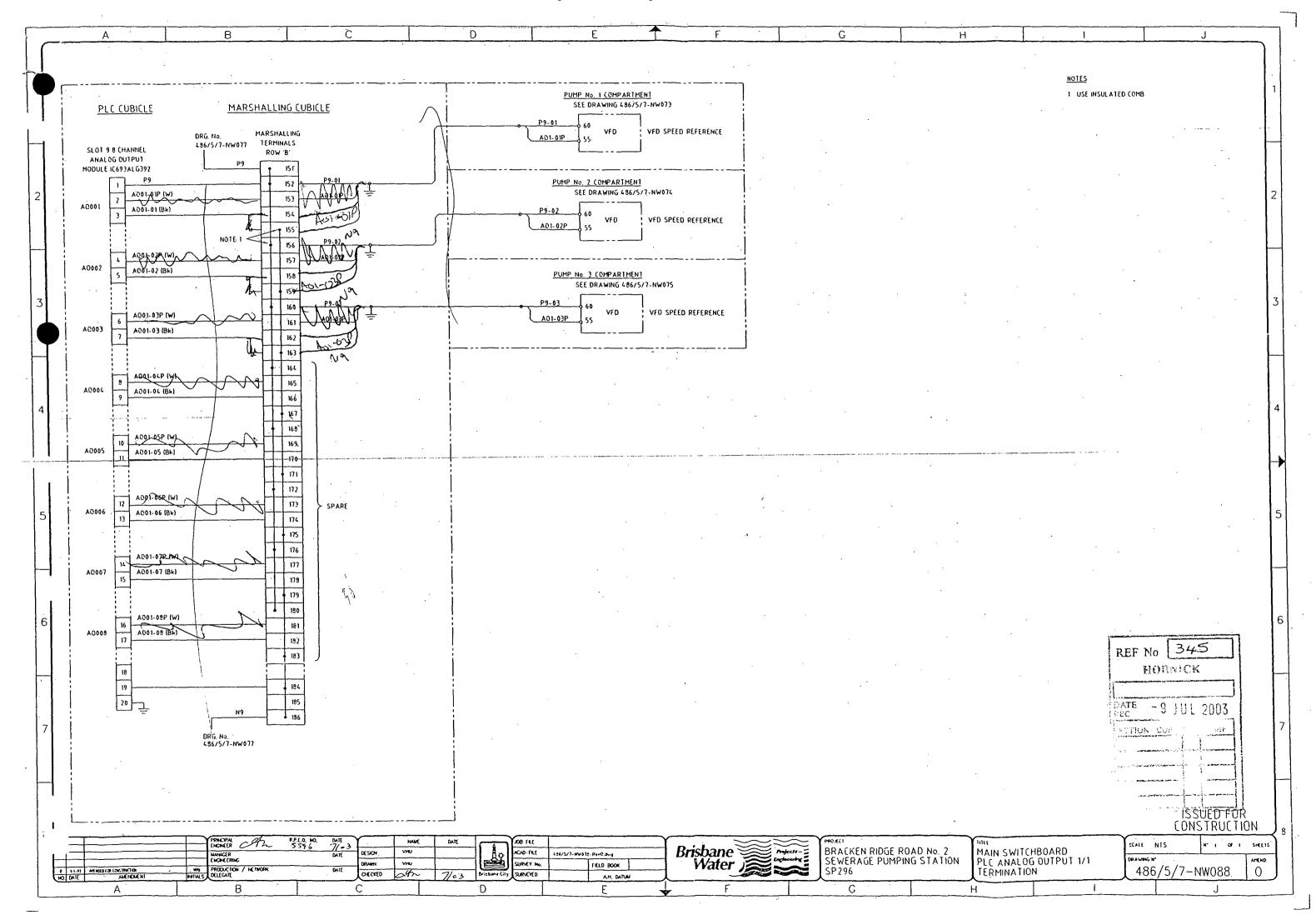
MAIN SWITCHBOARD PLC DIGITAL INPUT 2 TERMINATION

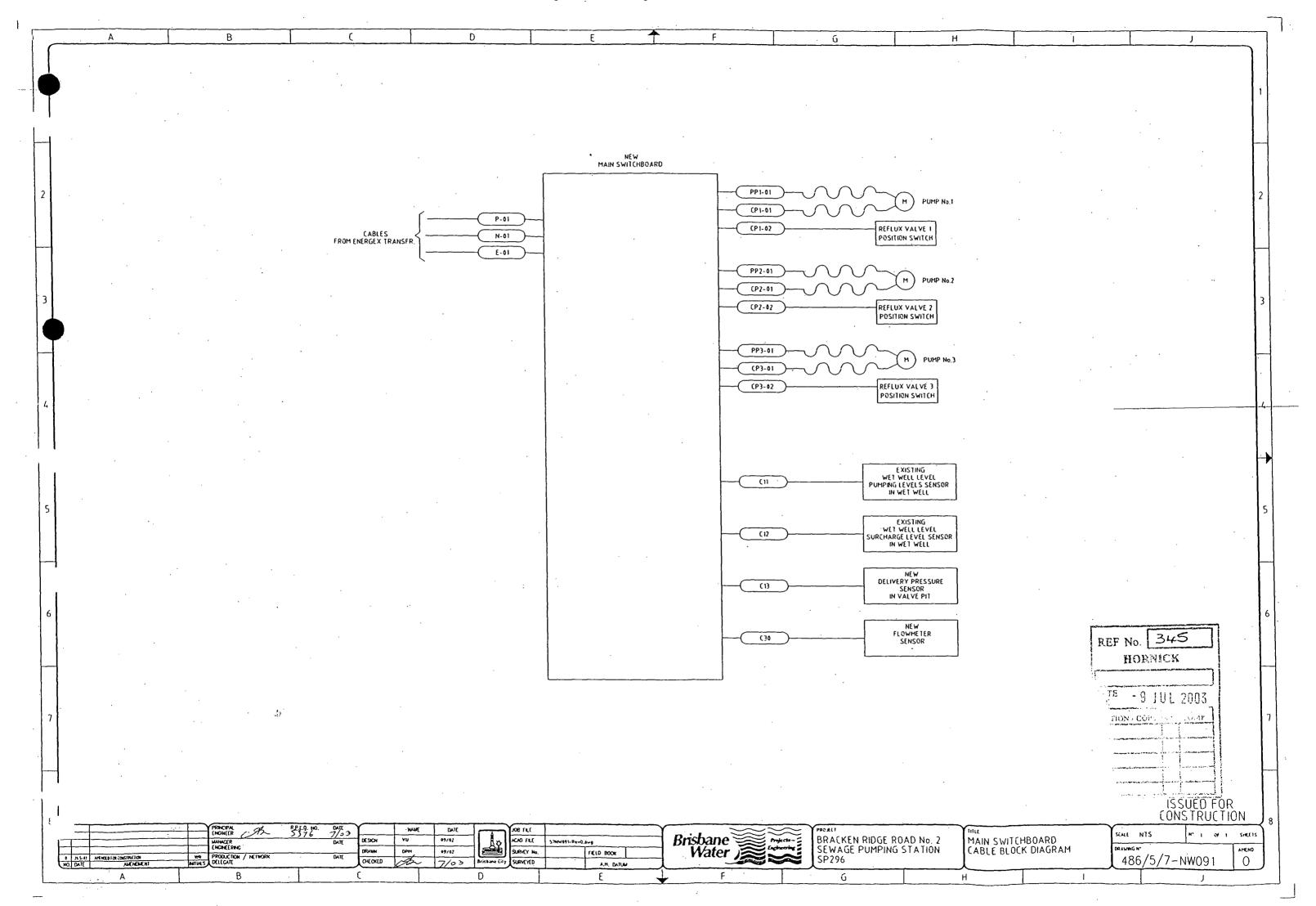












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