BRISBANE CITY COUNCIL

Sewage Pump Station SP117

Saltash St

Contract : **BW 70103-037**

Job Number : **WT400089**

ELECTRICAL INSTALLATION

OPERATIONS and MAINTENANCE MANUAL

VOLUME 1

INSTALLATION BY:

SJ Electric (Qld) Pty Ltd
19 Elliot Street
Albion Qld 4010

Telephone: 07 3256 1522 Fax: 07 3256 1533

INDEX

1. GENERAL

1.1 General Workplace Health and Safety

- The Workplace Health and Safety Act (1995) sets out the laws about Workplace Health and Safety for all workplaces, workplace activities and specified high risk plant. The Electrical Safety Act (2002) sets out the laws covering electrical safety. Nothing in this document is designed, in any way, to undermine the authority of the Acts.
- 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.
- 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.

1.2 Project Overview

Contract BW70103-037 was for the manufacture and testing of four (4) new pump station switchboards for various locations throughout Brisbane.

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

- Switchboards
- Instrumentation
- Civil Works

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.

1.3 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.

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 allows 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.
- Cubicle Fans Filter should be inspected and cleaned frequently.

1.4 Electrical Control System

General Description

The switchboards are manufactured from 3mm aluminium and are suitable for location outdoors; the switchboards have been designed by Brisbane Water and contain several separate sections including:

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

1.5 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.

2. MANUFACTURER'S TECHNICAL DATA

2. MANUFACTURER'S TECHNICAL DATA

TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type:	Circuit Breaker
Location:	Main Incomer Pump Circuit Breakers
Model Numbers:	XS400
Manufacturer:	Terasaki
Supplier:	NHP Pty Ltd 25 Turbo Drive Coorparoo QLD 4151 Ph: 07 3891 6008 Fx: 07 3891 6139

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TemBreak MCCBs

XS400 series thermal magnetic type

- Adjustment range 63 - 100 % of nominal current rating.
- Standards AS 2184/AS/NZS 3947-2.
- Adjustable thermal and magnetic trip.

XS400CJ (35 kA) 3 pole

Ampere rating	Min	Max	Cat. No.
250	160	250	XS400CJ 250 3
400	250	400	XS400CJ 400 3
400	Non-Auto (5 kA for 0.3 sec) [1])		Refer page 5 - 48

XS400CJ (35 kA) 4 pole

250	160	250	XS400CJ 250 4
400	250	400	XS400CJ 400 4

XS400NJ (50 kA) 3 pole

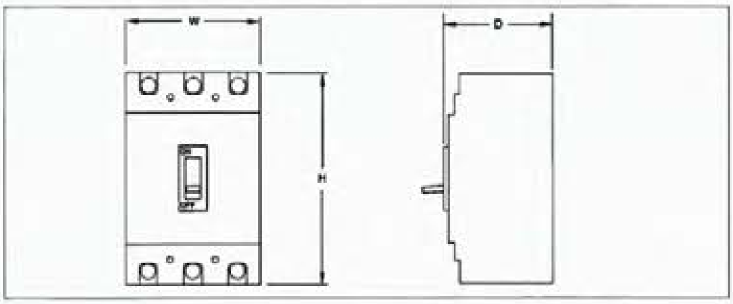
250	160	250	XS400NJ 250 3
400	250	450	XS400NJ 400 3

XS400NJ (50 kA) 4 pole

250	160	250	XS400NJ 250 4
400	250	400	XS400NJ 400 4

Dimensions (mm)

Description		Height	Width	Depth	kg
XS400CJ/NJ	3 pole	260	140	103	4.7
	4 pole	260	185	103	6.1



Notes: [1]) Load-break isolating switch only – no protection.
[2]) MCCBs only.
[3]) Poles in series. Refer applications Section 13.

Short circuit capacity

Model	I/C	Voltage
XS400CJ	35 kA (AS 2184)	415 V 50 Hz
XS400NJ	50 kA	415 V 50 Hz

DC use [3])	I/C	Voltage
XS400CJ	40 kA	250 V DC
XS400NJ	40 kA	250 V DC

Refer to ratings chart at the front of this section.
For ratings to AS/NZS 3947-2 and AS 2184, and Ics/Icu.

Cross reference table	Section
Accessories	6
Selectivity & cascade	13
Application data	13
Characteristic curves	7
Motor starting	13
Connection & mounting details	7 and 8
Detailed dimen. - MCCB only	7
- motor operators	7

Product extensions	Section
Chassis (TemWay, MHC, UHC)	6
TemCurve	13
Residual current relays	11

Base standards	Approvals
IEC 60947-2	ASTA/UK, Aust. standards
BS EN 60947 Part 2	**Marine**
VDE 0660 Part 1	NK/JAPAN
AS/NZS 3947-2/Aust./NZ	Lloyds R/UK
AS 2184-1990/Australia [2])	ABS/USA
JIS C 8372/JAPAN	GL/GERMANY
JEC 160/JAPAN	BV/FRANCE
	DNV NORWAY

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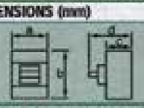
5

Standard TemBreak circuit breaker
Selection guide

Type		XM30PB		XS125CS		XS125CJ			XS125NS		XS125NJ		
Ampere frame		30A		125A					125A				
Number of poles		3P		1P *)	2P *) [i]	3P	4P [i]		1P *)	2P *)	3P	4P	
Outside view													
Rated current (A) In NRC – Nominal rated current; **ASR** – Adjustable setting range		NRC		NRC		NRC	ASR		NRC		NRC	ASR	
							min	max				min	max
Rated current at 40°C		0.7	8.0	16	50	20	12.5	20	16	50	20	12.5	20
		1.4	10	20	63	32	20	32	20	63	32	20	32
		2.0	12	25	80	50	32	50	25	80	50	32	50
		2.6		32	100	63	40	63	32	100	63	40	63
		4.0		40	125	100	63	100	40	125	100	63	100
		5.0				125	80	125			125	80	125
AC RATED INSULATION VOLTAGE (Ui)		690		690					690				
AC RATED BREAKING CAPACITY sym RMS (kA)													
IEC 60947-2 (Icu) IEC 60947-2 (Ics)	1100V	–		–					–				
AS/NZS 3947-2 (Icu) AS/NZS 3947-2(Ics)	1000V	–		–					–				
Note: Rated Impulse withstand voltage	690V	–		–					–		5/2.5		
Uimp (kV) is 8kV on all XS, XE and XH MCCB's	660V	–		–					–		5/2.5		
	500V	–		–		7.5/3.8			–		12/6		
	440V	85		10/5		10/5			22/11		22/11		
	415V	85		14/7		14/7			25/13		25/13		
	400V	85		18/9		18/9			25/13		25/13		
	380V	85		18/9		18/9			30/15		30/15		
	240V	125		14/7		25/13			25/13		25/13		
AS 2184	440V	85		14					25				
	415V	85		18					30				
NEMA AB-1	600V	85		–					–		12		
	480V	85		–		10			–		22		
without Inst.	240-690V	–		–					–				
DC RATED BREAKING	250V	–		–		10			–		15		
CAPACITY (kA)	125V	–		10		15			15		20		
RATED SHORT TIME CURRENT RMS (kA) (Icw)				–					–				
DIMENSIONS (mm)													
	a	78		30		90		120	30		90		120
	b	148		155					155				
	c	98		86					86				
	d	116		104					104				
Weight (kg) ◆ marked standard type		1.3		0.51		1.3		1.58	0.51		1.3		1.58
CONNECTION AND MOUNTINGS													
front connect (FC)	terminal screw	●		●					●				
	attached flat bar	–		–		○			–		○		
	solderless terminal (PWC)	○		○					○				
rear connect (RC)	bolt stud	○		–		○			–		○		
	flat bar stud	–		–					–				
plug-in (PM)	for switchboard	○		–		○			–		○		
	for distribution board	–		–		○			–		○		
draw-out (DO)		–		–					–				
STANDARD FEATURES													
	contact indicator	–		●					●				
	trip button	–		–		●			–		●		
PROTECTIVE FUNCTIONS													
Electronic type													
Adjustable LTD, STD & INST		–		–		–			–		–		
Adjustable GFT or Adjustable PTA (option)		–		–		–			–		–		
Trip indicators (option) (contacts)		–		–		–			–		–		
Thermal-magnetic type		fixed											
thermal and fixed magnetic trips		–		●		–			●		–		
thermal and adjustable magnetic trips		–		–					–				
adjustable thermal and fixed magnetic trips		–		–		●			–		●		
adjustable thermal and magnetic trips		–		–					–				
ACCESSORIES (option)	**CODE**												
Internally mounted auxiliary switch	AUX	●		–		●			–		●		
alarm switch	ALT	●		–		●			–		●		
shunt trip	SHT	●		●		●			●		●		
undervoltage trip	UVT	–		–		●			–		●		
Externally mounted motor operator	MOT	–		–		●			–		●		
external panel mounted type	XFE	–		–					–				
operating breaker mounted type	TFJ	●		–		●			–		●		
handle variable depth type	XFH	●		–		●			–		●		
IP 65 handle variable depth type	TLK	●		–		●			–		●		
extension handle		–		–					–				
mechanical interlock front type		●		–		●			–		●		
mechanical interlock rear type		–		–		●			–		●		
mechanical interlock cable type		–		–					–				
key interlock		●		–		●			●				
handle holder		●		●					●				
handle lock		●		●					●				
captive padlock attachment		–		●		●			●				
terminal cover front connect type		–		–		●			–		●		
terminal cover rear/plug-in type		–		–		●			–		●		
interpole barriers		–		–		●			–		●		
accessories lead terminals		●		–		●			–		●		
OCR sealing kit		–		–		●			–		●		

Notes:
*) 1 Pole breaker only. XS125CS and XS125NS respectively.
*) 2 pole breaker is a 3 pole breaker with the centre pole omitted.
● Supplied as standard. ○ Optional standard.
● Yes or available. – Not available
[i] Indent only

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Standard TemBreak circuit breaker
Selection guide

	XH125NJ	XE225NC	XS250NJ	XH250NJ	XS400CJ	XS400NJ
	125A	225A	250A	250A	400A	400A
	3P 4P	3P	3P 4P	3P 4P	3P 4P i	3P 4P i
						
	NRC ASR	NRC	NRC ASR	NRC ASR	NRC ASR	NRC ASR
	min max		min max	min max	min max	min max
	20 12.5 20	125 200	160 100 160	160 100 160	250 160 250	250 160 250
	32 20 32	150 250	250 160 250	250 160 250	400 250 400	400 250 400
	50 32 50	175				
	63 40 63					
	100 63 100					
	125 80 125					
	690	690	690	690	690	690
					ICU/ICS	ICU/ICS
	-	-	-	-	-	-
	-	-	-	-	-	-
	8/4	-	8/4	15/7.5	16/8	18/9
	8/4	-	8/4	15/7.5	16/8	18/9
	25/13	10/5	22/11	25/13	22/11	30/15
	42/21	15/7.5	25/13	42/21	30/15	42/12
	50/25	15/7.5	25/13	50/25	30/15	50/25
	50/25	18/9	25/13	50/25	35/18	50/25
	50/25	18/9	35/18	50/25	35/18	50/25
	85/43	25/13	50/25	85/43	50/25	85/43
	50	15	30	50	36	50
	50	18	35	50	36	50
	25	-	22	25	22	30
	42	15	25	42	30	42
	-	-	-	-	-	-
	40	10	40	40	40	40
	40	15	40	40	40	40
	-	-	-	-	-	-

	XH125NJ	XE225NC	XS250NJ	XH250NJ	XS400CJ	XS400NJ
	90 120	105	105 140	105 140	140 185	140 185
	155	165	165	165	260	260
	86	67	86	103	103	103
	104	82	107	124	131	131
	1.3 1.58	1.4	1.85 2.4	2.1 2.6	4.7 6.1	4.7 6.1

	XH125NJ	XE225NC	XS250NJ	XH250NJ	XS400CJ	XS400NJ
	◆	◆	◆	◆	◆	◆
	○	○ (Bar)	○ (Bar)	○ (Bar)	○ (Bar)	○ (Bar)
	○	○	○	○	○	○
	○	○	○	○	-	-
	-	-	-	-	○	○
	○	○	○	○	○	○
	-	-	-	-	-	-
	-	-	-	-	○	○

	XH125NJ	XE225NC	XS250NJ	XH250NJ	XS400CJ	XS400NJ
	●	●	●	●	●	●
	●	●	●	●	●	●

	XH125NJ	XE225NC	XS250NJ	XH250NJ	XS400CJ	XS400NJ
	-	-	-	-	-	-
	-	-	-	-	-	-
	-	-	-	-	-	-
	-	●	-	-	-	-
	-	-	-	-	-	-
	●	-	●	●	-	-
	-	-	-	-	●	●

	XH125NJ	XE225NC	XS250NJ	XH250NJ	XS400CJ	XS400NJ
	●	●	●	●	●	●
	●	●	●	●	●	●
	●	●	●	●	●	●
	●	-	●	●	●	●
	●	●	●	●	●	●
	-	-	-	-	-	-
	●	●	●	●	●	●
	●	●	●	●	●	●
	●	●	●	●	●	●
	-	-	-	-	-	-
	●	-	-	-	●	●
	●	●	●	●	●	●
	-	-	-	-	●	●
	●	●	●	●	●	●
	●	●	●	●	●	●
	●	●	●	●	●	●
	●	●	●	●	●	●
	●	●	●	●	●	●
	●	●	●	●	●	●
	●	●	●	●	●	●
	●	●	●	●	●	●
	●	●	●	●	●	●

5

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Section 7

MCCB operational characteristics & dimensions

7

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MCCB Technical data

Thermal Magnetic MCCBs

Thermal-Magnetic MCCBs are available from 125 AF to 800 AF. Depending on the type of MCCB thermal and/or magnetic trip setting may be adjustable.

MCCB type	Fixed thermal	Adjustable thermal	Fixed magnetic	Adjustable magnetic
XS125CS, XS125NS	●	-	●	-
XS125CJ, XS125NJ	-	●	●	-
XH125NJ, XH125PJ, TL100NJ	-	●	●	-
XH160PJ	-	●	●	-
XE225NC	●	-	●	-
XS250NJ, XH250NJ	-	●	●	-
XH250PJ	-	●	-	●
XS400CJ, XS400NJ, XH400PJ, TL250NJ	-	●	-	●
XS630CJ, XS630NJ, XH630PJ	-	●	-	●
XS800NJ	-	●	-	●
XH800PJ	-	●	-	●

Note: ● Yes
- No

7

Access to setting dials

From 125 AF to 250 AF the thermal adjustment is visible from the front of the MCCB. At 400 AF and above a protective cover must be removed to gain access to the settings. To achieve access to the settings, the cover screw under the 'sealed' label must be removed. To adjust the individual trip settings, turn the setting dial with a flat bladed screwdriver.
Once set, secure the cover and apply a new sealing label.

XH250NJ

XS400NJ

XS400NJ (cover removed)

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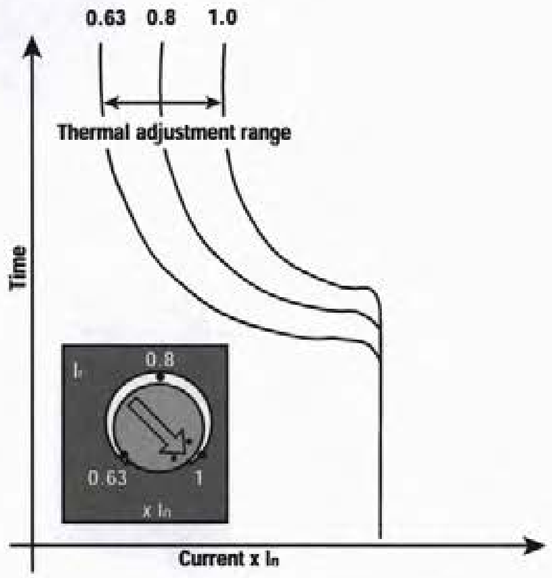
MCCB Technical data

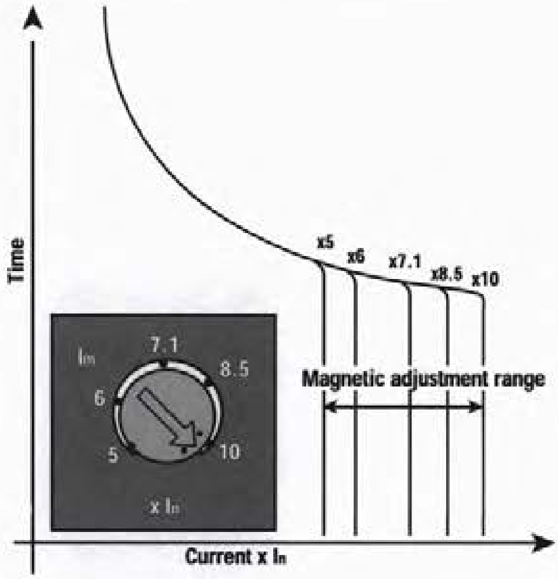
Thermal Adjustment

TemBreak MCCBs have a wide thermal adjustment range, one of the largest on the market. The rated current 'I_r' is continuously adjustable from 63 % to 100 % of its nominal current 'I_n'. There are three main points of calibration marked at 63 %, 80 % and 100 %, as shown in the diagram below.



Magnetic Adjustment

The magnetic adjustment is available on MCCBs of 400 AF and above. The magnetic setting 'I_m' is continuously adjustable from 500 % to 1000 % of its rated current 'I_n'. There are five main points of calibration marked as multiples of I_n; 5, 6, 7.1, 8.5 and 10. These are shown in the diagram below.



Examples

1. XS125NJ/125A MCCB set at I_r = 0.8, the rated current is calculated as 125 x 0.8 = 100 A
2. XS400NJ/400A MCCB set at I_m = 6, the magnetic setting is calculated as 400 x 6 = 2400 A
3. XS630NJ/630A MCCB set at I_r = 0.8 and I_m = 5.0

   The rated current is calculated as 630 x 0.8 = 504 A
   The magnetic setting is calculated as 630 x 5 = 3150 A

Note that the magnetic setting is a multiple of the nominal current In and not the rated current Ir.
All thermal and magnetic trip settings are expressed as AC RMS values.
All MCCBs are calibrated at 45 °C unless otherwise specified.

Breakers with adjustable magnetic trip

Breaker	Rated current (A)	Magnetic trip current (A) Scale 10	8.5	7.1	6	5
XS400CJ	250	2500	2125	1775	1500	1250
XS400NJ	400	4000	3400	2840	2400	2000
XH400PJ	400	4000	3400	2840	2400	2000
XS630CJ	400	4000	3400	2840	2400	2000
XS630NJ	630	6300	5355	4473	3780	3150
XH630PJ	630	6300	5355	4473	3780	3150
XS800NJ	800	8000	6800	5680	4800	4000
XH800PJ	800	8000	6800	5680	4800	4000

Note: Settings; 3-poles can be adjusted simultaneously with one adjustment dial.

7

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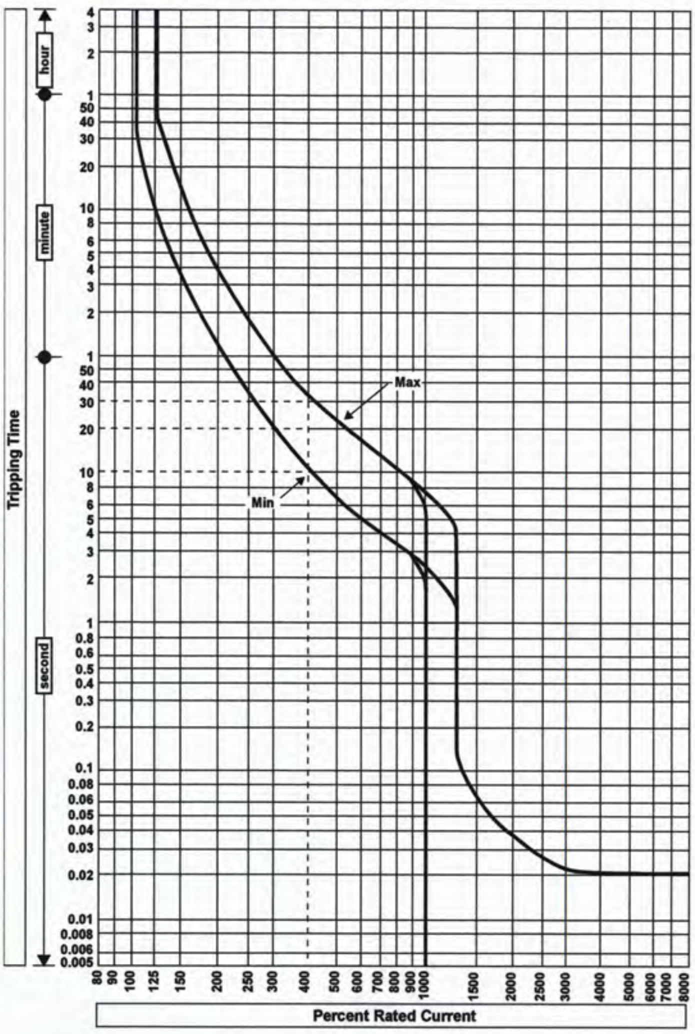
MCCB Technical data

Time/current characteristic curves



Example 1

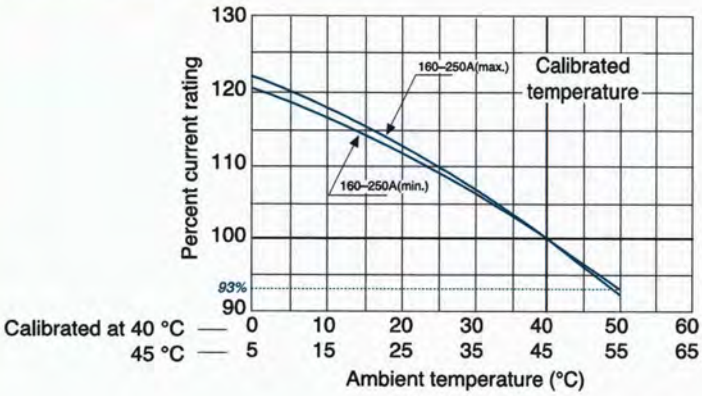
The XS250NJ set at its maximum thermal setting of 250A experiences an overload of 1000A. What would be the tripping time?

Solution
As the axis are 'percent' rated current the overload as a percentage to rated current is

$$\frac{100\text{ A}}{250} = 400\ \%$$

The maximum and minimum on the curve are the tolerance bands. Therefore at 400 % overload the tripping time would be as follows:
Maximum trip time ≈ 30 seconds
Minimum trip time ≈ 10 seconds
Average trip time ≈ 20 seconds
Due to strict quality control of the manufacturing and calibration processes, the characteristic curve of most MCCBs will follow the 'average' curve within the tolerance band.

Ambient compensating curves



Example 2

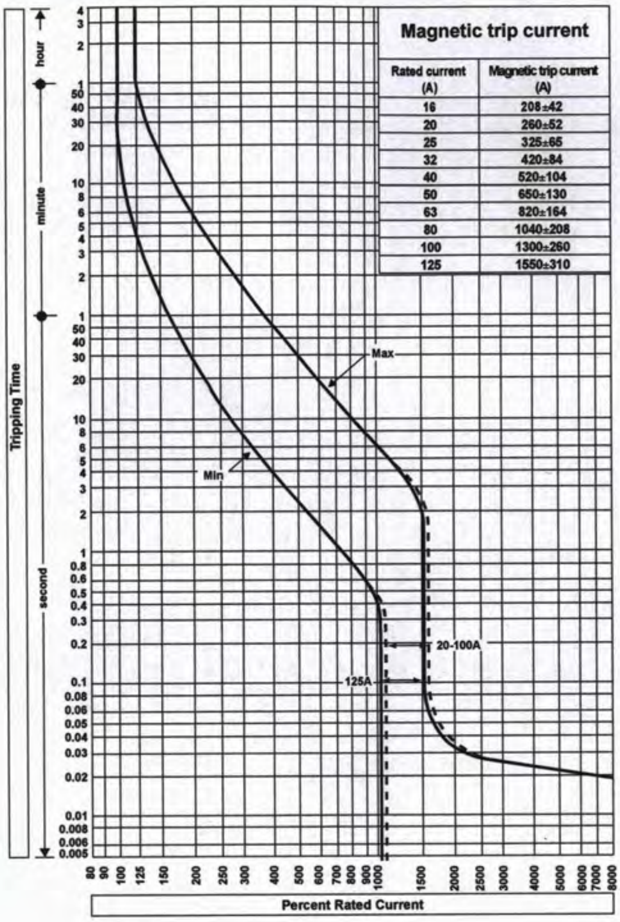
The XS250NJ is calibrated at 250 A for 45 °C ambient. If the temperature rose to 55 °C what effect would this have?

Solution
At 55 °C the ambient compensating factor is 93 %, i.e. 250 x 0.93 = 232.5 A
In other words the XS250NJ would act as an MCCB set at 232.5 A, in 55 °C.

MCCB Technical data

XS125CS, XS125NS

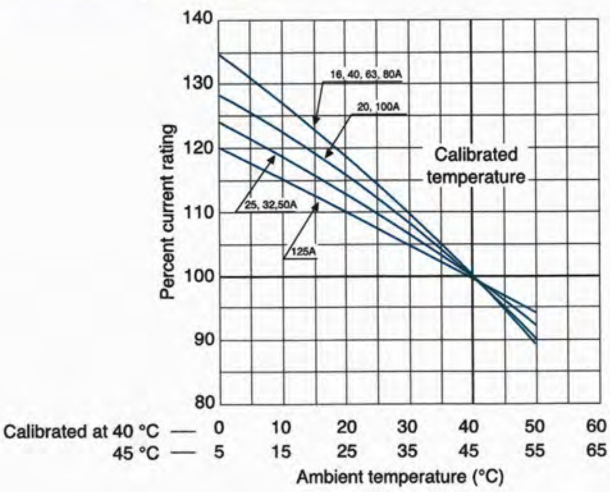
Time/current characteristic curves



Magnetic trip current

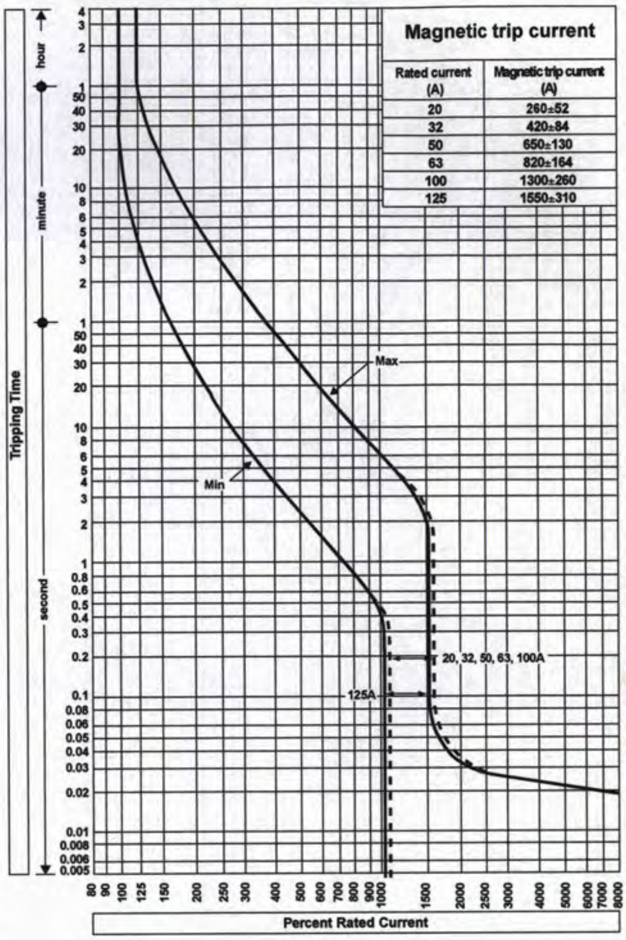
Rated current (A)	Magnetic trip current (A)
16	208±42
20	260±52
25	325±65
32	420±84
40	520±104
50	650±130
63	820±164
80	1040±208
100	1300±260
125	1550±310

Ambient compensating curves



XS125CJ, XS125NJ, XH125NJ, XH125NJ

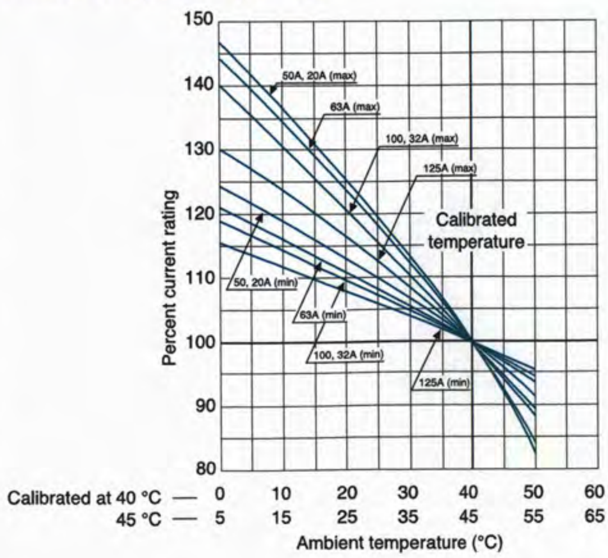
Time/current characteristic curves



Magnetic trip current

Rated current (A)	Magnetic trip current (A)
20	260±52
32	420±84
50	650±130
63	820±164
100	1300±260
125	1550±310

Ambient compensating curves



7

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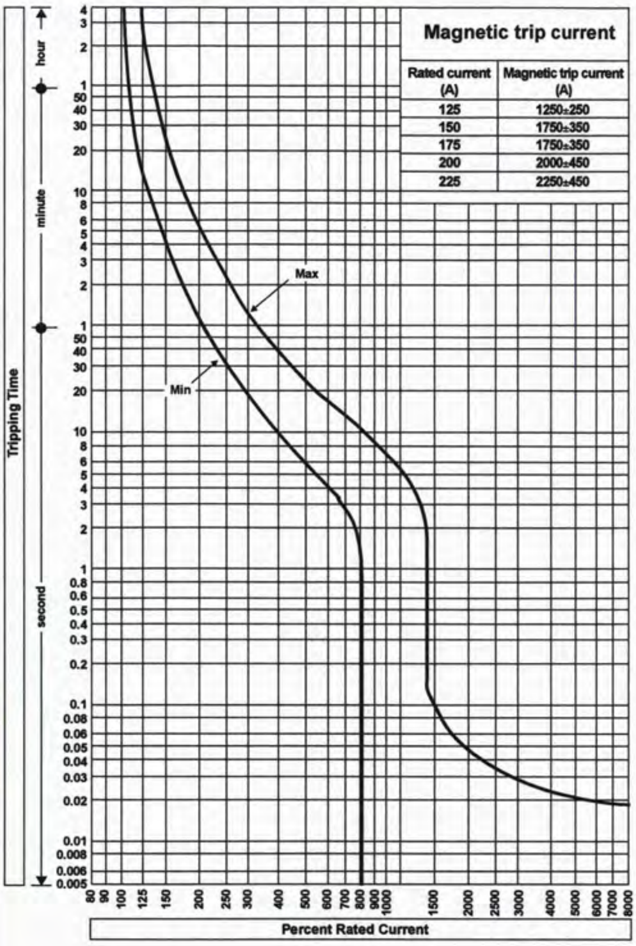
MCCB Technical data

XE225NC

Time/current characteristic curves

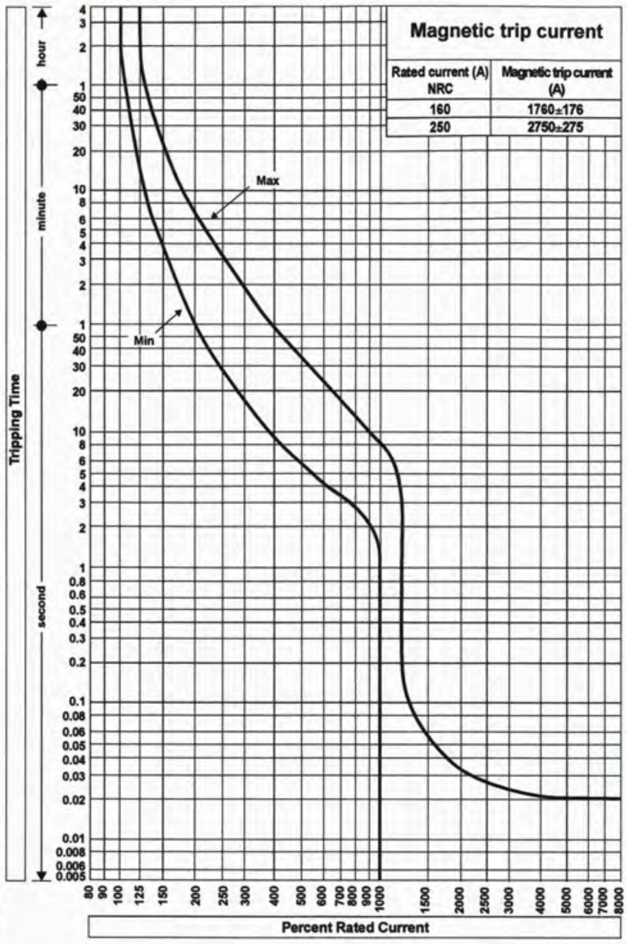


Magnetic trip current

Rated current (A)	Magnetic trip current (A)
125	1250±250
150	1750±350
175	1750±350
200	2000±450
225	2250±450

XH160PJ, XS250NJ, XH250NJ

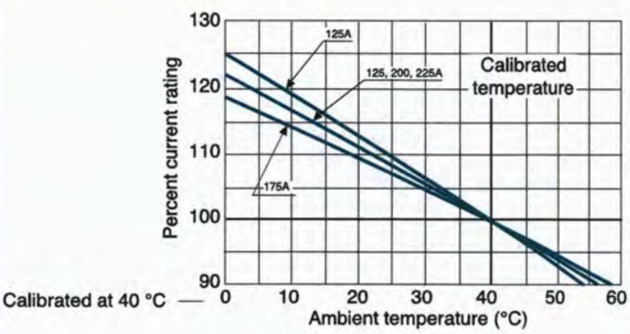
Time/current characteristic curves



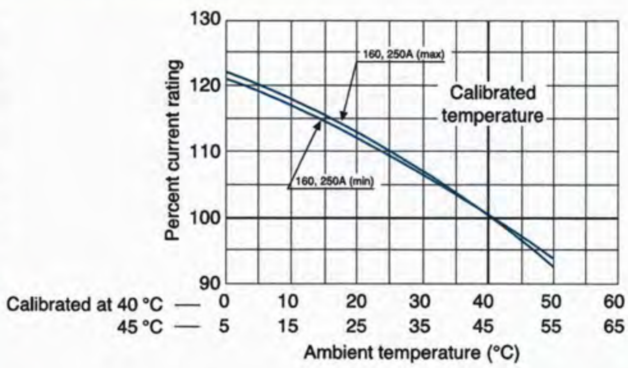
Magnetic trip current

Rated current (A) NRC	Magnetic trip current (A)
160	1760±176
250	2750±275

Ambient compensating curves



Ambient compensating curves



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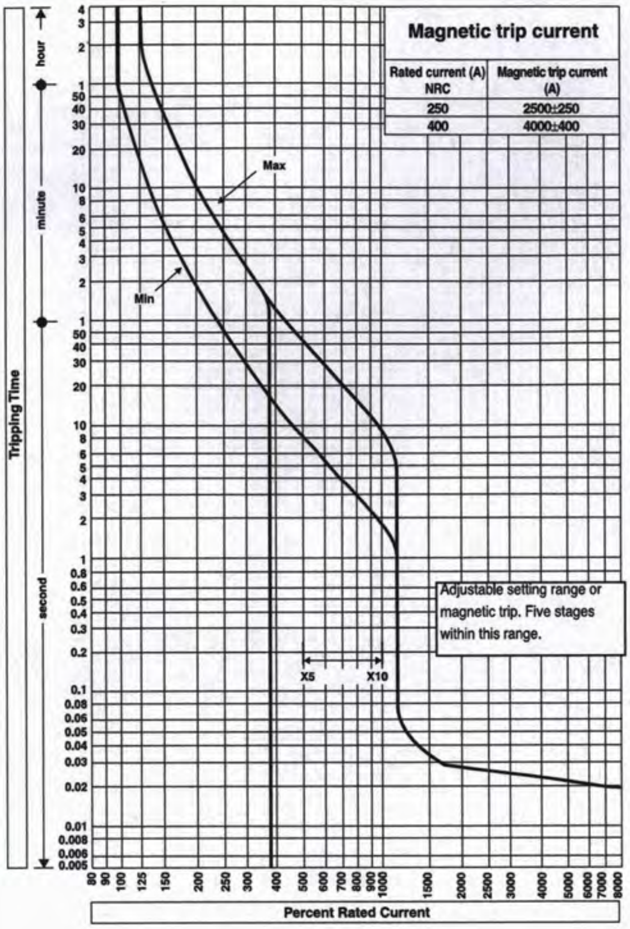
MCCB Technical data

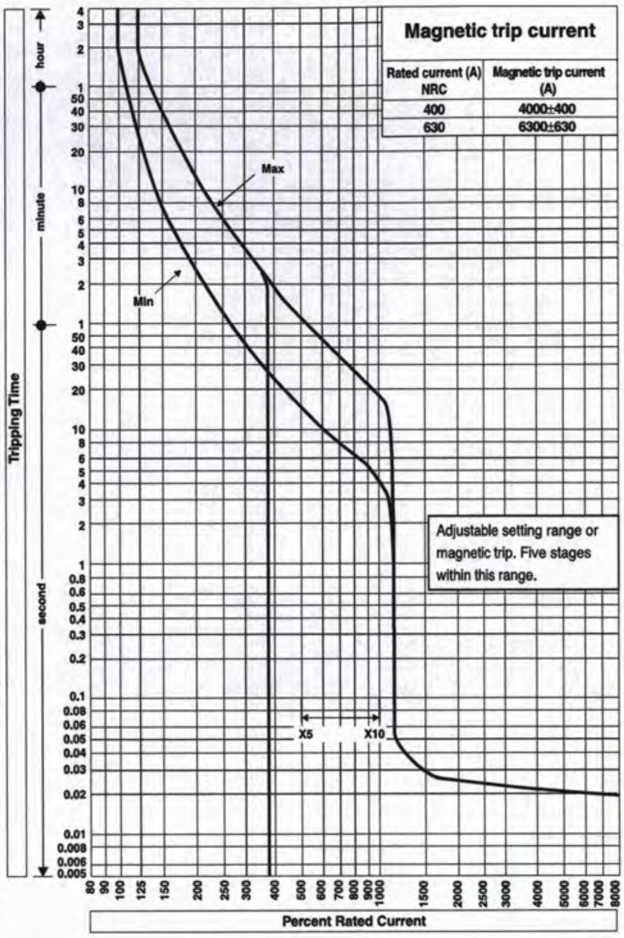
XH250PJ, XS400CJ, XS400NJ, XH400PJ

Time/current characteristic curves

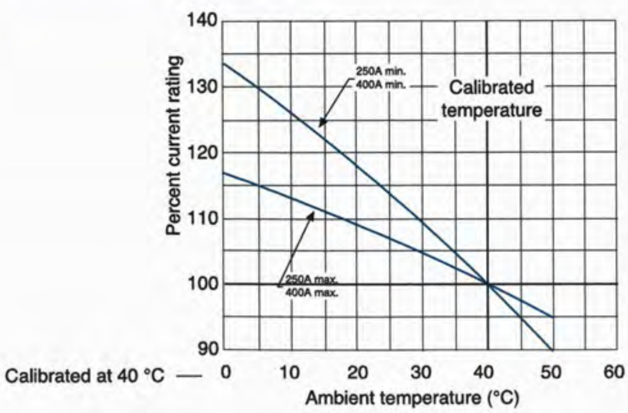


XS630CJ, XS630NJ, XH630PJ

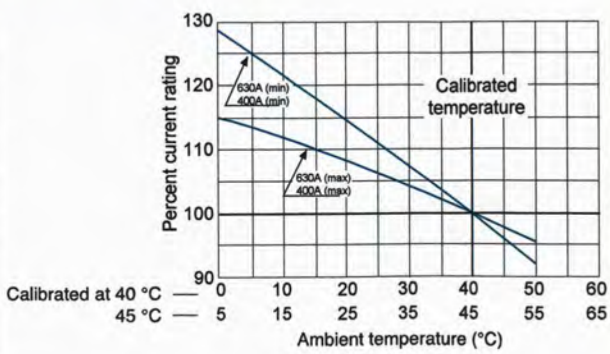
Time/current characteristic curves



Ambient compensating curves



Ambient compensating curves



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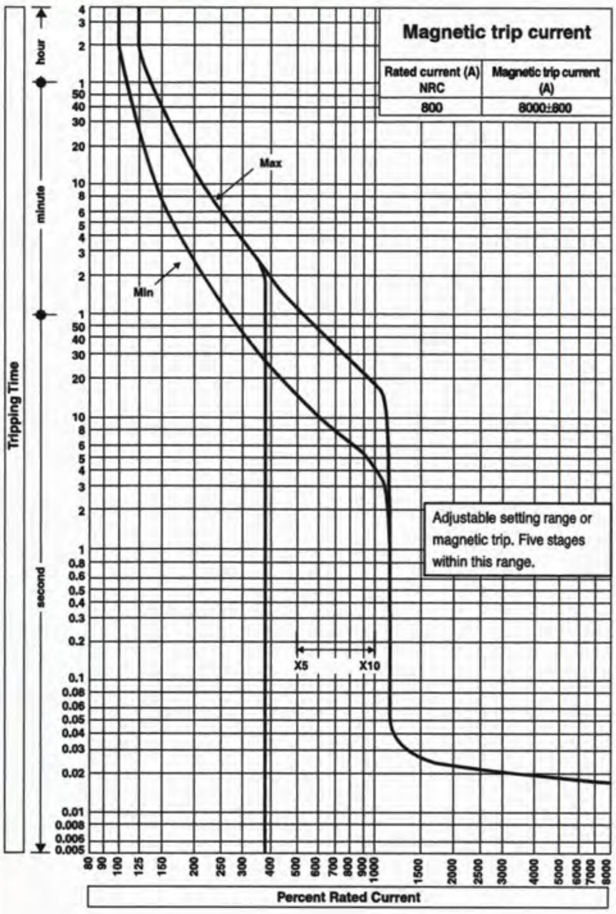
MCCB Technical data

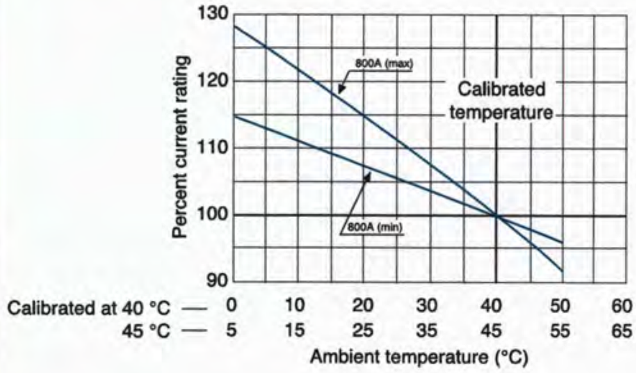
XS800NJ, XH800PJ

Time/current characteristic curves



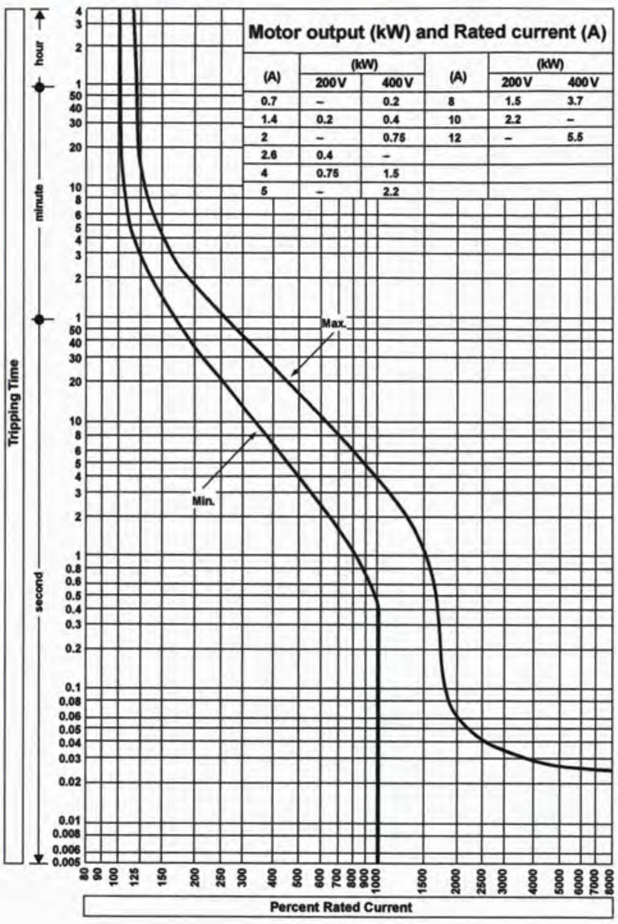
Magnetic trip current	
Rated current (A) NRC	Magnetic trip current (A)
800	8000±800

Ambient compensating curves



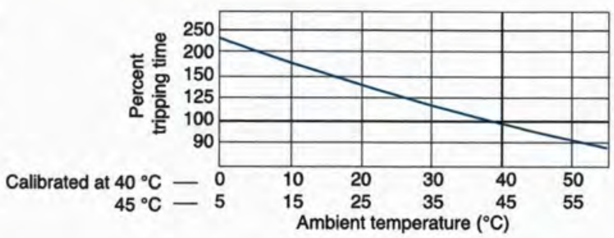
XM30PB

Time/current characteristic curves



Motor output (kW) and Rated current (A)					
(A)	(kW) 200V	(kW) 400V	(A)	(kW) 200V	(kW) 400V
0.7	–	0.2	8	1.5	3.7
1.4	0.2	0.4	10	2.2	–
2	–	0.75	12	–	5.5
2.6	0.4	–			
4	0.75	1.5			
5	–	2.2			

Ambient compensating curves



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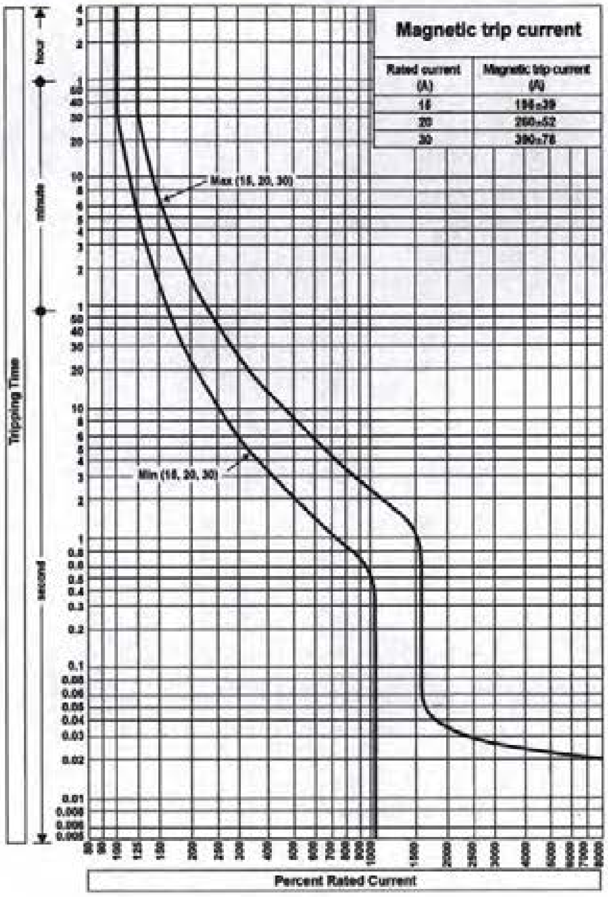
MCCB Technical data

TL30F

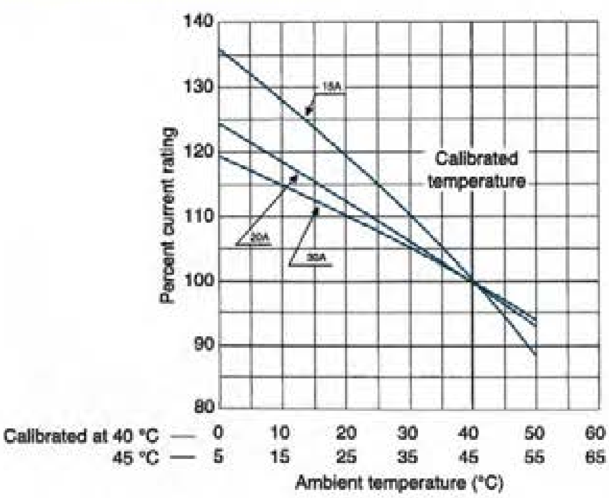
Time/current characteristic curves



Magnetic trip current

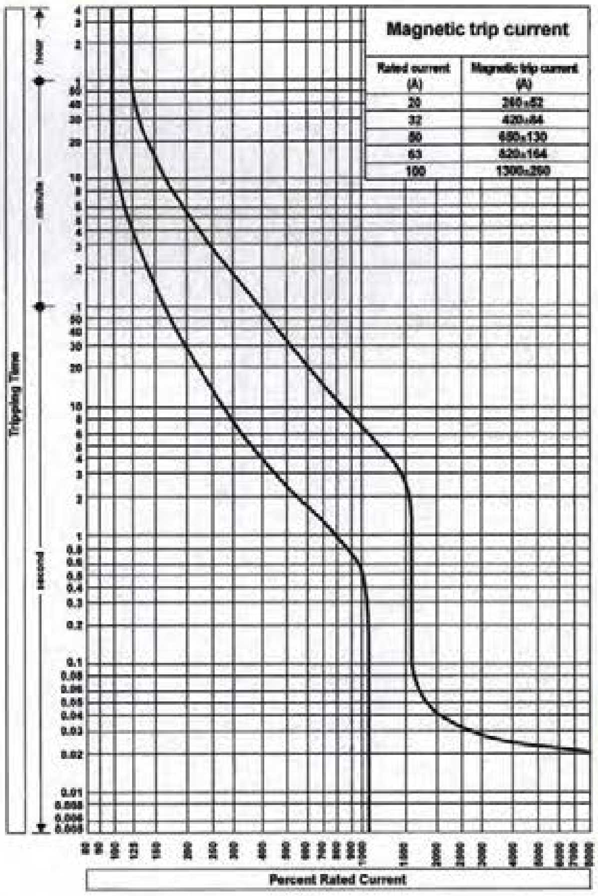
Rated current (A)	Magnetic trip current (A)
15	195±39
20	260±52
30	390±78

Ambient compensating curves



TL100NJ

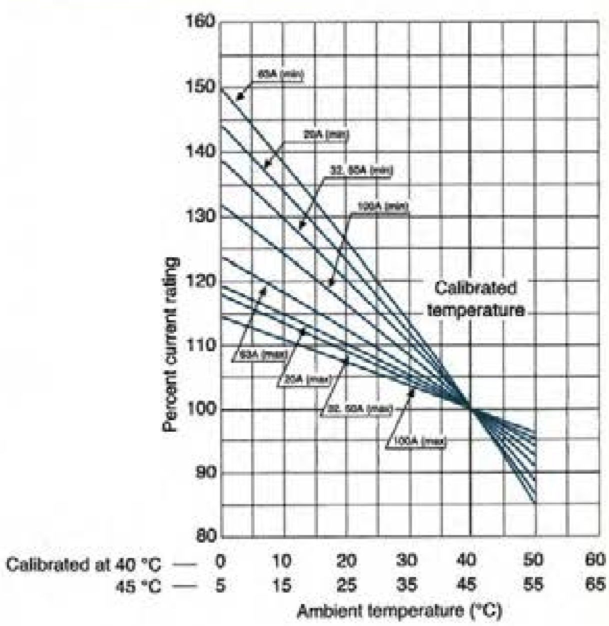
Time/current characteristic curves



Magnetic trip current

Rated current (A)	Magnetic trip current (A)
20	260±52
32	420±84
50	650±130
63	820±164
100	1300±260

Ambient compensating curves



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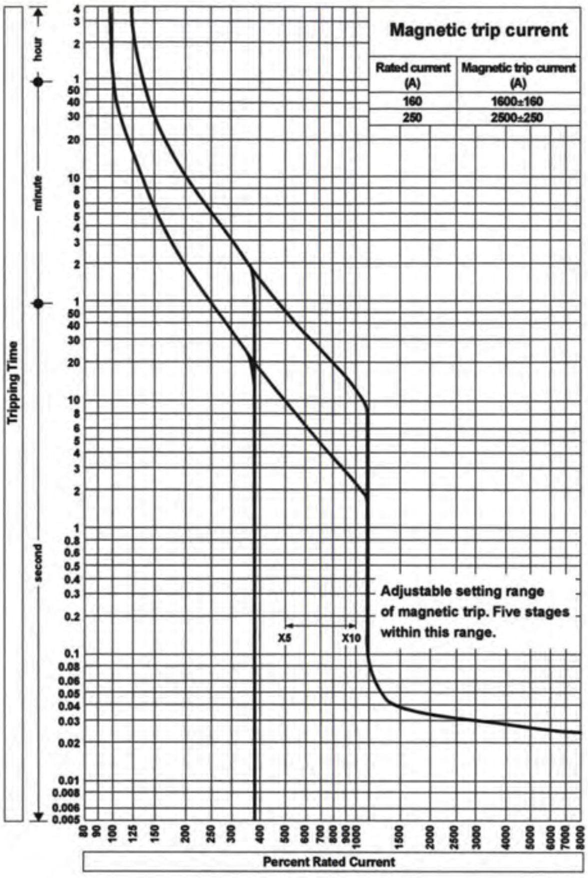
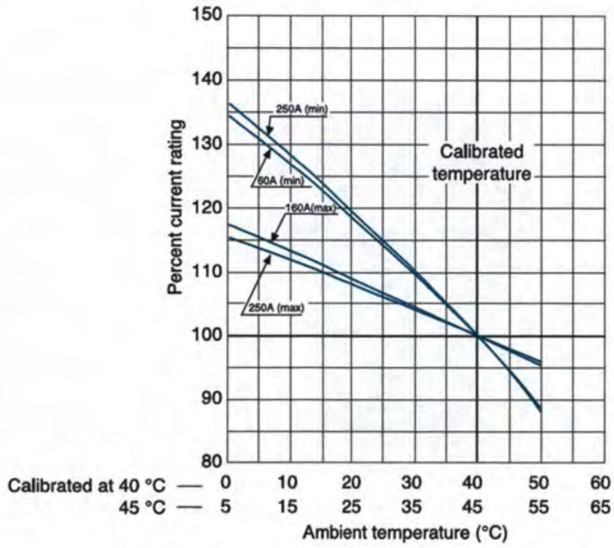
MCCB Technical data

TL250NJ

Time/current characteristic curves



Ambient compensating curves



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MCCB Technical data

Microprocessor based characteristics and adjustments

Characteristics

The standard microprocessor based MCCB from Terasaki has the most flexible characteristics on the European market. In addition to the standard overload and short circuit protection, there are a number of options available to meet specific applications.

MCCB type	LTD	STD	INST	I²T Ramp	Pick-up LED	Test port	PTA	GFT	internal LEDs	external LEDs
XS400, XH400 ¹)	●	●	●	●	●	●	◆	-	-	◆
XS630, XH630 ³)	●	●	●	●	●	●	◆	◆	-	◆
XS800, XH800 ³)	●	●	●	●	●	●	◆	◆	-	◆
XS1250SE ³)	●	●	●	●	●	●	◆	◆	◆	-
XS1600SE ²)	●	●	●	●	●	●	◆	◆	◆	-
XS2000NE	●	●	●	●	●	●	◆	◆	◆	-
XS2500NE	●	●	●	●	●	●	◆	◆	◆	-

Standard on all TemBreak Microprocessor MCCBs

Note: ● Standard
◆ Optional
\- Not available
¹) Includes TL400NE & XV400NE
²) Includes TL630NE to TL1250NE
³) Includes XV630, 800 & 1250

Legend		Application
LTD	**Long Time Delay**	Overload protection, True RMS
STD	**Short Time Delay**	Short circuit protection and selectivity
INST	**Instantaneous**	Short circuit protection, fast acting
I2t RAMP		Provides easier grading with downstream fuses
Pick-up LED		Lights on LTD overload, flashes on PTA pick-up
Test Port		Facility for TNS-1 OCR checker for calibration checking
PTA	**Pre-Trip Alarm**	Useful for loadshedding application
GFT	**Ground Fault Trip**	Protection against ground faults
LEDs	**Light Emitting Diodes**	Indication of fault for faster diagnosis
HI-INST	**High Instantaneous**	High inrush applications, increased selectivity

Standard for all TemBreak Microprocessor MCCBs

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Access to setting dials

To adjust the settings on the microprocessor TemBreak, the sealed label must be broken and the cover fixing screws removed. To adjust the individual trip settings, turn the setting dial with a flat bladed screwdriver. Align the setting required between the black dots marked on the dial.

XH400SE

XH400SE (cover removed)

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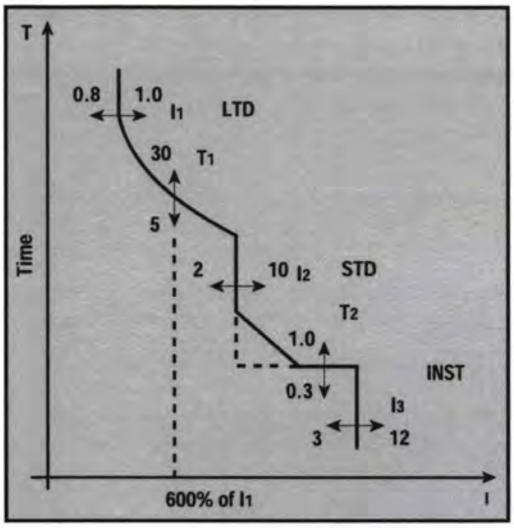
MCCB Technical data

Microprocessor based characteristics – adjustments, operation, settings

Standard time current curves



Each part of the characteristic curve can be independently adjusted. This unique adjustability of LTD, STD and INST enables the standard microprocessor MCCB to achieve more than 200,000 permutations of its time/current characteristic.

This makes the TemBreak microprocessor range one of the most flexible on the market.

To complement this range, NHP have developed TemCurve selectivity analysis software, which contains the full range of TemBreak MCCBs on database. This software package highlights the full benefit of having highly adjustable microprocessor MCCBs when involved with difficult selectivity problems.

Standard microprocessor adjustments

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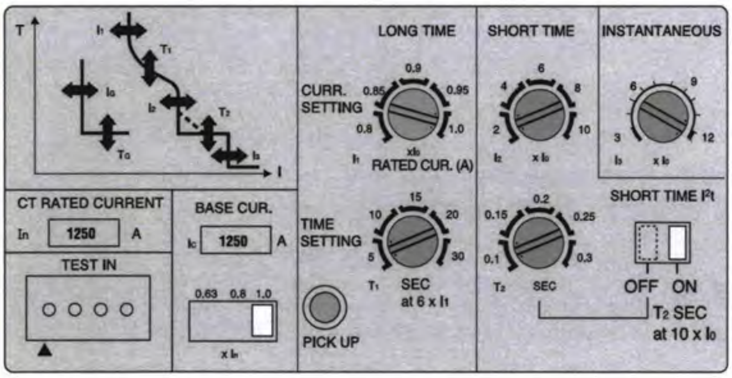

The I^2t ramp switch, which is provided as standard, assists in discrimination with downstream fuses.

With the switch off, the STD operates with a definite time characteristic: with the switch on, the characteristic alters to a ramp: , cutting off the corner which poses a potential selectivity problem.

Setting Dial		Available adjustments	
Base current setting	I_0	0.63 - 0.8 - 1.0 x I_n	Amps
LTD pick-up	I_1	0.8 - 0.85 - 0.9 - 0.95 - 1.0 x I_0	Amps
LTD setting	T_1	5 - 10 - 15 - 20 - 25 - 30 (at I_1 x 600 %)	Secs
STD pick-up	I_2	2 - 4 - 6 - 8 -10 x I_0	Amps
STD setting	T_2	0.1 - 0.15 - 0.2 - 0.25 - 0.3	Secs
INST pick-up	I_3	3 - 12 - x I_0 (continuously adjustable)	Amps

Note: A special generator T_1 setting adjustment of 1-5 sec (at I_1 x 600 %), is also available. Please contact NHP for details.

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MCCB Technical data

Adjustment of TemBreak (electronic type) tripping characteristics

Electronic models of TemBreak come standard with an 8-bit microprocessor overcurrent relay (OCR). It is the OCR which provides the functions necessary for protection, while maintaining a high level of reliability.

Note: The ground fault trip and pre-trip alarm cannot be used simultaneously in a single breaker.

The wide OCR adjustment range allows the circuit breaker to be set-up in order to trip under certain conditions. Adjustments can be made to the tripping current as well as the tripping time of the breaker.

Front view

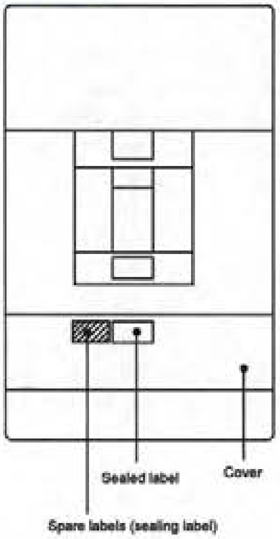
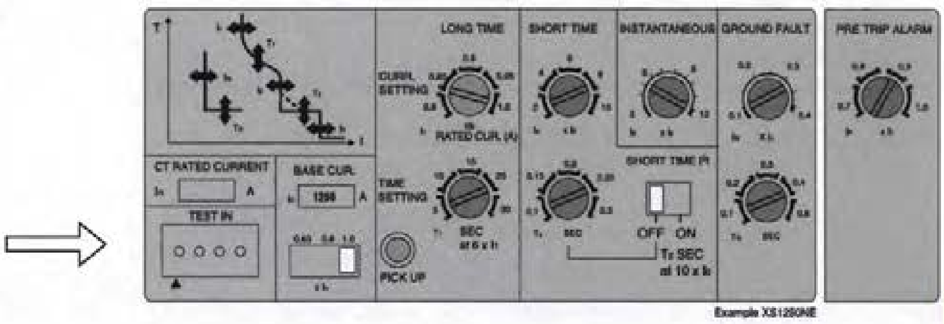


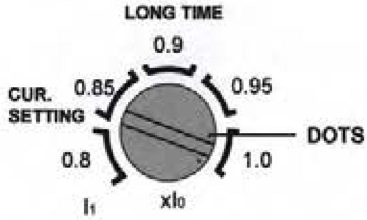
Figure 1. Electronic OCR adjustment possible (with label removed).



Adjustment method

Remove the sealing label, loosen and remove the cover fixing screws and remove the cover. To adjust the individual trip settings, turn the setting dial with a flat bladed screwdriver.

Note: Align the groove (end marked with dots) between the bands for the required setting.
For example, the diagram right shows I_0 = 1.0.
The INST and GFT pick-up currents are continuously adjustable.



Secure the cover and apply the sealing label.

7

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Innovators in Protection Technology

MCCB Technical data

Microprocessor based characteristics – adjustments, operation and examples

Overload adjustment

The rated current of the microprocessor based TemBreak is adjusted using two current multipliers. This process achieves high accuracy adjustment from 50 % to 100 %. These are the LTD pick-up dial (I_1) and the Base Current (I_0) selector switch.

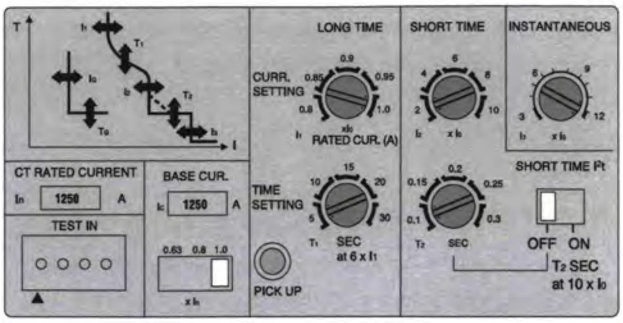
The rated current (LTD pick-up) is achieved as follows:

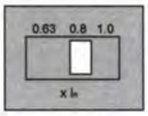
$I_{RATED} = I_n \times I_0 \times I_1$

In the example shown on the right the rating would be:

$I_{RATED} = 1250 \times 1.0 \times 1.0 = 1250$ A

In total there are 15 possible increments of adjustment between 50 and 100 % as shown below.



Base current 	63					80					100				
Current dial 	80	85	90	95	100	80	85	90	95	100	80	85	90	95	100
Breaker rated current (72% in this example)	50	54	57	60	63	64	68	72	76	80	80	85	90	95	100

Example - Settings

In the example shown on the right, what are all the settings in Amps?

Solution

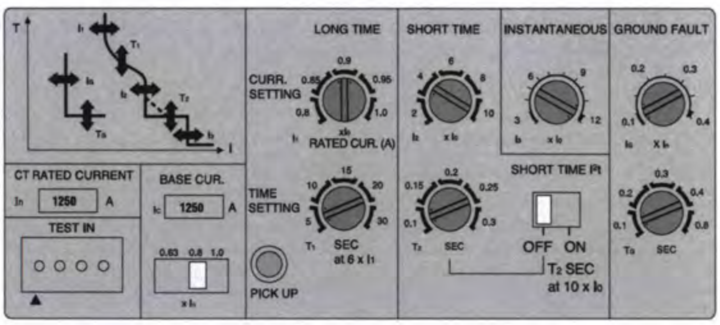
I_{RATING} LTD pick-up = $I_n \times I_0 \times I_1$
1250 x 0.8 x 0.9 = 900 A

STD pick-up = $I_n \times I_0 \times I_2$
1250 x 0.8 x 4 = 4000 A

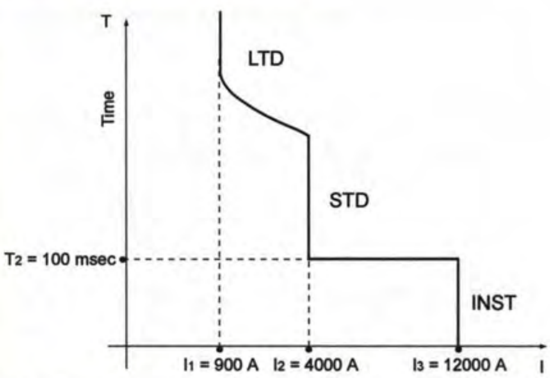
INST pick-up = $I_n \times I_0 \times I_3$
1250 x 0.8 x 12 = 12,000 A

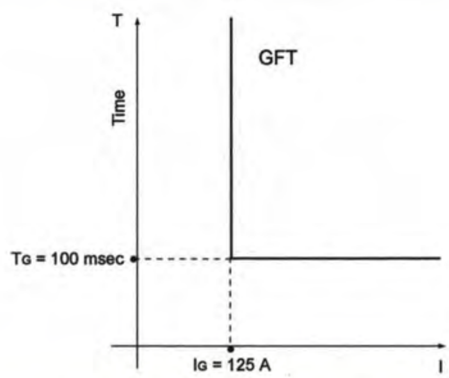
GFT pick-up = $I_n \times I_G$
1250 x 0.1 = 125 A

(Note that GFT is a function of I_n and not I_0)



Example - Time/Current curves





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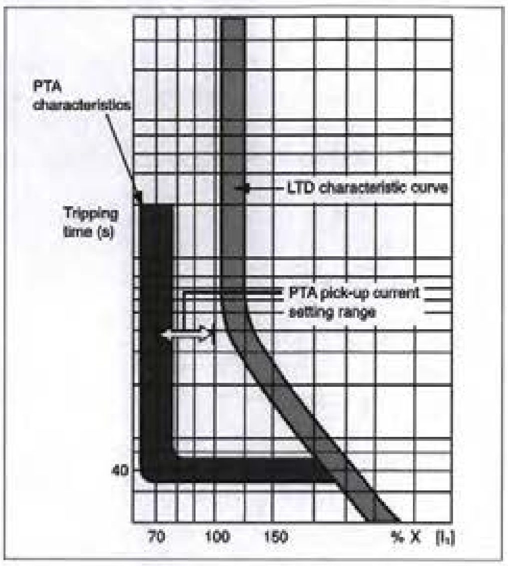
MCCB Technical data

Options (electronic type) TemBreak

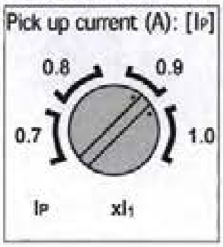
Pre-trip alarm (PTA)

The PTA continuously monitors the true RMS value of the load current. When the load current exceeds the pre-set current (Ip) an LED gives local alarm that the MCCB is approaching an overload situation.
Should the current Ip be exceeded for 40 secs a (N/O) contact will close to provide remote indication and/or load shedding.

PTA characteristics



PTA specifications

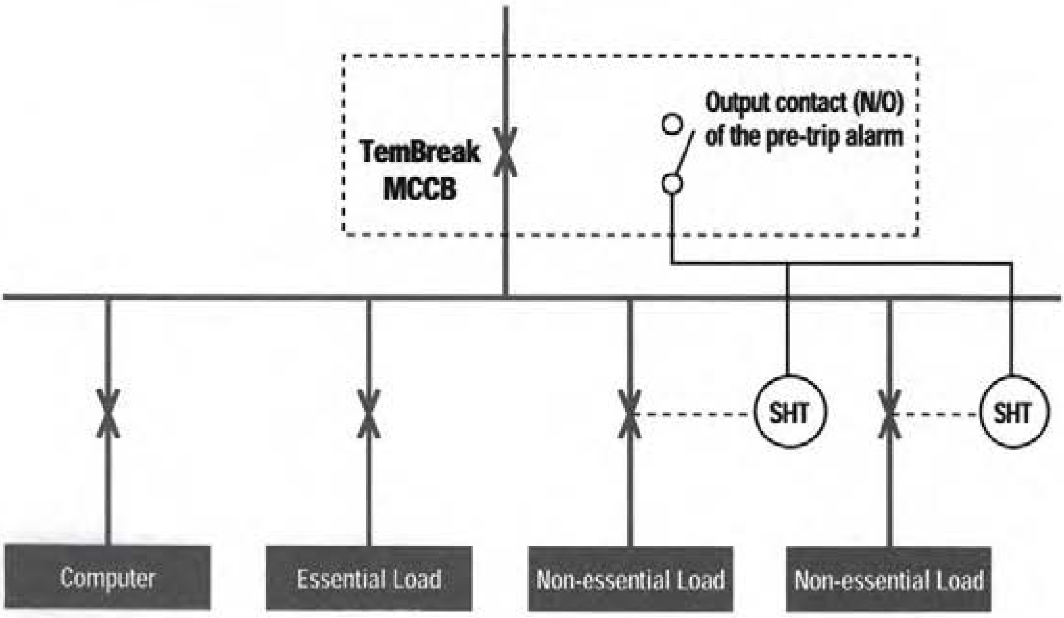


Adjustable steps of 70, 80, 90, 100 % of the selected rated current [I_1].

Setting tolerance ±10 %

Note: The long time-delay trip does not operate 'first' when the pick-up current is adjusted to 100 % of the rated current [I_1].

Operating time (s) [Ip]		40 secs (fixed definite time-delay) setting tolerance is ±10 %		
Output contact		Normally open contact, (1a) Integral lead is standard length (450 mm)		
			Resistive load	**Inductive load**
	Rating of contact	250 V AC	125 VA (2 A max)	20 VA (2 A max)
		220 V DC	60 W (2 A max)	10 W (2 A max)
PTA indication		Pick-up LED flickers		



7

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MCCB Technical data

Adjustment of TemBreak electronic type OCR with ground fault

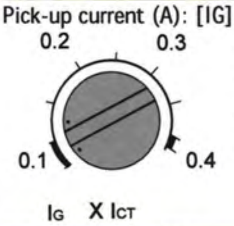
Ground fault trip

The GFT pick-up current is continuously adjustable from 10 % to 40 % of the rated CT current.

Notes: The ground fault trip and pre-trip alarm cannot be used simultaneously in a single breaker.
XS400SE, XH400SE are not available with ground fault function.
When a three pole breaker is used in a 3 phase, 4 wire system,
a separate CT is required for the neutral line. (refer NHP).

GFT specifications

Pick-up current (A): [IG]

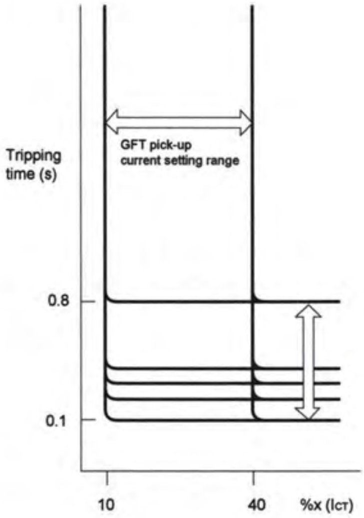


Continuously adjustable from 10 to 40 % of the rated CT current (Ict) setting tolerance is ± 15 %

Time-delay (S): [TG]

The GFT has a definite time-delay characteristic and is adjustable in steps of 0.1, 0.2, 0.3, 0.4, 0.8 s. Total clearing time is +50 ms and resettable time is –20 ms for the preset time delay.

GFT characteristics



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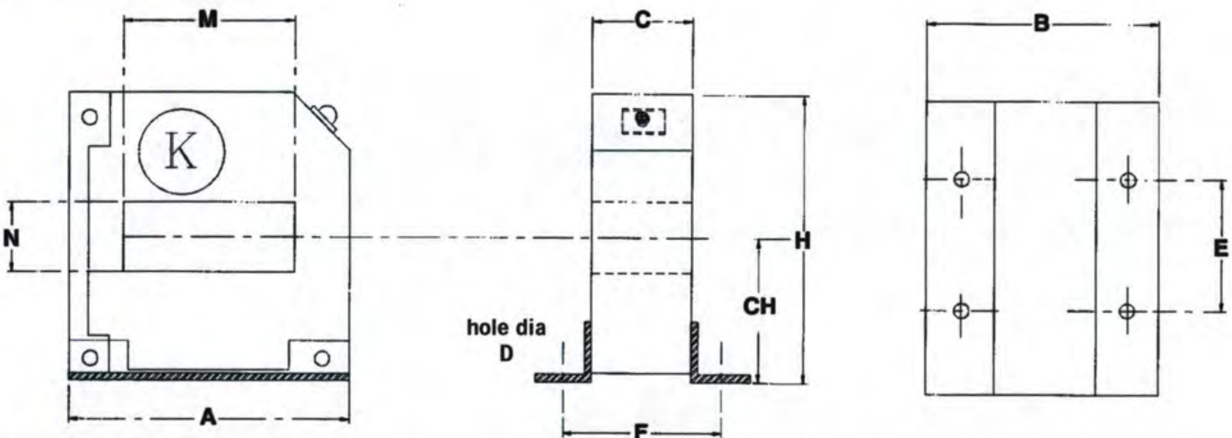
4th CT for GFT

Rating (A)	Type
2500	UX0Y0007A
2000	UX0Y0006A
1600	UX0Y0005A
1250	UX0Y0004A
1000	UX0Y0003A
800	UX0Y0002A
630	UX0Y0001A



Dimensions (mm)

Rating (A)	A	B	C	D	E	F	H	CH	M	N
2500-1000	140	110	50	10	80	85	145	75	85	35
800-630	105	100	40	8	50	75	110	57	50	20

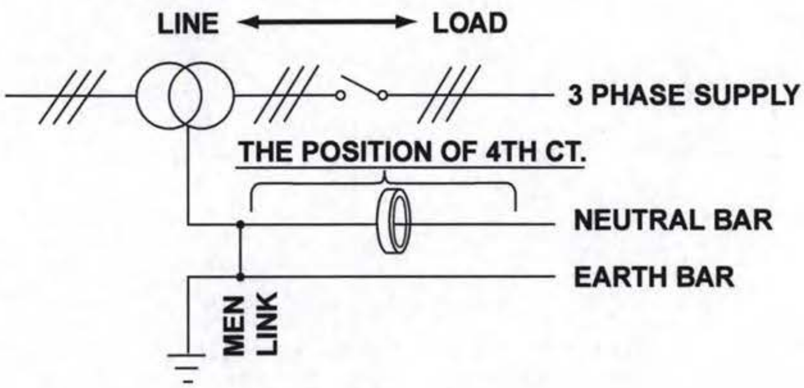
MCCB Technical data

TemBreak electronic type with ground fault

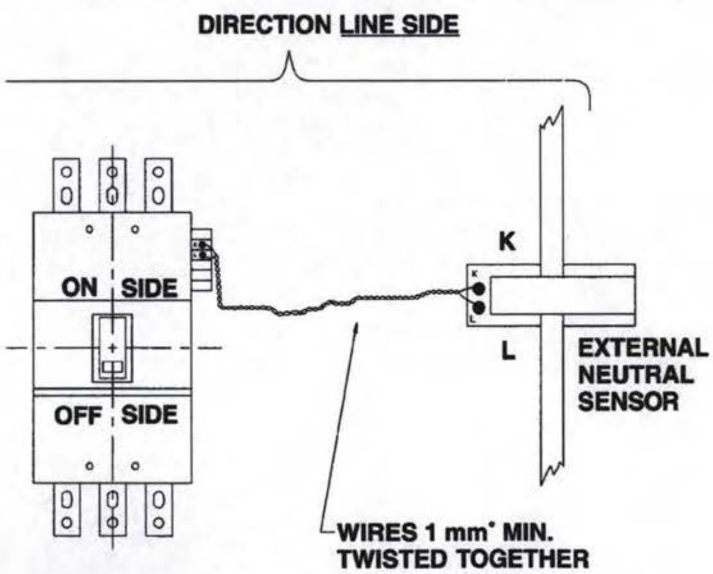
External neutral sensor (4th CT)

External neutral sensors are required whenever optional earth fault is used on 3 phase 4 wire systems

The position and direction of 4th CT



The direction of 4th CT



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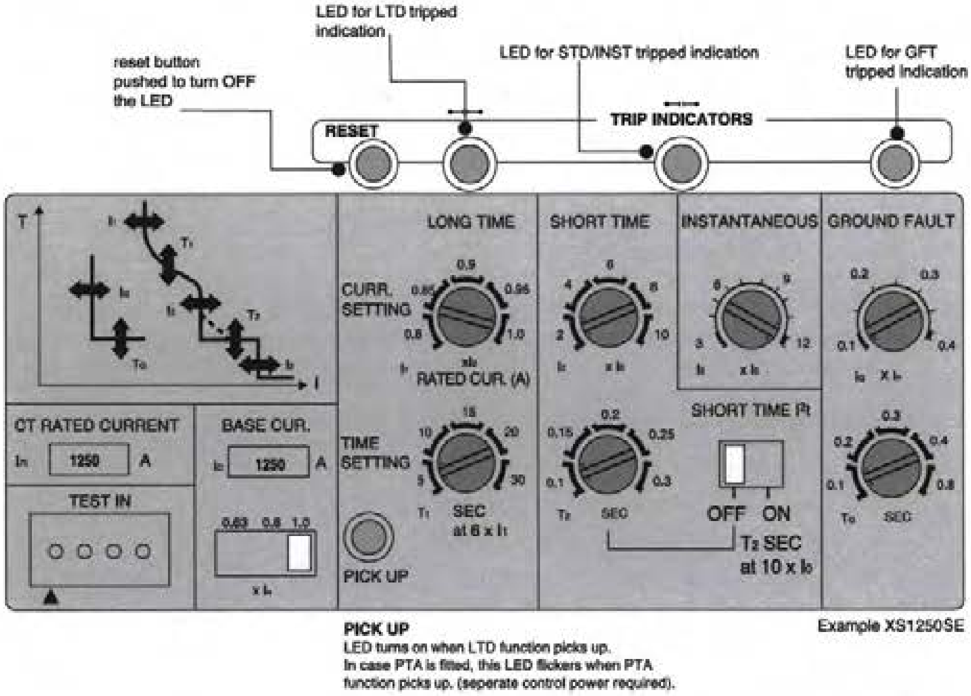
MCCB Technical data

Trip indicators

The LEDs when lit, indicate which trip function tripped the breaker eg, long-time-delay (LTD), short-time delay/ instantaneous (STD/INST) or ground fault (GFT) (control power required).

Note: If a pre-trip alarm (PTA) is fitted, the LED control power can be used (common).

Trip indicator display (1250 AF and above)



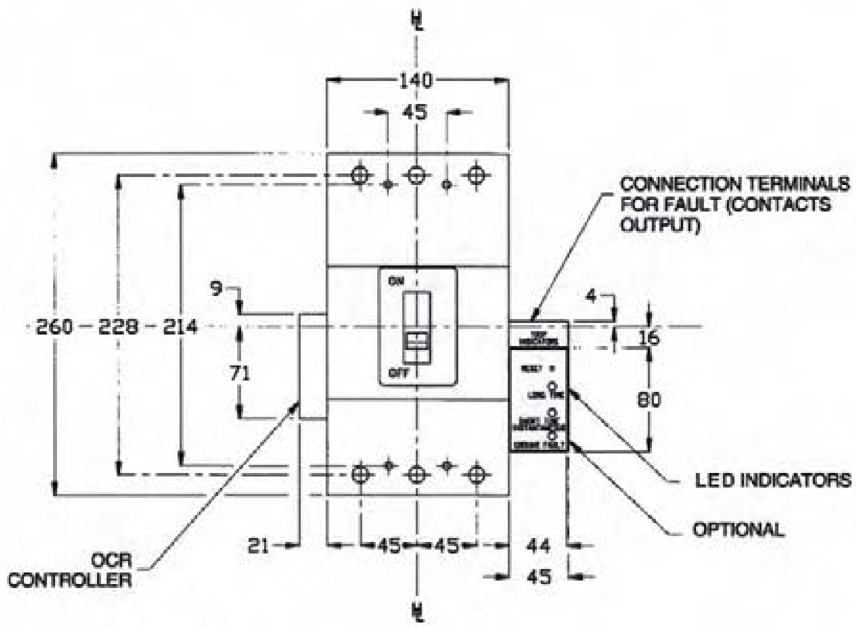
PICK UP
LED turns on when LTD function picks up.
In case PTA is fitted, this LED flickers when PTA function picks up. (seperate control power required).

Example XS1250SE

Trip indicator display (400 AF to 800 AF) and OCR controller example: XS, XH400

An optional feature available with TemBreak electronic type are fault indication contacts - these are voltage free and provide a signal of the cause of a trip (long time, STD/INST).

An external trip indicator box is required with 400AF models.



Notes: For dimensions of XS/XH800SE and PE refer to pages 7 - 40 and 7 - 41, add dimensions of OCR controller and trip indication box (above).

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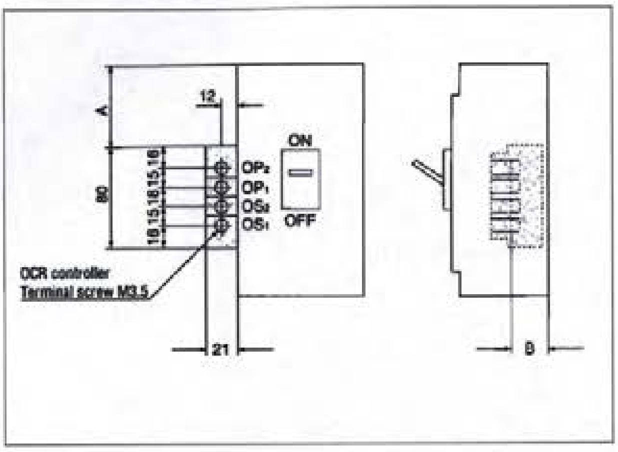
MCCB Technical data

OCR controller (PTA and trip indication)

OCR controller mounting position



Dimension table (mm)

Ampere frame	Type of MCCB	A With UVT controller	A Without UVT controller	B
400	XS400	34	97	48
	XH400/TL400NE	34	97	48
630	XS630/XV	64	151	60
	XH630	64	151	60
800	XS800/XV	64	151	60
	XH800	64	151	60
1250	XS1250SE/XV	51	114	72
1600	XS1600SE/TL-NE	51	114	92
2000	XS2000NE	54	180	115
2500	XS2500NE	54	180	115

OCR controller (PTA and trip indication)

The OCR controller is installed in the left hand side of the breaker (standard). This can also be installed externally to the breaker (please specify when ordering).

OCR controller specifications

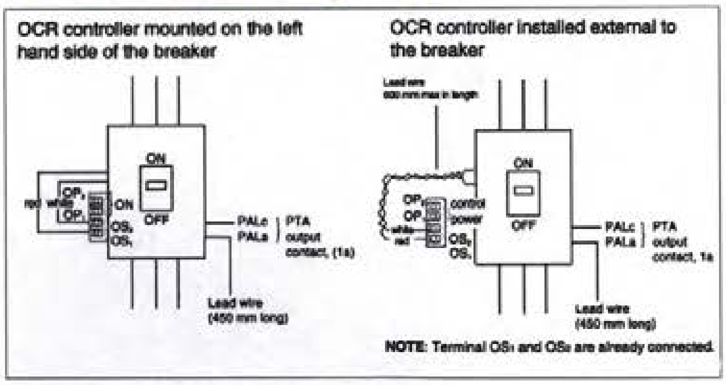
Control power source

Rated voltage 100-120 V AC or 200-240 V AC

Consumption 2 VA

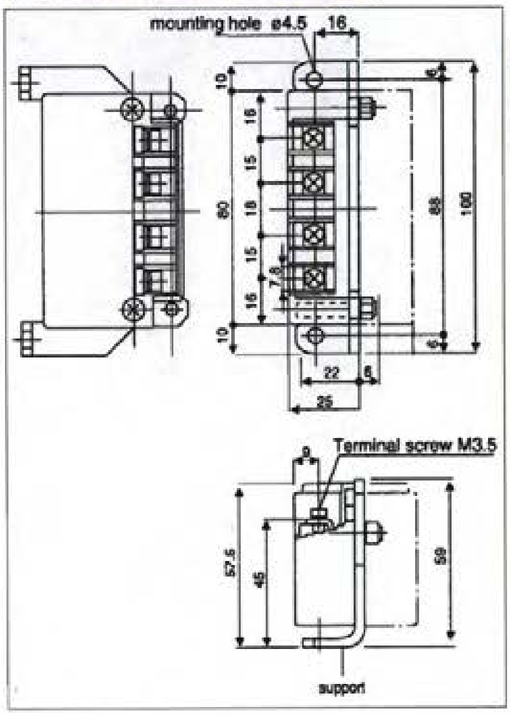
Note: The permissible range of control power is 85-110 % of the rated voltage.

OCR controller connection diagram [1] [2]



Notes: [1] Standard torque for the terminal screws M3.5 – 0.88–1.18 Nm (9–12 Kgf.cm).
[2] Connected cable size – Max 2.0 mm².

OCR controller dimensions (Installed external to the breaker)



7

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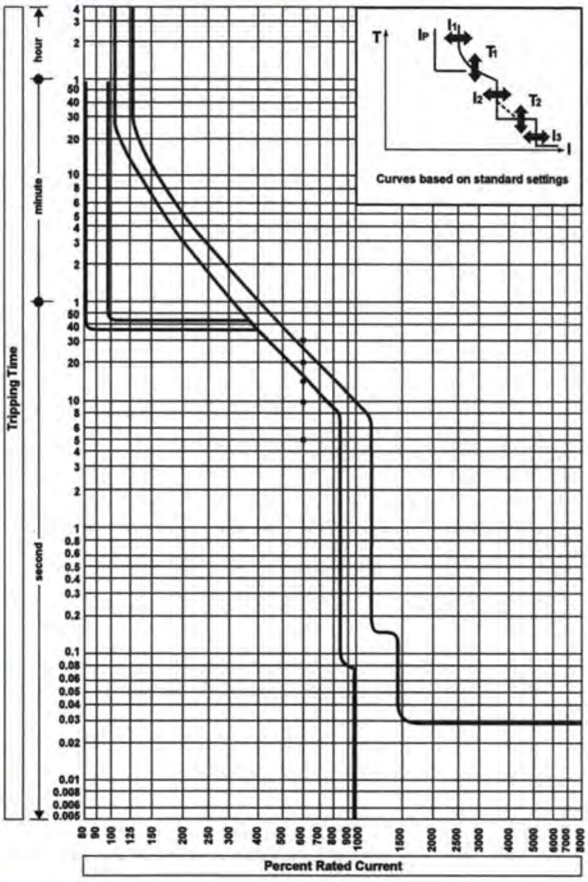
MCCB Technical data

Time/Current curves XS400, XH400, TL400NE, XV400

Time/current characteristic curves



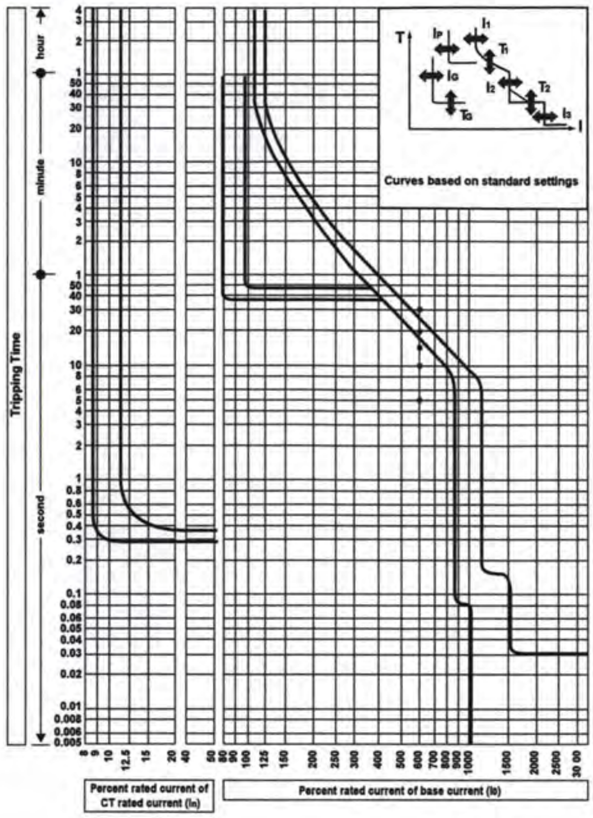
Overcurrent tripping characteristics

CT rated current (A) (I_n)	250, 400
Base current setting (A) (I_0)	(I_n) x (0.63-0.8-1.0)
Long time-delay pick-up current (A): (I_1)	(I_0) x (0.8-0.85-0.9-0.95-1.0) Non-tripping at (I_1) setting x 105 % and below. Tripping at 125 % and above.
Long time-delay time settings (S) (T_1)	(5-10-15-20-30) at (I_1) x 600 % current. Setting tolerance ± 20 %
Short time-delay pick-up current (A): (I_2)	(I_0) x (2-4-6-8-10) Setting tolerance ± 15 %
Short time-delay time settings (S) (T_2)	Opening time (0.1, 0.15, 0.2, 0.25, 0.3) in the definite time-delay. Total clearing time is +50 ms and resettable time - 20 ms for the time-delay setting
Instantaneous trip pick-up current (A) (I_3)	Continuously adjustable from (I_0) x (3 to 12) Setting tolerance ± 20 %
• Pre-trip alarm pick-up current (A) (I_P)	(I_1) x (0.7, 0.8, 0.9, 1.0) Setting tolerance ± 10 %
• Pre-trip alarm time setting (S) (T_P)	40 fixed definite time-delay. Setting tolerance ± 10 %

Note: • Optional.
Underlined values will be applied as standard ratings unless otherwise specified when ordering.

XS630, XH630, XS800, XH800, XV630, XV800

Time/current characteristic curves



Overcurrent tripping characteristics

CT rated current (A) (I_n)	630, 800
Base current setting (A) (I_0)	(I_n) x (0.63-0.8-1.0)
Long time-delay pick-up current (A): (I_1)	(I_0) x (0.8-0.85-0.9-0.95-1.0) Non-tripping at (I_1) setting x 105 % and below. Tripping at 125 % and above.
Long time-delay time settings (S) (T_1)	(5-10-15-20-30) at (I_1) x 600 % current. Setting tolerance ± 20 %
Short time-delay pick-up current (A): (I_2)	(I_0) x (2-4-6-8-10) Setting tolerance ± 15%
Short time-delay time settings (S) (T_2)	Opening time (0.1, 0.15, 0.2, 0.25, 0.3) in the definite time-delay. Total clearing time is +50 ms and resettable time - 20 ms for the time-delay setting
Instantaneous trip pick-up current (A) (I_3)	Continuously adjustable from (I_0) x (3 to 12) Setting tolerance ± 20 %
• Pre-trip alarm pick-up current (A) (I_P)	(I_1) x (0.7, 0.8, 0.9, 1.0) Setting tolerance ± 10 %
• Pre-trip alarm time setting (S) (T_P)	40 fixed definite time-delay. Setting tolerance ± 10 %
• Ground fault trip pick-up current (A) (I_G)	Continuously adjustable from (I_n) x (0.1 to 0.4) Setting tolerance ± 15 %
• Ground fault trip time setting (S) (T_G)	Opening time (0.1-0.2-0.3-0.4-0.8) in the definite time-delay. Total clearing time is +50 ms and resettable time is - 20 ms for the time-delay settings

Note: • Optional.
Underlined values will be applied as standard ratings unless otherwise specified when ordering.

7

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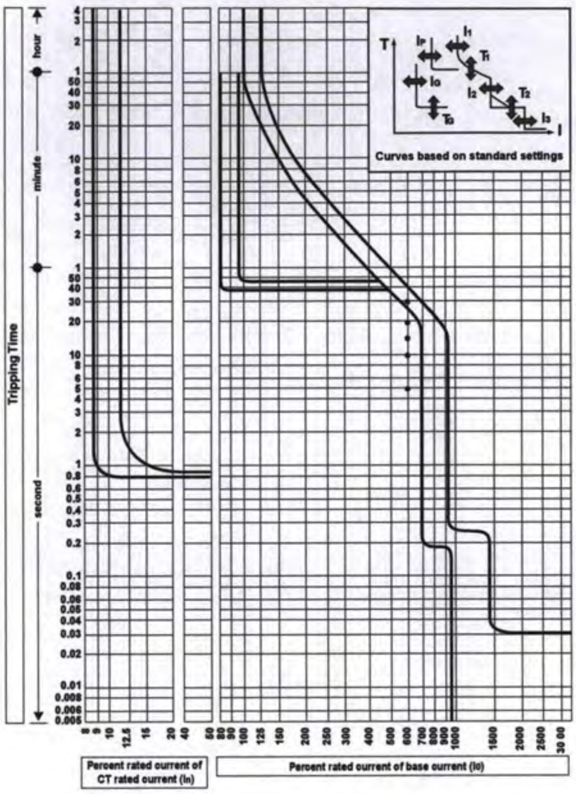
MCCB Technical data

Microprocessor based characteristics and adjustments

XS1250SE, XS1600SE, XS2000NE, XS2500NE, TL630NE, TL800NE, TL1250NE & XV1250

Time/current characteristic curves



Overcurrent tripping characteristics

CT rated current (A) (I_n)	1000, 1250, 1600, 2000, 2500
Base current setting (A) (I_0)	(I_n) x (0.63-0.8-1.0)
Long time-delay pick-up current (A): (I_1)	(I_0) x (0.8-0.85-0.9-0.95-1.0) Non-tripping at (I_1) setting x 105 % and below. Tripping at 125 % and above.
Long time-delay time settings (S) (T_1)	(5-10-15-20-30) at (I_1) x 600 % current. Setting tolerance ± 20 %
Short time-delay pick-up current (A): (I_2)	(I_0) x (2-4-6-8-10) Setting tolerance ± 15 %
Short time-delay time settings (S) (T_2)	Opening time (0.1, 0.15, 0.2, 0.25, 0.3) in the definite time-delay. Total clearing time is +50 ms and resettable time - 20 ms for the time-delay setting
Instantaneous trip pick-up current (A) (I_3)	Continuously adjustable from (Io) x (3 to 12) Setting tolerance ± 20 %
• Pre-trip alarm pick-up current (A) (I_P)	(I_1) x (0.7, 0.8, 0.9, 1.0) Setting tolerance ±10 %
• Pre-trip alarm time setting (S) (T_P)	40 fixed definite time-delay. Setting tolerance ±10 %
• Ground fault trip pick-up current (A) (I_G)	Continuously adjustable from (I_n) x (0.1 to 0.4) Setting tolerance ± 15 %
• Ground fault trip time setting (S) (T_G)	Opening time (0.1-0.2-0.3-0.4-0.8) in the definite time-delay. Total clearing time is +50 ms and resettable time is - 20 ms for the time-delay settings

Note: • Optional.
Underlined values will be applied as standard ratings unless otherwise specified when ordering.

7

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MCCB Technical data

Time/Current curves – Mathematical analysis

MCCB curves

A microprocessor MCCB has three major regions on its overcurrent tripping characteristic, namely Long Time Delay (LTD) for overload protection, Short Time Delay (STD) and Instantaneous (INST), both for short-circuit protection.

The following is an insight into how these curves interact and could act as a guide for hand-drawing the curves. TemCurve Selectivity Analysis Software is available for computerised generation of curves (refer to page 7 - 24).

Firstly consider the following basic characteristic curve shown in figure 1.

The LTD takes the form of a curve and has the following characteristic equation:

$(I^2-1).\ t = k$

where 'k' is a constant. To determine k, the calibration point of the LTD should be used, i.e. $t = T_1$ at $I_1 = 6$ (600 %).

IEC - 60947 - 2 states that a breaker must not trip below 105 % of its rated current, and always trip at 130 % of its rated current.
Terasaki microprocesssor MCCBs however are calibrated to trip between 105 % and 125 %, giving them a higher degree of accuracy. If the middle point is taken then the pick-up of the MCCB is 115 % of its rated current.

The STD and INST parts of the curve can be drawn more easily as they are simply a series of horizontal and vertical lines determined by the I_2 and T_2 settings for the STD, and I_3 setting for the INST.

Example

If we assume that we have:

XS1250SE with 1250A CTs and

$I_0 = 1,\ I_1 = 0.8,\ T_1 = 30$ secs,

$I_2 = 8,\ T_2 = 0.2$ sec and

$I_3 = 1_2$ (dial setting on OCR)

then the characteristic curve can be constructed as follows.

To draw the LTD we firstly need to determine the constant k, as follows:

$k = (I^2 - 1)\ \ t = (6^2 - 1)\ \ 30 = 1050$

giving the characteristic equation:

$(I^2 - 1)\ \ t = 1050$

By simple arithmetic the tripping times for each level of overload can now be determined.

For 400 % overload (for the example this is equivalent to 1250 x 1.0 x 0.8 x 4 = 400 A).

$$t = \frac{1050}{(I^2 - 1)} = \frac{1050}{(4^2 - 1)} = 70 \text{ secs}$$

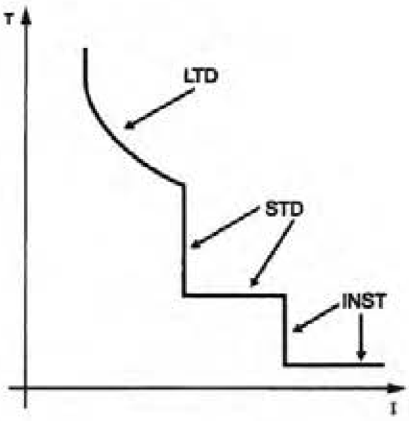
The STD and INST can be constructed as follows with

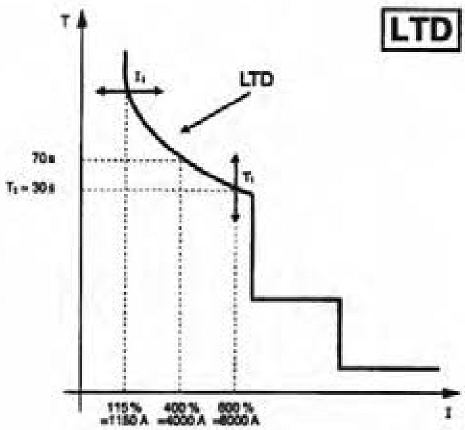
$I_2 = I_n \times I_0 \times I_2$

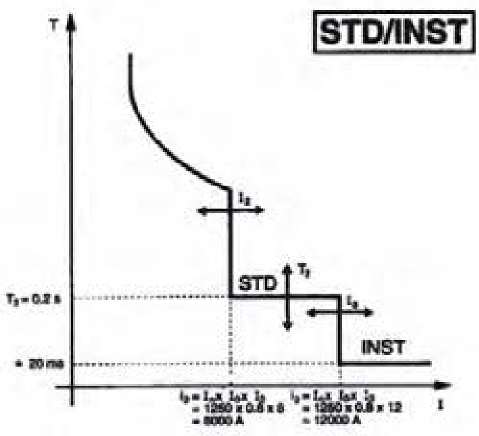
$I_3 = I_n \times I_0 \times I_3$

Please note that 20 ms is taken as an average time for the INST trip of the MCCB as it is the maximum time it will take the MCCB to trip. In practice the breaker will open much faster, particularly at high faults where the current limiting qualities of the MCCB become more effective.

Fig. 1







7

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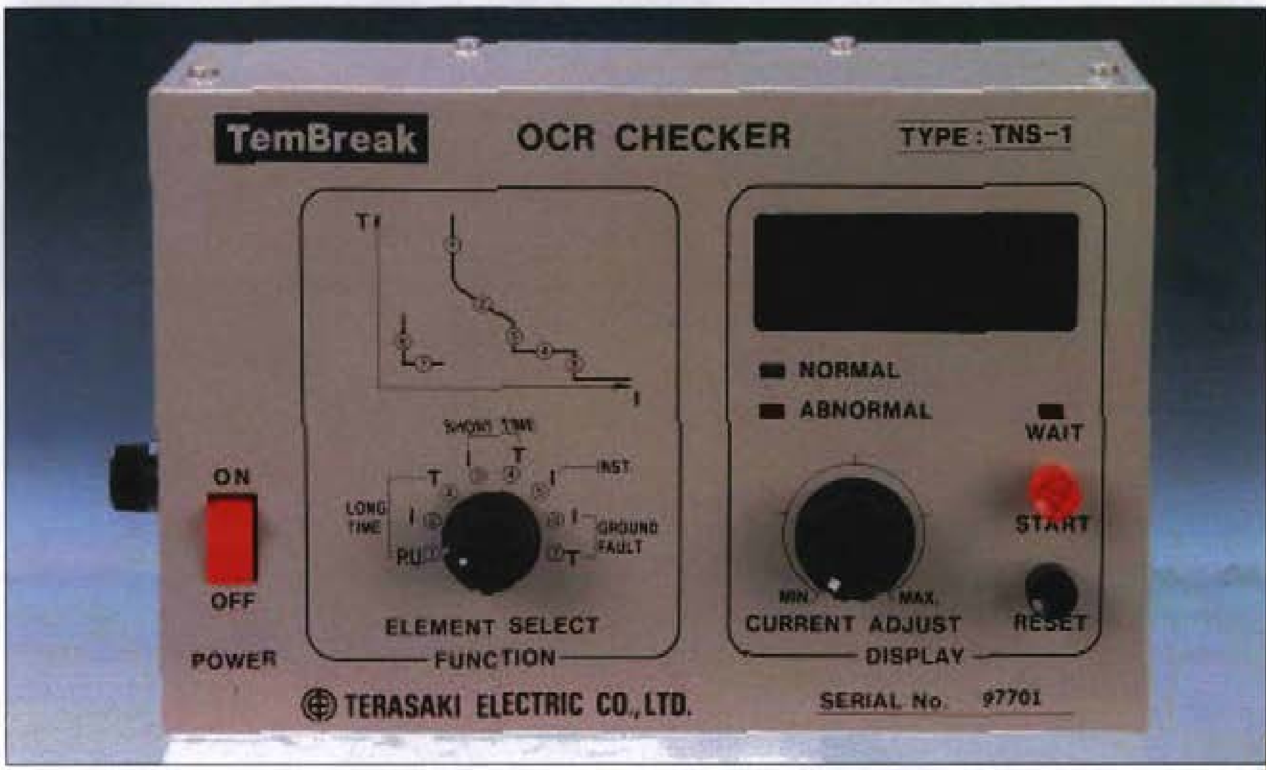
MCCB Technical data

OCR checker, inspection and maintenance



7

The TemBreak (Electronic) OCR checker, Type TNS-1, is a portable easy-to-use instrument for field testing the trip functions.

It checks the pick-up current and tripping time value of the LTD, STD, INST and GFT functions.

Ratings and specifications

Power source	100-110 V, 220-240 V AC single phase 50/60 Hz
Power consumption	30 VA
Application	LTD function check (set current and trip time values) STD function check (set current and trip time values) INST function check (set current value) GFT function check (set current and trip time values)
Measurement of set current values	Display 3-digit digital display Range 0-900 mA
Measurement of tripping time values	Range 0.00-99.9 seconds
Outline dimensions (mm)	200 W x 84 H x 130 D
Weight	2.7 kg

NHP

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NOW with AutoCAD output and complete device listing

TemCurve

Selectivity Analysis Software

Circuit breaker selection and set-up can be a laborious and time-consuming task. NHP has ensured that **TemCurve** 4.0, for "Windows™ 98, 2000, NT and XP is now even simpler to operate.

Hence, accurate results can be gained in a matter of minutes.

The database within **TemCurve** holds the characteristic curves for all Terasaki devices presently available from NHP. In addition to this, the extensive database of non-Terasaki devices allows you to produce accurate grading from the transformer primary side to the point of final distribution.

High quality prints can be output, including the characteristic curves for each chosen device, as well as a complete list of device settings.

Our objective is to provide you with the tools necessary to ensure your time is managed as effectively and efficiently as possible.

TemCurve has been developed wholly by NHP for the Australian market, but will also be used within the Terasaki organisation throughout the world.

For further information please contact your local NHP office or agent.

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MCCB Technical data

TemBreak XM30PB

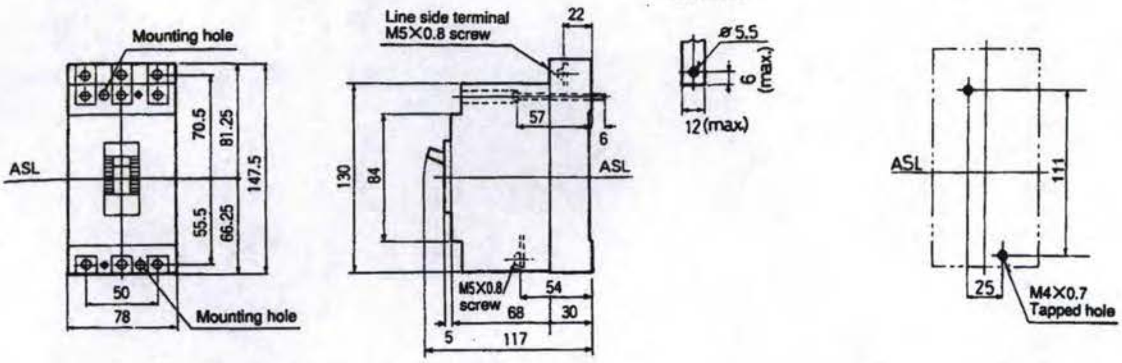
ASL: Arrangement standard line
HL: Handle frame centre line

Outline dimensions (mm)

Front connected (standard)

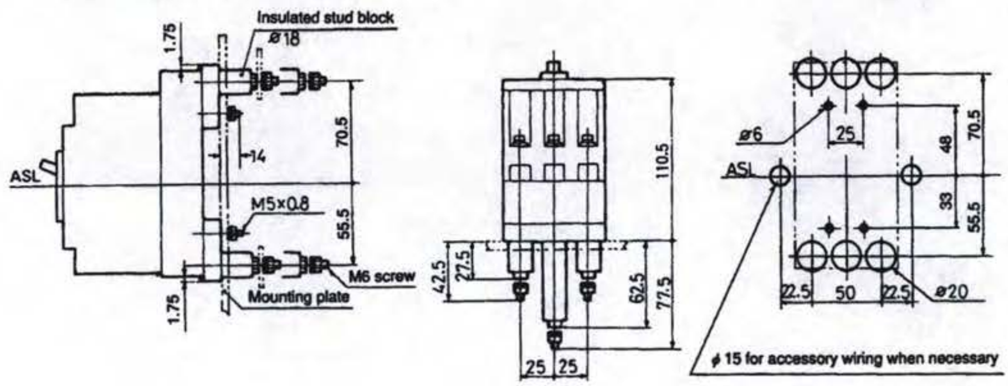
Preparation of conductor

Drilling plan

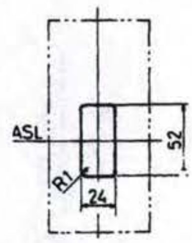


Rear connected (optional)

Drilling plan



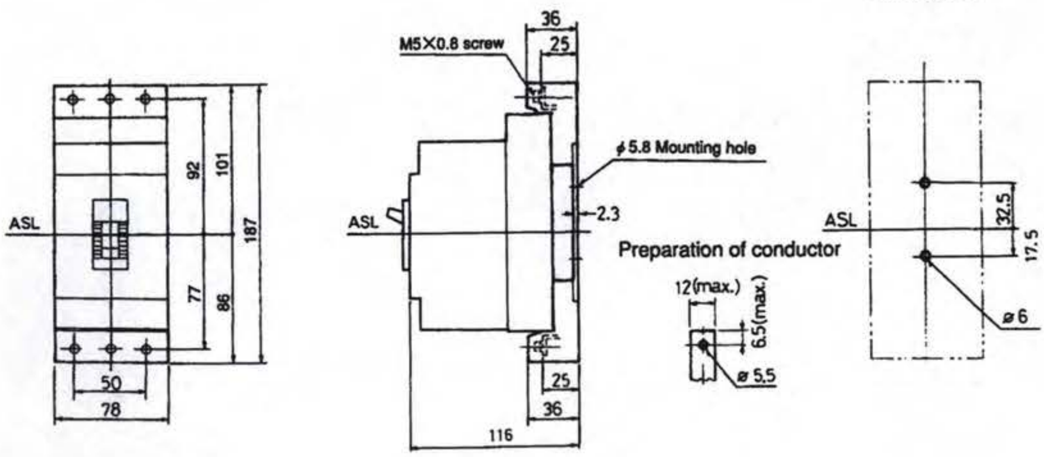
Panel cut-out



Panel cut-out dimensions shown give an allowance of 1.0 mm around the handle escutcheon.

Plug-in (optional)

Drilling plan



7

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MCCB Technical data

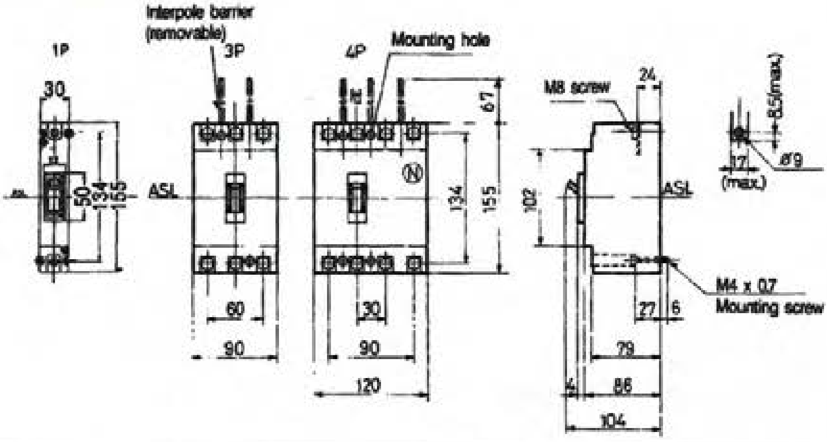
TemBreak XS125CS, CJ, NS, NJ, XH125NJ, PJ and TL30F MCCBs

Outline dimensions (mm)

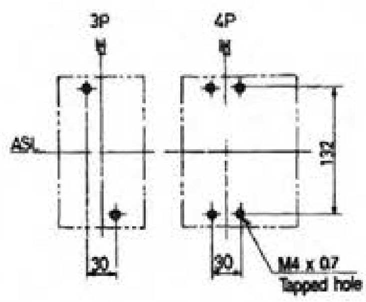
ASL: Arrangement standard line
ꟷ: Handle frame centre line

Front connected (standard)

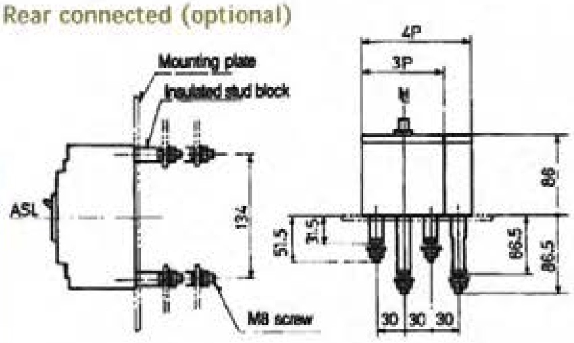
Note: XS125NS 1 pole only



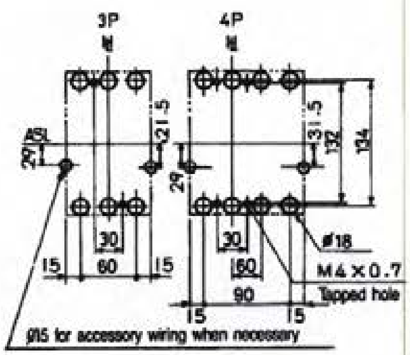
Drilling plan



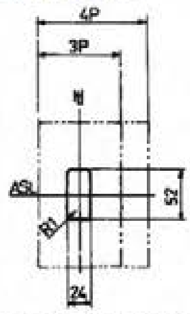
Rear connected (optional)



Drilling plan

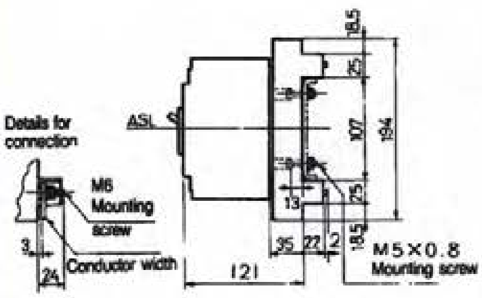


Panel cut-out

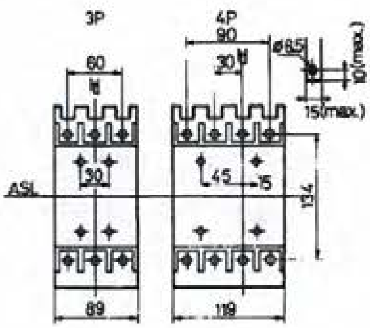


Panel cut-out dimensions shown give an allowance of 1.0 mm around the handle escutcheon.

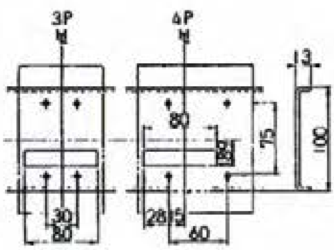
Plug-in (optional)



Mounting block



Drilling plan



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MCCB Technical data

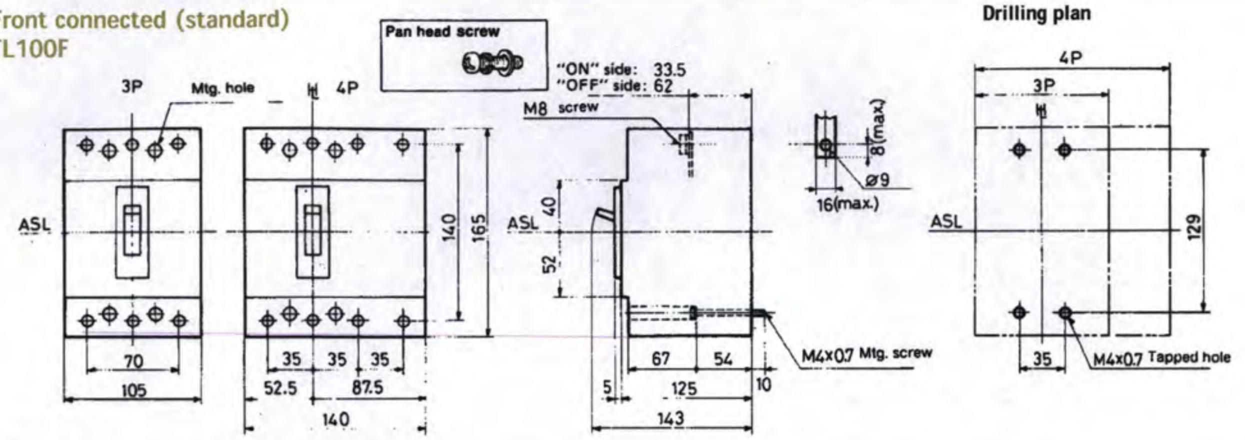
TemBreak TL100F/TL100EM – TL100NJ

ASL: Arrangement standard line
ℍ: Handle frame centre line

Outline dimensions (mm)

Front connected (standard)
TL100F

Drilling plan

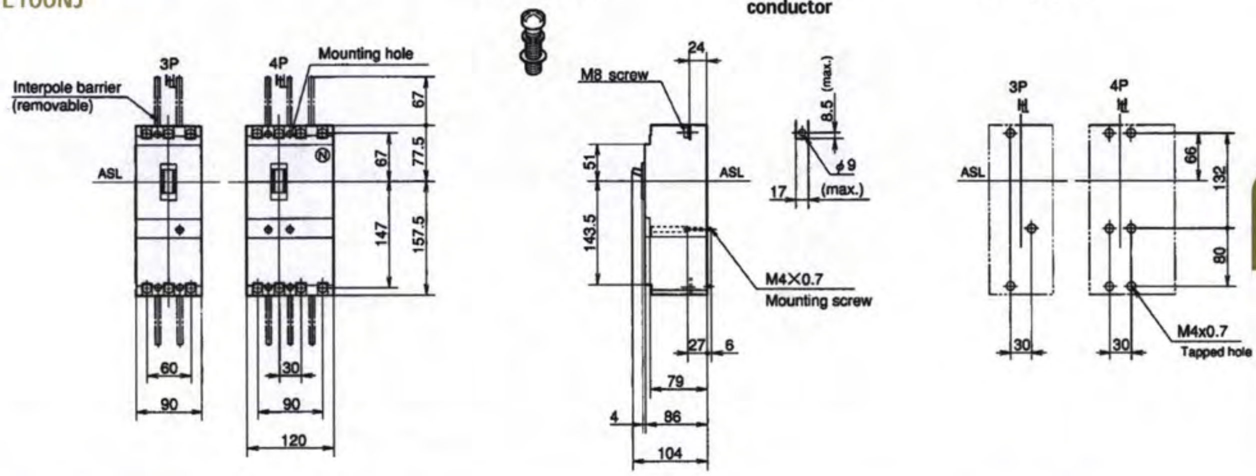


Front connected
TL100NJ

Pan head screw

Preparation of conductor

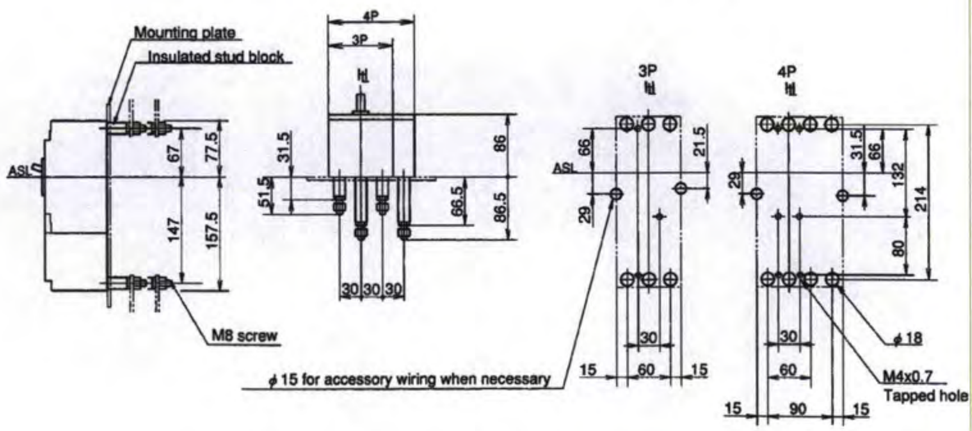
Drilling plan



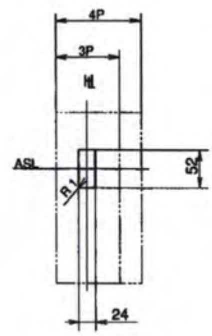
Rear connected

Bold stud type

Drilling plan



Panel cut-out



Panel cut-out dimensions shown give an allowance of 1.0 mm around the handle escutcheon.

Note: Interpole barriers standard on TL100NJ.

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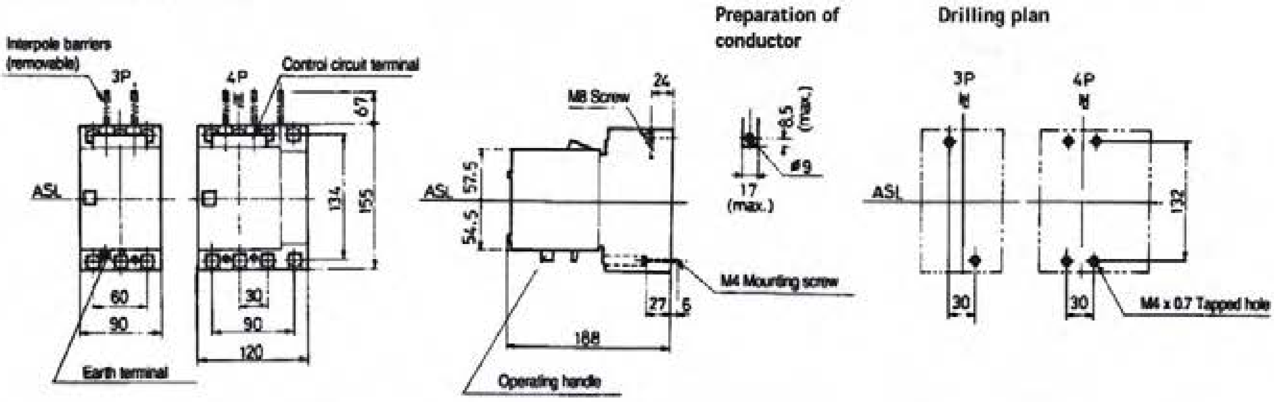
MCCB Technical data

Motor operators (XMB type) for XS125, XH125, TL100NJ, TL30F [1] [2]

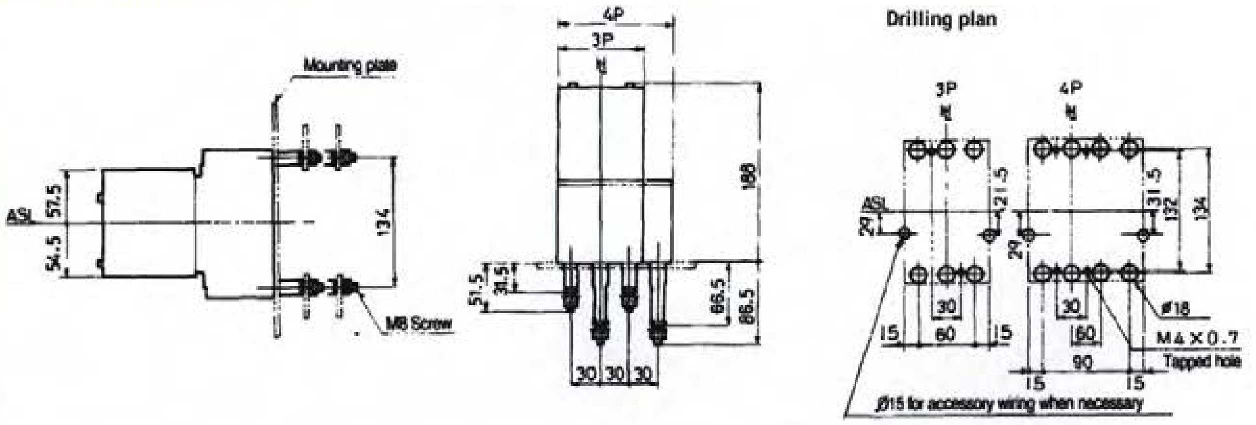
ASL: Arrangement standard line
℄: Handle frame centre line

Outline dimensions (mm)

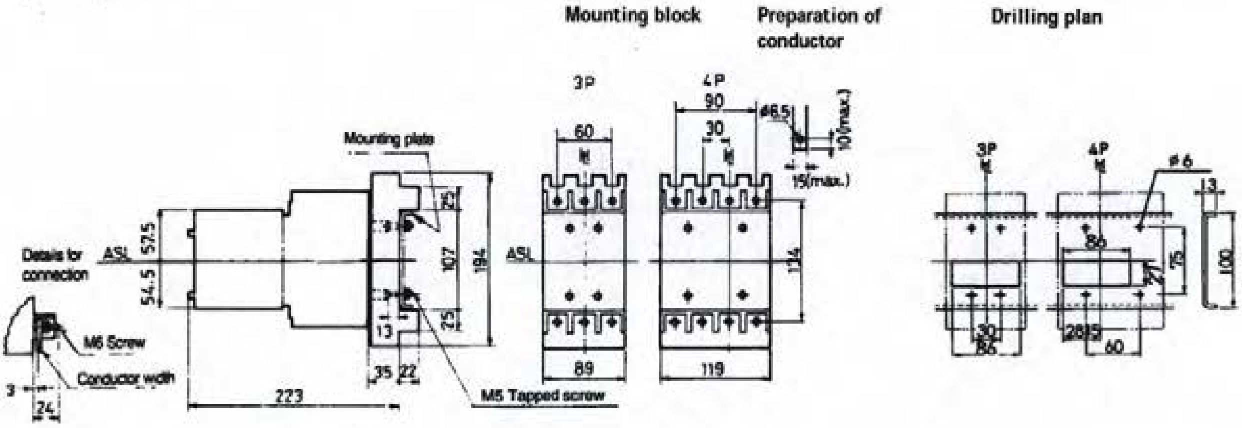
Front connected (standard)



Rear connected (optional)



Plug-in (optional)



Notes: [1] For dimensions of 7MB-3BA2 used for TL100F refer to NHP.
[2] Dimensions for TL100NJ not showing length of MCCB. Refer page 7 - 27.
Above outline dimensions are for AC motors. Contact NHP for details for DC motors.

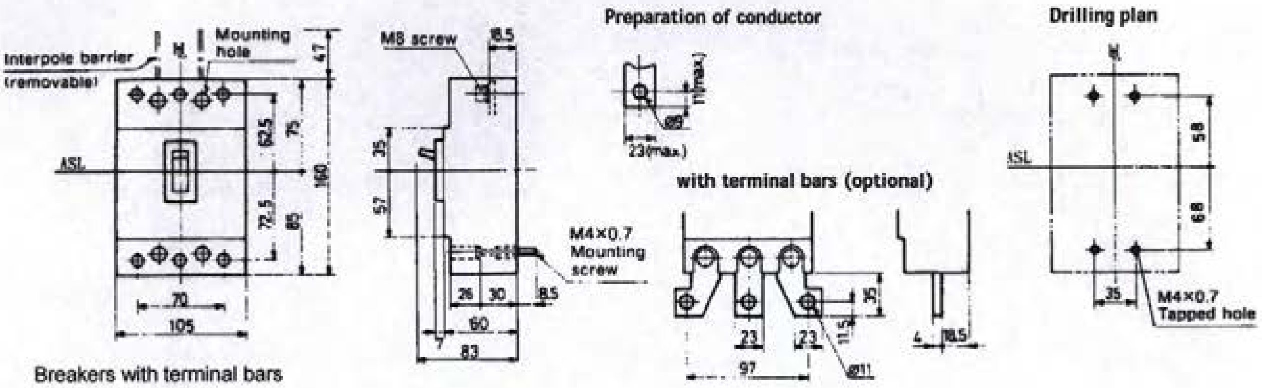
MCCB Technical data

TemBreak XE225NC

ASL: Arrangement standard line
℄: Handle frame centre line

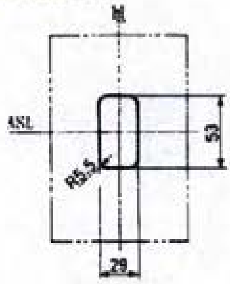
Outline dimensions (mm)

Front connected (standard)



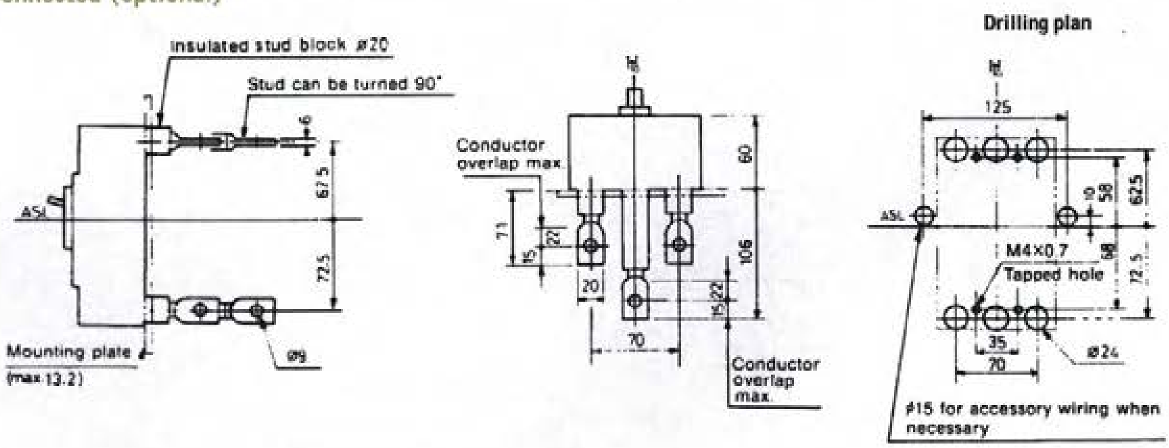
Breakers with terminal bars available on request

Panel cut-out



Panel cut-out dimensions shown give an allowance of 1.5 mm around the handle escutcheon.

Rear connected (optional)



Note: In the standard shipment mode, terminals on both the line side and the load side are in a horizontal orientation.

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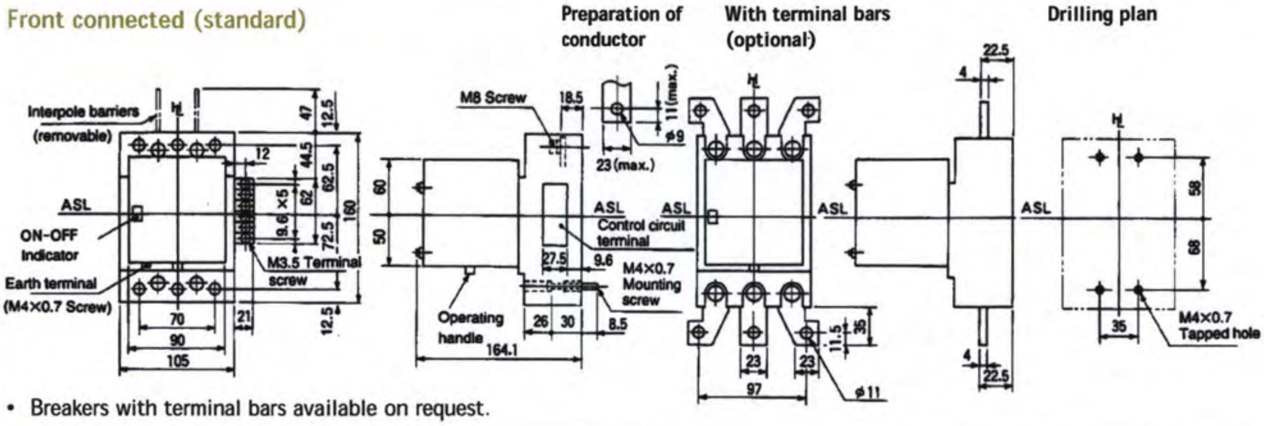
MCCB Technical data

Motor operators for XE225NC

ASL: Arrangement standard line
℄: Handle frame centre line

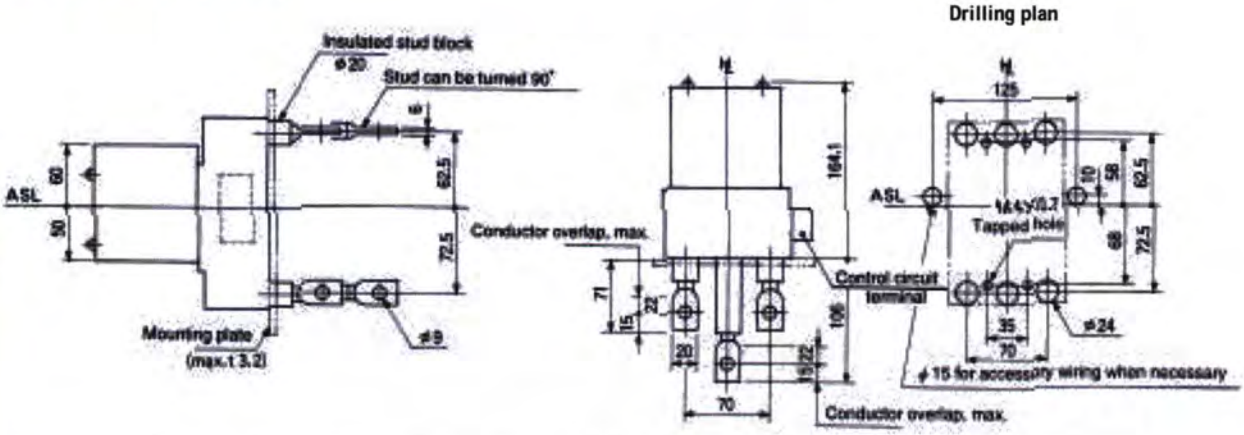
Outline dimensions (mm)

Front connected (standard)



• Breakers with terminal bars available on request.

Rear connected (optional)



Note: In the standard selection mode, terminals on both the line side and load side are in a horizontal orientation.

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MCCB Technical data

TemBreak XS250NJ

ASL: Arrangement standard line
℄: Handle frame centre line

Outline dimensions (mm)

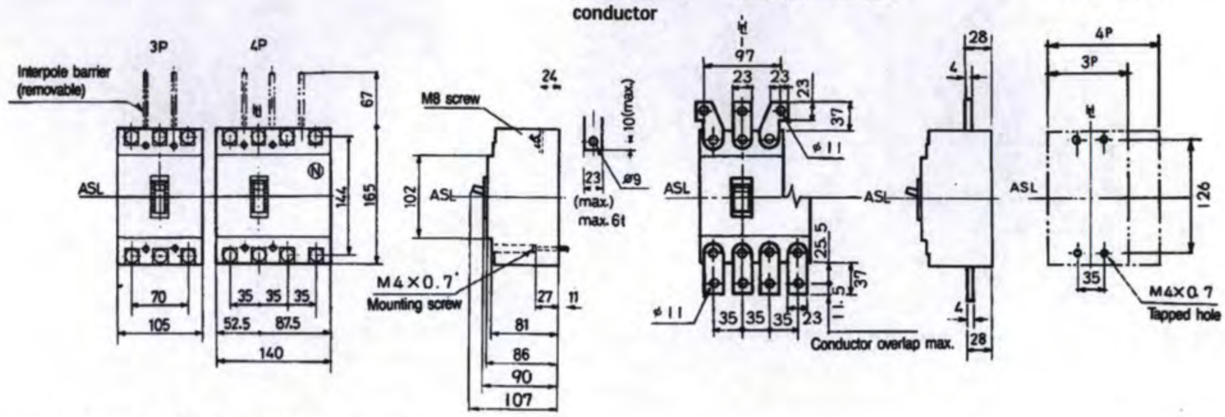
Front connected (standard)

(optional)

Preparation of conductor

With terminal bars

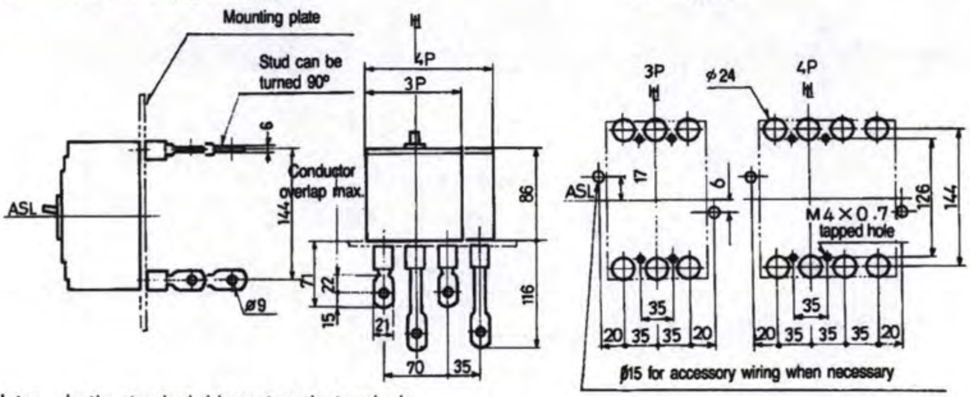
Drilling plan



Breakers with terminal bars available on request.

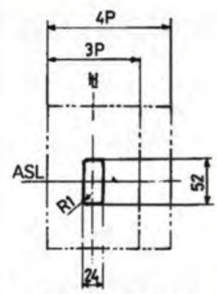
Rear connected (optional)

Drilling plan



Note: In the standard shipment mode, terminals on both the line side and the load side are in a horizontal orientation.

Panel cut-out

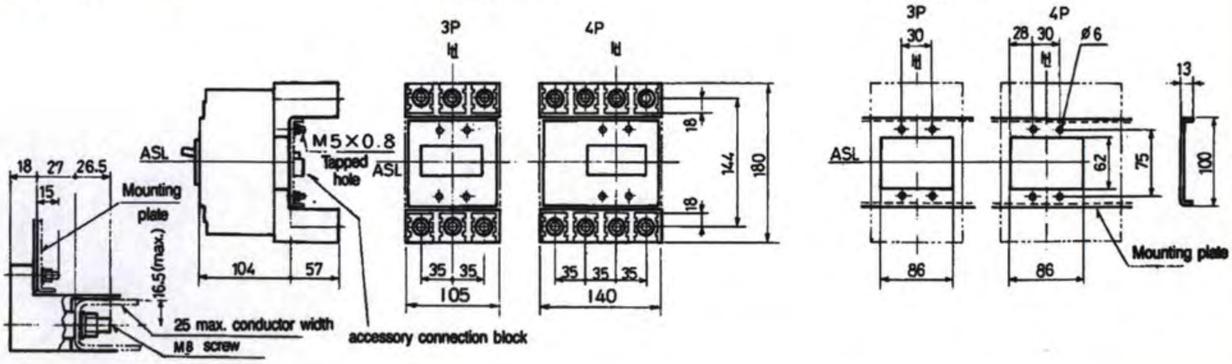


Panel cut-out dimensions shown give an allowance of 1.0 mm around the handle escutcheon.

Plug-in (optional)

Mounting block

Drilling plan



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MCCB Technical data

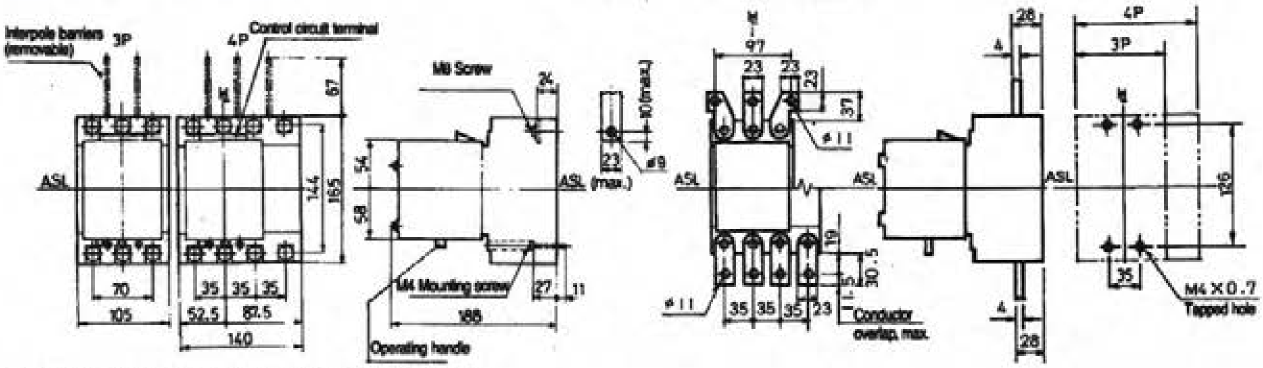
Motor operators (XMB type) for XS250NJ

ASL: Arrangement standard line
℄: Handle frame centre line

Outline dimensions (mm)

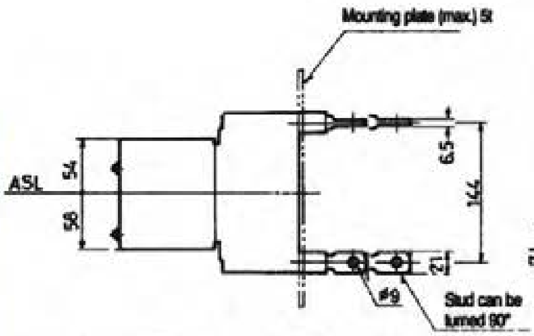
Front connected (standard)

Preparation of conductor | With terminal bars (optional) | Drilling plan



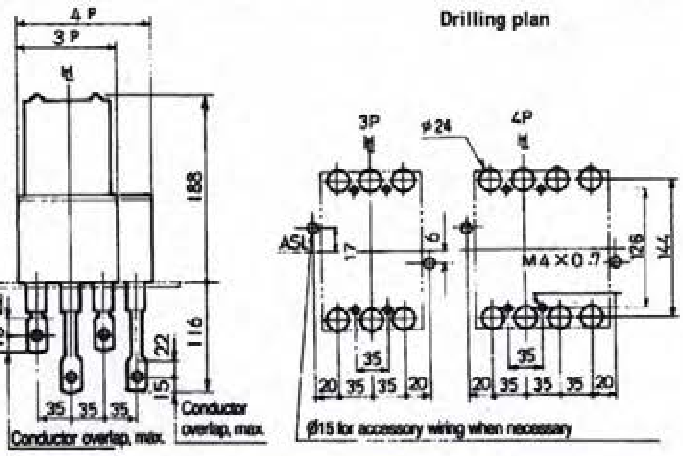
• Breakers with terminal bars available on request.

Rear connected (optional)



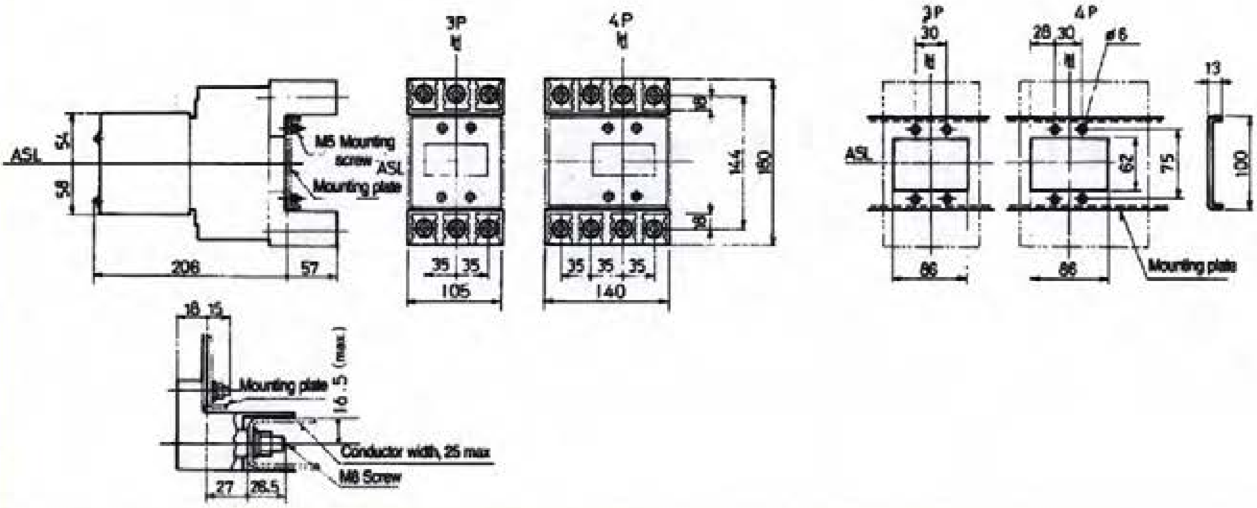
Note: In the standard selection mode, terminals on both the line side and the load side are in a horizontal orientation.

Drilling plan



Plug-in (optional)

Mounting block | Drilling plan



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

7

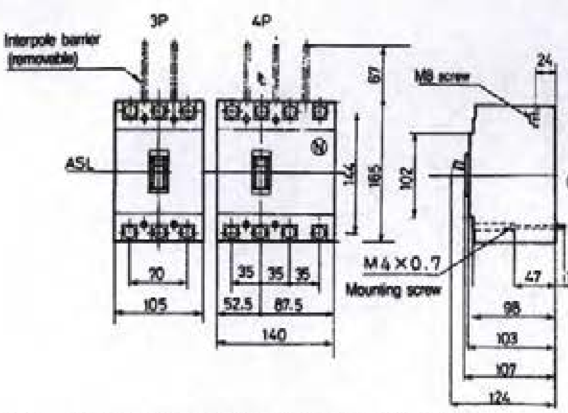
MCCB Technical data

TemBreak XH160PJ and XH250NJ

ASL: Arrangement standard line
℄: Handle frame centre line

Outline dimensions (mm)

Front-connected (standard)

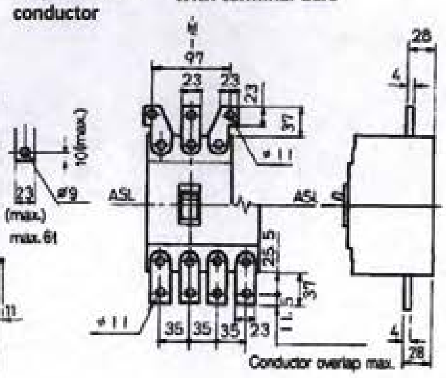


(optional)

Preparation of conductor

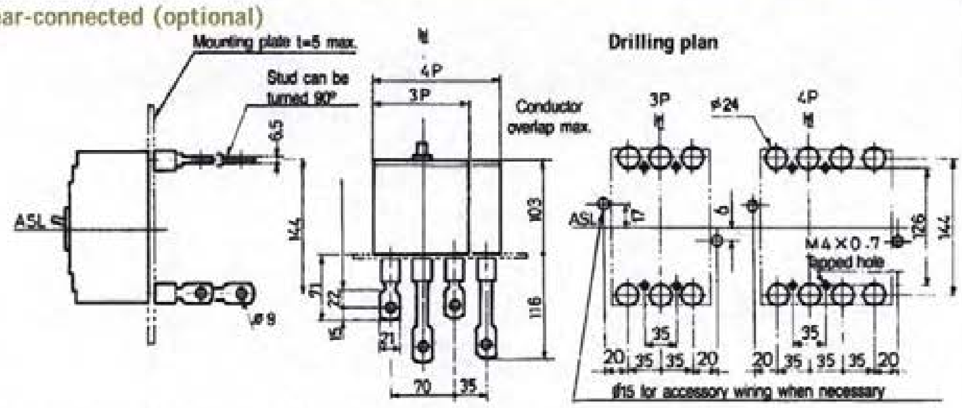
With terminal bars

Drilling plan



Note: Breakers with terminal bars available on request.

Rear-connected (optional)



Note: In the standard shipment mode, terminals on both the line side and the load side are in a horizontal orientation.

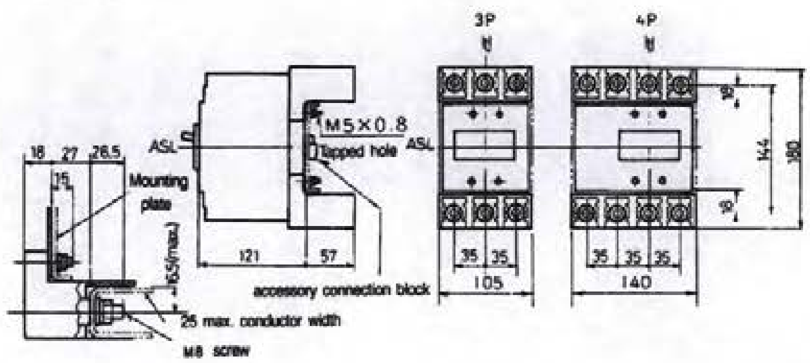
Panel cut-out

Panel cut-out dimensions shown give an allowance of 1.0 mm around the handle escutcheon.

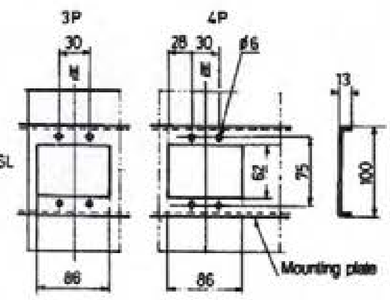
Plug-in (optional)

Details of connections

Mounting block



Drilling plan



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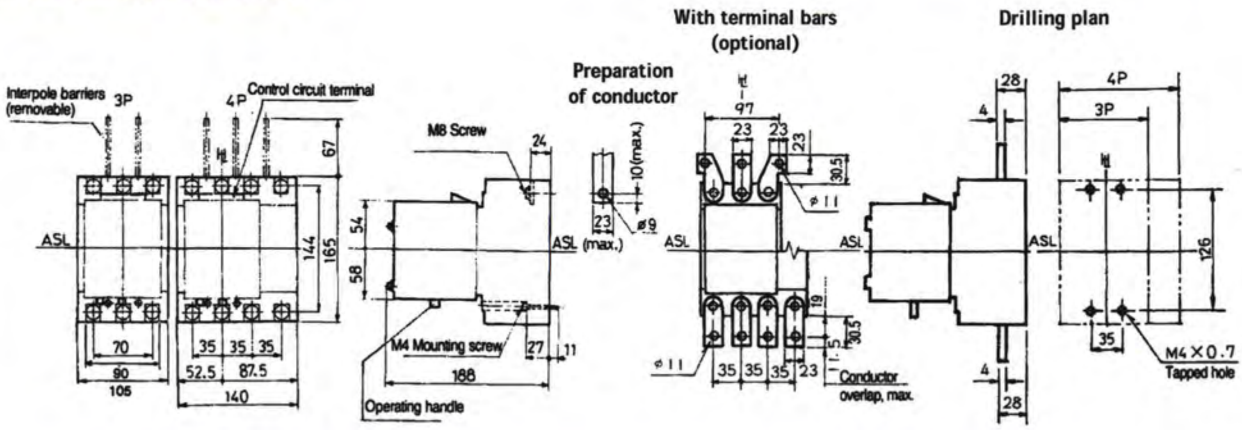
MCCB Technical data

Motor operators for XH160PJ and XH250NJ

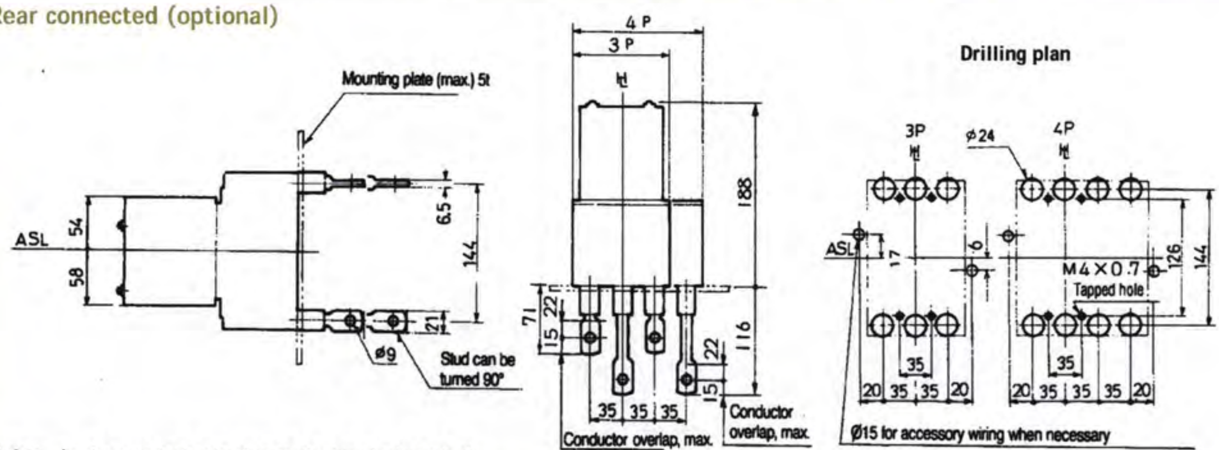
ASL: Arrangement standard line
Ⱶ: Handle frame centre line

Outline dimensions (mm)

Front connected (standard)

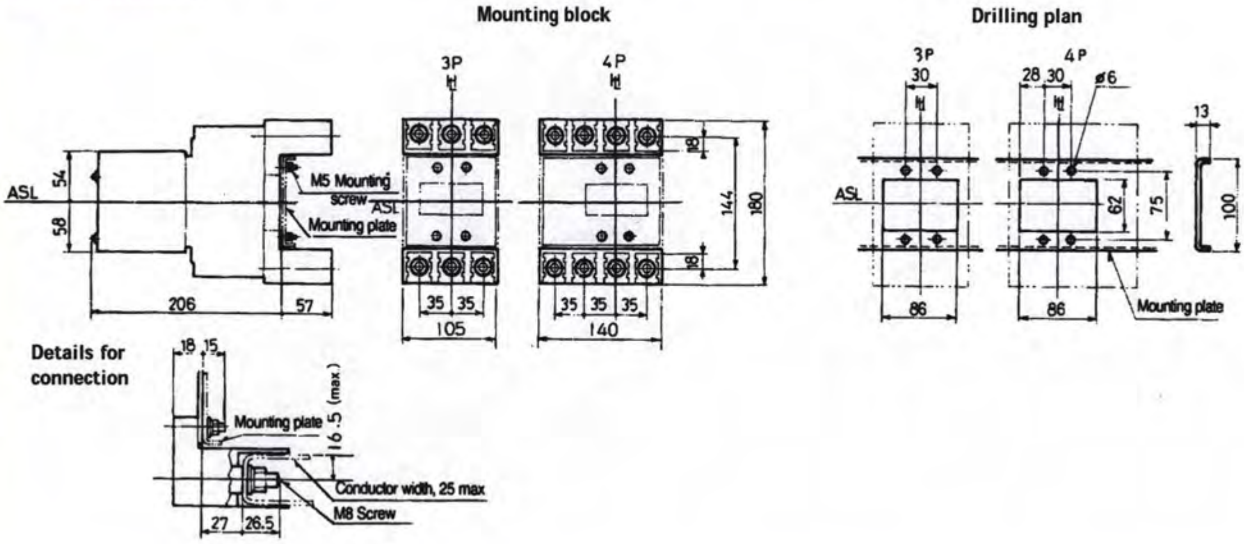


Rear connected (optional)



Note: In the standard selection mode, terminals on both the line side and the load side are in a horizontal orientation.

Plug-in (optional)



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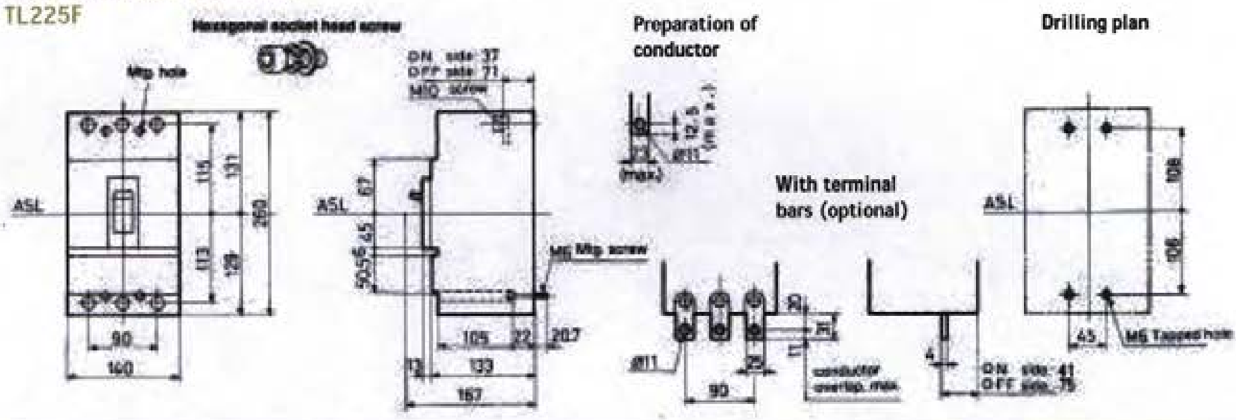
MCCB Technical data

TemBreak TL225F, TL250NJ

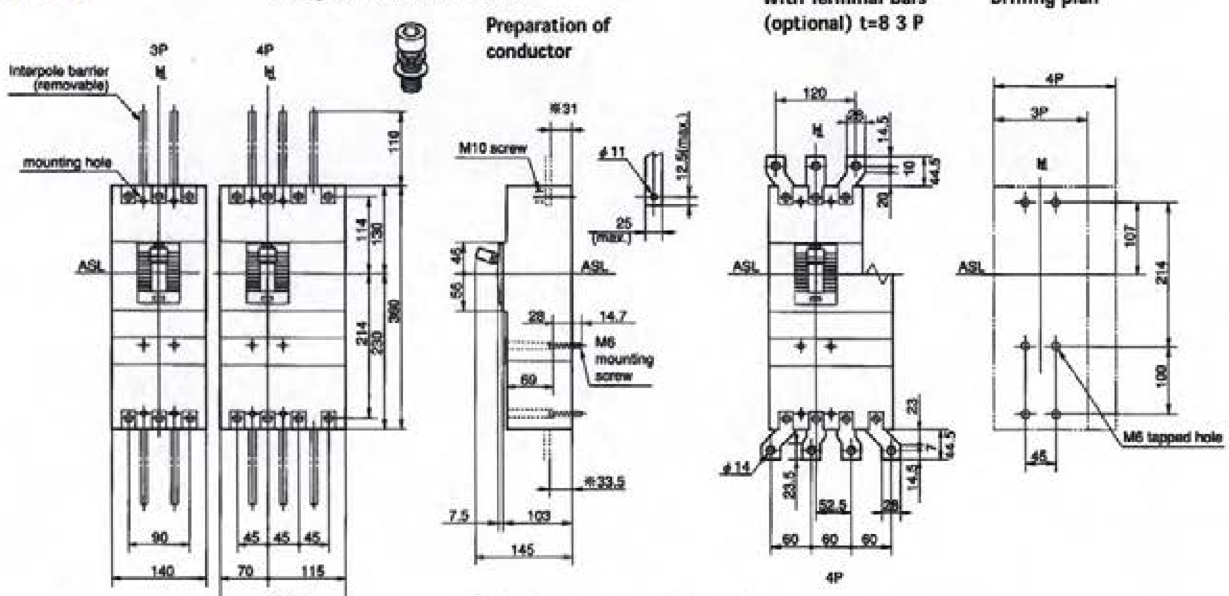
ASL: Arrangement standard line
℄: Handle frame centre line

Outline dimensions (mm)

Front connected (standard)
TL225F

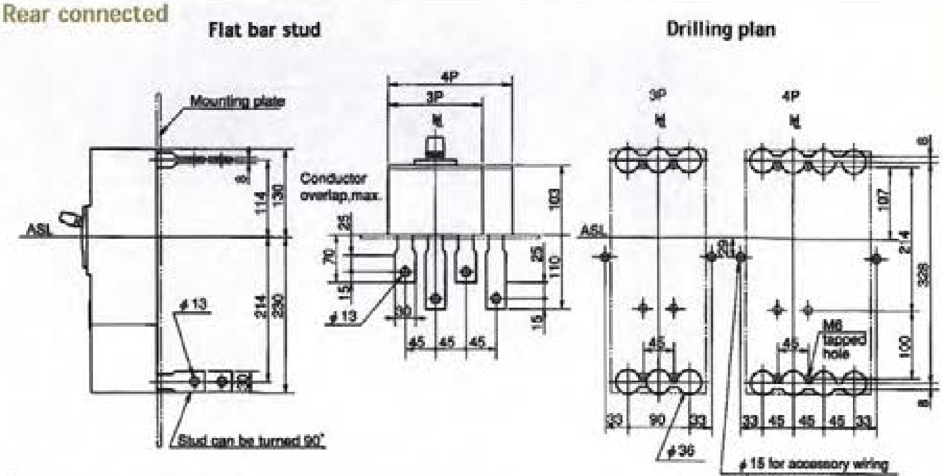


Front connected
TL250NJ



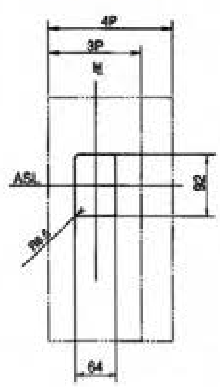
※Values for conductors or optional terminal bars

Rear connected



Note: In the standard selection mode, terminals on both the line side and the load side are in a horizontal orientation.

Panel cut-out



Panel cut-out dimensions shown give an allowance of 1.0 mm around the handle escutcheon.

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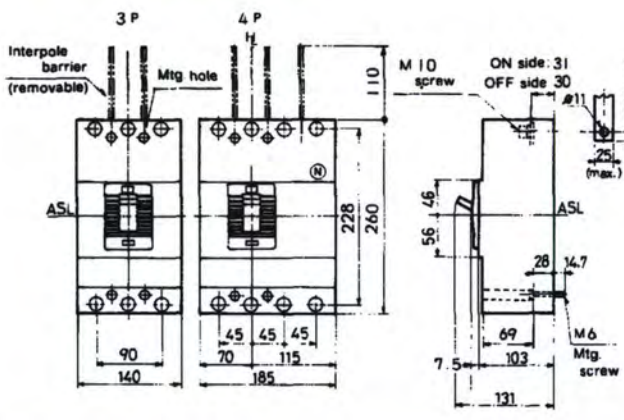
MCCB Technical data

TemBreak XS400, XH400, XH250PJ, XV400

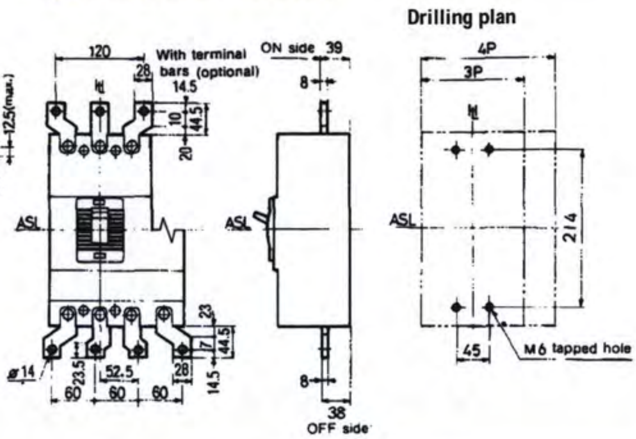
ASL: Arrangement standard line
H: Handle frame centre line

Outline dimensions (mm)

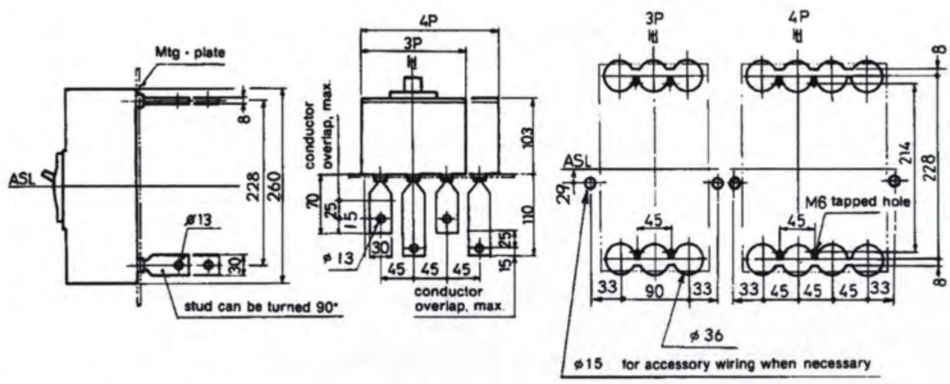
Front connected (standard)



Optional extension busbars



Rear connected (optional)

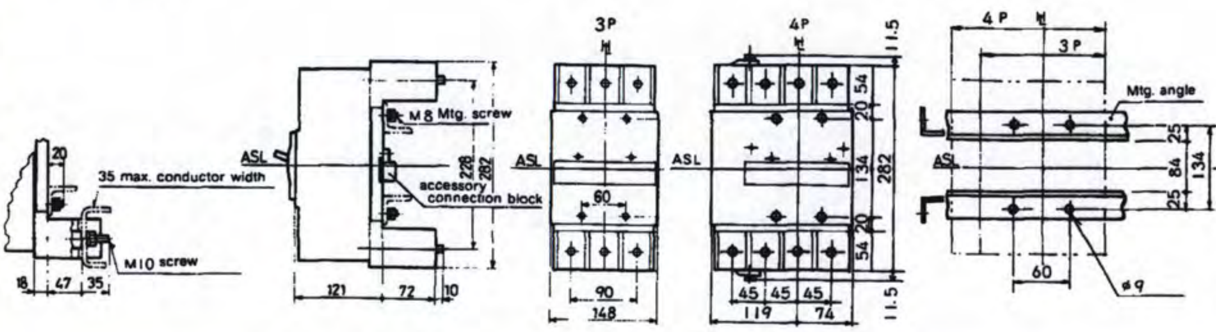


Note: In the standard selection mode, terminals on both the line side and the load side are in a horizontal orientation.

Panel cut-out

Panel cut-out dimensions shown give an allowance of 1.0 mm around the handle escutcheon.

Plug-in (optional)



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MCCB Technical data

TemBreak TL400NE

ASL: Arrangement standard line
ĦL: Handle frame centre line

Outline dimensions (mm)

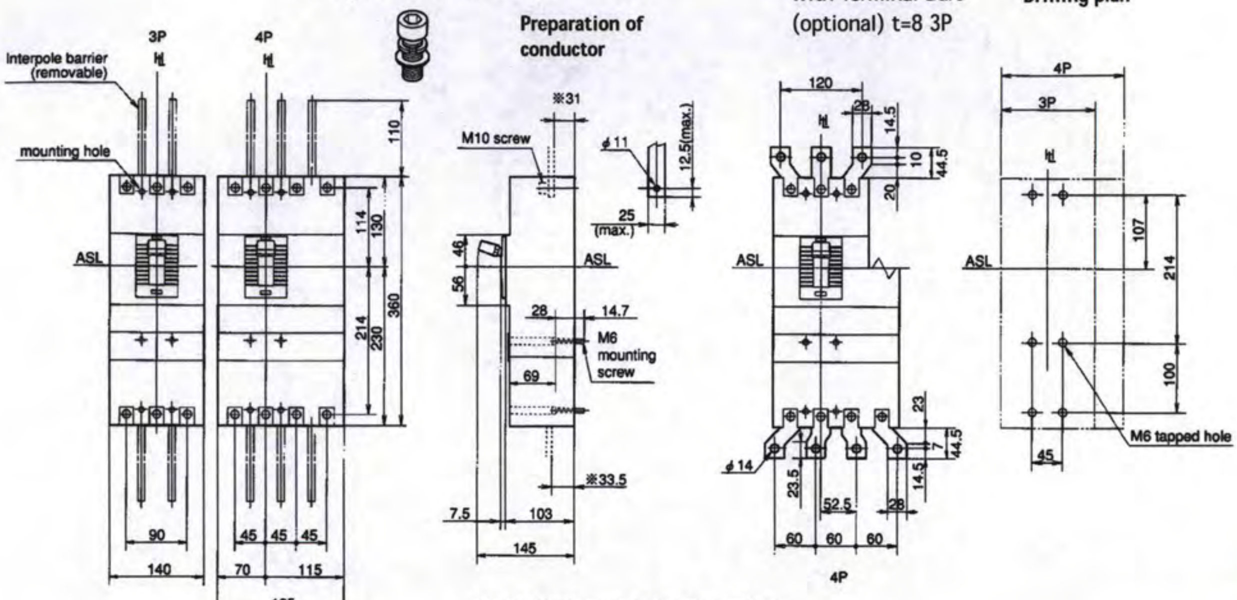
Front connected

Hexagonal socket head screw

Preparation of conductor

With Terminal Bars (optional) t=8 3P

Drilling plan

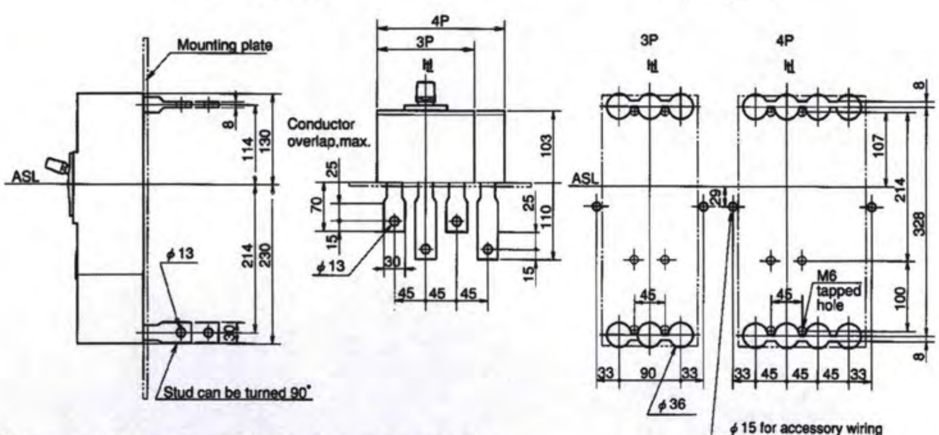


※Values for conductors or optional terminal bars

Rear connected

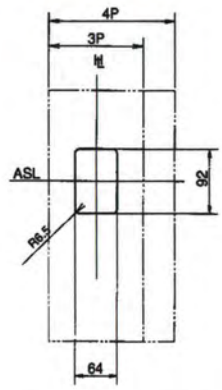
Flat bar stud

Drilling plan



Note: In the standard selection mode, terminals on both the line side and the load side are in a horizontal orientation.

Panel cut-out



Panel cut-out dimensions shown give an allowance of 1.0 mm around the handle escutcheon.

7

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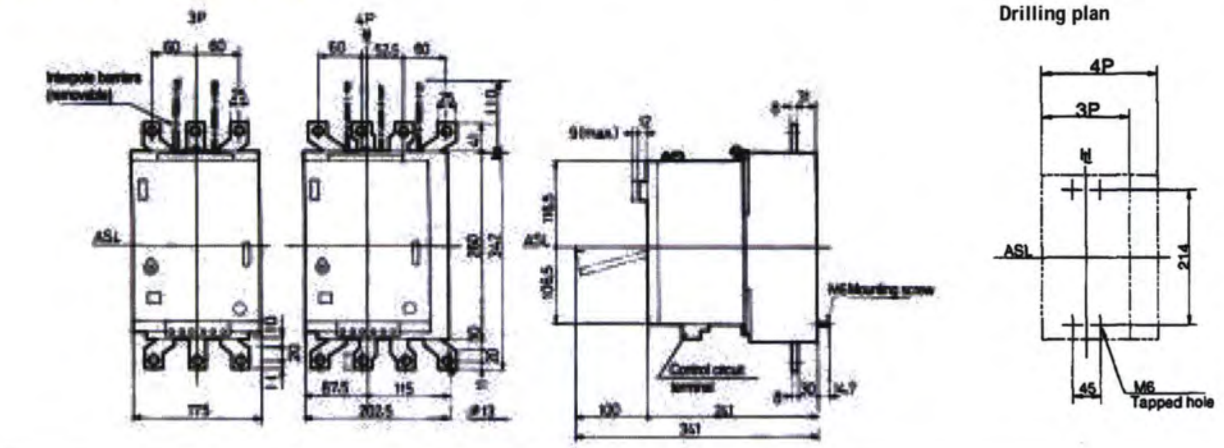
MCCB Technical data

Motor operators (XMC type) for XS400, XH400, XV400, TL250NJ, TL400NE [1])

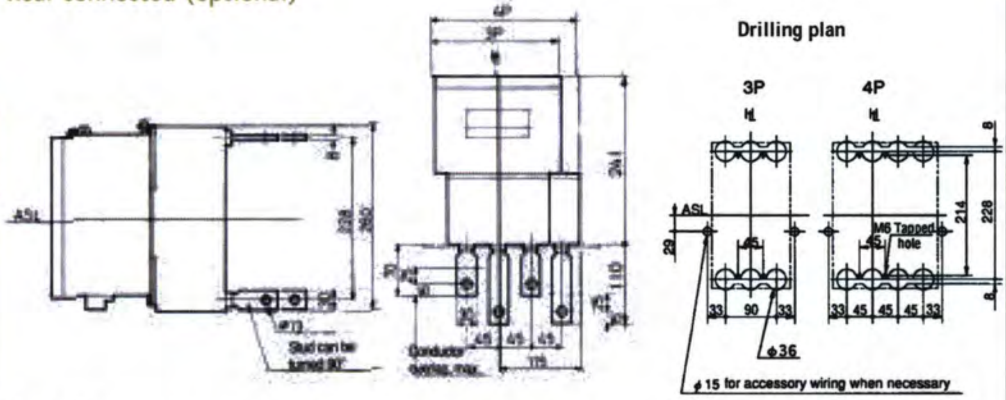
ASL: Arrangement standard line
℄: Handle frame centre line

Outline dimensions (mm)

Front connected (standard)

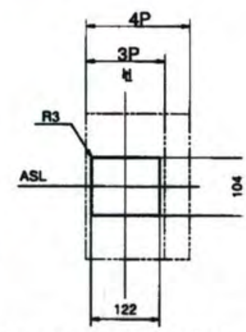


Rear connected (optional)



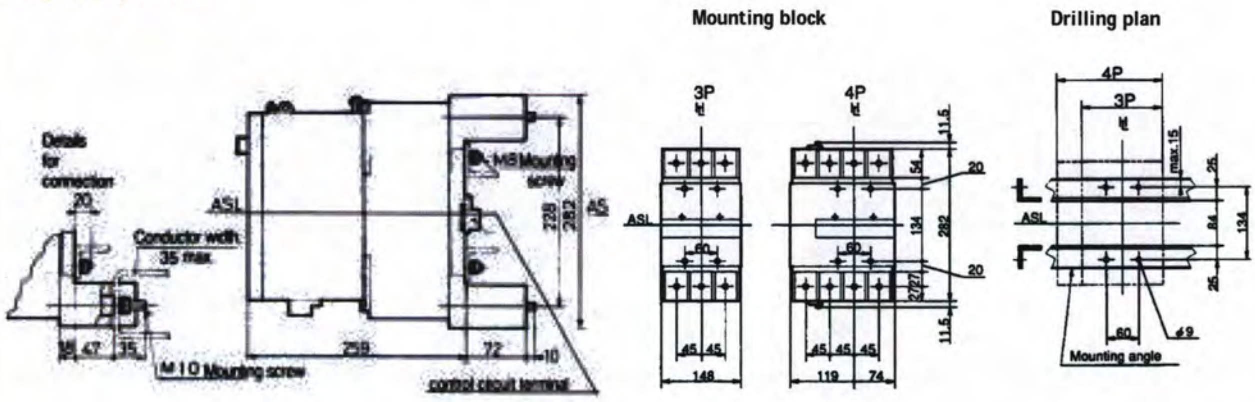
Note: In the standard selection mode, terminals on both the line side and the load side are in a horizontal orientation.

Panel cut-out



Panel cut-out dimensions shown give an allowance of 1.0 mm around the handle escutcheon.

Plug-in (optional)



Note: [1]) TL250NJ and TL400NE length dimension not shown.
Refer pages 7 - 35 and 7 - 37.

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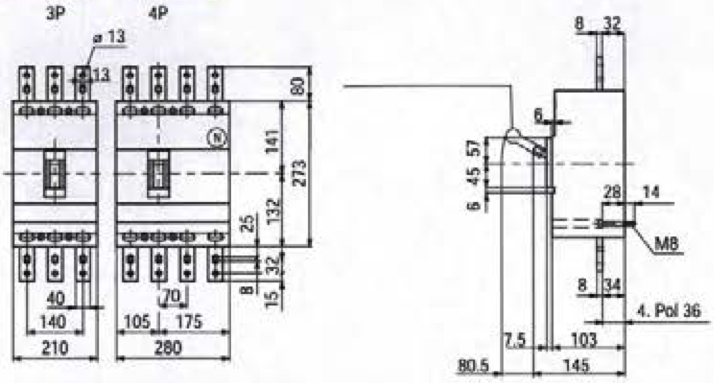
MCCB Technical data

TemBreak 630 AF XS630, XH630

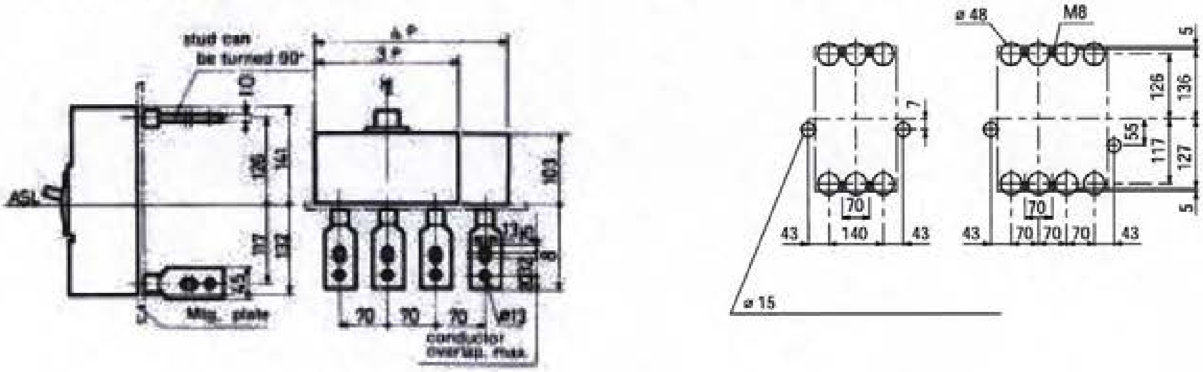
ASL: Arrangement standard line
℄: Handle frame centre line

Outline dimensions (mm)

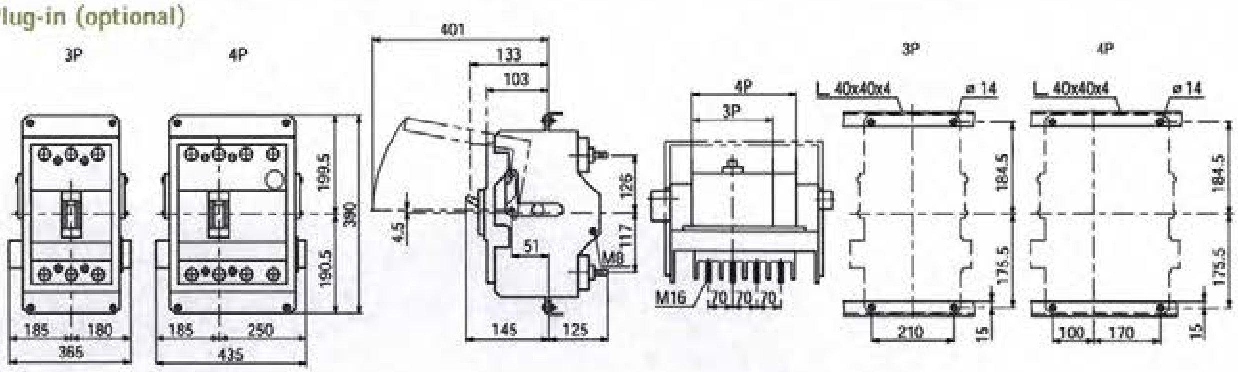
Front connected (standard)



Rear connected (optional)



Plug-in (optional)



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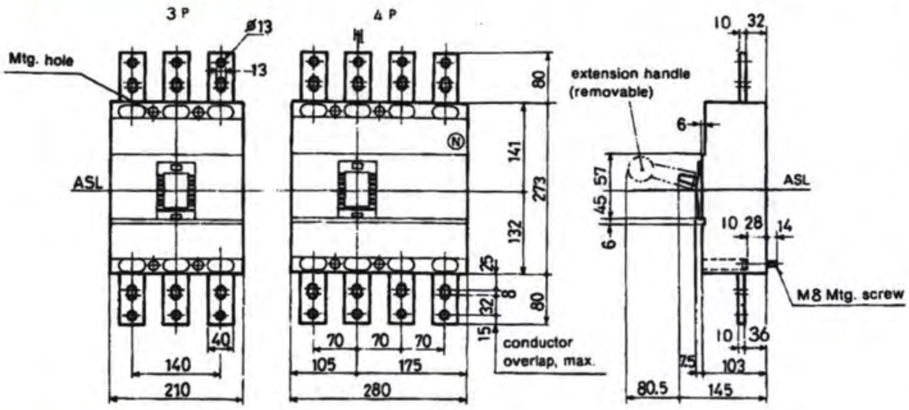
MCCB Technical data
TemBreak 800 AF XS800, XH800

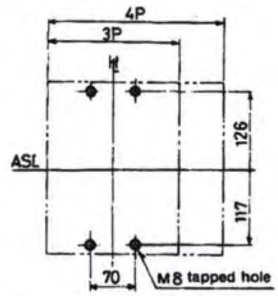
ASL: Arrangement standard line
ℍ: Handle frame centre line

Outline dimensions (mm)

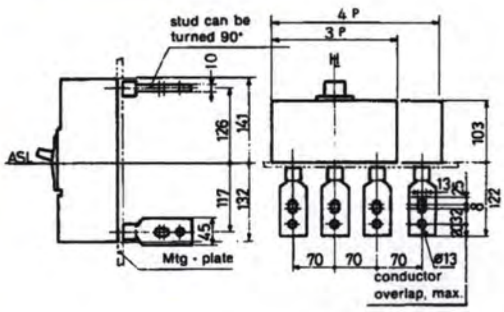
Front connected (standard)



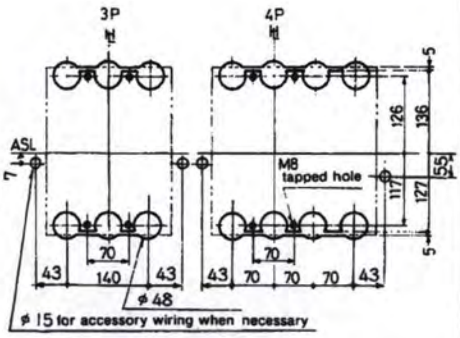
Drilling plan



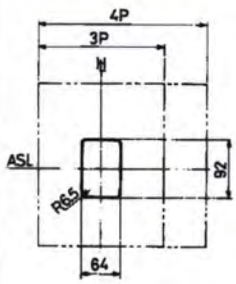
Rear connected (optional)



Drilling plan



Panel cut-out



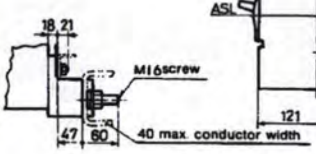
Panel cut-out dimensions shown give an allowance of 1.0 mm around the handle escutcheon.

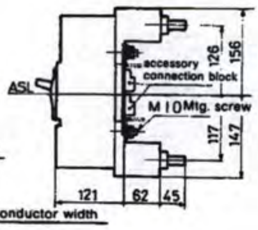
Plug-in (optional)

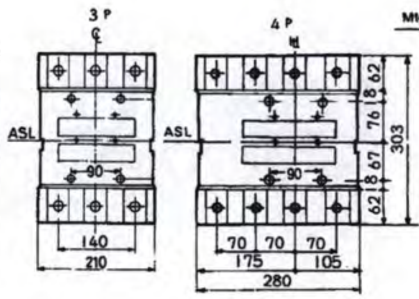
Mounting block

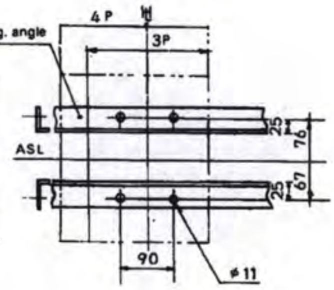
Drilling plan

Details for connection









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MCCB Technical data

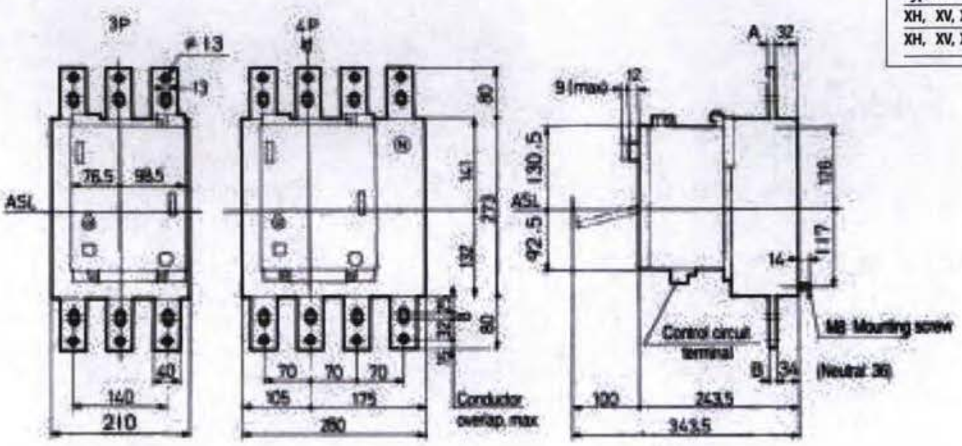
Motor operators (XMC type) for XS630, XH630, XS800, XH800

ASL: Arrangement standard line
HL: Handle frame centre line

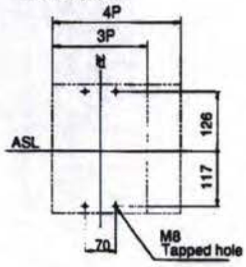
Outline dimensions (mm)

Front connected (standard)

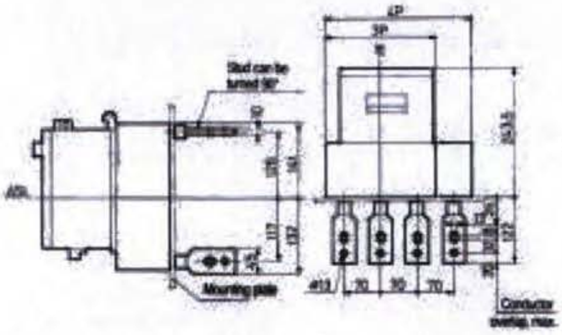
Types	A (mm)	B (mm) 3 pole	B (mm) N pole
XH, XV, XS800NE	10	36	36
XH, XV, XS630NE	8	36	36



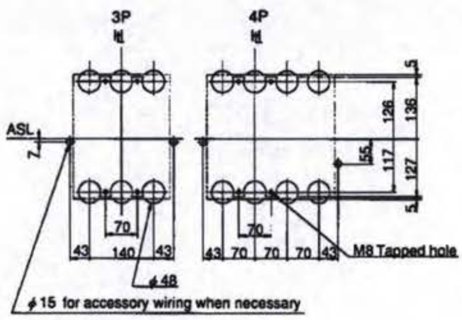
Drilling plan



Rear connected (optional)

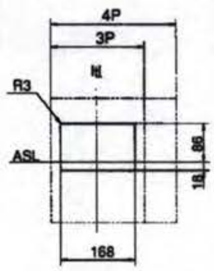


Drilling plan



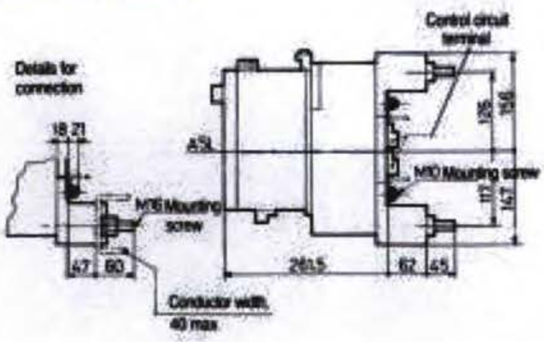
Note: In the standard selection mode, terminals on both the line side and the load side are in a horizontal orientation.

Panel cut-out

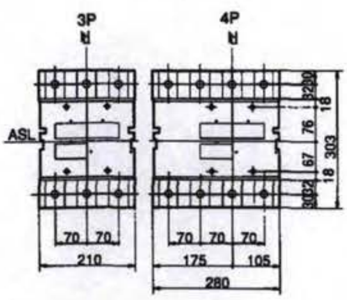


Panel cut-out dimensions shown give an allowance of 1.0 mm around the motor operator frame.

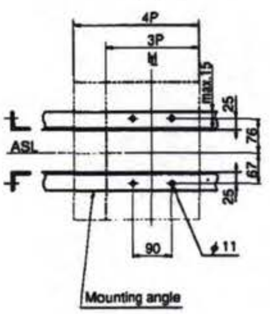
Plug-in (optional)



Mounting block



Drilling plan



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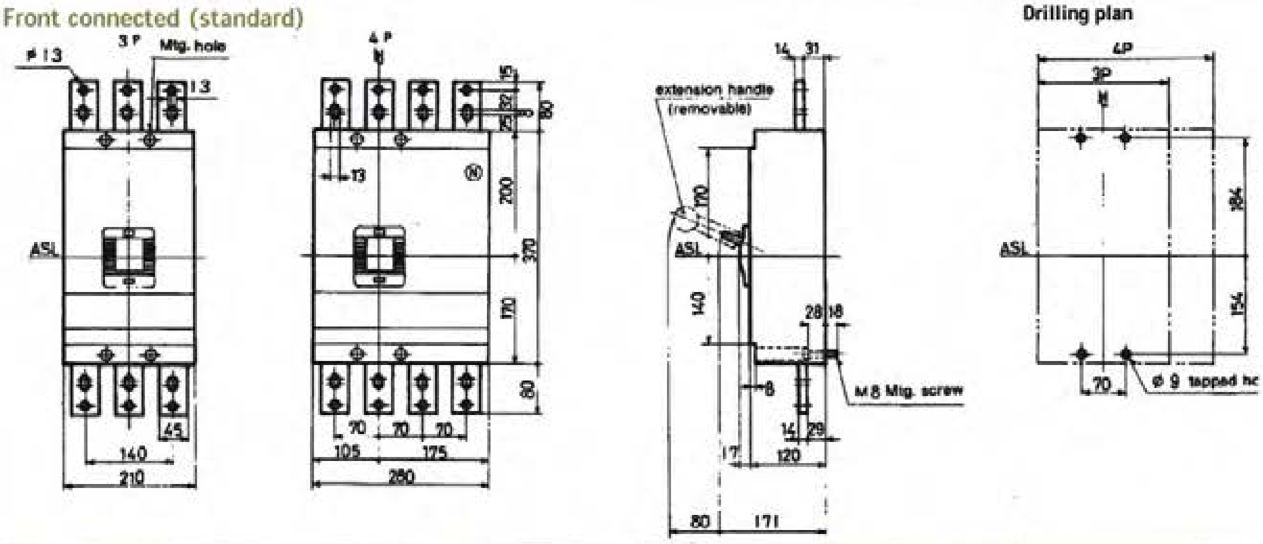
MCCB Technical data

TemBreak XS1250, XV1250

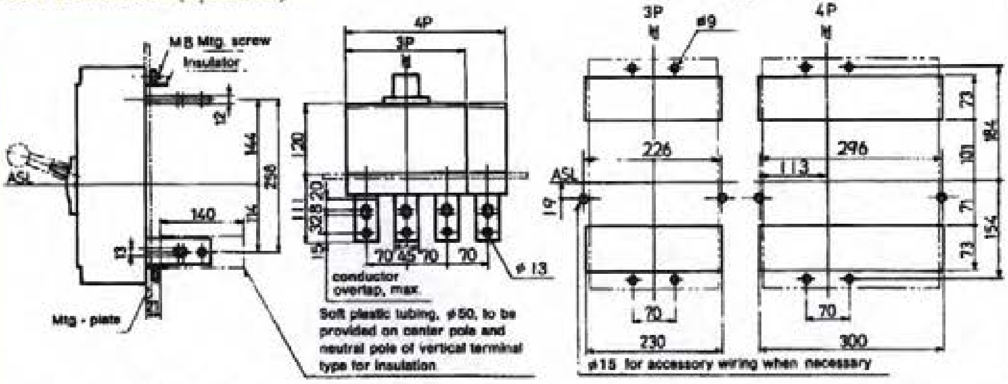
ASL: Arrangement standard line
℄: Handle frame centre line

Outline dimensions (mm)

Front connected (standard)

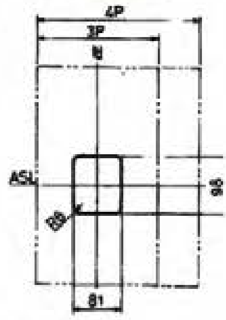


Rear connected (optional)



Note: In the standard shipment mode, terminals on both the line side and the load side are in a horizontal orientation.

Panel cut-out

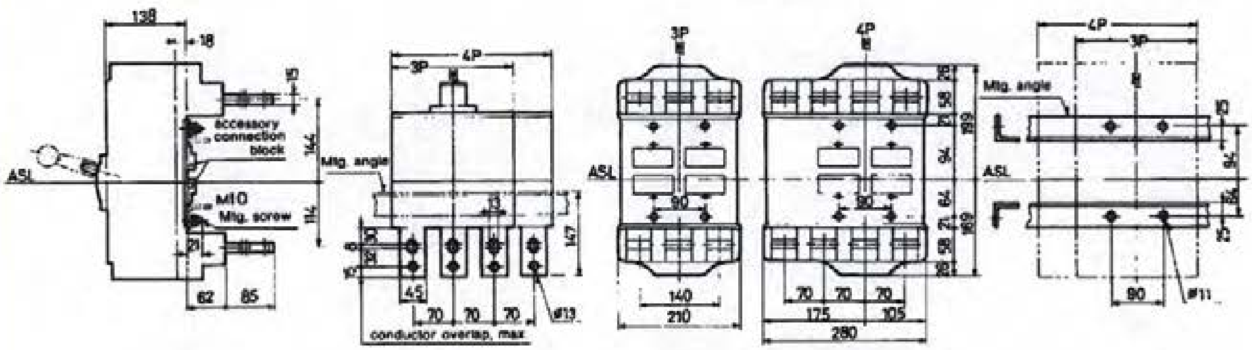


Panel cut-out dimensions shown give an allowance of 1.5 mm around the handle escutcheon.

Plug-in (optional)

Mounting block

Drilling plan



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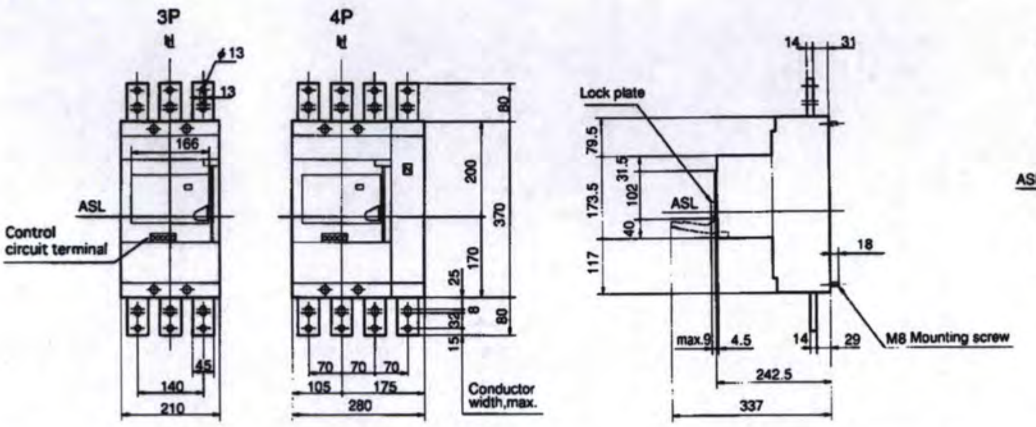
MCCB Technical data

Motor operators (XMD type) for XS1250, XV1250

ASL: Arrangement standard line
$\mathrm{H_L}$: Handle frame centre line

Outline dimensions (mm)

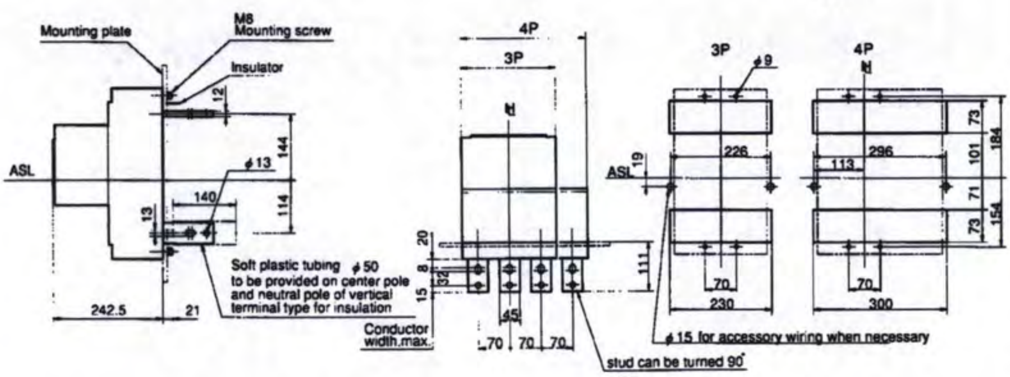
Front connected (standard)



Drilling plan

Rear connected (optional)

Drilling plan



Note: In the standard selection mode, terminals on both the line side and the load side are in a horizontal orientation.

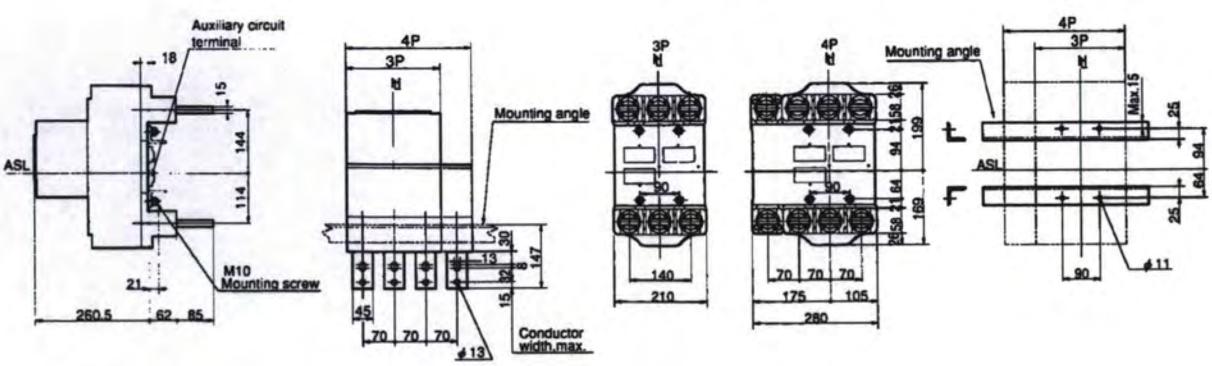
Panel cut-out

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

Plug-in (optional)

Mounting block

Drilling plan



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MCCB Technical data

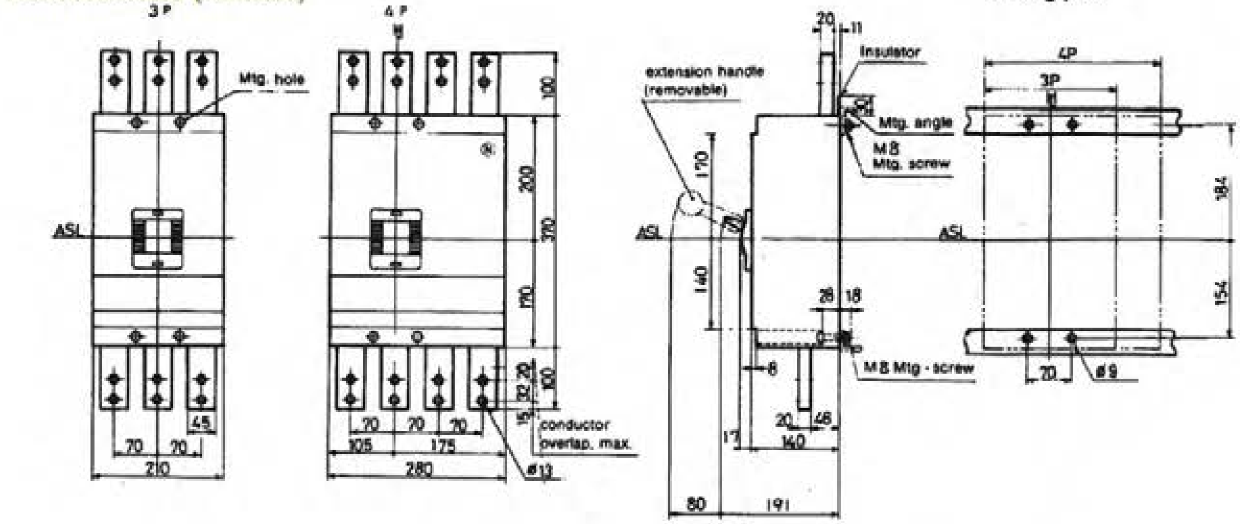
TemBreak XS1600SE, TL630, TL800, TL1250NE

ASL: Arrangement standard line
℄: Handle frame centre line

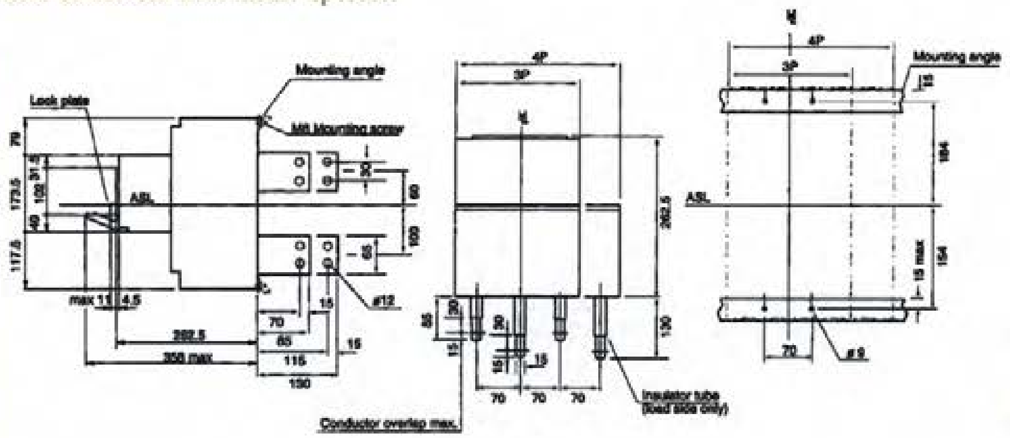
Outline dimensions (mm)

Front connected (standard)

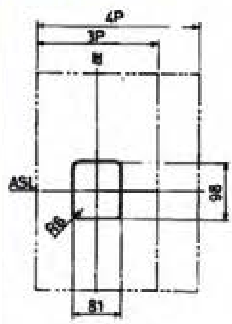
Drilling plan



Rear connected with motor operator



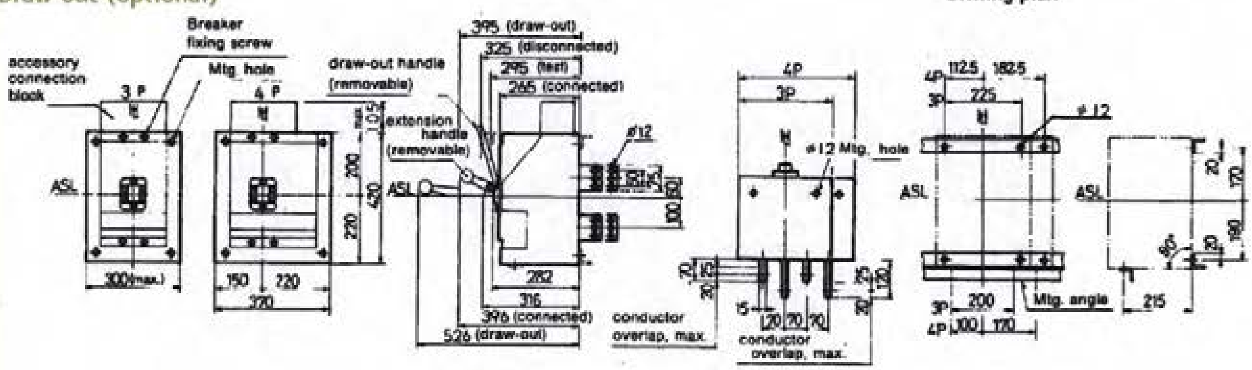
Panel cut-out



Panel cut-out dimensions shown give an allowance of 1.5 mm around the handle escutcheon.

Draw-out (optional)

Drilling plan



TERASAKI
Innovators in Protection Technology

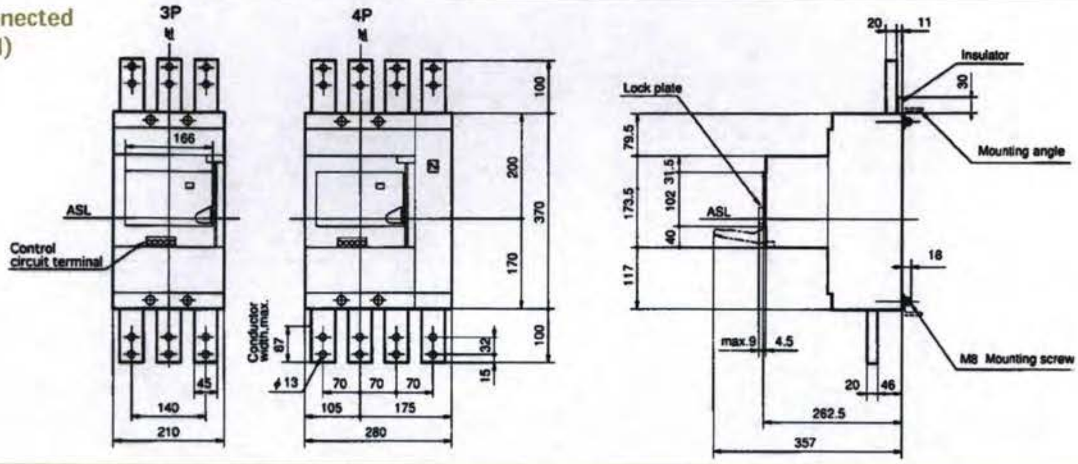
MCCB Technical data

Motor operators (XMD type) for XS1600SE types, TL630NE, TL800NE, TL1250NE

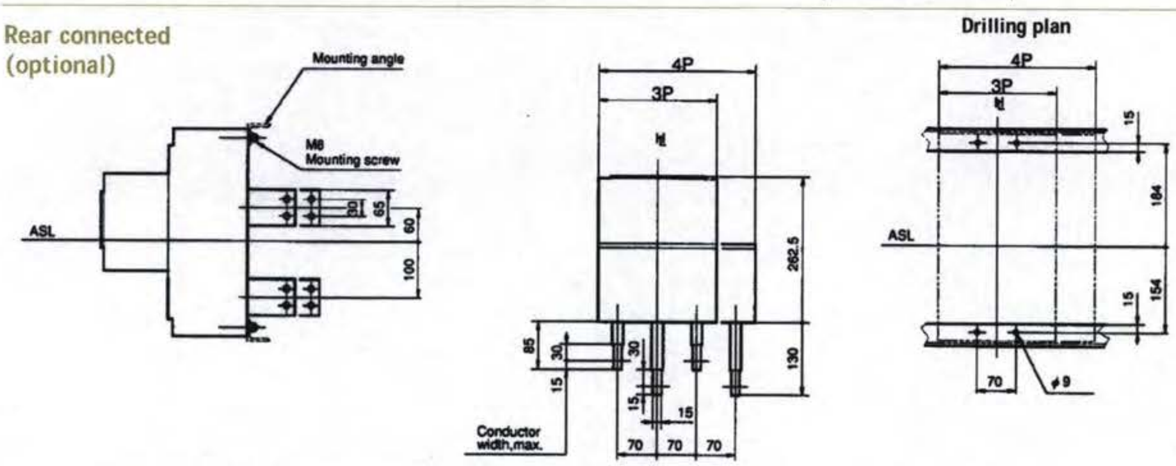
ASL: Arrangement standard line
ℍ: Handle frame centre line

Outline dimensions (mm)

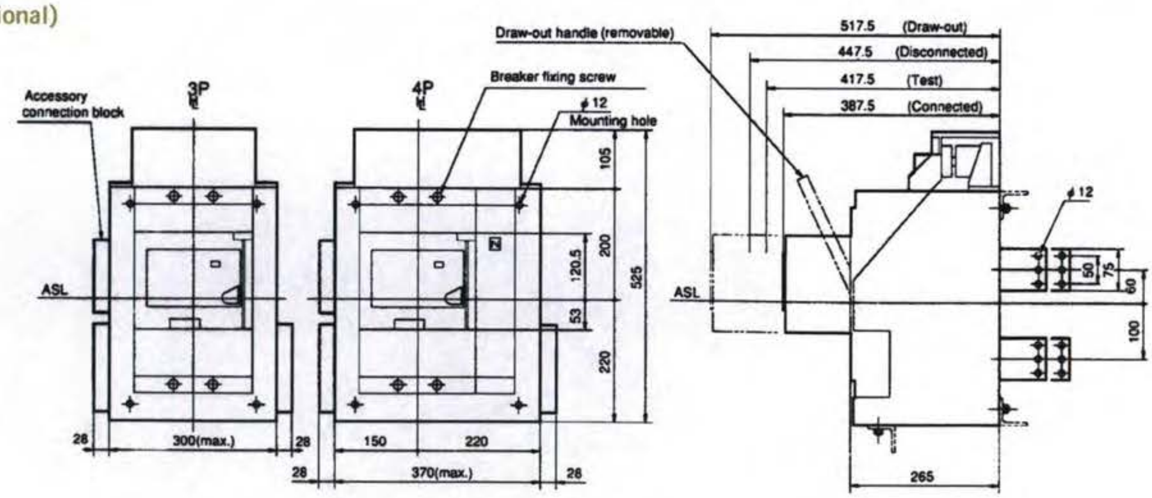
Front connected (standard)



Rear connected (optional)



Draw out (optional)



7

TERASAKI
Innovators in Protection Technology

MCCB Technical data

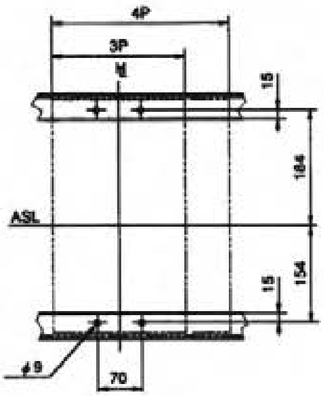
Motor operators for XS1600 TL630NE, TL800NE, TL1250NE

ASL: Arrangement standard line
℄: Handle frame centre line

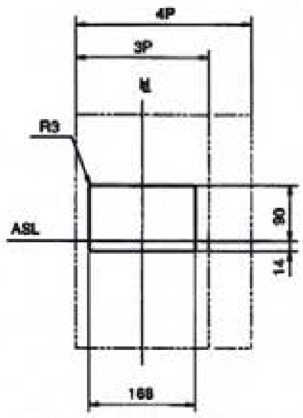
Outline dimensions (mm)

Front connected (standard)

Drilling plan

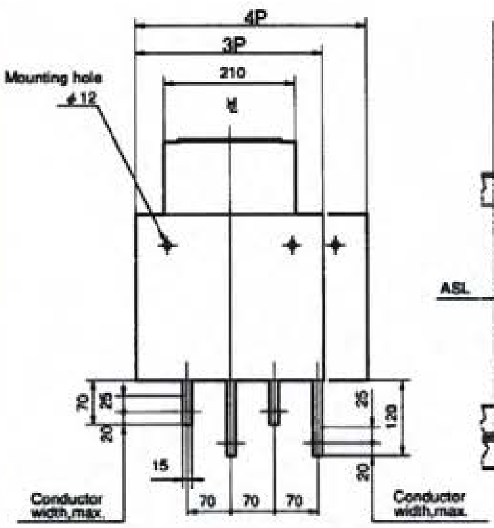


Panel cut-out

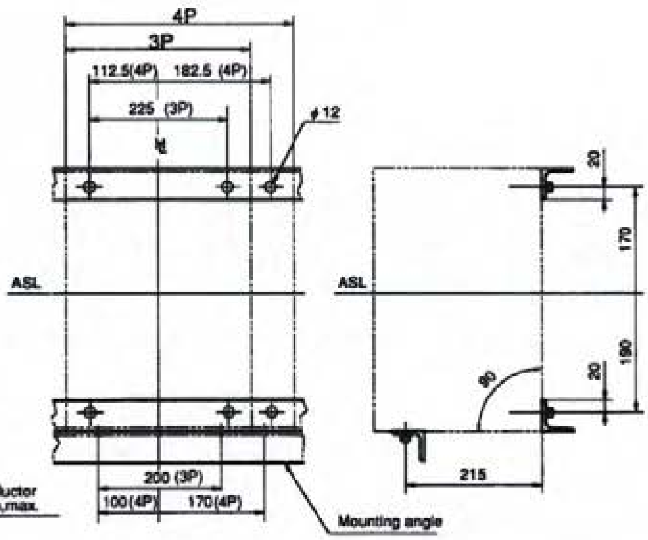


Panel cut-out dimensions shown give an allowance of 1.0 mm around the motor operator frame.

Draw out



Drilling plan



TERASAKI
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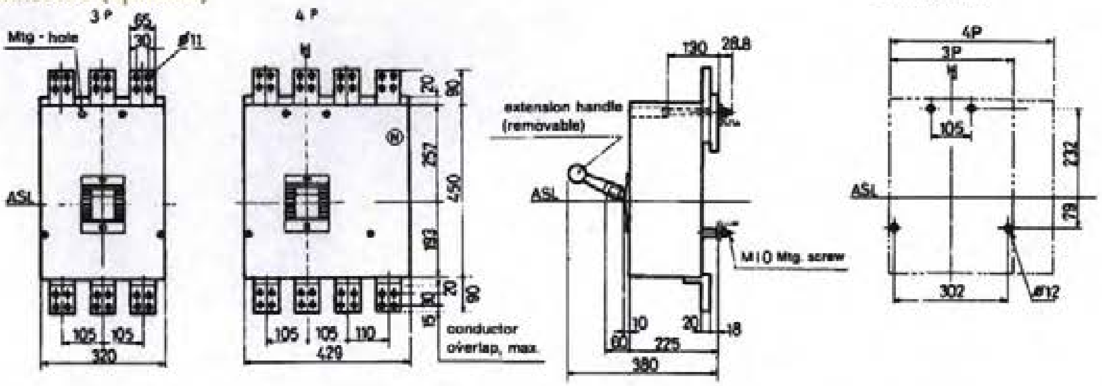
MCCB Technical data

TemBreak XS2000NE

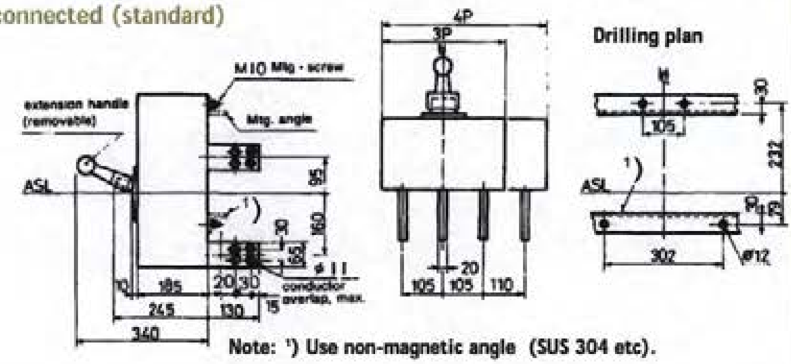
ASL: Arrangement standard line
℄: Handle frame centre line

Outline dimensions (mm)

Front-connected (optional)

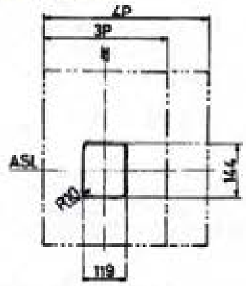


Rear-connected (standard)



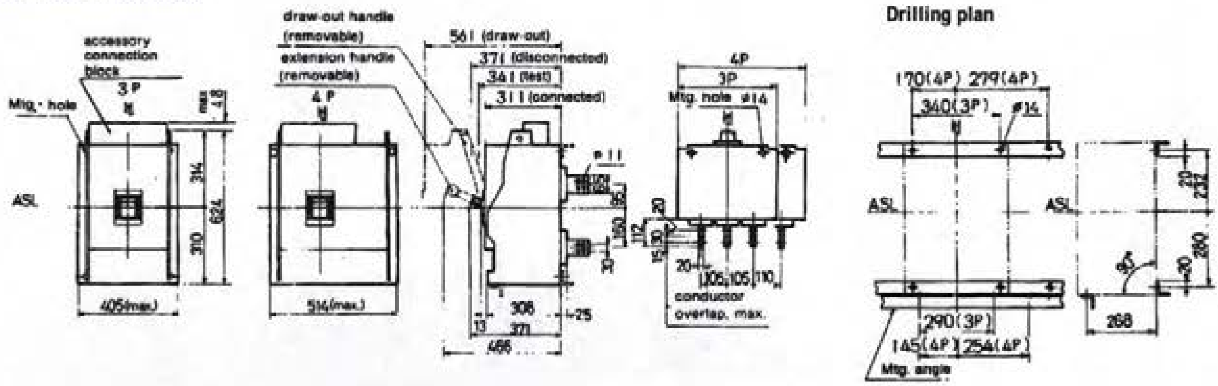
Note: [1]) Use non-magnetic angle (SUS 304 etc).

Panel cut-out



Panel cut-out dimensions shown give an allowance of 2 mm around the handle escutcheon.

Draw-out (optional)



TERASAKI

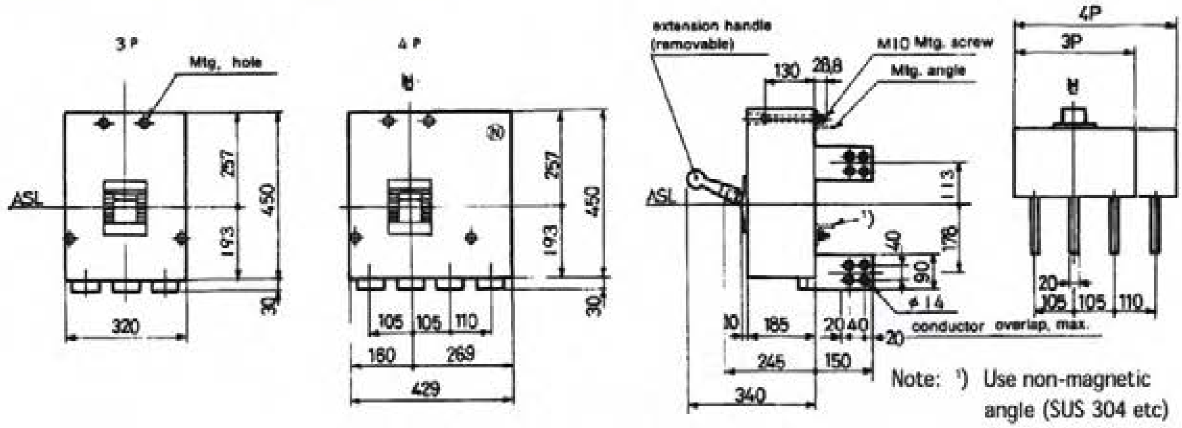
MCCB Technical data

TemBreak XS2500NE

ASL: Arrangement standard line
H: Handle frame centre line

Outline dimensions (mm)

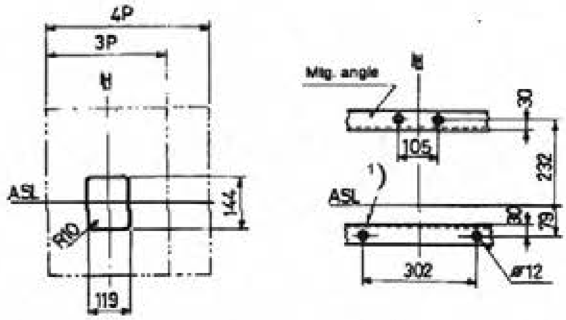
Rear-connected (RC standard, no FC version)



Note: 1) Use non-magnetic angle (SUS 304 etc)

Panel cut-out

Drilling plan



- Panel cut-out dimensions shown give an allowance of 2 mm around the handle escutcheon.

Note: 1) Use non-magnetic angle (SUS 304 etc)

Note: RC - Rear connected, FC - Front connected.

7

TERASAKI
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MCCB Technical data

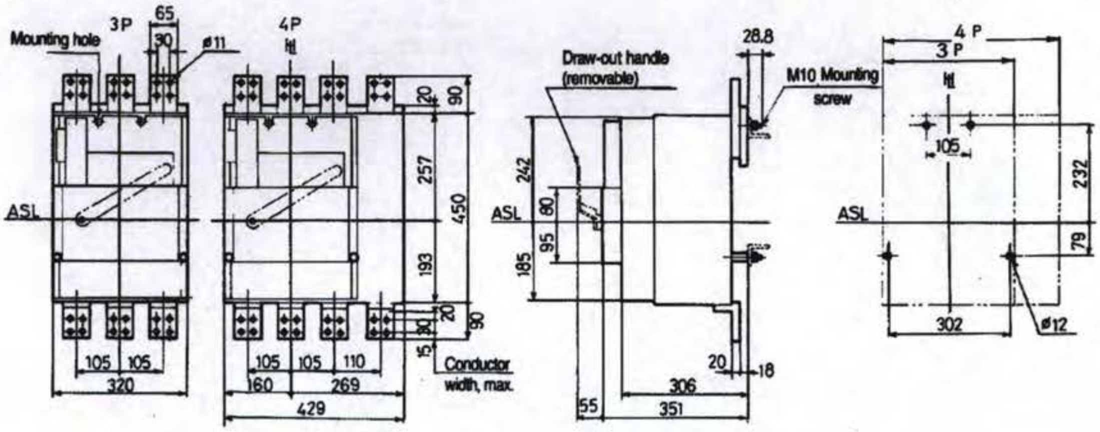
Motor operators (XMB type) for XS2000NE & XS2500NE

MCCB accessories

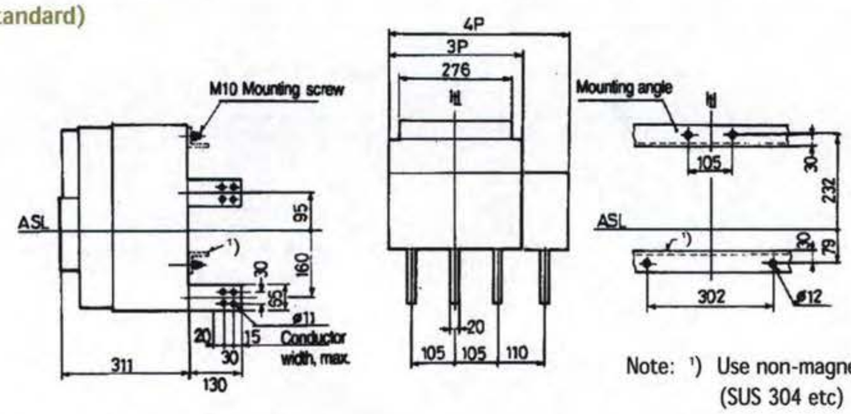
ASL: Arrangement standard line
H̶L: Handle frame centre line

Outline dimensions (mm)

Front connected (optional)

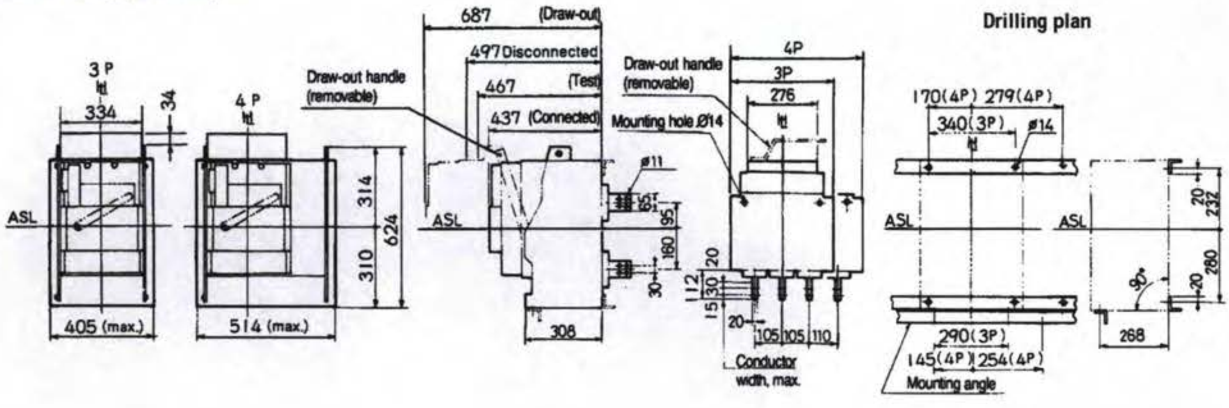


Rear connected (standard)



Note: [1]) Use non-magnetic angle (SUS 304 etc)

Draw-out (optional)



TERASAKI
Innovators in Protection Technology

MCCB Technical data

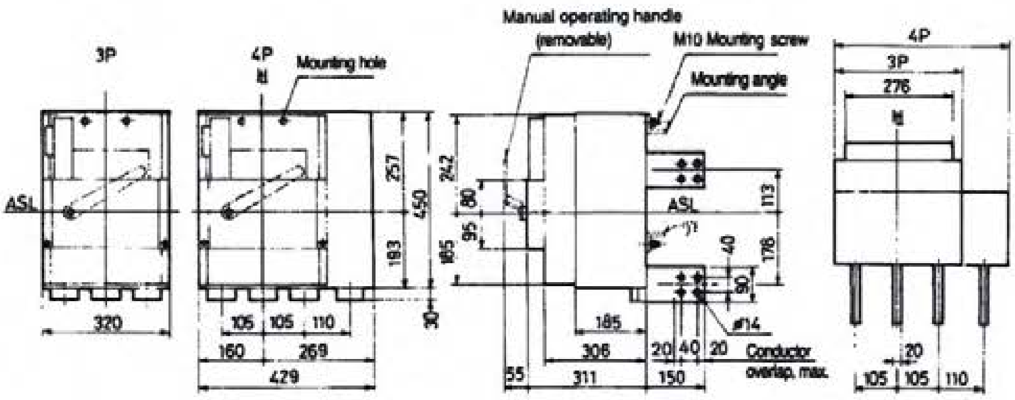
Motor operators XMB types for XS2000NE & XS2500NE

MCCB accessories

ASL: Arrangement standard line
H: Handle frame centre line

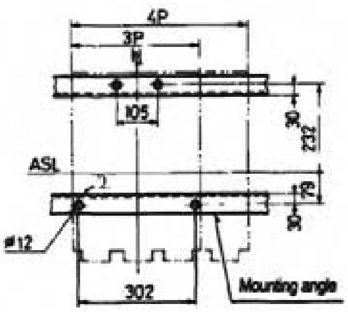
Outline dimensions (mm)

Front connected (standard)



Note: [1]) Use non-magnetic angle (SUS 304 etc)

Drilling plan



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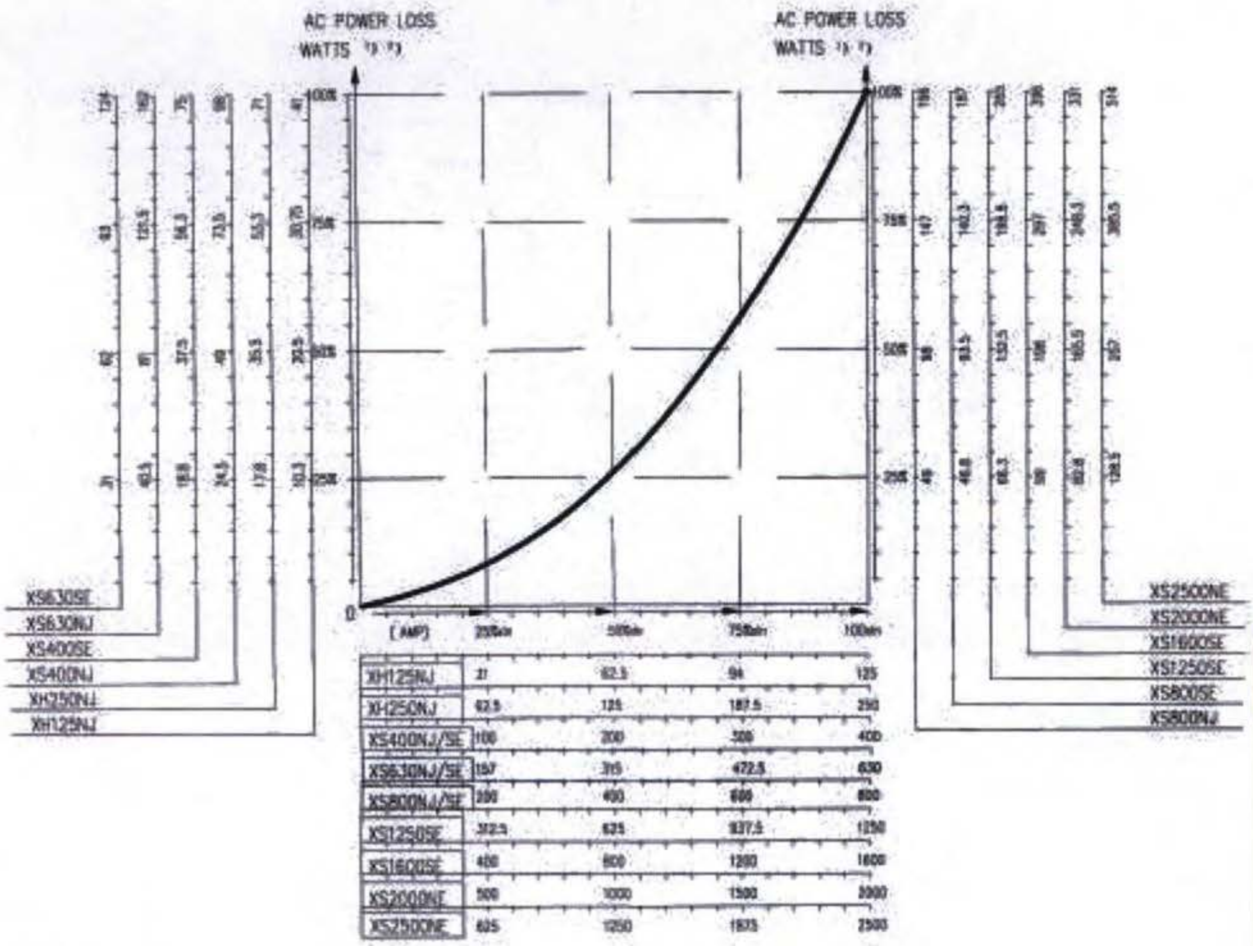
MCCB Technical data

AC power watts loss – 3 Pole MCCBs



Notes: Standard terminal arrangements.
125 - 1600 front connection.
2000 and above rear connection.
[1]) Watts loss figures are for 3 poles.
e.g. An XH125NJ operating at 125 A, will have a total watts loss of 41 watts.
[2]) Watts loss values are approximate and will vary according to ambient conditions and switchboard construction.

7

NHP and PowerCad - working together

PowerCad has established itself as the standard for electrical engineering design software for electrical engineering building services.
PowerCad contains a suite of electrical design software which provides solutions ranging from basic cable sizing up to complete electrical design and modelling. There are 5 software packages which have a stepped level of features. These are: QuickCable-LT™, QuickCable™, PowerCalc™, PowerCalc-H™, while the final and most powerful version is called PowerCad-5™.

The above is a typical screen representation providing a circuit schematic, along with an open window showing a protective device picture, its various device OCR settings, Cat. No. and other device details.

PowerCad 5 - application

Starting with a network single line diagram, the designer is able to assign the loads in the system from which the software calculates maximum demands, determines the appropriate cable sizes, and selects suitable protective devices and can finally undertake a powerful harmonic modelling function of the entire system. In order for the software to accurately model the protective devices in the system, PowerCad includes various device characteristic data as a library within its software, including Terasaki circuit breakers.

Note: PowerCad is a product of PowerCad Software Pty Ltd. Purchases of this software can be obtained from PowerCad. www.powercad.com.au

PowerCad-5™ design software now includes Terasaki circuit breakers

PowerCad 5 features:

- Maximum demand
- Cable sizing
- Conduit sizing
- Fault-loop impedance
- Cable voltage drop calculations
- Cable thermal stress
- Short circuit calculations
- Let-through energy
- Harmonic analysis
- Harmonic mitigation
- Power factor correction
- Network resonance
- L.V. Distribution Network Modelling
- Single Line diagram
- Single Line diagram export to AutoCad
- AutoCad interface for loads input
- Automatic mains & submains cable selections
- Automatic final subcircuit cable sizing
- Circuit breaker selection
- Co-ordination time-current curves
- Co-ordination curve on screen CB adjustment
- Substation sizing
- Motor Libraries and light fitting
- Luminare Libraries
- Extensive reporting with print preview
- Direct online support
- Standards AS/NZS, IEC, BS and CP5
- Generator sizing
- Harmonic active filtering
- Reactor passive filtering
- Transfer switches

NHP ELECTRICAL ENGINEERING PRODUCTS PTY LTD
A.B.N. 84 004 304 812

TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type: Motor Contactors

Location: Motor Starter Section

Model Numbers: CA7-9

Manufacturer: Sprecher & Schuh

Supplier: NHP Pty Ltd
25 Turbo Drive
Coorparoo QLD 4151

Ph: 07 3891 6008
Fx: 07 3891 6139

Attenti) prevent electrical shock, disconnect from power suu.c. before installing or servicing. Install in suitable enclosure. Keep free from contaminants.

Achtung: Vor Installations- oder Servicearbeiten Stromversorgung unterbrechen, um Unfälle zu vermeiden. Die Geräte müssen in einem passenden Gehäuse eingebaut und gegen Verschmutzung geschützt werden.

Attenzione: Per prevenire infortuni, togliere tensione prima dell'installazione o manutenzione. Installare in custodia idonea. Tenere lontano da contaminanti.

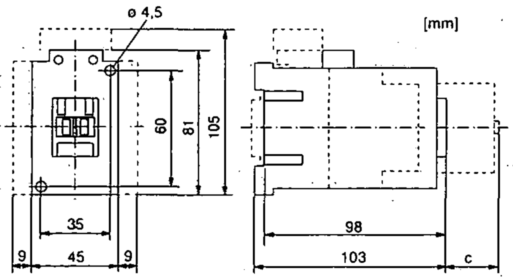
Attention: Avant le montage et la mise en service, couper l'alimentation secteur afin d'éviter tout accident. Prévoir une mise en coffret ou armoire appropriée. Protéger le produit contre les environnements agressifs.

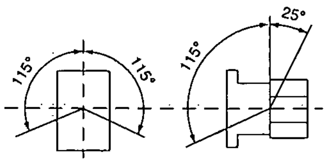
Atención: Desconectar la alimentación eléctrica antes de realizar el montaje y la puesta en servicio, con el objeto de evitar accidentes. Instalado en una caja o armario apropiado. Proteger el producto de los ambientes agresivos.

...-C30 /...-30
...-C37 /...-37

CE

IEC 60947-1/-4-1
EN 60947-1/-4-1
UL 508; CSA 22.2 No. 14;





-Min. distance lateral to grounded parts or walls = 6mm
-Min. seitlicher Abstand zu geerdeten Teile oder Wände = 6mm
-Distance latéral min. enver pièces mises à terre ou parois = 6mm
-Distanza laterale min. verso pezzi a massa o pareti ≈ 6mm
-Distancia lateral min. a chasis o paredes = 6mm

c [mm]	34	53	56

		11 mm; 1 x 2,5...10 mm²; 2 x 2,5...10 mm²; No. 14...4 AWG; Use 75°C Cu wire only; 1 x 2,5...16 mm²; 2 x 2,5...16 mm²; No. 14...4 AWG	2,5...3,5 Nm; 22...31 lb-in; No 3; Pozidriv No 2
A1 A2		9 mm; 1 x 1...2,5 mm²; 2 x 1...2,5 mm²; No. 16...12 AWG; Use 75°C Cu wire only; 1 x 1...4 mm²; 2 x 1...4 mm²; No. 16...12 AWG	1...1,5 Nm; 8,9...13 lb-in; No 3; Pozidriv No 2

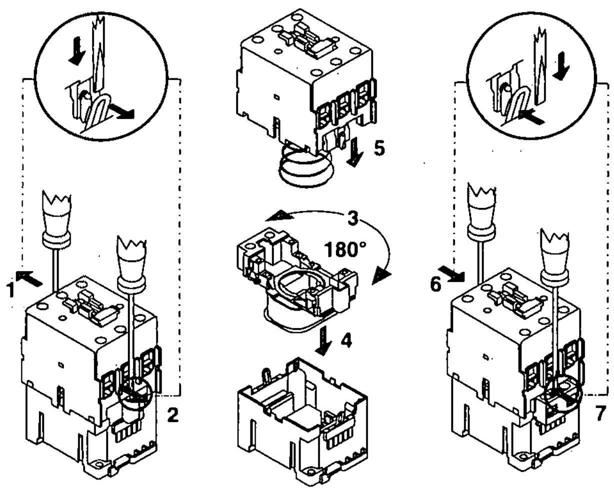
IEC 60947-4-1 EN 60947-4-1 Ue ≤ 690 V	gG max. Type 1	Type 2	max. Type 2
30	125 A	80 A	Tech Data
37	125 A	80 A	

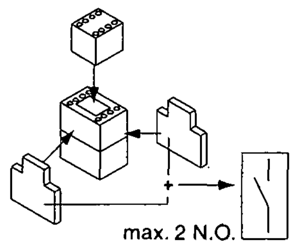
NOTICE (IEC/EN 60947-1) This product has been designed for environment A. Use of this product in environment B may cause unwanted electromagnetic disturbances in which case the user may be required to take adequate mitigation measures.
BEMERKUNG (IEC/EN 60947-1) Dieses Produkt ist für Umgebungsklasse A bestimmt. Der Gebrauch dieses Produktes in Umgebungsklasse B kann unerwünschte elektromagnetische Störungen verursachen, in diesem Fall muss der Benutzer die nötigen Massnahmen zur Verringerung ergreifen.
REMARQUE (IEC/EN 60947-1) Ce produit on l'utilise dans l'environnement A. L'utilisation de ce produit dans l'environnement B peut créer des perturbations électromagnétiques. En ce cas, l'utilisateur doit prendre des mesures pour diminuer les perturbatione électromagnétiques.
AVVERTENZA (IEC/EN 60947-1) Questo prodotto è stato progettatto per un ambiente di tipo A. L'utilizzo di questo prodotto in un ambiente B protrebbe causare disturbi elettromagnetici indesiderati, in questo caso potrebbe essere richiesto all'utilizzatore di prendere appropriate misure di mitigazione.
OBSERVACIÓN (IEC/EN 60947-1) Este producto se puede usar en el ambiente A. El uso en el ambiente B puede causar perturbaciones electromagnéticas. En ese caso de uso, el usuario debe tomar medidas de diminuir las perturbaciones electromagnétices.

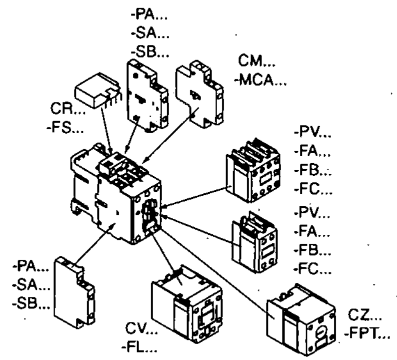
Electronically Controlled DC-Coil only!

USA/CND
Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes

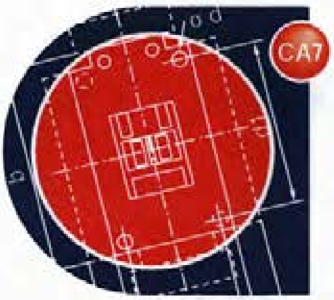
Size	Fuse 600 Volts Maximum	Circuit Breaker 600 Volts Maximum
30	110 A	125 A
37	125 A	125 A







Technische Änderungen vorbehalten
22.221.950-01 / 05. 2007
Ausgabe 10



Broad current range
Compact dimensions
Maximum flexibility

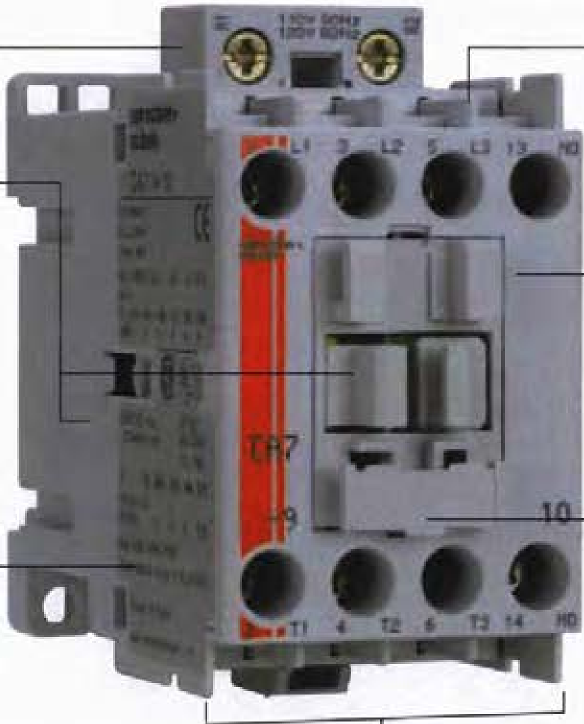
Series CA7 Contactors

Controls Motors to 60HP (@460/575V)

As Little as 45mm Wide

Reduces Panel Space

Mechanically Linked Auxiliaries



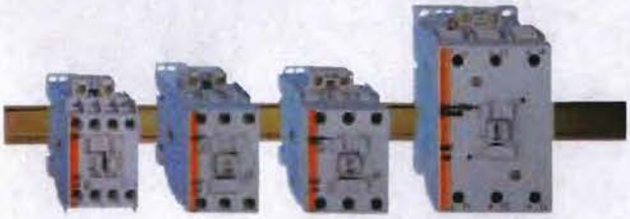
Compact dimensions with maximum performance! Our CA7 contactors control motors up to 60HP, in frame sizes ranging from 45mm (1-3/4") to a maximum of 72mm (2-3/4") wide.

Because of its modular design, CA7 is **flexible and easy to use.** All CA7 contactors use the **same accessories**, reducing the need to stock additional inventory. They are also mechanically and electrically compatible with Sprecher + Schuh's CEP7 electronic overload relay and KT7 motor circuit controller. This provides easy, clean installation for a variety of motor starter applications.

Whether part of a system or for individual use, the CA7 is the ***right* contactor for the job.**

sprecher+schuh

CA7 Series CA7 Contactors



Save space, save money

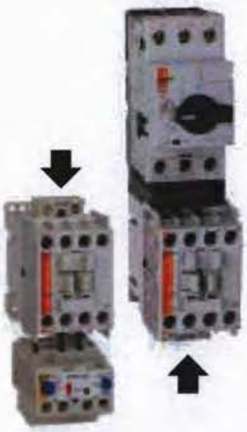
The CA7 contactor series includes ten contactors within four frame sizes. The two smallest sizes house capacities up to 25HP (@460V) and 30HP (@575V). They measure only 45mm (1-3/4") in width! Even the largest of the contactors – the CA7-85, controlling motors to 60HP – measures only 72mm (2-3/4") wide. The space you save with CA7 translates to **smaller panels and lower cost**.

Dual terminal technology provides additional wiring options, as well as increased reliability and a faster wiring process.

Dual wiring terminals speed installation

State-of-the-art technology

CA7 contactors utilize the latest design technology. Combined with Sprecher + Schuh's CEP7 solid state electronic overload relay, the CA7 becomes the most accurate and reliable motor starter available. **Mechanically linked contacts** provide safety for all applications. In addition, snap-on electronic timers and a PLC interface are also available.



Maximum flexibility

The CA7 contactor is designed for **ultimate flexibility**. Coil terminals can be supplied on the top or bottom, and are **field-reversible** to suit individual wiring needs. Auxiliary contacts can be mounted on the top and sides, for the most efficient use of panel space. In reversing applications where space may be tight, the mechanical interlock has a **built-in auxiliary** to save room.

Field-reversible coil terminals provide additional flexibility

Modular design

The CA7 contactor series includes **universal accessories** to fit every frame size. This provides incredible flexibility, and eliminates the need to purchase size-specific components.

Because of their **modular design**, CA7 contactors are easily joined to form complete starter combinations. The CA7 is specially designed for electrical and mechanical compatibility with our overload and motor circuit controllers.

CA7 Selected Technical Data

Catalog Number	AC-1 Amp Rating 40°C	Maximum Horsepower: Single Phase 115V	Single Phase 230V	Three Phase 200V	Three Phase 230V	Three Phase 460V	Three Phase 575V	Max. Aux. Contacts
CA7-9	32	1/3	1	2	2	5	7-1/2	9
CA7-12	32	1/2	2	3	3	7-1/2	10	9
CA7-16	32	1	3	5	5	10	15	9
CA7-23	32	2	3	5	7-1/2	15	15	9
CA7-30	50	2	5	7-1/2	10	20	25	9
CA7-37	50	3	5	10	10	25	30	9
CA7-43	85	3	7-1/2	10	15	30	30	8
CA7-60	100	5	10	15	20	40	50	8
CA7-72	100	5	15	20	25	50	60	8
CA7-85	100	7-1/2	15	25	30	60	60	8

See Sprecher + Schuh's general catalog for complete information and pricing on CA7 contactors.

Sprecher + Schuh US Division Headquarters
15910 International Plaza Dr., Houston, TX 77032
Tel: (281) 442-9000; Fax: (800) 739-7370
www.ssusa.cc

Sprecher + Schuh Canadian Division
3610 Nashua Dr., Unit 10, Mississauga, Ontario L4V 1L2
Tel: (905) 677-7514; Fax: (905) 677-7663
www.sscdn.cc

sprecher+schuh

Publication No: F-CA7-R1 10/02

sprecher+
schuh

Contact Block

Performance & Selection

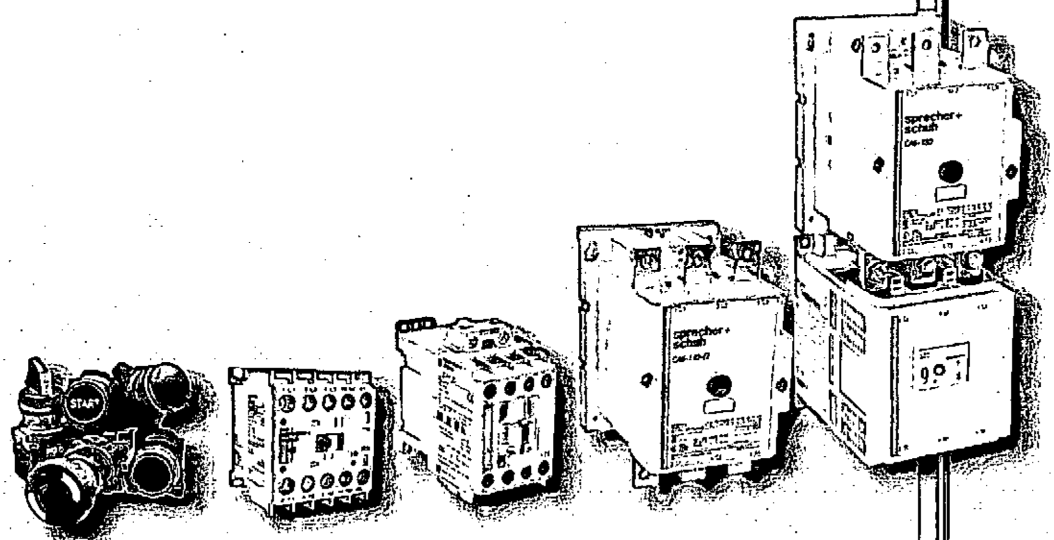


Table of Contents

Contact Block Considerations

A combination of many factors affect the dependability, life expectancy, and suitability of a contact block in any given application. Understanding the most important of those factors can help you select the best switch for your needs. In the pages that follow you'll gain a basic understanding of switch materials and properties, and how they affect switch performance.

Contact Material

The contact material forms the surfaces that come in contact with each other to establish an electrical circuit. Typical contact materials include fine silver, nickel-silver, and silver alloys. Fine silver provides low electrical resistance between the movable and stationary contact interface. Silver alloys form harder surfaces to reduce wear and help prevent contact welding.

In low voltage applications (below 48V DC and 0.1 A, or below 24V AC and 0.4 A) where excess oil or dust is present, the use of more noble alloys (such as palladium, gold, and their alloys) in the contact material is recommended. These alloys are highly reliable in this type of environment.

Silver alloys are susceptible to chemical attack which can affect reliability at low voltages. Noble metals resist chemical attack, but are susceptible to frictional polymer formation, which can affect reliability. Combining gold and palladium will resist frictional polymer formation.

Contact Construction

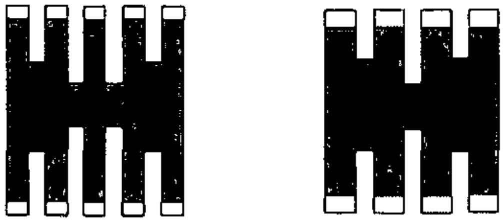
The perimeter of the contact is often shaped like a circle or rectangle and may have little effect on contact performance. The shape of the faces where the fixed and movable contacts meet is more important. This interface should not have two flat surfaces meeting. If one of the contacts has a flat surface, the other contact should be a rounded surface to provide a more defined and controlled touch point.

Figure 1. Bifurcated Spanner Example

The bifurcated style of construction provides a higher degree of reliability than the butt spanner because it divides each movable contact into two sections at the tip of the spanner. This minimizes the chance of foreign materials accumulating on contact surfaces and preventing the completion of the circuit. Even if foreign material accumulates on one of the contact tips, the second tip will most likely touch a clean spot establishing the circuit. Typically, the bifurcated spanner is designed for use in full voltage applications, where the arc between the spanner and stationary contacts will burn off small amounts of contamination in most cases. To aid contact cleaning the contact spanner is designed to flex, which wipes the stationary surface and allows each finger to act independently.

Contact Block Considerations

Figure 2. Pentafurcated and Quadfurcated Spanner Examples



In low voltage applications (below 48V DC and 0.1 A or below 24V AC and 0.4 A) pentafurcated/quadfurcated styles of construction provide the highest degree of reliability because they divide each movable spanner contact side into separate flexible fingers. Every part in the system is corrosion-resistant and the flexible spanner is designed to wipe the stationary contacts clean every time the circuit is opened or closed. This is important since the absence of an arc in low voltage environments means that contaminants will not be burned off, but will be eliminated by the wiping action. Therefore, the pentafurcated or quadfurcated are the most reliable styles of spanners available.

Some manufacturers use protrusions such as bars or nibs raised on the face of either the movable or stationary contact to help establish the circuit under low power conditions. These raised surfaces will tend to penetrate non-conducting films that may be present on contact surfaces. They may also lessen the chance of foreign matter preventing completion of the circuit. Such protrusions may, however, quickly burn away under arcing or higher current conditions.

Base materials to which the contact material is attached include copper alloys and steel. Copper alloy is preferable because of its thermal conductivity, electrical conductivity, and corrosion properties.

Contact Size/ Volume — Stationary vs. Movable

Contact size refers to the size of the face of the contact or the areas that meet to form the interface between the movable and stationary contacts. Volume is the total amount of contact material.

It is desirable to make one of the contacts smaller than the other so it stays within the perimeter of the other contact when switch action takes place. This arrangement provides greater assurance that alignment of contacts is maintained under repeated operation and resulting wear. Misalignment can cause severe contact wear and shorten switch life.

In the contact set, the movable contact is most often the smaller contact in both size and volume, so that its mass and resulting inertia can be minimized. Partly because of its low volume, the movable contact operates at a higher temperature than the stationary contact. Consequently, the stationary contact will also contribute to a greater rate of wear on the movable contact. The stationary contact is generally attached to a more massive base structure that provides a better heat sink than the movable contact structure.

In alternating current applications, the higher temperature of the movable contact can cause material to be expelled from the surface of the contact. The higher temperature can cause transfer of material to the cooler surface of the stationary contact as well. In direct current applications, the relative polarity of the contacts has a major effect on how the contact material is transferred from one surface to the other.

Contact Block Considerations

Contact Reliability

Contact reliability pertains to the ability of contacts to establish a circuit across the interface between the stationary and movable contact set(s) each time the switch is operated. This reliability can be most often adversely affected by two conditions:

- Mechanical debris within the switch
- Non-conducting films that form on the contact surfaces

Mechanical debris or dirt can be introduced into the switch during assembly. Dirt and debris can also be interjected during installation or can be a product of switch action. The wear produced by internal switch components sliding past one another during operation can generate dirt. Care must be taken in the design of moving mechanisms to keep this wear to a minimum.

Non-conducting film and oxides can be formed from gaseous contaminants that enter the switch from an external environment as well as being formed from internally generated reactants. Sealing methods have been developed to isolate the switch interior from the external environment. An understanding of the relationship of all the material used in the construction of a switch is required to eliminate the internally generated reactants. This requires knowledge of the post curing outgassing of any plastics, elastomers, paint, and other components used in the construction of the system. Some gases will react in the presence of an electric arc to form non-conducting films that will cause reliability problems if deposited on the contact face. The tendency of many thermoset plastics to continue to outgas for a period of time after curing has led to the use of thermoplastic materials in switch interiors.

Contact Resistance

Contact resistance pertains to resistance across the interface between a pair of movable and stationary contacts. The higher the value of this resistance, the more difficult it is to establish a circuit when the contacts close. This is especially true in low power circuits. Higher resistance also contributes to contact heating.

The initial contact resistance of both fine silver contacts and noble contact materials (gold, palladium, and their alloys) is 10...15 milliohms. However, the resistance of noble contact materials will remain relatively constant during their lifetime compared to silver contacts, which typically increase over time. These resistance values could vary with the ambient conditions in the vicinity of the contacts themselves.

Sealed switches have slightly higher initial contact resistances compared to silver contacts (80...150 milliohms, depending on type), but they remain stable over the life of the device.

Switch Design Considerations

In addition to the physical characteristics of the materials used in manufacturing, design considerations also affect the performance of a switching mechanism. In this section you'll gain an overview of those switch design fundamentals and how they affect switch performance.

Single Break vs. Double Break

Figure 3. Single Break Design

Figure 4. Double Break Design

Single break and double break refer to the number of contact pairs that are used to make or break the electrical circuit. Single break means the electrical circuit is controlled by one set of contacts. Double break means the electrical circuit is controlled by two sets of contacts in series.

In a single break design, the contact pair tends to repeatedly make and break the circuit on the same spot on the contact faces. This helps to keep the contact touch point clean, enhancing the contact reliability.

The double break design provides twice the length of air gap in the electrical circuit using the same stroke of the actuating member as with the single break design. The result is the electrical arc that is created by the opening of the circuit will be extinguished sooner and with less actuator movement as compared to a single break design.

Also, since the energy in the arc created upon contact opening is distributed across two air gaps, there is less tendency for the contacts to weld in the double break design.

On the other hand, because of the nature of the double break design, the contact points of the spanner may vary slightly with each actuation. This variation may, over time, affect switch reliability.

Contact Motion

Contact motion refers to the relative motion of the contact faces as they begin to touch one another. Various design techniques are utilized to increase the reliability of the contacts establishing the circuit as they meet.

A wiping or sliding action will help clear surfaces of dirt and oxides and break any nonconducting film that may have formed on contact surfaces. This type of action must be carefully controlled, especially with precious metal contacts, to avoid excessive mechanical wear of the contacts.

Contact tips on the end of the spanner must be capable of flexing and twisting to establish a seat on the surfaces of bifurcated/quadfurcated/pentafurcated stationary contacts. A sliding action of one contact against the other could cause continuity interruptions if the moving contact slides up over a piece of debris.

Switch Design Considerations

Spring Force

The spring force discussed in the following paragraphs is the force provided within the contact block that returns the contact structure to its normal or unoperated state when the external force applied to the device operator is removed. This force holds the contact structure in its normal state until an external force is again applied to the device operator.

The amount of spring force is determined by the force required to insure contact reliability under the conditions in a variety of applications. Sufficient force is required to break through contaminants that may be present on the contact faces on the normally closed (N.C.) contacts. The force should insure that contacts stay stable under possible shock and vibration. Light welds created by contact arcing on the normally open (N.O.) contacts should be able to be broken by spring force. The spring force required to maintain circuit reliability is dependant on the contact material hardness. Greater force is required for harder materials.

Spring force directly affects the external force required to operate and to some extent contribute to internal switch friction. Consideration must be given to these factors when determining the spring force used.

Overtravel

Overtravel in a switch pertains to the amount of travel occurring in a switch beyond what is required to operate. Overtravel allows for wear within the switch mechanism. It helps to insure the switch will continue to function as the contacts wear or erode. Overtravel also provides contact stabilization under conditions of shock and vibration.

Contact Underlap vs. Contact Overlap

Contact underlap and overlap refer to the relative action of the N.O. and N.C. contacts when the switch is actuated.

Underlap is the more common type of switch action. As the device operator is moved from its rest position to initiate switch action, the following events take place in order:

1. The N.C. contact opens.
2. There is a duration where no electrical continuity is present.
3. The N.O. contact closes.

In overlap type switch action, the N.O. contact makes its circuit before the N.C. contact breaks its circuit. There is never a period of time when electrical continuity is absent:

1. The N.O. contact closes.
2. There is a duration where both circuits are active.
3. The N.C. contact opens.

The type of switch action selected is dependant on the requirements of the specific user circuit application.

Switch Design Considerations

Direct Drive

NFPA 79 and EN 418 both require that emergency stops must be a direct drive design. A direct drive design switch will have continuous mechanical linkage from the external operating member to the contact carrier. It will not employ the use of any resilient members or springs in the mechanical actuating path to open the N.C. contacts.

A special case of direct drive design is a switch that complies with IEC 60947-5-1. It is designed so that contact separation will take place even though the contacts may have been welded or "sticking" during fault circuit conditions. A direct drive switch is designed to allow contact separation even if the contacts have been lightly welded during fault circuit conditions. The manufacturer provides the fusing level requirements needed to protect these contacts from welding. The actuator movement and actuator force required affecting contact separation are specified by the switch manufacturer.

This type of switch construction is used to help ensure that contact action takes place when the external operating member is actuated. By avoiding the use of any springs in the actuating path, a solid connection is provided directly from the external mushroom operator to the contacts.

Contact opening should always take place at the same point in the actuating stroke and with the same operating force. By their nature, these types of switches fall into the slow break/slow make category of devices although some special designs have been developed that provide positive opening in snap action devices. With increased awareness of safety concerns and the movement toward designing devices that are used globally, greater emphasis has been placed on the direct drive feature.

Contact Action

Contact action refers to how contacts make and/or break the electrical circuit they intend to control. There are two basic types of contact action: slow make/slow break and snap action.

In slow make/slow break action, the contact carrier and contacts move at the same rate of travel as the actuating mechanism. This action is most often obtained with direct drive switch designs. Since the rate of movement of the contacts is solely dependant on the speed of the external actuator, it can result in slow separation of contacts and create a condition called "teasing".

In the teasing condition, the air gap created to break the electrical circuit opens so slowly that arcing occurs between the faces of the stationary and moveable contacts. This arcing is detrimental to the contacts because of accelerated contact wear and material transfer and can cause the contacts to weld rather than separate. The arcing can also cause circuit problems by introducing noise.

Snap action design incorporates a resilient member or springs between the actuator and contact carrier. The springs cause the contacts to move independently of the actuating mechanism. The mechanism is designed so that when actuator movement takes place, not only does the contact carrier movement take place, but energy is also built up in the spring system. Prior to the point in the travel of the actuator where contact separation takes place, the contact carrier and spring system are designed to go into an overcenter mode.

Switch Design Considerations

At the overcenter point, sufficient energy is available in the spring system allowing the carrier to move independently of any further actuator motion and the contacts snap open. This rapid opening prevents teasing and minimizes contact welding. Some snap action devices also incorporate direct opening action. The direct opening action occurs slightly later in the travel than the normal snapover point if the contacts were slightly welded.

Mechanically Linked Contacts

This construction has also been known as "positively guided contacts". It combines a N.C. and N.O. contact combination to prevent N.C. and N.O. contacts from closing at the same time. This nomenclature is generally applied to control relays, but is also applicable to push buttons, pressure and temperature switches, and other control circuit devices. It is generally used for checking control circuit functions.

Time Delay

Time delay of a switching device is the interval between the time when the external operator of the switching device is actuated and the time when the contact action actually occurs.

In a switching device where time delay is provided, contact action takes place at a predetermined time interval after physical action has taken place to displace the external operator in a sufficient manner to operate the device. This time delay is fixed in some devices and adjustable in others to meet circuit requirements. Pneumatic timers are commonly used to perform this function.

Stacking

A switching device that has been designed for stacking has provisions for attaching multiple contact elements to the operator.

Stacking provides a means for multiple circuits to be actuated from a single external operator. A switching device with this capability can perform multiple functions or combinations of functions depending on the type of external operator. A selector switch type operator with several positions in combination with multiple contact elements is one example of this type of device.

Switch Design Considerations

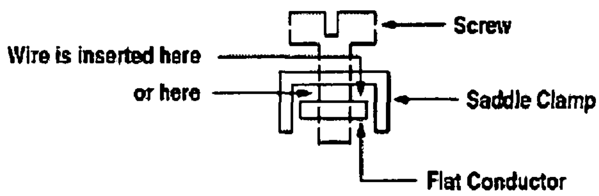
Wiring Termination

The following are examples of some of the more common methods of termination used.

Binding Head Screw
This screw has a larger than normal head. The underside of the screw head has a groove where the wire seats and is secured when the screw is tightened. It is most effective when used with solid wire. A cup washer can be added to accommodate stranded wire, but care must be exercised to ensure that all strands are secured

Saddle Clamp
This is a U-shaped clamp with a screw in the center. The screw threads into a flat conductor on the switching device and the legs of the U slide over the edges of the flat conductor in order to trap the wire.

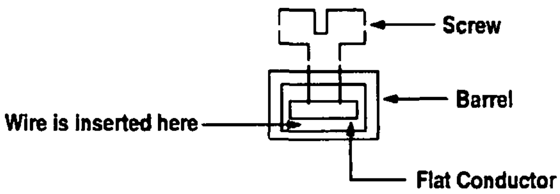
Figure 5.



The saddle clamp should be designed so it tilts to securely clamp a single wire on one side or a different wire size on each side of the clamp.

Barrel Type — This is similar to the saddle clamp design, but instead of a U-shaped clamp, the clamp is rectangular.

Figure 6.



The screw is not threaded into the flat conductor but rather bears against its top surface. This causes the barrel to be drawn upward clamping the wire between the undersurface of the flat conductor and the lower portion of the barrel. A major advantage is the wire is easy to insert into the clamping area.

Pressure Plate
A pressure plate is essentially a flat piece of material with a screw in the center. As with the saddle clamp, the screw threads into the flat conductor on the switching device. Even though the pressure plate is flat, it is designed to force the individual strands of wire to the center of the face plate that comes in contact with the conductor on the switching device where they are restrained. In addition, features are often designed into the body of the switching device that prevent any wire strands from escaping the pressure plate clamping action.

Switch Design Considerations

Stab Type

This type of termination is often termed quick-connect, push-on, fast-on, etc. The connection between the switching device and the wire is made with special complementary connection parts. The male part is normally built into the switching device and the female part is mechanically attached to the wire end. Termination is accomplished by mating the connector parts. This method provides a quick way to attach wires to the switching device and it is easy to remove the wires for service.

PC Pin

These are switching devices that can be soldered directly to a printed circuit board or plugged with pin connectors into receptacles mounted on the board.

Lugs and Ferrules

These devices are mechanically secured to the wire end. They make it easier to attach the wire to the switch terminal. They are normally used with stranded wire.

- Lugs provide a flat projection that is usually shaped like a fork or ring. The projection can be inserted under the head of the screw, inserted into saddle clamps, or slipped under pressure plates.
- Ferrules provide a pin type projection well suited for use with saddle clamps, pressure plates, and barrel type terminals.

Solder

Solder can be applied to the end of stranded wire to prevent the individual strands of wire from separating. The end of the wire becomes solid when soldered and can be used with saddle clamps, pressure plates, and barrel type terminals. It should be noted that the solder end will be quite hard and will resist the crushing effect of clamping means. Because of the irregular shape obtained through soldering, only partial contact between the wire and the terminal could result.

Spring-Clamp

This termination style is designed to minimize wiring time. The optimized spring-clamp is designed to reduce stress relaxation while maintaining contact force. An opening force is applied by a lever. The wire is then inserted and the opening force is removed. Upon force removal, the spring-clamp closes on the wire. This design is good for vibration environments.

Because of the large variety of termination options and the importance of establishing and maintaining a reliable connection between the switching device and the circuit, standards have been developed to address this area. The Underwriters Laboratories Pullout and Secureness test is used to insure that termination methods have sufficient strength to retain the wire under conditions of use. This test also determines if the wire strands have been damaged during the wiring process or are susceptible to breakage under conditions of use.

Switch Design Considerations

Finger-Safe

A finger-safe device provides a degree of protection from accidental, casual contact of live electrical parts by personnel. Only those components meeting or exceeding the requirements of IEC standard IP2X (listed under IEC 529) can be considered finger-safe.

Those standards describe a model test finger, along with guidelines for the manner in which the test finger is to be manipulated in the vicinity of the wiring terminals to determine if the switching device provides the required degree of protection.

Some switching devices achieve the finger-safe condition by basic device design while others require an external attachment.

The finger-safe feature is becoming more prevalent as safety issues take on added importance. Higher voltage levels pose a greater risk of injury and liability. A concern of finger-safe design is it may provide a false sense of security to personnel who have access to the area where electrical terminations are made.

Special Considerations

Every switch serves as just one element in a complete system. Where and how that system operates plays a significant role in which switch will deliver the most cost-effective performance over time. In the section that follows, you'll gain a better understanding of some of the extraordinary issues involved in switch specification.

Environmental Considerations

Careful consideration of the environment to which the switching device is subjected will help ensure proper operation and acceptable service life. Consideration of external environmental conditions of the operators includes temperature and humidity, shock and vibration, and exposure to washdown, cutting fluids, etc., encountered during operation.

In installations where an unfriendly external environment exists, the switching device should be housed in an enclosure designed to isolate it from the environment. Various enclosure ratings have been developed for use in specific environments and these ratings are regulated by industry standards. The external environment of the switching device can have a profound effect on the operation of the device and on its service life.

Conditions generated within enclosures can also have a negative effect on switch operation and life. Condensation, internally generated chemicals, or trapped dirt are some of the more common problems. In addition, since each switching device is made of a variety of materials, each produces its own internal environment. Caution must be taken during the design of the switching device to ensure the materials selected are proper for this kind of device and are compatible with one another.

The following information points out some key internal and external conditions affecting switching devices, as well as their effects.

Temperature
All electrical devices have a maximum operating temperature rating and this rating is generally understood by the user. The maximum storage temperature and the effects of low temperature are not as well-understood.

Exceeding the high temperature limits can cause degradation of materials within the switch. This degradation can weaken switch parts or release gases from plastics and elastomers. A change in physical dimensions may occur, affecting operational travel and force. A very low temperature environment can cause sticking of the actuator and compromise the return action provided by the internal springs within the switching devices. Great care should be taken to exclude freezing liquids from the vicinity of the external operator or the switch may be inoperative under available levels of operating force.

Large fluctuations in temperature can lead to condensation of water or other liquids, and result in the problems relating to humidity, chemicals, and gases listed below (in those cases it is generally helpful to ventilate the enclosure).

Humidity
Moisture can cause the formation of rust and corrosion on metallic parts as well as contribute to electrical problems such as arc tracking.

Chemicals and Gases
This class of contaminants can cause degradation of material used in the product in a

variety of ways. Corrosion of metallic parts and the degradation of physical properties of plastics and elastomers are among the most common effects. The formation of conductive films on the surface of the insulation can cause arc tracking.

Dirt and Debris
Whether originating internally from wear or damage, or externally, this material can cause friction between moving parts, increase wear, and reduce switch life. Dirt on contacts increases resistance and contributes to contact reliability problems.

Shock and Vibration
Consideration must be given to the shock and vibration to which the switching device is subjected. Severe shocks can cause unintended momentary contact operation that could result in circuit malfunction. Long term exposure to vibration can cause premature wear of the switch elements and generation of internal dirt. Even a poorly designed panel door can repeatedly subject a switching device to damaging shock and vibration.

It's also important to handle a switch with care during installation to avoid damaging shock.

Physical Abuse
Improper handling of the switching device during shipping or installation can cause damage to device components that could affect operation.

Environmentally Sealed Devices

An environmentally sealed device isolates the contact area from the environment.

The most common type of construction has the contacts hermetically sealed within a glass envelope. Prior to sealing, the interior of the glass envelope is filled with an inert gas that keeps the environment around the contacts stable. This construction keeps out explosive gases or contaminants that could affect contact reliability. Since the contacts are not accessible for actuation by mechanical means, they are operated by means of magnetic flux.

A special version of the sealed switch known as a logic reed is used in logic circuits. The logic reed is characterized by very short contact bounce, typically less than 0.5 milliseconds.

Contact isolation can also be accomplished by mechanical means such as a flexible diaphragm. These methods do not, however, provide a true hermetic seal, and are more susceptible to wear and degradation.

Switch Design Considerations

Standards and Approvals

Standards have been developed by industry groups and governmental units to help ensure that switching devices meet certain requirements with regard to installation criteria, safe operation, load carrying ability, minimum mechanical and electrical life, etc.

Once a particular design has met the requirements of a specific standard, a marking may be affixed to devices constructed according to that design indicating that the standards of that particular agency have been met.

Users need to be aware of which standards pertain to the products used in their locations and which approvals are required. Requirements vary depending on the application and the governmental unit having jurisdiction. Some of the standards that apply to switching devices are listed below:

- UL 508
- NEMA ICS 5 part 1
- IEC 60947-5-1
- CSA 22.2 No. 14

Switch Life

Switch life can be defined in a variety of ways. It can be defined as the time when the switch physically fails and can no longer provide contact action. It can also be defined as the point when the operating characteristics change to such a degree that switch action is no longer reliable or the parameters fall outside those required for that application. Examples of the latter would be an increase in operating force or excessive travel to obtain contact action.

A switching device may wear out due to mechanical considerations. Repeated operations cause physical wear of parts due to friction, shock, and stress, and can lead to eventual component failure. Dirt and debris generated by the moving mechanism can cause binding and can be a source of contact contamination.

The electrical life of a switch is not necessarily related to its mechanical life. The electrical life of a switch is primarily load dependant, because the electrical load is the main source of heating in — and damage to — current carrying components. High current loads can also contribute to arcing at the contacts during contact action. This arcing action results in contact erosion and deformation and can lead to welding of the contacts. As a result, it is good practice to evaluate both mechanical and electrical life ratings before selecting a switching device.

The switch environment can cause corrosion. This may lead to friction, physical failure of components, and dirt or corrosion in the contact areas.

Low level switching and infrequent use may allow buildup of film on contact faces, affecting contact reliability. Logic reed switches or switches with precious metal contacts are ideal in these applications.

Special Considerations

Shock and Vibration

Shock and vibration refer to the physical conditions that are present in the environment where the switch operates. These conditions often introduce undesirable motion into the device mechanism.

Sources of shock can be the normal motion of the equipment where the device is mounted or the expected movement of the entire control system. Such motion may be repetitive in nature or may occur only periodically under specific situations such as startup, etc. The user may try to anticipate random, abnormal conditions which could result in a high shock situation. One-time mishandling during shipping and installation can cause damage that will affect operation.

Another source of high shock is the slamming of control panel doors where the switching devices are mounted. In order to minimize the effect of known vibration, the axis of actuation of the switching device should not lie on the same plane as that of the direction of normal equipment vibration.

Contact reliability can be affected by shock and vibration. Continual vibration causes mechanical wear and under load conditions, arcing can lead to welding of contacts. A severe shock can cause unintended, momentary contact operation that could result in circuit malfunction.

The mechanical wear caused by long term exposure to vibration can result in the generation of dirt and debris which affects contact reliability and causes added friction in the sliding portions of the mechanism.

Dielectric Strength

Dielectric strength is a measure of the ability of the insulation used in the switching device to withstand the application of a voltage across its surface or through its mass. This will determine the maximum electrical rating of the device.

Degradation of the dielectric strength of insulation can lead to failure of the device. Unintended electrical continuity may be established between circuit elements and ground. In either case, the result is a failure of the switch to perform its intended function.

The most common type of failure is due to arc tracking across the surface of the insulation. The combination of a particular insulation and environmental conditions such as moisture and/or certain gases in the presence of an electrical arc can result in the buildup of a conducting path.

Special Considerations

Contact Block Ratings

The contact block rating of a switching device is the electrical load that the device is capable of switching. This rating is expressed in voltage and current and typically refers to the maximum values that can be switched in a specified number of operations. Although contact blocks are usually rated for maximum conditions, there is a practical low load limit that the contacts will switch in a reliable manner.

Exceeding the high loads can cause burning and pitting of the contacts leading to welding and contributing to arc tracking. If the load to be switched is of a very low energy level, any contaminants or non-conducting films on the contacts may prevent a circuit from being established when the contacts are operated. If loads below 48V DC and 0.1 A, or below 24V AC and 0.4 A, are to be switched, the user must be cautious when selecting the contact materials. If the switching is within a typical Type 4/4X/13 environment, the quadfurcated/ pentafurcated blocks should be used for ultimate reliability. If the switching is within Class 1 and 2 Division 2 environment, without a sealing well or a conduit seal off, logic reed, sealed switch, or stackable sealed switch contact blocks should be used. If this type of switch is used at the high end of the rating, then caution should be exercised if these contacts are used for switching low energy loads. The feature built in for establishment of low energy loads may have been burned away during high load switching operations.

Due to the growing popularity of solid-state devices being used in control circuits, the trend in industry is toward lower energy loads.

sprecher+
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Divisional Headquarters

Sprecher+Schuh US Division Headquarters
15910 International Plaza Dr., Houston, TX 77032
Tel: (281) 442-9000 Fax: (800) 739-7370

Sprecher+Schuh Canadian Division
3610 Nashua Dr., Unit 10, Mississauga, Ontario LV4 1L2
Tel: (905) 677-7514 Fax: (905) 677-7663

www.sprecherschuh.com

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TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type: Surge Diverter

Location: Main Incomer

Model Numbers: TDS-180-4S-277

Manufacturer: Critec

Supplier: Energy Correction Options
PO Box 431
Kelvin Grove, QLD. 4059

Ph: 07 3356 0577
Fx: 07 3356 1432
Web: www.ecoptions.com.au

ERITECH

TDS

CRITEC® Transient Discriminating Surge Diverters

ERICO

Surge Protection And Surge Ratings

The stress, which an SPD will experience under surge conditions, is a function of many complex and interrelated parameters. These include:

- Location of the SPD(s) within the structure – are they located at the main distribution board or within the facility at secondary board, or even in front of the end-user equipment?
- Method of coupling the lightning strike to the facility – for example, is this via a direct strike to the structures LPS, or via induction onto building wiring due to a nearby strike?
- Distribution of lightning currents within the structure – for example, what portion of the lightning current enters the earthing system and what remaining portion seeks a path to remote grounds via the power distribution system and equipotential bonding SPDs?
- Type of power distribution system – the distribution of lightning current on a power distribution system is strongly influenced by the grounding practice for the neutral conductor. For example, in the TN-C system with its multiple earthed neutral, a more direct and lower impedance path to ground is provided for lightning currents than in a TT system.
- Additional conductive services connected to the facility – these will carry a portion of the direct lightning current and therefore reduce the portion which flows through the power distribution system via the lightning equipotential bonding SPD.
- Type of waveshape – it is not possible to simply consider the peak current which the SPD will have to conduct, one also has to consider the waveshape of this surge. It is also not possible to simply equate the areas under the current-time curves (also referred to as the action integral) for SPDs under different waveshapes.

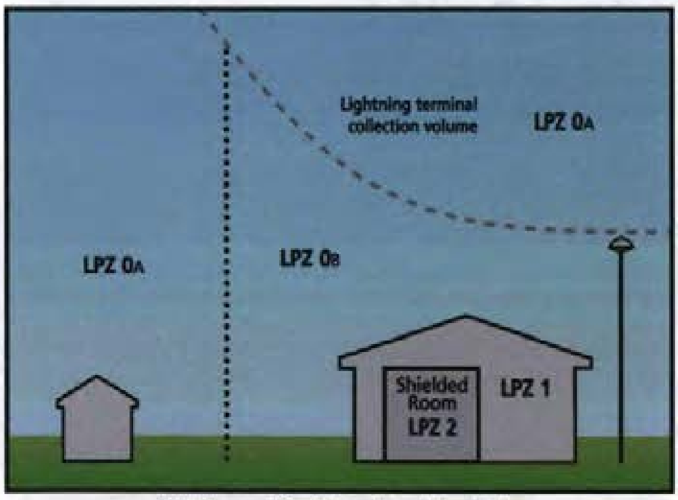
Many attempts have been made to quantify the electrical environment and "threat level" which an SPD will experience at different locations within a facility. The new IEC℠ standard on lightning protection, IEC 62305-4 "Protection against lightning - Part 4: Electrical and electronic systems within structures" has sought to address this issue by considering the highest surge magnitude which may be presented to an SPD based on the lightning protection level (LPL) being considered. For example, this standard postulates that under a LPL I the magnitude of a direct strike to the structure's LPS may be as high as 200kA 10/350. While this level is possible, its statistical probability of occurrence is approximately 1%. In other words, 99% of discharges will be less than this postulated 200 kA peak current level.

An assumption is made that 50% of this current is conducted via the building's earthing system, and 50% returns via the equipotential bonding SPDs connected to a three wire plus neutral power distribution system. It is also assumed that no additional conductive service exists. This implies that the portion of the initial 200 kA discharge experienced by each SPD is 25 kA.

Simplified assumptions of current dispersion are useful in considering the possible threat level, which the SPD(s) may experience, but it is important to keep in context the assumptions being made. In the example above, a lightning discharge of 200kA has been considered. It follows that the threat level to the equipotential bonding SPDs will be less than 25kA for 99% of the time. In addition, it has been assumed that the waveshape of this current component through the SPD(s) will be of the same waveshape as the initial discharge, namely 10/350, while in reality the waveshape have been altered by the impedance of building wiring, etc.

Many standards have sought to base their considerations on field experience collected overtime. For example, the IEEE* guide to the environment C62.41.1 and the recommended practice C62.41.2 present two scenarios of lightning discharge and different exposure levels under each of these depending on the location where the SPD is installed. In this standard, Scenario II depicts a direct strike to the structure, while Scenario I depicts a nearby strike and the subsequent conducted current into a structure via power and data lines. The highest surge exposure considered feasible to an SPD installed at the service entrance to a facility under Scenario I is 10kA 8/20, while under Scenario II it is considered to be 10kA 10/350 (exposure Level 3).

From the above, it is apparent that the selection of the appropriate surge rating for an SPD depends on many complex and interconnected parameters. When addressing such complexities, one needs to keep in mind that one of the more important parameters in selecting an SPD is its limiting voltage performance during the expected surge event, and not the energy withstand which it can handle.



Protection zones defined by specific product application.

2

Advanced Technologies – The ERICO® Advantage

Transient Discriminating Technology

To meet the fundamental requirements of performance, longer service life and greater safety under real world conditions, ERICO has developed Transient Discriminating (TD) Technology.

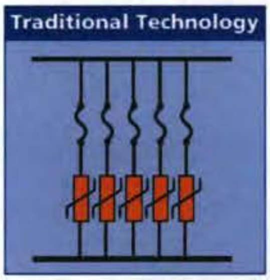
This quantum leap in technology adds a level of "intelligence" to the Surge Protection Device enabling it to discriminate between sustained abnormal over-voltage conditions and true transient or surge events. Not only does this help ensure safe operation under practical application, but it also prolongs the life of the protector since permanent disconnects are not required as a means of achieving internal over-voltage protection.

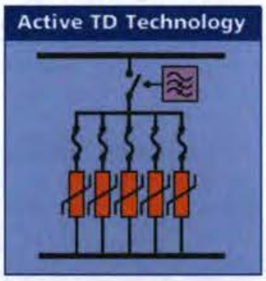
Traditional Technologies

Conventional SPD technologies utilize metal oxide varistors and/or silicon avalanche diodes to clamp or limit transient events. However, these devices are susceptible to sustained 50/60Hz mains over-voltage conditions which often occur during faults to the utility system. Such occurrences present a significant safety hazard when the suppression device attempts to clamp the peak of each half cycle on the mains over-voltage. This condition can cause the device to rapidly accumulate heat and in turn fail with the possibility of inducing a fire hazard.

The Core of TD Technology

The secret to ERICO's Transient Discriminating Technology is its *active frequency discrimination* circuit. This patented device can discriminate between a temporary over-voltage (TOV) condition and a very fast transient, which is associated with lightning or switching-induced surges. When the transient frequencies are detected, the patented Quick-Switch within TD activates to allow the robust protection to limit the incoming transient. The frequency discriminating circuit that controls the Quick-Switch helps ensure that the SPD device is immune to the effects of a sustained 50 or 60Hz TOV. This allows the device to keep operating, in order to help provide safe and reliable transient protection, even after an abnormal over-voltage condition has occurred.

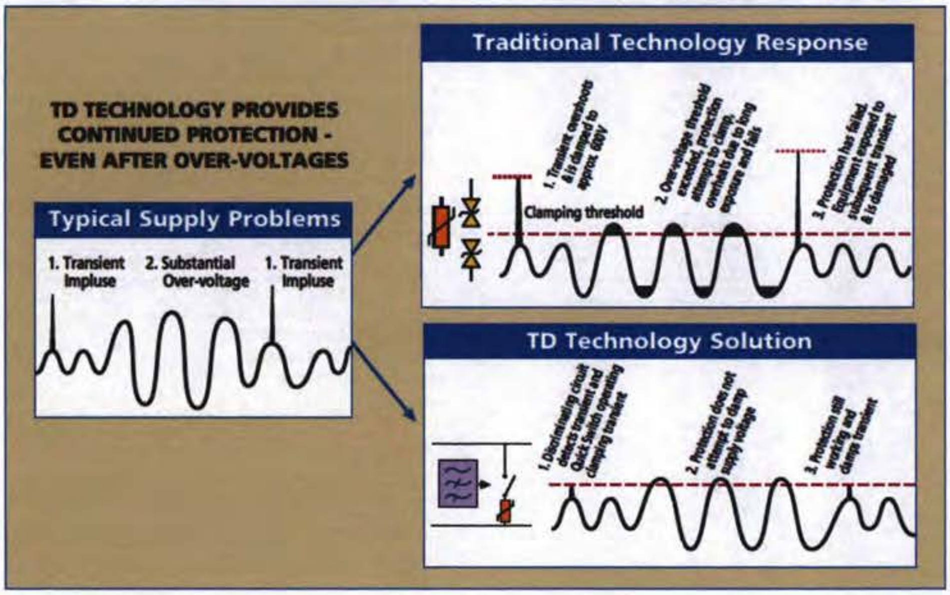




Meeting & Exceeding UL® Standards

The CRITEC® range of surge protection devices from ERICO® employing TD Technology has been specifically designed to meet and exceed the new safety requirements of UL 1449 Edition 3. To meet the abnormal over-voltage testing of UL 1449 Edition 3, many manufacturers of SPD devices have incorporated fuse or thermal disconnect devices which permanently disconnect all protection from the circuit during an over-voltage event. Transient Discriminating Technology on the other hand will allow the SPD device to experience an abnormal over-voltage up to twice its nominal operating voltage and still remain operational even after this event! This allows the device to help provide safe, reliable and continuous protection to your sensitive electronic equipment. TD Technology is especially recommended for any site where sustained over-voltages are known to occur, and where failure of traditional SPD technologies cannot be tolerated.

The UL 1449 testing standard addresses the safety of an SPD device under temporary and abnormal overvoltage conditions, but does not specifically mandate a design that will give a reliable, long length of service in the real world. Specifically, UL 1449 tests that the SPD remains operational at 10% above nominal supply voltage, allowing SPD manufacturers to design products that permanently disconnect just above that. Most reputable manufacturer's designs allow for up to a 25% overvoltage, while ERICO's TD Technology gives even greater overhead.



TDS130

CRITEC® TDS Surge Diverter - TDS130 Series

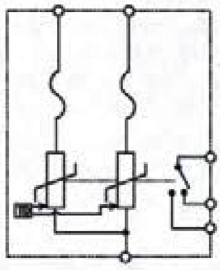
Features

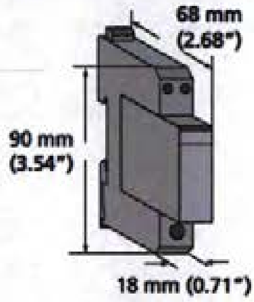
- CRITEC TD Technology with thermal disconnect protection
- Compact package, modular DIN rail mounting for limited space requirements
- Three modes of protection: L-N, L-PE & N-PE
- Indication flags and voltage-free contacts provide remote status monitoring
- Separate plug and base design facilitates replacement of a failed surge module
- 15kA 8/20µs surge rating per mode
- CE, UL® 1449 Edition 3 Listed

Surges and voltage transients are a major cause of expensive electronic equipment failure and business disruption. Damage may result in the loss of capital outlays, such as computers and communications equipment, as well as consequential loss of revenue and profits due to unscheduled system down-time.

The TDS130 series of surge suppressors provide economical and reliable protection from voltage transients on power distribution systems. The TDS130 is specifically designed for the protection of single phase power supplies within instrumentation and control applications. They are conveniently packaged for easy installation on 35 mm DIN rail within control panels.

CRITEC® TD technology helps ensure reliable and continued operation during sustained and abnormal over-voltage events. Internal thermal disconnect devices help ensure safe behavior at end-of life. A visual indicator flag provides user-feedback in the event of such operation. The TDS130 provides a set of optional voltage-free contacts for remote signaling that maintenance is required.





The convenient plug-in module and separate base design facilitates replacement of a failed surge module without needing to undo installation wiring.

Model	TDS1301TR150	TDS1301TR240
Item Number for Europe	702421	702422
Nominal Voltage, U_n	120-150 VAC	220-240 VAC
Max Cont. Operating Voltage, U_c	170VAC	275VAC
Stand-off Voltage	230VAC	440VAC
Frequency	0-100Hz	
Nominal Discharge Current, I_n	8kA 8/20µs per mode	
Max Discharge Current, I_{max}	15kA 8/20µs L-N 15kA 8/20µs L-PE	
Protection Modes	L-G, L-N, N-G	
Technology	TD Technology with thermal disconnect	
Short Circuit Current Rating, I_{sc}	200kAIC	
Back-up Overcurrent Protection	63AgL, if supply > 63A	
Voltage Protection Level, U_p	500V @ 3kA (L+N-G) 800V @ 3kA (L-N)	800V @ 3kA (L+N-G) 1500V @ 3kA (L-N)
Status	N/O, N/C Change-over contact, 250V~/0.5A, max 1.5 mm² (#14AWG) terminals Mechanical flag / remote contacts (R model only)	
Module Width	1 M	
Dimensions H x D x W: mm (in)	90 x 68 x 18 (3.54 x 2.68 x 0.71)	
Weight: kg (lbs)	0.12 (0.26)	
Enclosure	DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA-1)	
Connection	1 mm² to 6 mm² (#18AWG to #10AWG) Line and Neutral Terminals ≤25 mm² (#4AWG) stranded ≤35 mm² (#2AWG) solid PE Terminal	
Mounting	35 mm top hat DIN rail	
Temperature	-40°C to 80°C (-40°F to 176°F)	
Humidity	0% to 90%	
Approvals	CE, IEC® 61643-1, UL® 1449 Ed 3 Recognized Component Type 2	
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B IEC 61643-1 Class II UL® 1449 Ed3 In 3kA mode	
Replacement Module	TDS130M150	TDS130M240
Replacement Module (Europe)	702432	702424

TDS150

CRITEC® TDS Surge Diverter - TDS150 Series

Features

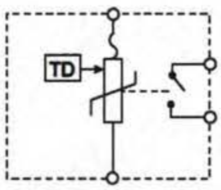
- CRITEC® TD Technology with thermal disconnect protection
- Compact design fits into DIN distribution panel boards and motor control centers
- 35 mm DIN rail mount – DIN 43 880 profile matches common circuit breakers
- Indication flags and voltage-free contacts provide remote status monitoring
- Separate plug and base design facilitates replacement of a failed surge module
- 50kA 8/20µs maximum surge rating provides protection suitable for sub-distribution panels and a long operational life
- Available in various operating voltages to suit most common power distribution systems
- CE, UL® 1449 Edition 3 Listed

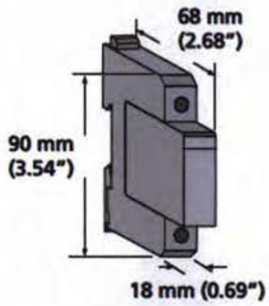
Surges and voltage transients are a major cause of expensive electronic equipment failure and business disruption. Damage may result in the loss of capital outlays, such as computers and communications equipment, as well as consequential loss of revenue and profits due to unscheduled system down-time.

The TDS150 series of surge suppressors provide economical and reliable protection from voltage transients on power distribution systems. They are conveniently packaged for easy installation on 35 mm DIN rail within main distribution panelboards.

CRITEC® TD technology helps ensure reliable and continued operation during sustained and abnormal over-voltage events. Internal thermal disconnect devices help ensure safe behavior at end-of-life. A visual indicator flag provides user-feedback in the event of such operation. As standard, the TDS150 provides a set of voltage-free contacts for remote signaling that maintenance is required.

The convenient plug-in module and separate base design facilitates replacement of a failed surge module without needing to undo installation wiring.





Model	TDS1501SR150	TDS1501SR240	TDS1501SR277	TDS1501SR560
Item Number for Europe	702404	702406	702407	702408
Nominal Voltage, U_n	120-150 VAC	220-240 VAC	240-277 VAC	480-560 VAC
Max Cont. Operating Voltage, U_c	170VAC	275VAC	320VAC	610VAC
Stand-off Voltage	240VAC	440VAC	480VAC	700VAC
Frequency	0-100Hz			
Short Circuit Current Rating, I_{sc}	200kAIC			
Back-up Overcurrent Protection	125AgL, if supply > 100A			
Technology	TD with thermal disconnect			
Max Discharge Current, I_{max}	50kA 8/20µs			
Nominal Discharge Current, I_n	25kA 8/20µs	20kA 8/20		
Protection Modes	Single mode (L-G, L-N or N-G)			
Voltage Protection Level U_p	400V @ 3kA 1.0kV @ In	700V @ 3kA 1.2kV @ In	800V @ 3kA 1.6kV @ In	1.8kV @ 3kA 2.4kV @ In
Status	N/O, N/C Change-over contact, 250V~/0.5A, max 1.5 mm² (#14AWG) terminals Mechanical flag / remote contacts (R model only)			
Dimensions H x D x W: mm (in)	90 x 68 x 18 (3.54 x 2.68 x 0.69)			
Module Width	1 M			
Weight: kg (lbs)	0.12 (0.26)			
Enclosure	DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA-1)			
Connection	≤25 mm² (#4AWG) stranded ≤35 mm² (#2AWG) solid			
Mounting	35 mm top hat DIN rail			
Temperature	-40°C to 80°C (-40°F to 176°F)			
Humidity	0% to 90%			
Approvals	CE, IEC® 61643-1, UL® 1449 Ed 3 Recognized Component Type 2			
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B, Cat C ANSI®/IEEE® C62.41.2 Scenario II, Exposure 2, 50kA 8/20µs IEC 61643-1 Class II UL® 1449 Ed3 In 20kA mode			
Replacement Module	TDS150M150	TDS150M240	TDS150M277	TDS150M560

TDS1100

CRITEC® TDS Surge Diverter - TDS1100 Series

Features

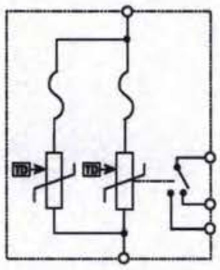
- CRITEC® TD Technology with thermal disconnect protection
- Compact design fits into DIN distribution panel boards and motor control centers
- 35 mm DIN rail mount – DIN 43 880 profile matches common circuit breakers
- Indication flags and voltage-free contacts provide remote status monitoring
- Separate plug and base design facilitates replacement of a failed surge module
- 100kA 8/20μs maximum surge rating provides protection suitable for sub-distribution panels and a long operational life
- Available in various operating voltages to suit most common power distribution systems
- CE, UL® 1449 Edition 3 Listed

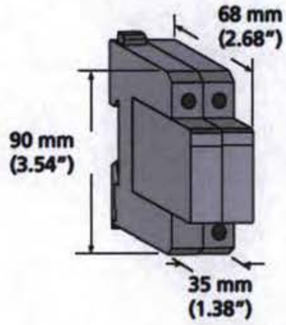
Surges and voltage transients are a major cause of expensive electronic equipment failure and business disruption. Damage may result in the loss of capital outlays, such as computers and communications equipment, as well as consequential loss of revenue and profits due to unscheduled system down-time.

The TDS1100 series of surge suppressors provide economical and reliable protection from voltage transients on power distribution systems. They are conveniently packaged for easy installation on 35 mm DIN rail within main distribution panelboards.

CRITEC® TD technology helps ensure reliable and continued operation during sustained and abnormal over-voltage events. Internal thermal disconnect devices help ensure safe behavior at end-of-life. A visual indicator flag provides user-feedback in the event of such operation. As standard, the TDS1100 provides a set of voltage-free contacts for remote signaling that maintenance is due.

The convenient plug-in module and separate base design facilitates replacement of a failed surge module without needing to undo installation wiring.





Model	TDS11002SR150	TDS11002SR240	TDS11002SR277	TDS11002SR560
Item Number for Europe	702409	702411	702412	702413
Nominal Voltage, U_n	120-150 VAC	220-240 VAC	240-277 VAC	480-560 VAC
Max Cont. Operating Voltage, U_c	170VAC	275VAC	320VAC	610VAC
Stand-off Voltage	240VAC	440VAC	480VAC	700VAC
Frequency	0-100Hz			
Short Circuit Current Rating, I_{sc}	200kAIC			
Back-up Overcurrent Protection	125AgL, if supply > 100A			
Technology	TD with thermal disconnect			
Max Discharge Current, I_{max}	100kA 8/20μs			
Impulse Current, I_{imp}	12.5kA 10/350μs			
Nominal Discharge Current, I_n	50kA 8/20μs	40kA 8/20μs		
Protection Modes	Single mode (L-G, L-N or N-G)			
Voltage Protection Level, U_p	400V @ 3kA 1.0kV @ 20kA	700V @ 3kA 1.2kV @ 20kA	800V @ 3kA 1.6kV @ 20kA	1.8kV @ 3kA 2.4kV @ 20kA
Status	N/O, N/C Change-over contact, 250V~/0.5A, max 1.5 mm² (#14AWG) terminals Mechanical flag / remote contacts (R model only)			
Dimensions H x D x W: mm (in)	90 x 68 x 35 (3.54 x 2.68 x 1.38)			
Module Width	2 M			
Weight: kg (lbs)	0.24 (0.53)			
Enclosure	DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA-1)			
Connection	≤25 mm² (#4AWG) stranded ≤35 mm² (#2AWG) solid			
Mounting	35 mm top hat DIN rail			
Temperature	-40°C to 80°C (-40°F to 176°F)			
Humidity	0% to 90%			
Approvals	CE, IEC® 61643-1, UL® 1449 Ed 3 Recognized Component Type 2			
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B, Cat C ANSI®/IEEE® C62.41.2 Scenario II, Exposure 3, 100kA 8/20μs, 10kA 10/350μs IEC 61643-1 Class I and Class II UL® 1449 Ed3 In 20kA mode			
Replacement MOV Module	TDS150M150	TDS150M240	TDS150M277	TDS150M560

Features

- CRITEC® TD Technology with thermal disconnect protection
- Compact design fits into DIN distribution panel boards and motor control centers
- 35 mm DIN rail mount – DIN 43 880 profile matches common circuit breakers
- Indication flags and voltage-free contacts provide remote status monitoring
- Separate plug and base design facilitates replacement of a failed surge module
- 50kA 8/20µs maximum surge rating provides protection suitable for sub-distribution panels and a long operational life
- Available in various operating voltages to suit most common power distribution systems
- CE, UL® 1449 Edition 3 Listed

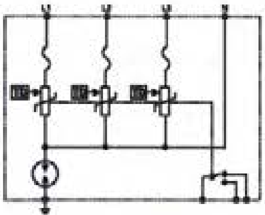
TDS350

CRITEC® TDS Surge Diverter - TDS350 Series

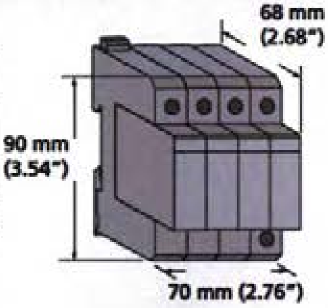
Surges and voltage transients are a major cause of expensive electronic equipment failure and business disruption. Damage may result in the loss of capital outlays, such as computers and communications equipment, as well as consequential loss of revenue and profits due to unscheduled system down-time.

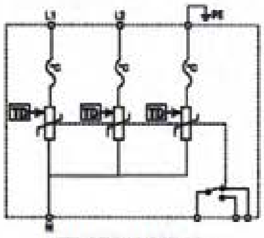
CRITEC® TD technology helps ensure reliable and continued operation during sustained and abnormal over-voltage events. Internal thermal disconnect devices help ensure safe behavior at end-of-life. A visual indicator flag provides user-feedback in the event of such operation. As standard, the TDS provides a set of voltage-free contacts for remote signaling that maintenance is due.

The convenient plug-in module and separate base design facilitates replacement of a failed surge module without needing to undo installation wiring.

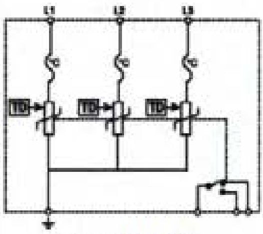


TDS350TT

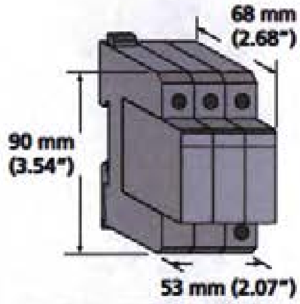




TDS50120/240



TDS350TNC



Model	TDS350TNC150	TDS50120240	TDS350TNC277	TDS350TT150	TDS350TT277
Item Number for Europe	702414	702419	702417	702416	702418
Nominal Voltage, U_n	120-150 VAC		240-277 VAC	120-150 VAC	240-277 VAC
Max Cont. Operating Voltage, U_c	170/295VAC	240/480VAC	320/536VAC	170/295VAC	320/536VAC
Stand-off Voltage	240/415VAC	240/480VAC	480/813VAC	240/415VAC	480/813VAC
Frequency	0-100Hz				
Short Circuit Current Rating, I_{sc}	200kAIC				
Back-up Overcurrent Protection	125AgL, if supply > 100A				
Technology	TD with thermal disconnect				
Max Discharge Current, I_{max}	50kA 8/20µs			12.5kA 10/350µs N-PE 50kA 8/20µs	
Nominal Discharge Current, I_n	25kA 8/20µs		20kA 8/20	25kA 8/20µs	20kA 8/20
Protection Modes	L-N	L-N, N-PE	L-N	L-N, N-PE	
Voltage Protection Level, U_p	400V @ 3kA 1.0kV @ In		800V @ 3kA 1.6kV @ In	400V @ 3kA 1.0kV @ In	800V @ 3kA 1.6kV @ In
Status	N/O, N/C Change-over contact, 250V~/0.5A, max 1.5 mm² (#14AWG) terminals Mechanical flag / remote contacts				
Dimensions H x D x W: mm (in)	90 x 68 x 53 (3.54 x 2.68 x 2.07)			90 x 68 x 70 (3.54 x 2.68 x 2.76)	
Module Width	3 M			4 M	
Weight: kg (lbs)	0.36 (0.79)			0.5 (1.10)	
Enclosure	DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA-1)				
Connection	≤25 mm² (#4AWG) stranded ≤35 mm² (#2AWG) solid				
Mounting	35 mm top hat DIN rail				
Temperature	-40°C to 80°C (-40°F to 176°F)				
Humidity	0% to 90%				
Approvals	CE, IEC® 61643-1, UL® 1449 Ed 3 Recognized Component Type 2				
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B, Cat C ANSI®/IEEE® C62.41.2 Scenario II, Exposure 2, 50kA 8/20µs IEC 61643-1 Class II UL® 1449 Ed3 In 20kA mode				
Replacement MOV Module	TDS150M150		TDS150M277	TDS150M150	TDS150M277
Replacement GDT Module	-			SGD112M	
Replacement GDT Module (Europe)	-			702403	

7

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www.erico.com

AUSTRALIA
Phone +61-2-8751-8500
Fax +61-2-9475-5334

CHINA
Phone +86-21-3430-4878
Fax +86-21-5831-8177

HUNGARY
Phone +068-00-165-38
Fax +31-13-583-5499

NORWAY
Phone +800-100-73
Fax +800-100-66

SWITZERLAND
Phone +0800-558-697
Fax +0800-559-615

BELGIUM
Phone +0800-757-48
Fax +0800-757-60

DENMARK
Phone +808-89-373
Fax +808-89-372

INDONESIA
Phone +62-21-575-0941
Fax +62-21-575-0942

POLAND
Phone +48-71-374-4022
Fax +48-71-374-4043

THAILAND
Phone +66-2-267-5776
Fax +66-2-636-6988

BRAZIL
Phone +55-11-3623-4333
Fax +55-11-3621-4066

FRANCE
Phone +33-4-77-365-656
Fax +33-4-77-553-789

ITALY
Phone +39-02-8474-2250
Fax +39-02-8474-2251

SINGAPORE
Phone +65-6-268-3433
Fax +65-6-268-1389

UNITED ARAB EMIRATES
Phone +971-4-881-7250
Fax +971-4-881-7270

CANADA
Phone +1-800-677-9089
Fax +1-800-677-8131

GERMANY
Phone +0-800-189-0272
Fax +0-800-189-0274

MEXICO
Phone +52-55-5260-5991
Fax +52-55-5260-3310

SPAIN
Phone +34-93-467-7726
Fax +34-93-467-7725

UNITED KINGDOM
Phone +0808-2344-670
Fax +0808-2344-676

CHILE
Phone +56-2-370-2908
Fax +56-2-370-2914

HONG KONG
Phone +852-2764-8808
Fax +852-2764-4486

NETHERLANDS
Phone +31-13-583-5400
Fax +31-13-583-5499

SWEDEN
Phone +0207-909-08
Fax +0207-989-64

UNITED STATES
Phone +1-440-248-0100
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E712B-WWEN E798LT07WWEN 01110.6M8

TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type:	Surge Filter
Location:	Main Incomer
Model Numbers:	TDF-10A-240V
Manufacturer:	Critec
Supplier:	Energy Correction Options PO Box 431 Kelvin Grove, QLD. 4059 Ph: 07 3356 0577 Fx: 07 3356 1432 Web: www.ecoptions.com.au

ERITECH

Features

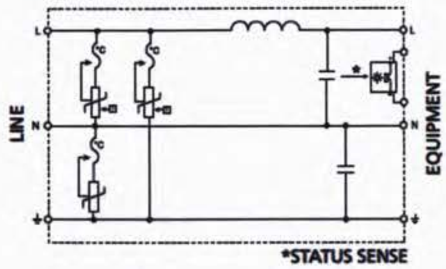
- CRITEC® Transient Discriminating (TD) Technology provides increased service life
- In-line series protection
- High efficiency low pass sine wave filtering – ideal for the protection of switched mode power supplies
- Three modes of protection: L-N, L-PE & N-PE
- 35 mm DIN rail mount – simple installation
- LED status indication and opto-isolated output – for remote status monitoring
- CE, UL® 1449 Ed. 3 Listed

TDF

CRITEC® Transient Discriminating Filter

The TDF series has been specifically designed for process control applications to protect the switched mode power supply units on devices such as PLC controllers, SCADA systems and motor controllers. Units are UL® Recognized and available for 3A, 10A and 20A loads and suitable for 110-120V ac/dc and 220-240Vac circuits.

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



Model	TDF3A120V	TDF3A240V	TDF10A120V	TDF10A240V	TDF20A120V	TDF20A240V
Item Number for Europe	700001	700002	700003	700004	700005	700006
Nominal Voltage, U_n	110-120 V	220-240 V	110-120 V	220-240 V	110-120 V	220-240 V
Distribution System	TN-C-S, TN-S					
Max Cont. Operating Voltage, Uc	170VAC	340VAC	170VAC	340VAC	170VAC	340VAC
Stand-off Voltage	240V	400V	240V	400V	240V	400V
Frequency	0-60Hz	50/60Hz	0-60Hz			50/60Hz
Max Line Current, I_L	3 A		10 A		20 A	
Operating Current @ U_n	135 mA	250 mA	240 mA	480 mA	240 mA	480 mA
Max Discharge Current, I_{max}	10kA 8/20μs N-PE 20kA 8/20μs L-N 20kA 8/20μs L-PE					
Protection Modes	All modes protected					
Technology	In-line series low pass sine wave filter TD Technology					
Voltage Protection Level, U_p	500V @ 500A 250V @ 3kA	700V @ 500A 600V @ 3kA	500V @ 500A 250V @ 3kA	700V @ 500A 600V @ 3kA	500V @ 500A 250V @ 3kA	700V @ 500A 600V @ 3kA
Filtering	-62dB @ 100kHz		-65dB @ 100kHz		-53dB @ 100kHz	
Status	Green LED. On=Ok. Isolated opto-coupler output					
Dimensions H x D x W: mm (in)	90 x 68 x 72 (3.54 x 2.68 x 2.83)		90 x 68 x 144 (3.54 x 2.68 x 5.67)			
Module Width	4 M		8 M			
Weight: kg (lbs)	0.7 (1.54)		1.48 (3.25)		1.57 (3.46)	
Enclosure	DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA®-1)					
Connection	1 mm² to 6 mm² (#18AWG to #10)					
Mounting	35 mm top hat DIN rail					
Back-up Overcurrent Protection	3A		10A		20A	
Temperature	-35°C to 55°C (-31°F to 131°F)					
Humidity	0% to 90%					
Approvals	C-Tick, CE (NOM 3A, 120V), CSA 22.2, UL® 1283, UL® 1449 Ed 3 Recognized Component Type 2					
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B, Cat C					

(1) Opto-coupler output can be connected to DINLINE Alarm Relay (DAR275V) to provide Form C dry contacts.

WARNING
ERICO products shall be installed and used only as indicated in ERICO's product instruction sheets and training materials. Instruction sheets are available at www.erico.com and from your ERICO customer service representative. Improper installation, misuse, misapplication or other failure to completely follow ERICO's instructions and warnings may cause product malfunction, property damage, serious bodily injury and death.

www.erico.com

ERICO®

ERITECH®

Features

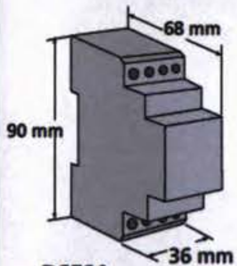
- In-line series protection
- EMI/RFI noise filtering – protects against industrial electrical noise
- Compact design – fits into motor control and equipment panels
- Three modes of protection: L-N, L-PE & N-PE
- 35 mm DIN rail mount – simple installation
- LED power indicator

DSF

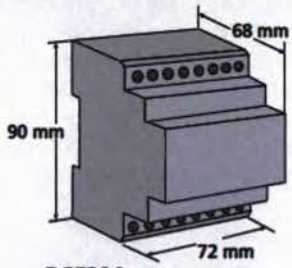
CRITEC® Dinline Surge Filter

The "two port" DSF 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. The 30V unit is suitable for 12V and 24Vac/dc signaling and control systems.

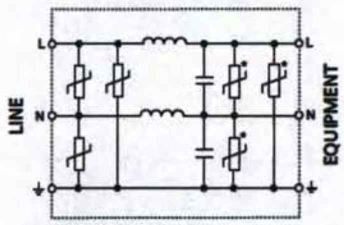
The 6A DSF series incorporates a space efficient, low pass, series filter which provides attenuation to high frequency interference. The larger 20A model provides status indication and a higher surge rating, making this ideal for the protection of higher risk equipment.



DSF6A



DSF20A



*DSF20A275V only

Model	DSF6A30V	DSF6A150V	DSF6A275V	DSF20A275V
Item Number for Europe	702090	701000	701030	701020
Nominal Voltage, U_n	24	110-120 V	220-240 V	
Distribution System	1Ph 2W+G			
System Compatibility	TN-S, TN-C-S			
Max Cont. Operating Voltage, Uc	30VAC, 38VDC	150VAC	275VAC	
Frequency	0-60Hz	50/60Hz		
Max Line Current, I_L	6 A			20 A
Operating Current @ U_n	7 mA			
Max Discharge Current, I_{max}	4kA 8/20µs	16kA 8/20µs		15kA 8/20µs L-N 15kA 8/20µs L-PE 25kA 8/20µs N-PE
Protection Modes	All modes protected			
Technology	In-line series filter MOV			
Voltage Protection Level, U_p	110V @ 3kA	400V @ 3kA	750V @ 3kA	710V @ 3kA
Filtering	-3dB @ 300kHz			-3dB @ 62kHz
Status	LED power indicator			Status indicator
Dimensions H x D x W: mm (in)	90 x 68 x 36 (3.54 x 2.68 x 1.42)			90 x 68 x 72 (3.54 x 2.68 x 2.83)
Module Width	2 M			4 M
Weight: kg (lb)	0.2 (0.441)			0.7 (1.543)
Enclosure	DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA-1)			
Connection	1 mm² to 6 mm² (#18AWG to #10AWG)			
Mounting	35 mm top hat DIN rail			
Back-up Overcurrent Protection	6A			20A
Temperature	-35°C to 55°C (-31°F to 131°F)			
Humidity	0% to 90%			
Approvals	C-Tick, CE, NOM, UL® 1449 Ed 3 Recognized Component Type 2	C-Tick, CE		
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B			

ANSI is a registered trademark of the American National Standards Institute. IEEE is a registered trademark the Institute of Electrical and Electronics Engineers, Incorporated. NEMA is a registered trademark the National Electrical Manufacturers Association. UL is a registered trademark Underwriters Laboratories, Inc.

WARNING
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ERICO®

E8175-WWEN E800LT07WWEN 00813.6M8

ERICO

TRANSIENT DISCRIMINATING FILTER

INSTALLATION INSTRUCTIONS

MODEL NUMBER
TDF-3A-120V
TDF-10A-120V
TDF-20A-120V
TDF-3A-240V
TDF-10A-240V
TDF-20A-240V

1. PREPARATION

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

CAUTION NOTES:

1. *The installation of this Surge Protector should follow all applicable electrical codes, such as the National Electrical Code, or the Canadian Electrical Code.*
2. *Check to make sure line voltage does not exceed Surge Protector voltage requirement.*
3. *Prior to installation ensure that the TDF is of the correct voltage, current, and frequency rating for your application.*
4. *The earth terminal must be connected to a low impedance earth (< 10 ohms) for correct operation.*
5. *Do not perform a "Flash Test" or use a Mega-Ohm Meter (Megger) to test circuits that are protected with TDF modules. Damage may occur to the TDF modules.*
6. *Follow all instructions to ensure correct and safe operation.*
7. *Do not attempt to open or tamper with the TDF units in any way as this may compromise performance and will void warranty.*

2. INTRODUCTION

Transient Discriminating Filters (TDF) are packaged in "DIN 43 880" profile enclosures for simple installation onto 35mm DIN rails. They can be selected for use on distribution systems with nominal RMS voltages of 120Vac or 240Vac at frequencies of 50/60Hz. The 120Vac unit also operates on nominal 125Vdc supplies.

3. QUICK INSTALLATION OVERVIEW

Install in the following manner:

1. Ensure that power is removed from the area and the circuits that will be connected.
2. Snap lock the TDF module to the DIN rail.
3. Install the appropriate upstream overcurrent protection.
4. Connect wiring to the indicated i/p and o/p terminals.
5. Apply power and observe correct operation of the Status Indication, and alarm facilities if provided - see Section 11.

4. PROTECTION CONCEPTS

To optimize effectiveness of the TDF protection, the unprotected and protected wiring should be separated. Wiring from the exposed transient source to the TDF should be considered unprotected and kept approximately 12" (300mm) from all other wiring wherever possible. Wiring on the equipment side of the TDF should be considered protected.

The separation of protected and unprotected wiring is recommended to minimize the risk that transients conducted on unprotected wiring may cross couple onto protected circuits, and diminish the level of protection available from the TDF module.

The terminals on the TDF module are labeled "INPUT/LINE" (unprotected side) and "OUTPUT/LOAD" (protected side) assuming that the source of the transients is on the input side of the TDF module.

For applications where the transient source is on the load side of the TDF module, the TDF should be reverse connected with the INPUT/LINE terminals connected to the load side, toward the source of the transients.

5. MOUNTING

TDFs are designed to clip to 35mm DIN rails (standard EN50022). Unless otherwise mechanically restrained, use horizontal DIN rails with the TDF module spring clips to the bottom and the label text the correct way up.

NOTE: *TDFs must be installed in an enclosure or panel that:*

- *prevents the TDF unit temperature from exceeding 122°F (50°C)*
- *provides adequate electrical and safety protection*
- *prevents the ingress of moisture and water*
- *allows TDF status indicators to be inspected*

6. GROUND FAULT CIRCUIT INTERRUPTION (GFCI)

Where GFCI protectors (RCDs/ELCBs) are used, it is preferable that the TDF modules be installed prior to these devices (i.e. upstream). If this is not done, nuisance tripping of the GFCIs may occur during transient activity.

7. CONDUCTOR TERMINATION

Each TDF terminal is designed to accept wire sizes from 10 to 18 AWG (1.5mm² to 6mm²) solid or stranded conductor. The wire insulation should be stripped back 5/16" (8mm).

NOTE: *Do not use greater than 9inlbs (1Nm) of torque when tightening the terminals. For UL compliance, where two wires may need to be terminated into one terminal, the permissible wire size is 18AWG each.*

8. FUSING AND ISOLATION

Overcurrent protection must be installed in the upstream circuit of every TDF to provide protection to the unit itself, the load and the wiring in case of fault situations. The current rating of the breaker or fuse used should be determined according to below. However, the current rating should be less than the rating of the wiring. For example, if a 20A TDF were installed in a circuit with wiring that can carry 15A, then a 15A overcurrent device must be installed upstream to protect both the TDF and wiring from overload.

MAX FUSE SIZES:	*TDF RATING*	*FUSE RATING*
	3A	**4A**
	10A	**10A**
	20A	**20A**

9. STATUS INDICATION

TDF modules have a single Status Indicator on the front panel. When power is applied and full surge capacity is available, the Status Indicator will be illuminated. Should power be applied and the indicator fail to illuminate, the TDF should be replaced, as optimum protection is no longer provided.

10. MAINTENANCE & TESTING

Before removing a TDF module from service, ensure that the power has been removed from the module. Replacement of a TDF module should only be undertaken by qualified personnel.

NOTE: *TDF units should be inspected periodically, and also following any periods of lightning or transient voltage activity. Check the Status Indicator and replace the module if it is not illuminated as detailed in Section 9 STATUS INDICATION.*

11. DINLINE ALARM RELAY (DAR)

The TDF status monitoring circuit which provides the visual Status Indicator, also provides a low voltage opto-coupler alarm output circuit. Should voltage free alarm contacts be required, the ERICO Inc, DINLINE ALARM RELAY (DAR) should be used.

The DAR module provides a fully isolated dry contact alarm output. One DAR can be used per TDF, or up to 16 TDFs can be connected in series to one DAR to provide a common dry contact alarm output.

Ensure that the voltage rating of the alarm wiring is rated in accordance with the other voltages present in the equipment. This would normally be the same voltage rating as that used for the TDF module input wiring.

It is recommended that the DAR unit be powered from the output/load side of the TDF being monitored, however the DAR can be powered from other circuits. This allows for example, one DAR unit to be connected to separate TDFs which are protecting a three phase circuit.

NOTE: *Depending upon the usage of the DAR output contacts, failure of power to the DAR may be interpreted as a failure of one or more TDFs. Visual inspection of the DAR and TDF Status Indicator is required to clarify this situation.*

12. USE OF OTHER INTERFACES

ERICO, Inc. DAR units are recommended for the interfacing of equipment to the TDF opto-coupler alarm output circuit. The direct connection of other equipment to the TDF opto-coupler alarm output circuit may not provide sufficient isolation or exceed the opto-coupler specifications. This may damage the TDF and/or the connected equipment. Warranty may be voided under such circumstances. However, the specifications for TDF alarm output has been provided for those who desire to use the TDF opto-coupler output directly.

The TDF alarm opto-coupler output is available on terminals 3 and 5. Terminal 3 is the positive and 5 is the negative side. This output is an open collector transistor output of the opto-coupler. When the opto-coupler is driven on, it should be arranged to have 2mA flowing through it. For use with 24Vdc circuits, a 12kΩ current limiting burden resistor is required. For use with 12Vdc circuits, a 5.6kΩ current limit resistor is required. For use with 5Vdc circuits, a 2.2kΩ current limit resistor is required.

NOTE: *In connecting to the TDF opto-coupler alarm output, do not reverse the +/- connections or exceed the maximum permissible ratings (30Vdc) as damage may occur.*

TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type: Surge Filter Alarm Relay

Location: Main Incomer

Model Numbers: DAR-275V

Manufacturer: Critec

Supplier: Energy Correction Options
PO Box 431
Kelvin Grove, QLD. 4059

Ph: 07 3356 0577
Fx: 07 3356 1432
Web: www.ecoptions.com.au

ERICO

DINLINE ALARM RELAY (DAR)

INSTALLATION INSTRUCTIONS

MODEL NUMBER
DAR 275V

1. PREPARATION

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

CAUTION NOTES:

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

2. INTRODUCTION

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

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

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

3. MOUNTING

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

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

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

4. ELECTRICAL CONNECTION

The interconnecting wiring should:

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

CONNECTION TO TELECOMMUNICATIONS NETWORKS

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

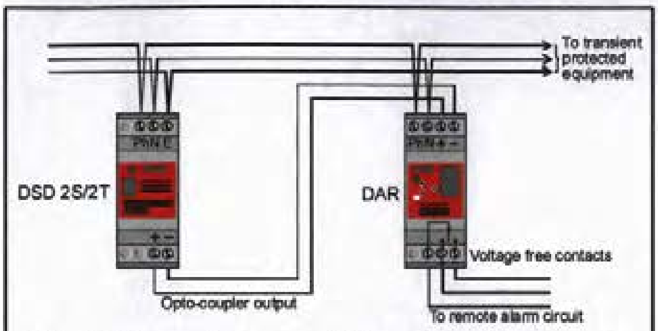
ERICO

DINLINE ALARM RELAY

INSTALLATION INSTRUCTIONS

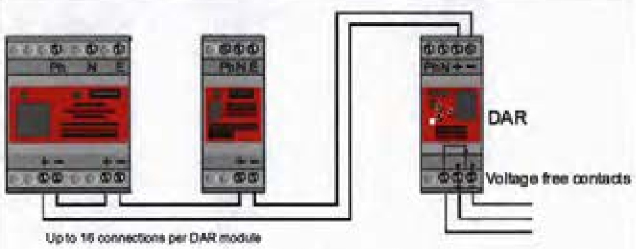
5. INTERCONNECTION

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



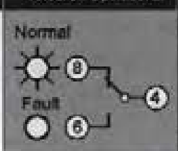
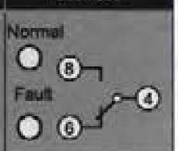
+/- terminal connections are polarity sensitive. Do not reverse.

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



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

5. STATUS INDICATION

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

6. FUSING AND ISOLATION

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

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

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

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

6. MAINTENANCE & TESTING

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

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

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

7. USE OF OTHER INTERFACES

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

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

2.6

TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type:	Phase Failure Relay
Location:	Common Control
Model Numbers:	252-PS GW
Manufacturer:	Crompton
Supplier:	Crompton Instruments. PO Box 5108 Minto Business Center Minto NSW, 2566 Ph: 02 9603 2066 Fx: 02 9603 9335

tyco / Electronics / Energy Division **INSTALLATION INSTRUCTIONS**

Ref: IW250PMSH – Rev 6 – March 02

Protector Trip Relays
DIN Rail & Wall Mounted 250 Series
Thermistor Trip, Speed Sensing & Phase Angle

Models Covered

252-PMM	252-PMT	252-PSF	252-PSG
253-PH3	252-PMM	252-PMT	

Introduction

Thermistor Trip Relay (252-PMM & 252-PMT).
The 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 green LED indicates when the thermistor temperature is within normal working limits. The unit is designed such that the alarm relay is energised when normal temperatures are reached.
Model 252-PMM has the facility for manual resetting, so that the trip condition remains after normal operating temperature is reached, until manual intervention occurs.

Phase 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 proportional to speed.

No.1 Relay energises on rising speed
No.2 Relay energises on rising speed
No.3 Relay de-energises on rising speed

This product is designed for use only with magnetic coil inductive sensors.

Warning

- During normal operation, voltages hazardous to life may be present at some of the terminals of this unit. Installation and servicing should be performed only by qualified, properly trained personnel abiding by local regulations. Ensure all supplies are de-energised before attempting connection or other procedures.
- It is recommended adjustments be made with the supplies de-energised, but if this is not possible, then extreme caution should be exercised.
- Terminals should not be user accessible after installation and external installation provisions must be sufficient to prevent hazards under fault conditions.
- This unit is not intended to function as part of a system providing the sole means of fault protection - good engineering practice dictates that any critical function be protected by at least two independent and diverse means.

Never open circuit the secondary winding of an energised current transformer.

Crompton INSTRUMENTS

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. Vibration 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 is 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.

Connection diagrams should be 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.

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 that can be set to suit operating requirements and they are factory calibrated as follows:-

1. % 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.
2. Time Delay
   For all voltage ranges 10% maximum delay.
3. 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 be returned to the factory or to the nearest Crompton Instruments Service Centre

Electromagnetic Compatibility
This unit has been designed to provide protection against EM (electro-magnetic) interference in line with requirements of EU and other regulations. Precautions necessary to provide proper operation of this and adjacent equipment will be installation dependent and so the following can only be general guidance:-

- Avoid routing wiring to this unit alongside cables and products that are, or could be, a source of interference.

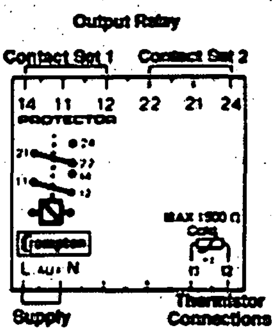
Ref: IW250PMSH – Rev 6 – March 02

Protector Trip Relays
DIN Rail & Wall Mounted 250 Series Thermistor Trip, Speed Sensing & Phase Angle

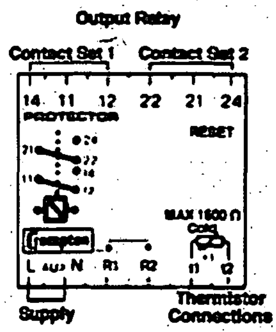
- The auxiliary supply to the unit should not be subject to excessive interference. In some cases, a supply line filter may be required.
- To protect the product against incorrect operation or permanent damage, surge transients must be controlled. It is good EMC practice to suppress differential surges to 2kV or less at the source. The unit has been designed to automatically recover from typical transients, however in extreme circumstances it may be necessary to temporarily disconnect the auxiliary supply for a period of greater than 5 seconds to restore correct operation.
-
- Screened communication and small signal leads are recommended and may be required. These and other connecting leads may require the fitting of RF suppression components, such as ferrite absorbers, line filters etc., if RF fields cause problems.

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! MT

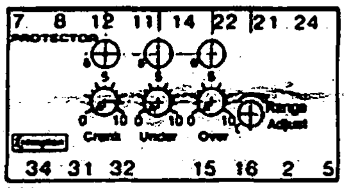


252-PMM

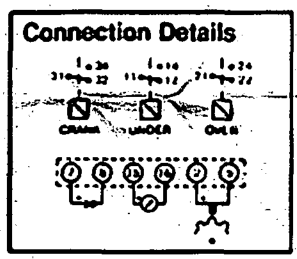


252-PMM can operate in either an automatic or a manual reset mode.
For automatic the reset link R1-R2 is to be disconnected.
For manual the reset link R1-R2 must be inserted.

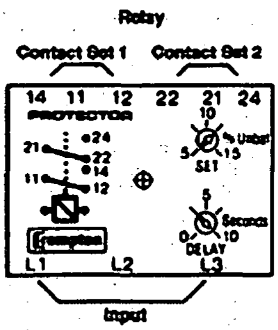
253-PH3



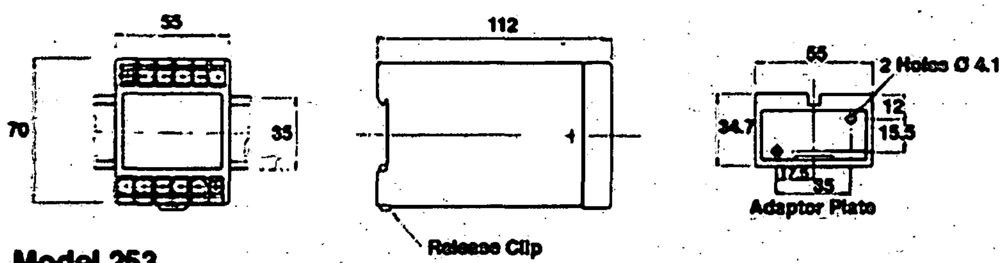
253-PH3



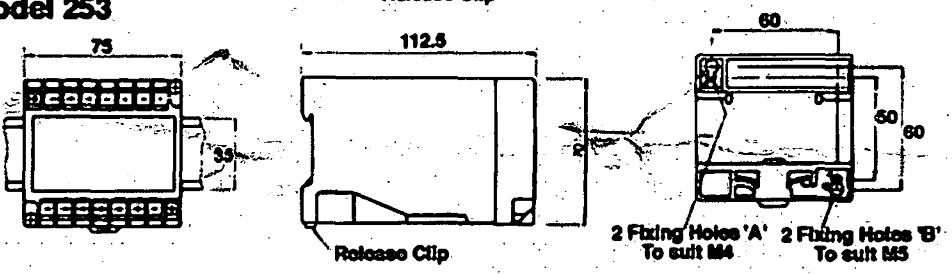
2! SF
2! SG



Model 252



Model 253



Crompton INSTRUMENTS

Tyco Electronics UK Limited
Crompton Instruments
Freebournes Road, Witham, Essex, CM8 3AH, UK
Phone: +44 1376 509 509 Fax: +44 1376 509 511 http://energy.tycoelectronics.com

TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

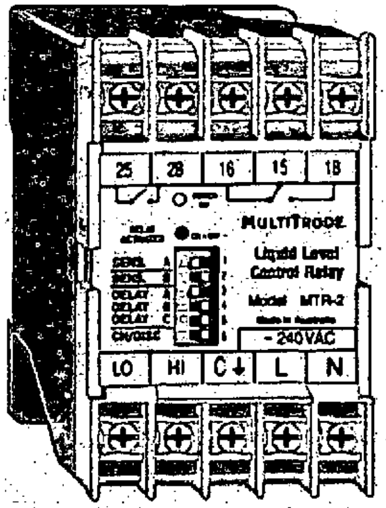
Equipment Type:	Level Relay
Location:	Common Control
Model Numbers:	MTR 240VAC
Manufacturer:	Multitrode
Supplier:	Multitrode Pty Ltd 130 Kinston Road Underwood. QLD 4119 Tel: 07 3340 7000 Fax: 07 3340 7077

Introduction

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

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

2 Electrical Overview



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

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

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

3 DIP Switches

3.1 DIP Switches

(See Wiring Diagram for full program functions.)

3.1.1 DIP 1 & 2

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

3.1.2 DIP 3, 4 & 5

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

3.1.3 DIP 6

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

3.2 Relay Contacts & their Applications

3.2.1 Contacts 15, 16 & 18

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

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

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

3.2.2 Contacts 25 & 28

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

4 Practical Overview

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

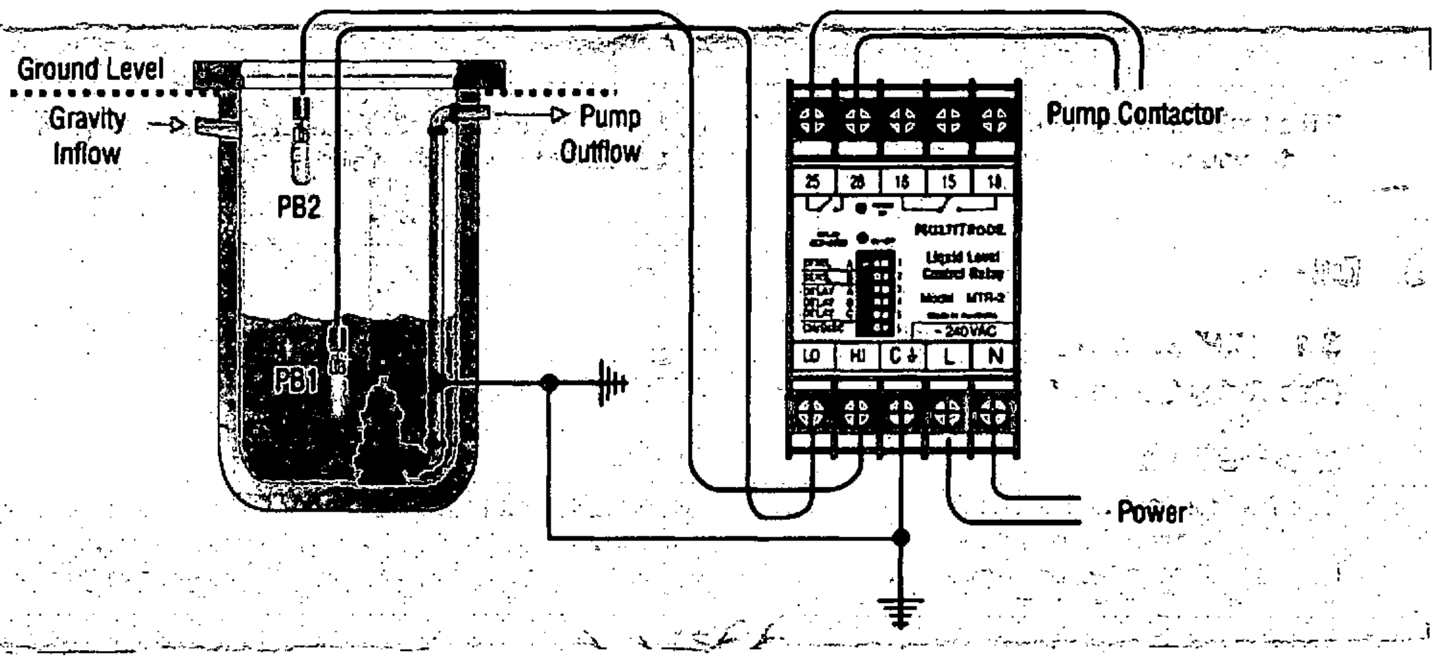
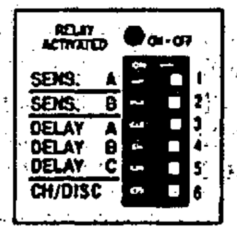


Figure 1 – Discharge Mode

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



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

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

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

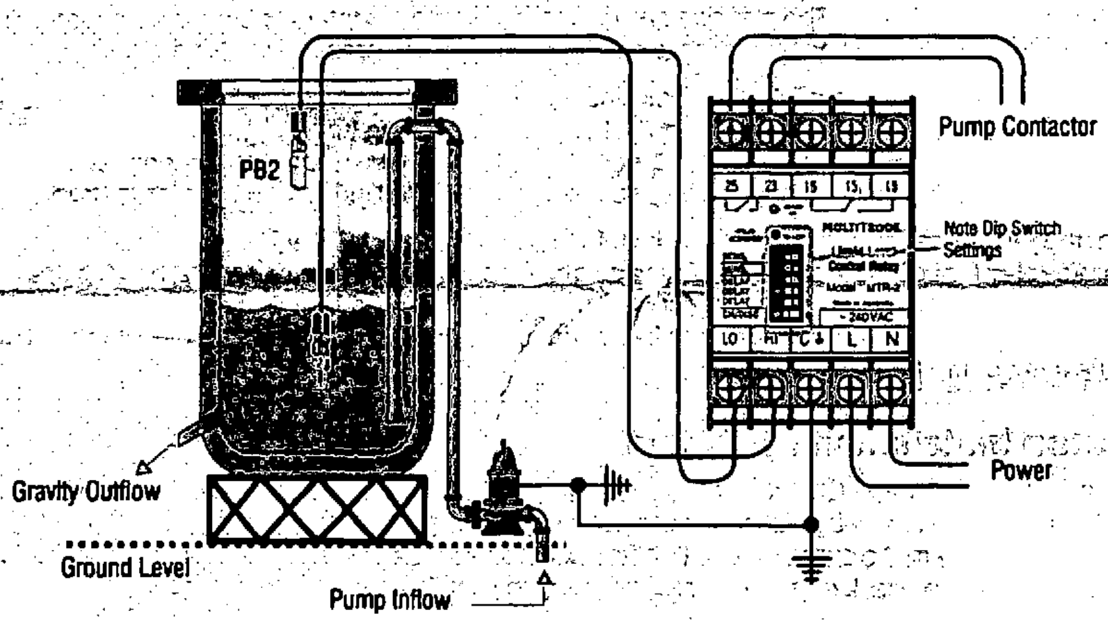
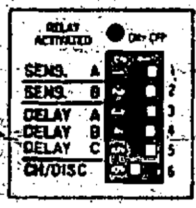


Figure 2 – Charge Mode

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



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

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

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

4.3 MTRA Relay with Alarm (Discharge Applications Only)

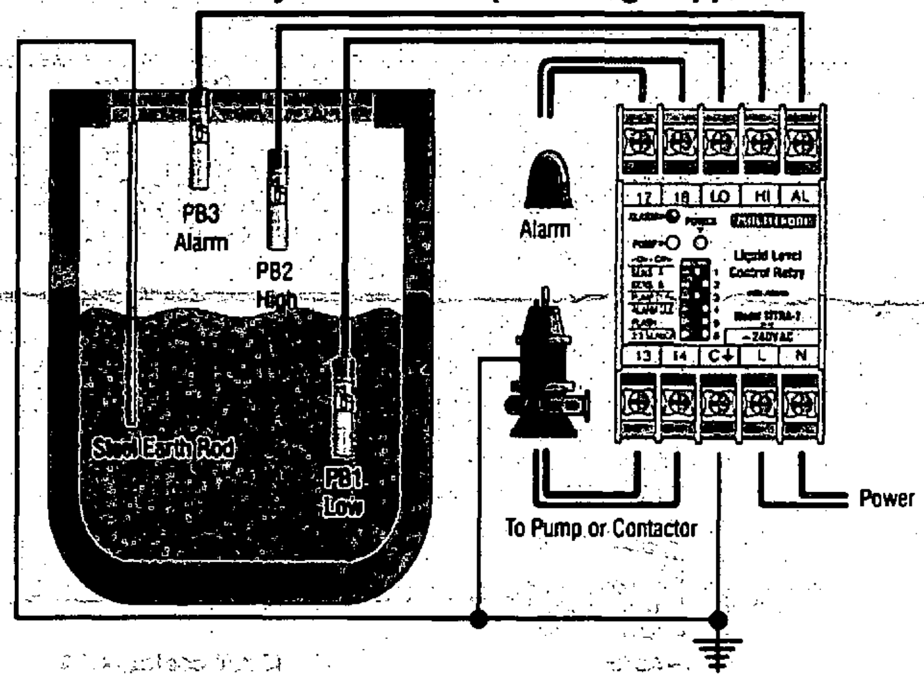


Figure 3 - MTRA Operation

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

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

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

5 Most Common Installation Problems

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

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

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

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

6 Troubleshooting

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

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

MULTITRODE
Leaders in Pump Station Management Technology

MultiTrode Pty Ltd—Australia
Ph: +61 7 3340 7000
Fx: +61 7 3340 7077

Sydney—Australia
Ph: +61 2 9533 7735
Fx: +61 2 9533 7790

MultiTrode Inc—USA
Ph: +1 561 994 8090
Fx: +1 561 994 6282

2.8

TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type:	Radio
Location:	RTU Section
Model Numbers:	DR900-06A02-D0
Manufacturer:	Trio
Supplier:	Brisbane Water

TRIO DATACOM

TC-900DR USER GUIDE

41 Aster Avenue Carrum Downs 3201 Australia Tel: 61 3 9775 0505 Fax: 61 3 9775 0606

GENERAL

The Trio DataCom TC-900DR is a full duplex 900 MHz Radio featuring a fully integrated 4800/9600 bps data radio modem and antenna diplexer. Configuration of the unit is fully programmable, with parameters held in non volatile memory (NVRAM). All configuration parameters are accessible using the TC-DRPROG installation package, consisting of a programming lead, manual and software which will run on a PC under Windows 95/98/NT. It is essential that each unit is programmed to suit individual requirements prior to operation. *For detailed information refer to the TC-900DR Handbook.*

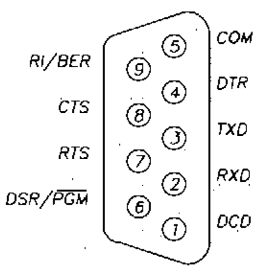
DATA CONNECTION

The data connection is via a DB9 connector labeled 'Port A' (shown below), which is wired as a DCE.

User Serial "Port A" Pin Assignment.

EXTERNAL VIEW OF 'PORT A

NOTE: Pin 6 and pin 9 provide a dual function which depends on the mode that the TC-900DR is operating in.

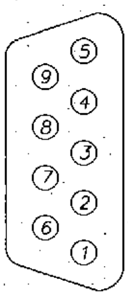


PIN NO. & FUNCTION
1. ***DATA CARRIER DETECT (DCD)***
2. ***RECEIVE DATA OUTPUT (RXD)***
3. ***TRANSMIT DATA IN (TXD)***
4. ***DATA TERMINAL READY (DTR)***
5. ***COMMON (COM)***
6. ***PROGRAM PIN (PGM)***
7. ***REQUEST TO SEND (RTS)***
8. ***CLEAR TO SEND (CTS)***
9. ***BIT ERROR RATE PIN (BER)***

User Serial "Port B" Pin Assignment.

Port B can be used as a secondary data steam (independent of Port A) once configured by the programmer. Port B also has one connection that may be of use for installation. This connection (Pin 9) is Receive Signal Strength Indicator (RSSI) output. 0-5V where 1.5V typically indicates -110dBm and every 0.5V increase indicates an improvement of » 10dBm.

EXTERNAL VIEW OF 'PORT B'



PIN NO. & FUNCTION
1. ***DATA CARRIER DETECT (DCD)***
2. ***RECEIVE DATA O/P (RxD)***
3. ***TRANSMIT DATA O/P (TxD)***
4. ***UNUSED***
5. ***COMMON***
6. ***DATA SET RECEIVE (DSR)***
7. ***UNUSED***
8. ***UNUSED***
9. ***RECEIVE SIGNAL STRENGTH***

NOTE: Port B Pin 9 output has a high impedance of around 50K OHMS and loading will decrease accuracy of the RSSI measurement.

POWER CONNECTIONS

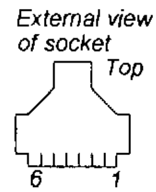
The power required is 13.8VDC nominal, at 600mA (Tx) nominal. If the POWER LED indicator is not illuminated once power is applied, check the internal 1Amp fuse fitted within the unit.

<u>POWER</u> CONNECTOR	<u>PIN</u> ASSIGNMENT
TOP PIN	***+VE SUPPLY (13.8vdc)***
BOTTOM PIN	***GROUND***

AUXILIARY CONNECTOR

The auxiliary connector is primarily for use with the optional audio handset. The connections to this auxiliary 6 pin RJ11 connector are as follows:

<u>PIN</u> NUMBER	FUNCTION
1	***8 VOLTS***
2	***AUDIO OUT***
3	***GROUND***
4	***MIC INPUT/SENSE***
5	***GROUND***
6	***MANUAL PTT***



The optional audio handset is recommended as an aid in checking installations for radio path viability. This audio handset will only function when fitted prior to applying power to the unit.

The modem upon power up will check the presence of the handset and will inhibit data being transmitted so that voice communications can be established.

Once the path tests have been conducted the audio handsets **MUST be REMOVED** and the unit powered up with the handset removed before data communication can commence.

USER INDICATIONS

The TC-900DR provides 4 LED's that show status information to the user - POWER, RXSIG, SYNC, and TXMIT indications.

The POWER is indicated by a green LED and simply signifies that power has been applied to the unit.

The RXSIG LED (yellow) indicates the level of RSSI signal from the radio IF strip, compared to a threshold level set in the configuration data programmed by the user. If the signal is above the threshold, then the LED indicator is turned on.

In all operation modes except "Programmer mode", the SYNC LED (yellow) indicates when the modem has detected a valid data stream. The SYNC LED is activated, when the modem detects a valid HDLC flag sequence, and remains active until an invalid sequence of seven or more consecutive "1" bits is detected.

The SYNC LED will not be turned on if the RSSI signal strength (as indicated by the RXSIG LED) is below the minimum threshold. This prevents false SYNC detection from noise.

The TXMIT LED (red) indicator is connected directly to the modem's PTT output transistor. Whenever the radio is transmitting, this TXMIT LED indicator will be on.

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SPECIAL MODES OF OPERATION

Part of the power-up/reset initialisation phase of the TC-900DR are tests to determine if the modem should enter one of 3 "special operation" modes. *In these modes the TC-900DR won't operate in its standard run mode.*

- Programmer mode.
- Bit error rate test mode.
- Handset mode.

These modes are only entered if the required setup conditions are present at power up. An error mode of operation can also be entered into, if during normal operation, an error condition occurs.

PROGRAMMER MODE

CABLE - Pins 2, 3, 4, 5 straight through with Pin 6 on the DB9 connector of Port A, connected to pin 5. When the modem is powered up with this fitted, the controller senses this and attempts to enter "Programmer mode" and the "SYNC" LED will flash approx. once per second. (Note, the TC-DRPROG programming software and lead has the required connections). Failure to supply the correct password in time, will cause the modem to abandon the "Programmer mode" attempt, and go on with it's normal power-up procedure.

BIT ERROR RATE TEST MODE

Pin 9 of the DB9 connector of Port A, is normally the Ring Indicate output line. However, if this pin is driven positive (connecting it to pin 6 [DSR] and pin 7 [RTS]), then the modem's data transmitter and receiver will enter the BER test mode. This will activate the RF transmitter, and generate a scrambled bit pattern which should be decoded at a receiver as a constant logic "1" level in the unscrambled data. Any errors in the decoded bitstream, will be "0", and the receiver portion of the modem in this mode, will activate the SYNC LED every time it sees a "0" bit.

Note: As the TC-900DR is full duplex this test can operate in both directions simultaneously.

Every error bit detected, will activate the SYNC LED. For error rates of 1 in 10^3 and above, the SYNC LED will be ON most of the time. A 1 in 10^4 error rate will show the SYNC LED active for approximately 10% of the time. This function provides a crude indication of Bit Error Rate for installation purposes. Note: Error count messages (ET:XXXX) for every 10,000 bits are presented to Port A for the user. If pin 9 ceases to be driven positive, then the BER Test mode is terminated, and the modem restarts it's initialisation phase.

HANDSET MODE

The DFM4-9 modem tests for the presence of a handset plugged into the handset auxiliary port at power up. If a handset is plugged in, the modem will not generate a data stream. However, it will continue to indicate received RF signal strength. The handset has a PTT button, and this signal is connected across the modem's PTT output. Thus the handset PTT switch will activate the TXMIT LED. It is essential to remove the handset from the unit and reapply power to the unit in order to return to normal operation.

ERROR INDICATION MODES

There are 3 error conditions that cause the RXSIG & SYNC LEDs to be used for error indications and not their normal purpose. Two are fatal conditions, that cause the modem to restart after the duration of the error indication phase.

TRANSMIT POWER LOW

While the modem activates the radio transmitter, it periodically checks the transmit power. If the power measurement is less than a threshold set in the non-volatile memory, then the RXSIG and SYNC LEDs are made to alternate, approximately 4 times per second. The TXMIT LED will also be on during this process. This indication condition will persist for the duration of the transmission. As soon as the transmission is discontinued, the error indication will cease, and the two LEDs revert to their normal function. Factory set to 100 milliWatts.

NVRAM READ ERROR

The DFM4-9DR modem accesses the non-volatile memory as part of it's initialisation phase, to read programming configuration data. If the communication protocol with the device is violated, or the non-volatile memory CRC checksum is found to be incorrect, then the modem indicates this by flashing the RXSIG and SYNC LEDs twice alternately. That is, one LED operates ON and OFF twice, then the other. A total of five cycles of this occurs, then the modem restarts initialisation.

SYNTHESISER LOCK DETECT ERROR

If at any time during normal operation, BER mode, or handset mode, the TBB206 frequency synthesiser indicates an out of lock condition, the modem enters an error indication mode for a short time before restarting.

One LED is turned ON (○), the LEDs are swapped, then both turned OFF (●). Then the latter LED ON again, swap LEDS, and then OFF. This will give the appearance of a sweeping motion between the LEDs. The following table shows all error condition displays.

Tx PWR Err		NVRAM Err		SYNTH Err	
RXSIG	SYNC	RXSIG	SYNC	RXSIG	SYNC
○	●	○	●	○	●
●	○	●	●	●	○
○	●	○	●	●	●
●	○	●	●	●	○
○	●	●	○	○	●
●	○	●	●	●	●
○	●	●	○		repeat
●	○	●	●		
continue			repeat		

MOUNTING AND ANTENNA CONNECTION

The TC-900DR should be mounted in a cool, dry, vibration free environment, whilst providing easy access to screws and connections. There are 4 mounting holes on the unit. The antenna should be an external yagi antenna but can be a ground independent dipole mounted via a feeder to the antenna connector (SMA type) for short range applications. However the whole radio modem should be clear of the associated data equipment to prevent mutual interference.

ASSEMBLY OF POWER LEAD

A small plastic bag containing a molex connector (M5557-2R) and two pins (M5556-TL) is provided in the packing box.

The pins are designed to take 18-24 (AWG) wire size with insulation range 1.3 - 3.10mm.

Please take care when crimping the pins. 04/01

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TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type: Impulse Suppressor

Location: RTU Section

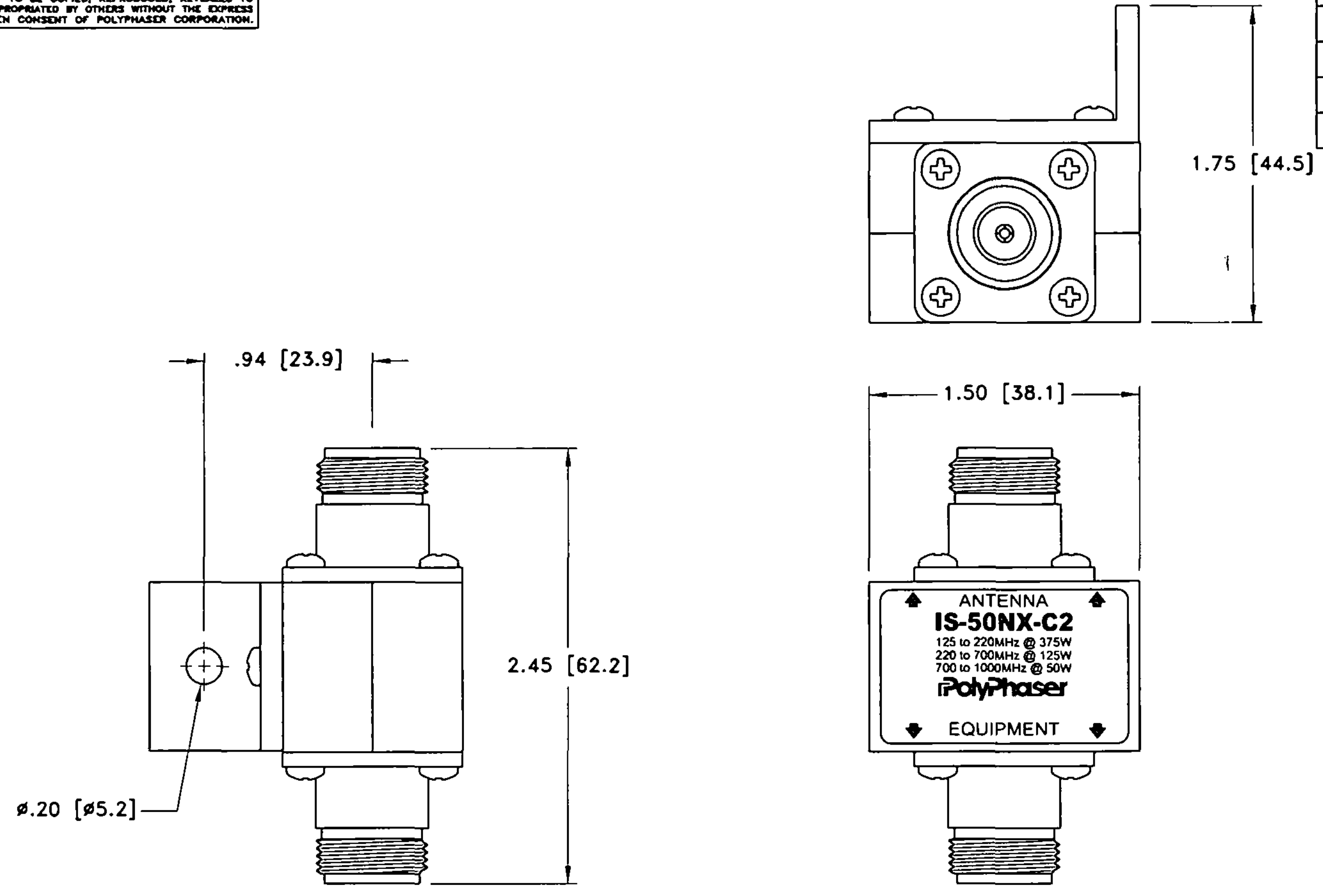
Model Numbers: IS-50NX-C2

Manufacturer: Polyphaser

Supplier: Brisbane Water

REVISIONS

REV LTR	DATE	ENG	MKTG	Q.A.
A	01/30/96 PJP	T. K.	– –	R. M.
B	06/30/99 JCG	K.C.B.	T.G.F.	R. M.
C	01/16/01 SH	KCB	PH	RM
D	11/18/02 SH	LC	SD	LJ



MAXIMUM CHARACTERISTICS

SURGE:
50kA IEC 1000-4-5 8/20µs WAVEFORM 500 JOULES

TURN ON:
600Vdc ±20%

TURN ON TIME:
2.5ns FOR 2kV/ns

FREQUENCY RANGE:
125MHz TO 1GHz

VSWR:
≤1.1:1 OVER FREQUENCY RANGE

INSERTION LOSS:
≤0.1dB OVER FREQUENCY RANGE

TEMPERATURE:
-45°C TO +85°C STORAGE/OPERATING +50°C

CUSTOMER APPROVAL: ______________________ DATE: ____________

ALL DIMENSIONS SHOWN ABOVE ARE FOR REFERENCE ONLY.

DRAFTER J. CALLISTER	DATE 09/21/93	PolyPhaser CORPORATION
MECH ENGINEER – – – –	DATE – – –	P.O. BOX 9000, MINDEN, NV 89423-9000 (775) 782-2511 FAX (775) 782-4476
ELEC ENGINEER J. JONES	DATE 04/12/95	DWG NO/PART NO/DESCRIPTION IS-50NX-C2 CUSTOMER PRINT
MARKETING – – – –	DATE – – –	
QUALITY DEPT R. MATHEUS	DATE 04/12/95	CAGE CODE 61114 / FILE NAME -C1 / SCALE 1/1 / SHEET 1 OF 1

2.10

TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type:	Radio/DC Converter
Location:	RTU Section
Model Numbers:	PB1H-2412G-CC
Manufacturer:	Powerbox
Supplier:	Brisbane Water

PBIH Series

15-150 WATTS DC/DC SINGLE OUTPUT

Features

- **Wide selection of models**
- **4 input voltage ranges**
- **High efficiency**
- **Low output ripple**
- **Proven reliability**
- **Good thermal margins**

Specifications

INPUT	
Input voltage	12VDC (9.2–16) 24VDC (19–32) 48VDC (38–63) 110VDC (85–140)
Inrush current	20A max. for 110V only
OUTPUT	
Output voltage	See table
Voltage adjustment	±10%, ±5% for PBIH-F
Output current	See table
Ripple & noise	Output Volts x 1% + 50mV to -100mV pk-pk
Line regulation	0.8% over input range
Load regulation	0.9%, 0%–100% load
Temperature coefficient	0°C to 50°C, 0.03% per °C
Overvoltage protection	O.V. clamp, PBIH-F Output shutdown, PBIH-G, J, M, R – input must be switched off for at least 30S to reactivate
Overcurrent protection	Fold back – PBIH-F Current limiting, PBIH-G, J, M, R (PBIH-R series is adjustable); PBIH110xxR models are not adjustable
Drift	Output V x 0.5% + 15(mV) per 8 hrs after 1 hr warm-up
Rise Time	200mS max. – PBIH-F, M, R 100mS max. – PBIH-G, J (at 25°C)
Holdup time	10mS (only 110V input)
Remote sense	PBIH-R Series only

OPERATING	
Efficiency	70%–89%
Safety isolation (1 minute)	Type – 12, 24, 48V input Input – Output: 1500VAC Input– Case: 1500VAC Output– Case: 500VAC Type– 110V input Input– Output: 2000VAC Input– Case: 2000VAC Output– Case: 500VAC
Insulation resistance	50M (500VDC) Input – Case
Parallel operation	Consult sales office for details
Remote control	PBIH-R Series: Open link: output normal Short link: output off
ENVIRONMENTAL	
Operating temperature	0°C to 50°C full load
Cooling	Convection cooled
Storage temperature	-20°C to +85°C
Humidity	85%
Shock	30G, PBIH-F, G and J
Vibration	(5Hz–10Hz, 10mm), (10Hz–50Hz) 2G, PBIH-F, G and J
STANDARDS AND APPROVALS	
Safety	Designed to UL1950
C-tick	AS/NZS CISPR11 Group 1, Class A
MECHANICAL	
Weight	PBIH-F : 250g PBIH-G : 380g PBIH-J : 410g PBIH-M : 800g PBIH-R : 1.4kg

powerbox

PBIH Series

15-150 WATTS DC/DC SINGLE OUTPUT

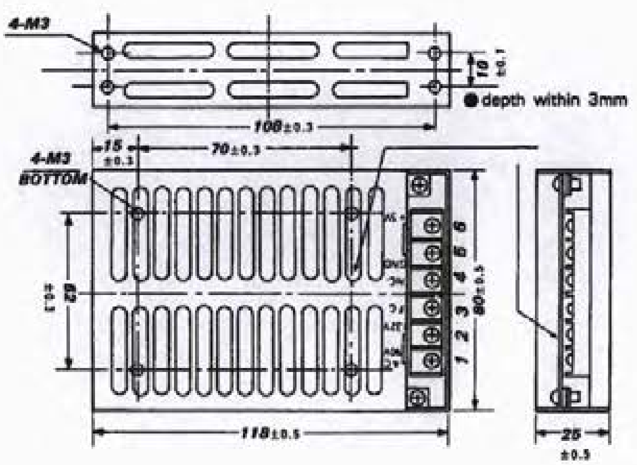
Selection Table

MODEL NUMBER	INPUT	OUTPUT		OUTPUT POWER
PBIH-1205F	9.2-16V	5V	3A	15W
PBIH-1212F	9.2-16V	12V	1.2A	15W
PBIH-1215F	9.2-16V	15V	1A	15W
PBIH-1224F	9.2-16V	24V	0.62A	15W
PBIH-2405F	19-32V	5V	3A	15W
PBIH-2412F	19-32V	12V	1.2A	15W
PBIH-2415F	19-32V	15V	1A	15W
PBIH-2424F	19-32V	24V	0.62A	15W
PBIH-4805F	38-63V	5V	3A	15W
PBIH-4812F	38-63V	12V	1.2A	15W
PBIH-4815F	38-63V	15V	1A	15W
PBIH-4824F	38-63V	24V	0.62A	15W
PBIH-11005F	85-140V	5V	3A	15W
PBIH-11012F	85-140V	12V	1.2A	15W
PBIH-11015F	85-140V	15V	1A	15W
PBIH-11024F	85-140V	24V	0.62A	15W
PBIH-1205G	9.2-16V	5V	5A	25W
PBIH-1212G	9.2-16V	12V	2.1A	25W
PBIH-1215G	9.2-16V	15V	1.7A	25W
PBIH-1224G	9.2-16V	24V	1.1A	25W
PBIH-1248G	9.2-16V	48V	0.5A	25W
PBIH-2405G	19-32V	5V	5A	25W
PBIH-2412G	19-32V	12V	2.1A	25W
PBIH-2415G	19-32V	15V	1.7A	25W
PBIH-2424G	19-32V	24V	1.1A	25W
PBIH-2448G	19-32V	48V	0.5A	25W
PBIH-4805G	38-63V	5V	5A	25W
PBIH-4812G	38-63V	12V	2.1A	25W
PBIH-4815G	38-63V	15V	1.7A	25W
PBIH-4824G	38-63V	24V	1.1A	25W
PBIH-4848G	38-63V	48V	0.5A	25W
PBIH-11005G	85-140V	5V	5A	25W

MODEL NUMBER	INPUT	OUTPUT		OUTPUT POWER
PBIH-11012G	85-140V	12V	2.1A	25W
PBIH-11015G	85-140V	15V	1.7A	25W
PBIH-11024G	85-140V	24V	1.1A	25W
PBIH-11048G	85-140V	48V	0.5A	25W
PBIH-1205J	9.2-16V	5V	8A	50W
PBIH-1212J	9.2-16V	12V	3.3A	50W
PBIH-1215J	9.2-16V	15V	2.7A	50W
PBIH-1224J	9.2-16V	24V	1.7A	50W
PBIH-1248J	9.2-16V	48V	0.8A	50W
PBIH-2405J	19-32V	5V	10A	50W
PBIH-2412J	19-32V	12V	4.3A	50W
PBIH-2415J	19-32V	15V	3.4A	50W
PBIH-2424J	19-32V	24V	2.5A	50W
PBIH-2448J	19-32V	48V	1A	50W
PBIH-4805J	38-63V	5V	10A	50W
PBIH-4812J	38-63V	12V	4.3A	50W
PBIH-4815J	38-63V	15V	3.4A	50W
PBIH-4824J	38-63V	24V	2.5A	50W
PBIH-4848J	38-63V	48V	1A	50W
PBIH-11005J	85-140V	5V	10A	50W
PBIH-11012J	85-140V	12V	4.3A	50W
PBIH-11015J	85-140V	15V	3.4A	50W
PBIH-11024J	85-140V	24V	2.5A	50W
PBIH-11048J	85-140V	48V	1A	50W
PBIH-1205M	9.2-16V	5V	18A	100W
PBIH-1212M	9.2-16V	12V	9A	100W
PBIH-1215M	9.2-16V	15V	7A	100W
PBIH-1224M	9.2-16V	24V	4.5A	100W
PBIH-1248M	9.2-16V	48V	2A	100W
PBIH-2405M	19-32V	5V	20A	100W
PBIH-2412M	19-32V	12V	9A	100W
PBIH-2415M	19-32V	15V	7A	100W

MODEL NUMBER	INPUT	OUTPUT		OUTPUT POWER
PBIH-2424M	19-32V	24V	5A	100W
PBIH-2448M	19-32V	48V	2A	100W
PBIH-4805M	38-63V	5V	20A	100W
PBIH-4812M	38-63V	12V	9A	100W
PBIH-4815M	38-63V	15V	7A	100W
PBIH-4824M	38-63V	24V	5A	100W
PBIH-4848M	38-63V	48V	2A	100W
PBIH-11005M	85-140V	5V	20A	100W
PBIH-11012M	85-140V	12V	9A	100W
PBIH-11015M	85-140V	15V	7A	100W
PBIH-11024M	85-140V	24V	5A	100W
PBIH-11048M	85-140V	48V	2A	100W
PBIH-1205R	9.2-16V	5V	27A	150W
PBIH-1212R	9.2-16V	12V	13A	150W
PBIH-1215R	9.2-16V	15V	10A	150W
PBIH-1224R	9.2-16V	24V	6.5A	150W
PBIH-1248R	9.2-16V	48V	3.3A	150W
PBIH-2405R	19-32V	5V	30A	150W
PBIH-2412R	19-32V	12V	14A	150W
PBIH-2415R	19-32V	15V	11A	150W
PBIH-2424R	19-32V	24V	7A	150W
PBIH-2448R	19-32V	48V	3.5A	150W
PBIH-4805R	38-63V	5V	30A	150W
PBIH-4812R	38-63V	12V	14A	150W
PBIH-4815R	38-63V	15V	11A	150W
PBIH-4824R	38-63V	24V	7A	150W
PBIH-4848R	38-63V	48V	3.5A	150W
PBIH-11005R	85-140V	5V	30A	150W
PBIH-11012R	85-140V	12V	14A	150W
PBIH-11015R	85-140V	15V	11A	150W
PBIH-11024R	85-140V	24V	7A	150W
PBIH-11048R	85-140V	48V	3.5A	150W

PBIH-F



• Dimensions in mm

terminal No.	
1	0 V (DC in)
2	+V (DC in)
3	FG
4	NO Connection
5	−V out
6	+V out

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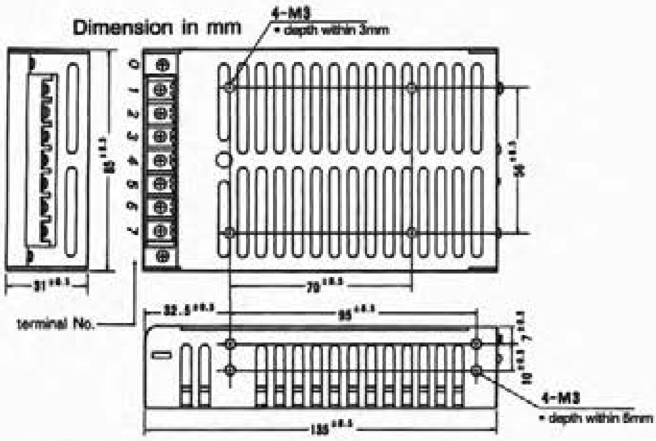
PBIH Series

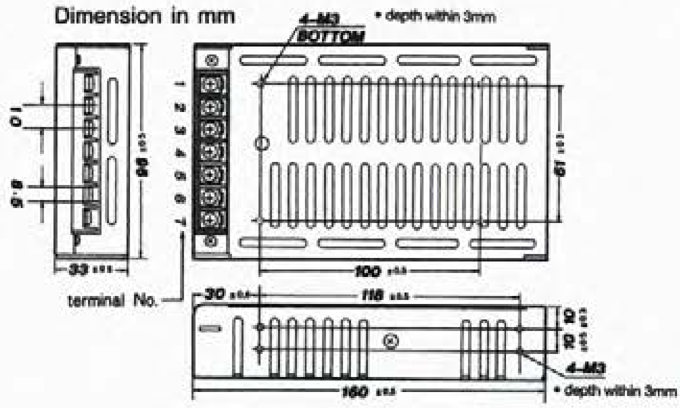
15-150 WATTS SINGLE OUTPUT

PBIH-G



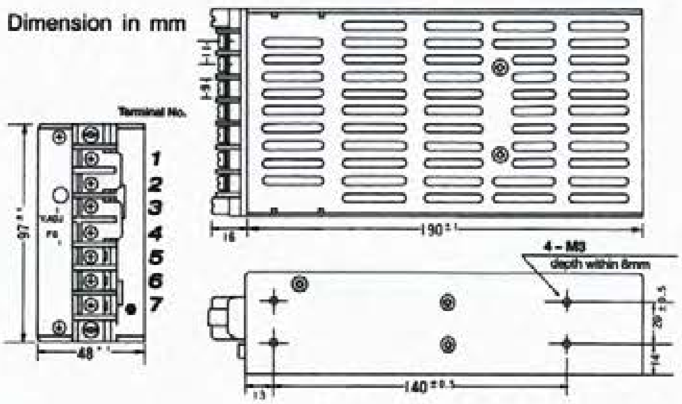
Terminal	Connection
0	FG
1	DC +V in
2	0V in
3	LFG
4	NO
5	NO
6	-V out
7	+V out

PBIH-J



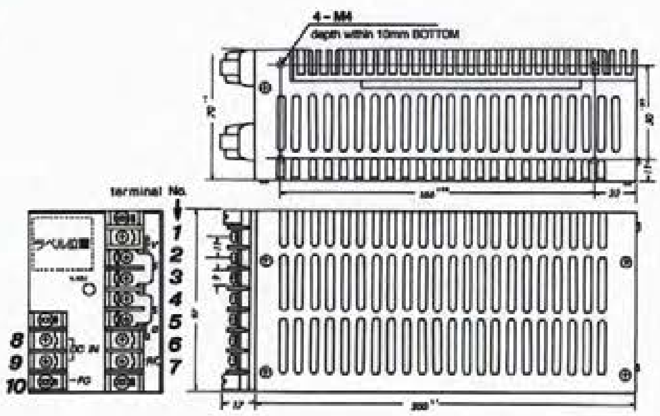
Terminal	Connection
1	FG
2	DC +V in
3	0V in
4	LFG
5	-V out
6	+V out
7	NC

PBIH-M



Terminal	Connection
1	+V out
2	+V out
3	-V out
4	-V out
5	FG
6	-V in
7	+V in

PBIH-R



Terminal	Connection
1, 2	+V out
3	+S
4	-S
5, 6	-V out
7	Remote Control
8	DC +V in
9	DC 0V in
10	FG

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TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type:	Modem/Power Supply
Location:	RTU Section
Model Numbers:	PB251
Manufacturer:	Powerbox
Supplier:	Brisbane Water

PB251 Series

220-330 WATTS DC UPS

Features

- **Ultra-low noise output**
- **Independent battery charging output**
- **DC output OK & battery OK alarms & LEDs**
- **Battery-LVD and alarm**
- **Over-temperature protection**
- **Battery fuse fail LED**

Specifications

INPUT	
Voltage:	190 to 264 vac, or 190 to 400VDC
Line regulation:	0.2%typical
Current:	1.4A maximum
Inrush current:	10A maximum
Frequency:	45 to 65 Hz
OUTPUT	
Voltage	See table
Current	See table
Load regulation	0.5%typical
Current limit type - load cct	Constant current
Current limit type - batt. cct	Constant current
Short circuit protection	Indefi nite, auto-resetting
Over-voltage protection	17.5 to 20V latching (13.8Vdc output) 31.5 to 39V latching (27.6Vdc output)
Ripple & noise 100 MHz bandwidth	28mVp-p (13.8Vdc output) 55mVp-p (27.6Vdc output)
ENVIRONMENTAL	
Operating temperature	0 to 70^{o}C ambient with derating, 5...90% relative humidity (non-condensing)
Over-temperature protection	Automatic & auto-resetting
Cooling requirement	Natural convection
Efficiency	80% minimum

STANDARDS & APPROVALS	
Safety	Complies with AS/NZS 60950, class 1, NSW Office of Fair Trading Approval N20602
EMC	Emissions comply with AS/NZS CISPR11, Group 1, Class B. Complies with ACA EMC Scheme, Safety & EMC Regulatory Compliance Marked
Isolation i/p-o/p i/p-ground o/p-ground	4242VDC for 1 minute 2121VDC for 1 minute 707VDC for 1 minute
ALARMS & BATTERY FUNCTIONS	
Converter ON/OK alarm	Indicated by voltage-free changeover relay contacts &
green LED	ON=PSU OK
Battery low (& fuse) alarm	10.2 to 12.6V for 12V battery, adjustable 20.4 to 25.2V for 24V battery, adjustable Indicated by voltage-free changeover relay contacts & green LED: ON=BATT OK
Low voltage disconnect	9.6 to 12V for 12V battery, adjustable 19.2 to 24V2 for 4V battery, adjustable
Charger over-load protection	Auto-resetting electronic circuit breaker
Reverse polarity protection	Internal battery fuse
Battery to load voltage drop	0.2 to. 0.25V typical
MECHANICAL	
Case size	264 L x 172 W x 67 H mm
Case size with heatsink	264 L x 186 W x 67 H mm
Rack size	232 D x 19" W x 2RU H
Weight	1.9 kg
Weight with heatsink	2.1 kg
Weight (rack mounted version)	5.5 kg

Selection Table

MODEL NUMBER	OUTPUT VDC	OUTPUT I_{LOAD}	OUTPUT I_{BATT}	OUTPUT POWER
PB251-12CM	13.8V	16A	2A	220W
PB251-12CM-H	13.8V	20A	2A	275W
PB251-24CM	27.6V	11A	2A	300W
PB251-24CM-H	27.6V	12A	2A	330W
PB251-12RML	13.8V	20A	4A	275W
PB251-12B	13.8V	20A	4A	275W
PB251-24RML	27.6V	12A	2A	330W

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

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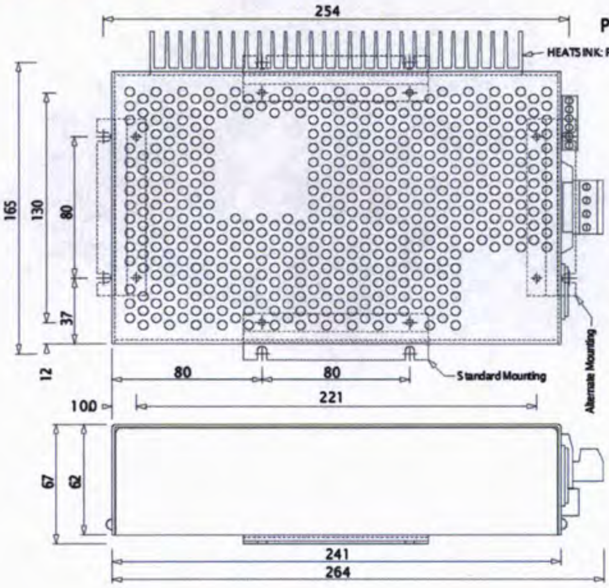
PB251 Series

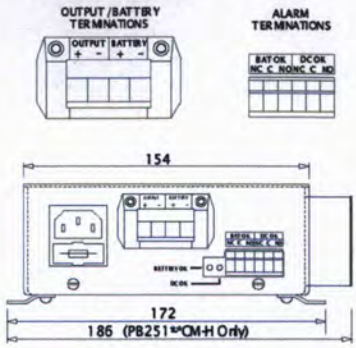
275-330 WATTS DC UPS

Technical Illustrations

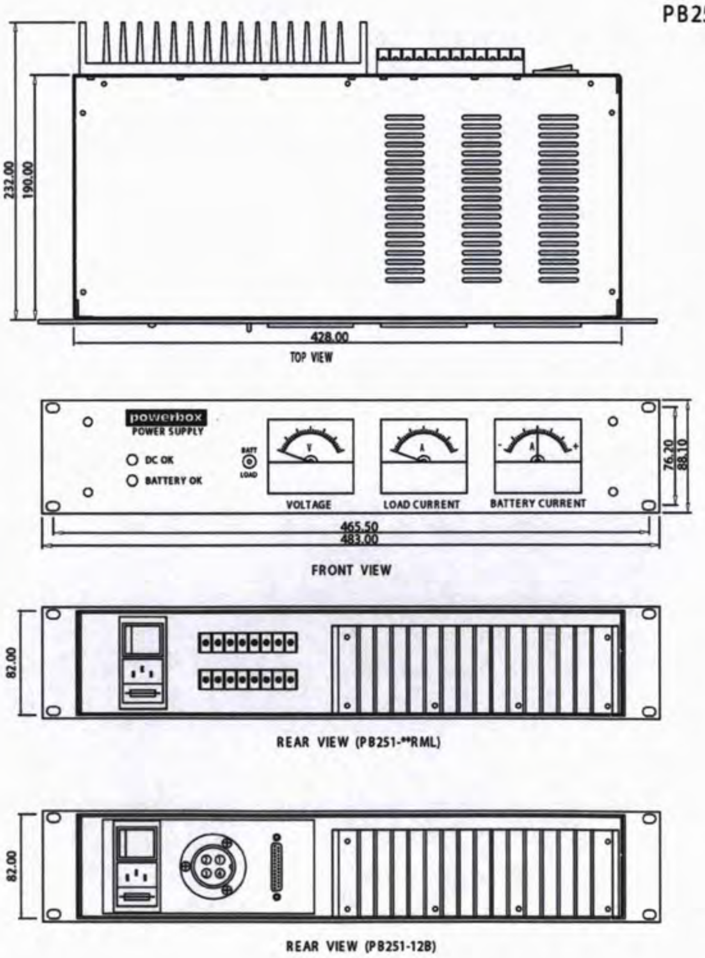
PB251**CM (-H) MECHANICAL OUTLINE



NOTES:
1. Mounting Centres: Suitable for M4 Hardware
   Standard: 165x80mm
   Alternate: 254x80mm
2. M3 threaded holes on bottom of base.
   Standard: 130x80mm centres
   Alternate: 221x80mm centres
3. AC Mains: 10A Class 1 IEC60320 power inlet
4. Output and Battery: 4W Pluggable Screw Terminal Block
   Suitable for up to 4 sq. mm wire.
5. Alarms: 6W Pluggable Screw Terminal Block
   Suitable for up to 1.5 sq. mm wire.

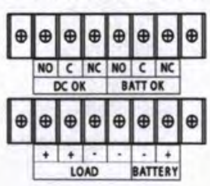


PB251-**RML & -12B MECHANICAL OUTLINE

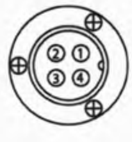


NOTES:
1. 2RU x 19" rack enclosure per IEC297
2. Mounting slots are suitable for M6 hardware.
3. Input connector is a 10A Class 1 IEC60320 inlet.
4. 2 meter IEC mains cord with Australian plug is supplied with unit.
5. PB251-12B alarm terminal is DB25 female.
6. PB251-12B output and battery connector is Hirose pn. HS28R-4A.
   Mating connector is Hirose pn. HS28P-4A (not supplied).
7. PB251-**RML alarm and output terminals are M3.5 screws suitable for ring or fork lugs up to 8 mm wide.

PB251-**RML ALARM AND OUTPUT TERMINALS

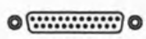


PB251-12B OUTPUT & BATTERY CONNECTOR



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

PB251-12B ALARM CONNECTOR



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

TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type:	Level Probe
Location:	Common Control
Model Numbers:	020130FSP
Manufacturer:	Multitrode
Supplier:	Multitrode Pty Ltd 130 Kinston Road Underwood. QLD 4119 Tel: 07 3340 7000 Fax: 07 3340 7077

The MultiTrode Probe

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

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

Reliable in all conditions

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

Positive pump cut-out

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

Safe for people and environment

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

Cost savings

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

Standard and custom probes

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

Installation

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

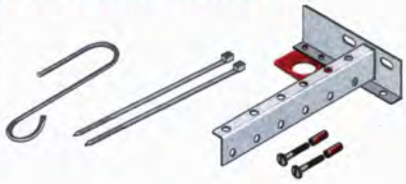
MTAK-1 Mounting Kit (Supplied)

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

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

MTAK-2 Mounting Kit (Optional extra)

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



Ordering Examples and Information

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

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

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

MULTITRODE www.multitrode.com

MultiTrode Pty Ltd · Australia
Brisbane Technology Park 18 Brandl Street
PO Box 4633 Eight Mile Plains Qld 4113
Tel: +61 7 3340 7000 Fax: +61 7 3340 7077
sales@multitrode.com.au

MultiTrode Inc · USA
6560 East Rogers Circle
Boca Raton Florida 33487
Tel: +1 561 994 8090 Fax: +1 561 994 6282
sales@multitrode.net

MultiTrode Probe Immersion Table

WATER • WASTEWATER • PUMP STATION • TECHNOLOGY

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

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

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

Unless stated otherwise, all aqueous solutions are 100%.

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

MULTITRODE

MultiTrode Probe Specifications

Materials:

Sensors:	Avesta 254 SMO high grade stainless steel alloy
Casing:	uPVC premium quality extruded tube
Cable:	PVC/PVC multi-core, purpose-manufactured
Resin:	Fast cure, low viscosity, and solvent free
	Compressive Strength (TM-45) 7 days at 25°C (77°F) = 60 N/mm²
	Elastic Modulus in Compression (TM-45) 7 days at 25°C = 60 N/mm²
	Flexural Strength (TM-46) 7 days at 25°C (77°F) = Specimen did not break under test
	TG (TM-22) 7 days at 25°C (77°F) = 30°C (86°F)
Dimensions:	32 mm (1 ¼ in) diameter x specified length
Mounting:	via the supplied suspension/cleaning bracket inside the wet well

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

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

Cable:	10-core	3-core	Single-core
Conductor Size	0.75mm²	0.75mm²	1.00mm²
Strands/Conductor	24	24	30
Ohms/km	25	25	20
Ohms/mile	40	40	32

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

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

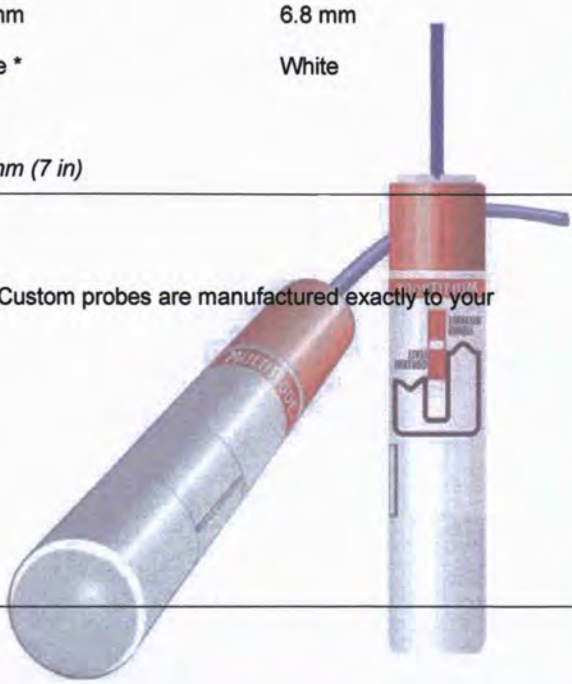
** All multi-core cables are printed: "1-ONE-1", "2-TWO-2" = etc. every 200mm (7 in)*

Custom Probes:

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

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

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



Leaders in Pump Station Management Technology www.multitrode.com

TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type:	Soft Starter
Location:	Drive section
Model Numbers:	MSF 2.0
Manufacturer:	Emotron
Supplier:	Siemens Ltd. 885 Mountain Highway Bayswater Vic 3153 Tel: 137 222 Fax: 1300 360 222

Emotron MSF 2.0 Softstarter

Instruction manual

English

emotron
DEDICATED DRIVE

Valid for the following softstarter models:
MSF 2.0

MSF 2.0

SOFTSTARTER
Instruction manual

Document number: 01-4135-01
Edition: r1
Date of release: 25-07-2007

Safety instructions

Safety

The softstarter should be installed in a cabinet or in an electrical control room.

- The device must be installed by trained personnel.
- Disconnect all power sources before servicing.
- Always use standard commercial fuses, slow blow e.g. gl, gG types, to protect the wiring and prevent short circuiting. To protect the thyristors against short-circuit currents, superfast semiconductor fuses can be used if preferred. The normal guarantee is valid even if superfast semiconductor fuses are not used.

Operating and maintenance personnel

1. Read the whole Instruction Manual before installing and putting the equipment into operation.
2. During all work (operation, maintenance, repairs, etc.) observe the switch-off procedures given in this instruction as well as any other operating instruction for the driven machine or system. See Emergency below.
3. The operator must avoid any working methods which reduce the safety of the device.
4. The operator must do what he can to ensure that no unauthorised person is working on the device.
5. The operator must immediately report any changes to the device which reduce its safety to the user.
6. The user must undertake all necessary measures to operate the device in perfect condition only.

Installation of spare parts

We expressly point out that any spare parts and accessories not supplied by us have also not been tested or approved by us.

Installing and/or using such products can have a negative effect on the characteristics designed for your device. The manufacturer is not liable for damage arising as a result of using non-original parts and accessories.

Emergency

You can switch the device off at any time with the mains switch connected before the softstarter (both motor and control supply voltage must be switched off).

Dismantling and scrapping

The enclosure of the softstarter is made of recyclable material such as aluminium, iron and plastic. Legal requirements for disposal and recycling of these materials must be complied with.

The softstarter contains a number of components demanding special treatment, such as thyristors for example. The circuit boards contain small amounts of tin and lead. Legal requirements for the disposal and recycling of these materials must be complied with.

General warnings

WARNING! Make sure that all safety measures have been taken before starting the motor in order to avoid personal injury.

WARNING! Never operate the softstarter with the front cover removed.

WARNING! Make sure that all safety measures have been taken before switching on the power supply.

Contents

1. General information

This manual describes the Emotron Softstarter MSF 2.0.

1.1 How to use the Instruction Manual

This instruction manual tells you how to install and operate the softstarter MSF 2.0. Read the whole Instruction Manual before installing and putting the unit into operation.

Once you are familiar with the softstarter, you can operate it from the control panel by referring to chapter 5. page 27. This chapter describes all the functions and possible settings.

1.2 Integrated safety systems

The device is equipped with a protection system which reacts to:

- Over temperature
- Voltage unbalance
- Over- and under voltage
- Phase reversal
- Phase loss
- Motor overload protection thermal and PTC.
- Motor load monitor, protecting machine or process maximum or minimum alarm
- Starts per hour limitation

The softstarter is equipped with a connection for protective earth ⏚ (PE).

All MSF 2.0 softstarters are IP 20 enclosed types, except MSF-1000 and MSF-1400 which are delivered as open chassis IP00.

1.3 Safety measures

These instructions are a constituent part of the device and must be:

- Available to competent personnel at all times.
- Read prior to installation of the device.
- Observed with regard to safety, warnings and information given.

The tasks in these instructions are described so that they can be understood by people trained in electrical engineering. Such personnel must have appropriate tools and testing instruments available. Such personnel must have been trained in safe working methods.

The safety measures laid down in DIN standard VDE 0100 must be guaranteed.

The user must obtain any general and local operating permits and meet any requirements regarding:

- Personnel safety
- Product disposal
- Environmental protection

NOTE! The safety measures must remain in force at all times. Should questions or uncertainties arise, please contact your local sales outlet.

1.4 Notes to the Instruction Manual

NOTE: Additional information as an aid to avoiding problems.

CAUTION: Failure to follow these instructions can result in malfunction or damage to the softstarter.

WARNING: Failure to follow these instructions can result in serious injury to the user in addition to serious damage to the softstarter.

Important

For all enquiries and spare parts orders, please quote the correct name of the device and serial number to ensure that your inquiry or order is dealt with correctly and swiftly.

1.5 Type number

Fig. 1, page 5 gives an example of the type code number used for an Emotron MSF Softstarter. With this code number the exact type of the softstarter can be determined. This identification will be required for type specific information when mounting and installing. The code number is located on the product label, on the front of the unit.

MSF	-017	525	2	C	V	N
1	2	3	4	5	6	7

Fig. 1 Type number.

Table 1

Position	Configuration parameter	Description
1	Softstarter type	MSF 2.0 type, Fixed
2	Motor current	017-1400 A
3	Mains supply voltage	525 V 690 V
4	Control supply voltage	2=100-240 V 5=380-500 V
5	Control panel option	C=Standard, no external control panel H=External control panel
6	Coated boards option	-=No coated boards V=Coated boards
7	Communication option	N=No COM included S=RS232/485 included D=DeviceNet included P=Profibus included

1.6 Standards

The device is manufactured in accordance with these regulations:

- IEC 60947-4-2
- EN 60204-1, Safety of Machinery, Electrical equipment of machines, part 1, General requirements and VDE 0113.
- EN 61000-6-4, EMC, Emission standard for industrial environments
- EN 61000-6-3, EMC, Emission standard for residential, commercial and light-industrial environments
- EN 61000-6-2, EMC, Immunity for industrial environments
- GOST
- UL 508

1.7 Tests in accordance with norm EN 60204 standard

Before leaving the factory, the device was subjected to the following tests:

- Through connection of earthing system:
  a) visual inspection.
  b) check that earthing wire is firmly connected.
- Insulation
- Voltage
- Function

1.8 Transport and packing

The device is packed in a carton or plywood box for delivery. The outer packaging can be recycled. The devices are carefully checked and packed before dispatch, but transport damage cannot be ruled out.

Check on receipt

Check that the goods are complete as listed on the delivery note, see type no. etc. on the rating plate.

Is the packaging damaged?

Check the goods for damage (visual check).

If you have cause for complaint

If the goods have been damaged during transport:

- Contact the transport company or the supplier immediately.
- Keep the packaging (for inspection by the transport company or for returning the device).

Packaging for returning the device

Pack the device so that it will resist shock and impact.

Intermediate storage

After delivery or after it has been dismounted, the device can be stored before further use in a dry room.

1.9 Unpacking MSF-310 and larger types

The MSF 2.0 softstarter is attached to the plywood box/ loading stool by screws, and the softstarter must be unpacked as follows:

1. Open only the securing plates at the bottom of the box (bend downwards). Then lift up the box from the loading stool, both top and sides in one piece.
2. Loosen the three (3) screws on the front cover of the softstarter unit, down by the lower logo.
3. Push up the front cover about 20 mm so that the front cover can be removed.
4. Remove the two (2) mounting screws at the bottom of the softstarter.
5. Lift up the softstarter unit at the bottom about 10 mm and then push backwards about 20 mm so that the softstarter can be removed from the mounting hooks* at the top. The hooks are placed under the bottom plate and cannot be removed until the softstarter is pulled out.
6. Loosen the two screws (2) for the mounting hooks and remove the hooks.
7. The hooks are used as an upper support for mounting the softstarter.

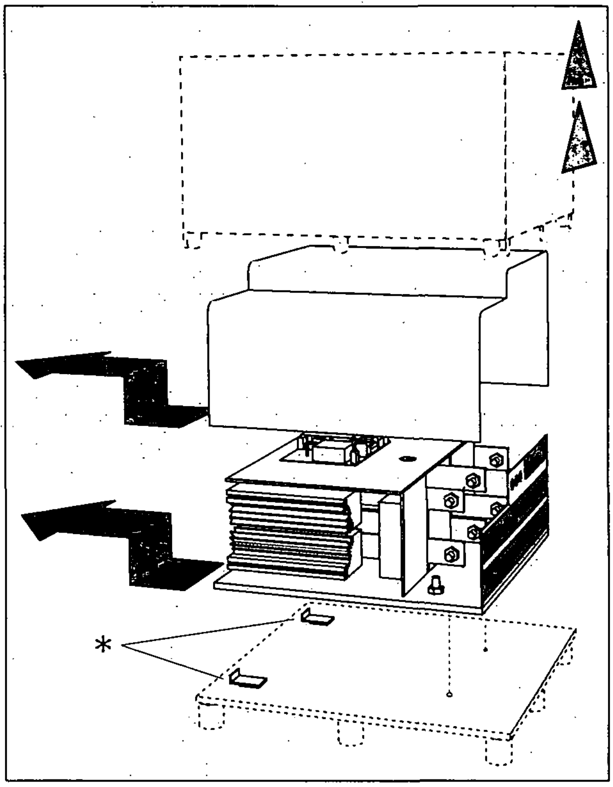


Fig. 2 Unpacking MSF-310 and larger models.

1.10 Glossary

1.10.1 Abbreviations

In this manual the following abbreviations are used:

Table 2 Abbreviations

Abbreviation	Description
FLC	Full load current
DOL	Direct on-line

1.10.2 Definitions

In this manual the following definitions for current, voltage, power, torque and speed are used:

Table 3 Definitions

Name	Description	Unit
I_{nsoft}	Nominal softstarter current	A
P_{nsoft}	Nominal softstarter power	kW, HP
N_{nsoft}	Nominal softstarter speed	rpm
T_n	Nominal motor torque	Nm, lbft
U_n	Nominal motor voltage	V
I_n	Nominal motor current	A
P_n	Nominal motor power	kw, HP
P_{normal}	Normal load	% of P_n

2. Description

In this chapter different starting methods for induction motors are explained and compared. The functionality of softstarters with torque control and their advantages and limitations compared to other starting methods are explained.

First a brief account of the background theory of starting induction motors will be given in section 2.1. Thereafter the different starting methods based on the usage of reduced voltage will be described and compared. This chapter will also cover softstarters with torque control. In section 2.3 some common starting methods based on other physical principles are explained. With this information some limitations of the reduced voltage starters will become clear. In section 2.4 there is a brief analysis of which applications may benefit from using a softstarter.

2.1 Background theory

The following two sections deal with motors with squirrel-cage rotors. In contrast to a wound rotor, the squirrel-cage rotor consists of straight conductors, which are short-circuited together at both ends.

When such a motor is connected directly to the line voltage it will typically draw a starting current of about 5 to 8 times its nominal current while the resulting starting torque will be about 0.5 to 1.5 times its nominal torque. In the following picture a typical starting characteristic is shown. The x-axis represents the speed relative to the nominal speed while the y-axis shows the torque and the current respectively, even those normalized to their nominal values. The dashed line indicates the nominal values.

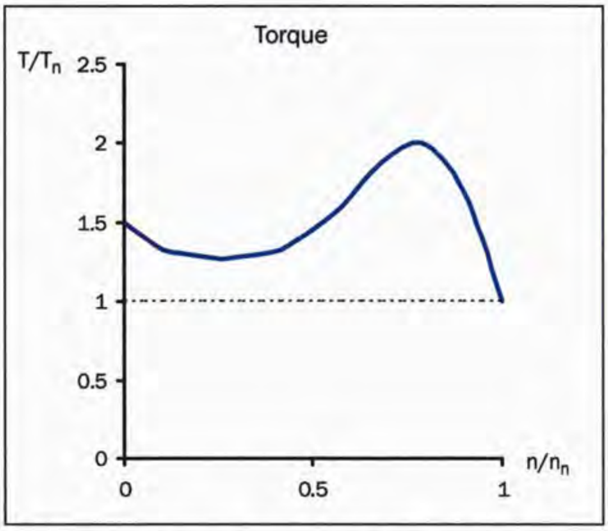


Fig. 3 Typical torque characteristics for the DOL start

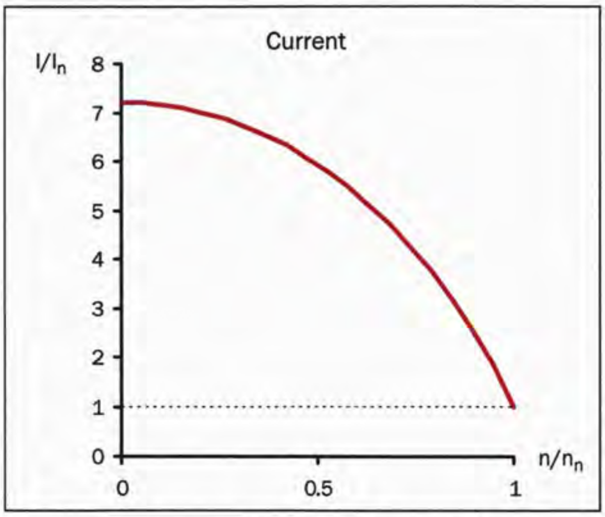


Fig. 4 Typical current characteristics for the DOL start

For many industrial applications direct on-line starting is not convenient, as the supply in this case has to be dimensioned to deliver the unnecessarily high starting current. Moreover, most applications do not gain anything from the high starting torque. Instead there is a risk of mechanical wear or even damage because of the resulting jerk at speedup.

The acceleration torque is determined by the difference between motor and load torque. The figure below shows some typical torque characteristics for constant speed applications. For comparative purposes, the inducion motors' torque characteristic is added to the diagram.

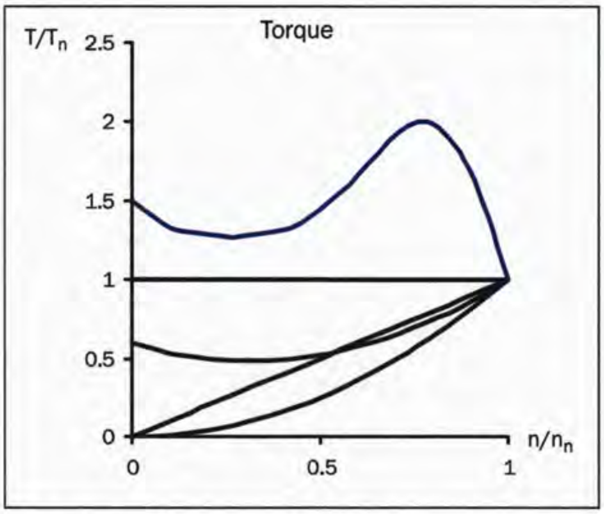


Fig. 5 Typical load torque characteristics

Typical applications with constant load are elevators, cranes and conveyors. Linear load characteristics are found for calendar rollers and smoothing machines; quadratic correlation between speed and torque is typical for pumps and fans.

Some applications like conveyors or screws may need an initial torque boost. However, for many applications it can be seen that the torque needed is much lower than the torque delivered by the induction motor in a DOL start.

A common method to reduce both starting torque and current is to decrease the motor voltage during starting. The following figure shows how the motor's torque and current characteristics are changed when the supply voltage is reduced.

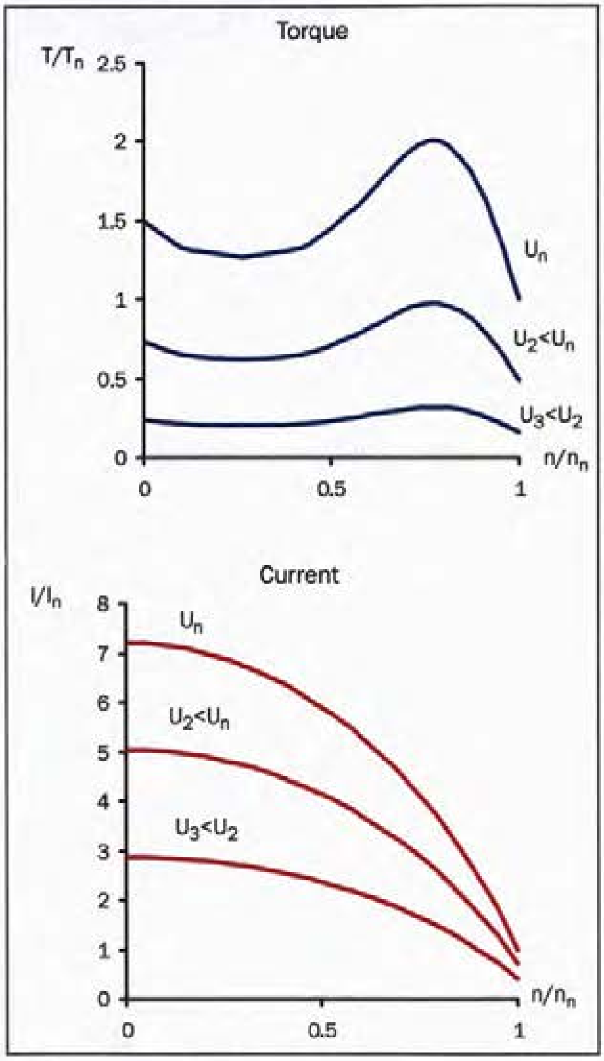


Fig. 6 Reduced voltage start

A general rule of thumb is that the torque at each operating point is roughly proportional to the square of the current. This means when the motor current is decreased by a factor of two by means of reducing the supply voltage, the torque delivered by the motor will be decreased by a factor of four (approximately).

$$T \sim I^2$$
$$I_{LV} = 1/2\ I_{DOL} \rightarrow T_{LV} \approx 1/4\ T_{DOL}$$
$$I_{LV} = 1/3\ I_{DOL} \rightarrow T_{LV} \approx 1/9\ T_{DOL}$$

LV=low voltage
DOL=Direct on line

This relationship is the base for any starting method using reduced voltage. It can be seen that the possibility of reducing the starting current depends on the correlation between the motor's and the load's torque characteristic. For the combination of an application with very low starting load and a motor with very high starting torque, the starting current may be reduced significantly by means of decreasing the voltage during start. However, for applications with high starting load it may – depending on the actual motor – not be possible to reduce the starting current at all.

2.2 Reduced voltage starting

This section describes different starting methods which are based on the reduced-voltage principle explained above. A pump and its quadratic torque characteristic are used as an example.

The star-delta starter is the simplest example of a reduced voltage starter. The motor phases are first star connected; at about 75% of nominal speed the phase connection is then changed to delta. To enable star-delta start, both ends of all three motor windings have to be available for connection. Moreover, the motor has to be dimensioned for the (higher) voltage in the delta connection. The following figure shows the resulting torque and current characteristics.

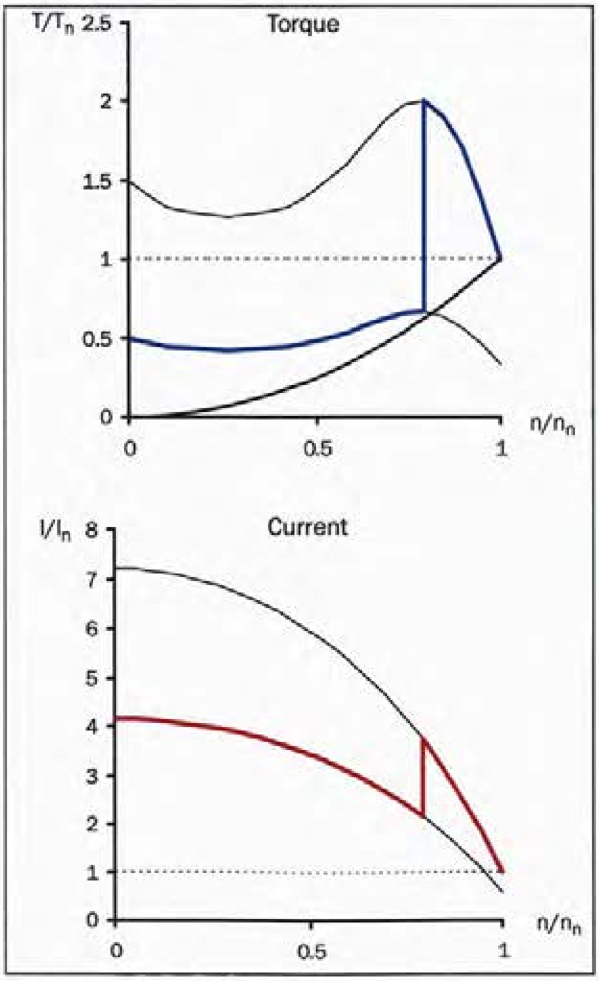


Fig. 7 Star-delta start

The disadvantage of the star-delta start is that it cannot be adapted to a special application. Both the voltage in star and in delta connection are defined by the supply, the resulting starting performance depends on the motor's DOL characteristic. For some applications the star-delta starter cannot be used as the resulting torque in star connection is too low to start rotating the load. On the other hand for low load applications further savings of starting current are impossible even though a big torque reserve is available. Moreover, the resulting abrupt rise of torque first at start and later when changing from star to delta connection may contribute to mechanical wear. The high transient currents during start-delta transition create unnecessary excess heat in the motor.

Better performance is achieved with a voltage ramp start, which a simple electronic softstarter can provide. The voltage is increased linearly from an initial value to the full supply voltage by means of phase angle control. The resulting torque and current characteristics are shown in the following figure.

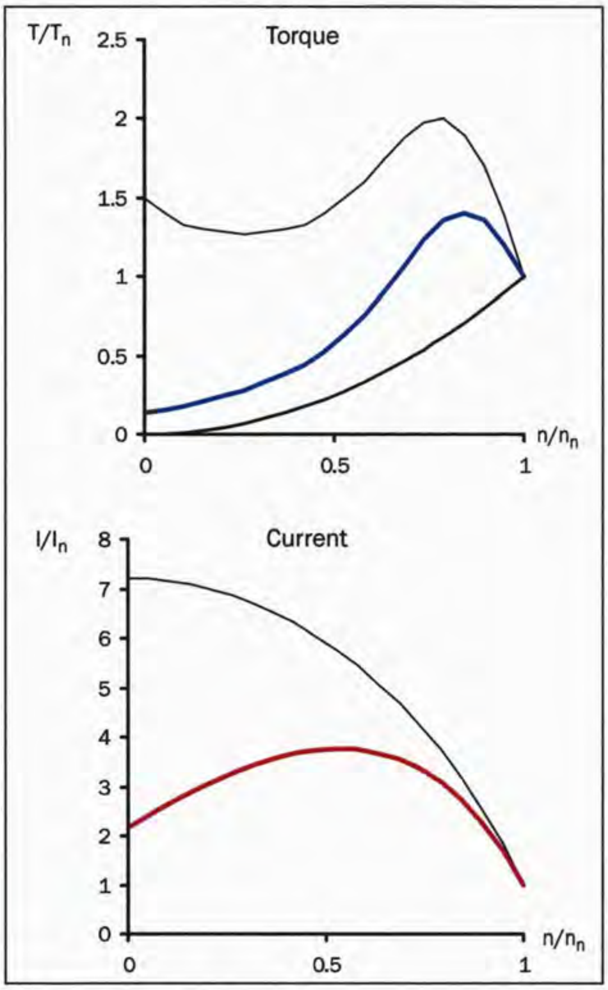


Fig. 8 Soft starting – voltage ramp

Obviously a much smoother start is realized compared to the star-delta start and the starting current is decreased.

A softstarter i often used to keep the starting current below a desired level. For the example above, setting a current limit of three times the nominal current may be desirable. The following figure shows the resulting torque and current characteristics.

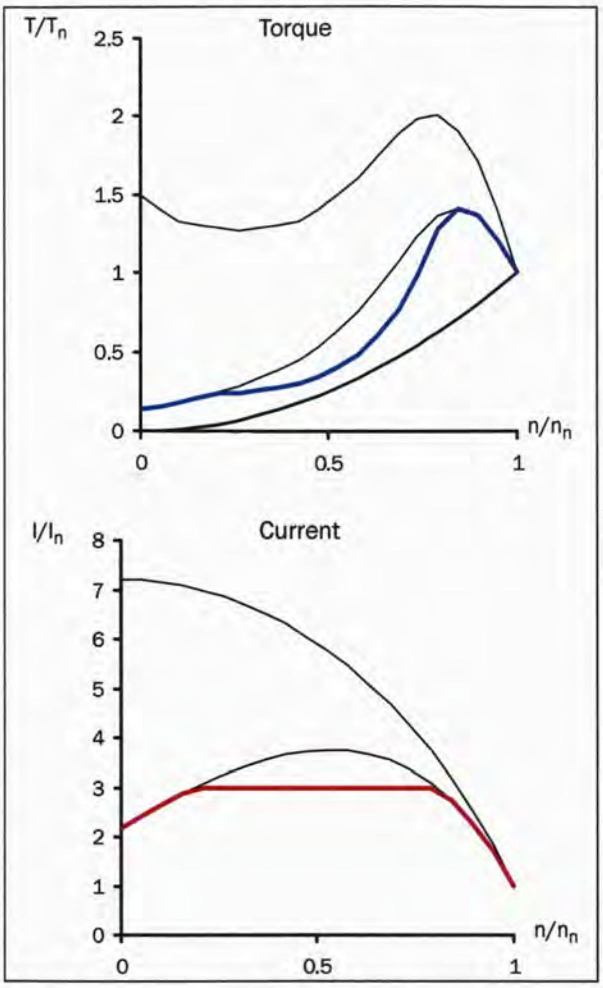


Fig. 9 Soft starting – voltage ramp with current limit

Once again the figure illustrates that the resulting performance depends on the combination of motor and load characteristics. In the example above the motor torque is close to the load torque at about half speed. This means for some other applications with different load characteristics (for example a linear torque-speed correlation) this particular motor would need more than three times the nominal current to start.

The most sophisticated electronic softstarters use torque control, which results in an almost constant acceleration during the start. A low starting current is also achieved. However, even this start method uses reduced motor voltage and the quadratic correlation between current and torque described in the first section of this chapter is still valid. This means, the lowest possible starting current is determined by the combination of motor and load characteristics.

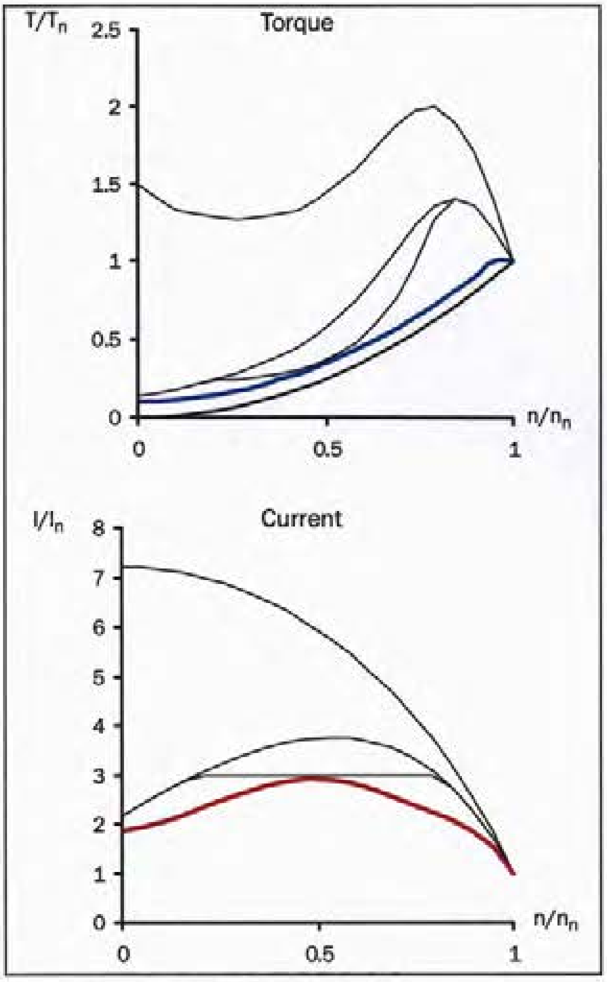


Fig. 10 Soft starting – torque control

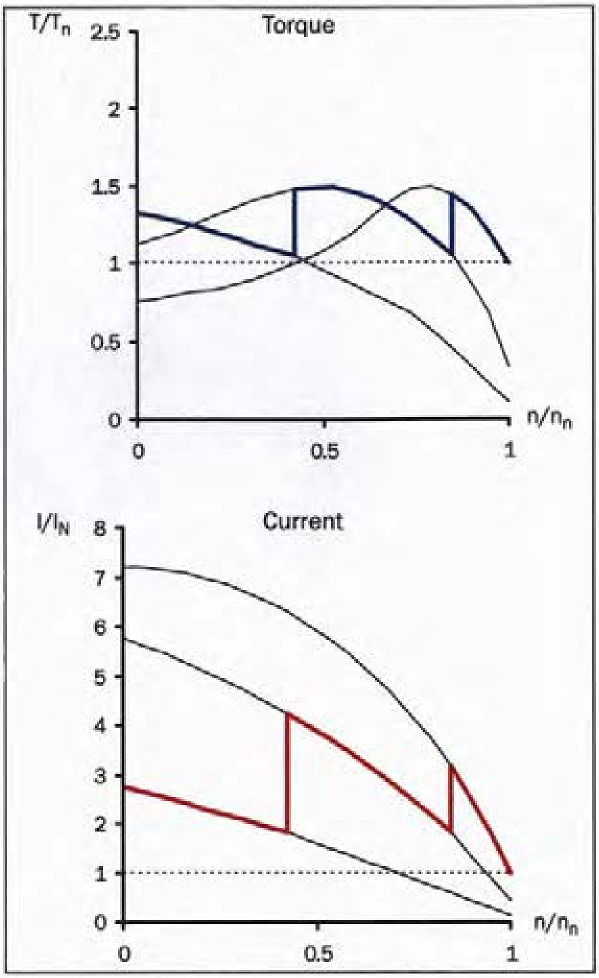


Fig. 11 Rotor-resistance starting

For optimal starting performance, correct setting of the soft-starter's parameters such as initial torque and end torque at start and start time is important. The choice of parameters is explained in detail in section 8.7, page 55.

2.3 Other starting methods

In contrast to the preceding sections of this chapter, which focused on squirrel-cage motors, slip-ring motors are dealt with later on. A slip-ring motor is equipped with a wound rotor; one end of each rotor winding is available for external connection via slip-rings. These motors are often optimized for rotor resistance starting, e.g. with short-circuited rotor windings they develop a very low torque at an extremely high current. For starting external resistances are connected to the rotor windings. During the start, the resistance value is decreased in several steps until the rotor windings are short-circuited at nominal speed. The following figure shows typical torque and current characteristics for a slip-ring motor during the start with an external rotor-resistance starter.

Because of the low starting torque it is often not possible to short-circuit the rotor windings and replace the rotor-resistance starter with a softstarter. However, it is always possible to use a frequency inverter instead. The following illustration shows how the torque and current characteristics are affected when the stator frequency is changed.

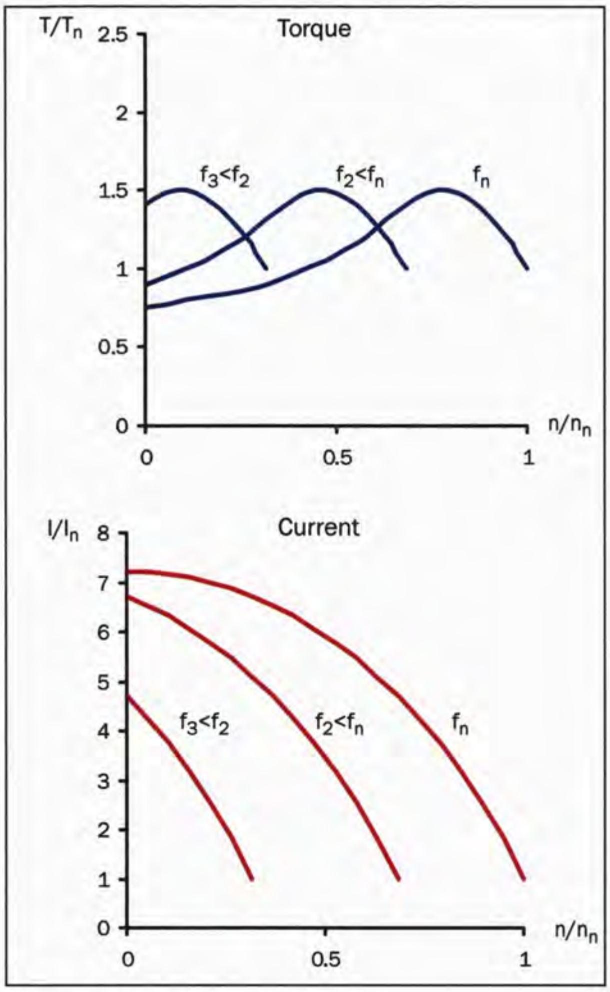


Fig. 12 Voltage/frequency regulation

Thus, such a motor can be started with a quite simple frequency inverter with voltage-frequency regulation. This solution is even valid for all other applications, which for some reason (high load torque compared to motor torque etc.) cannot be started by a softstarter.

2.4 Use of softstarters with torque control

To determine if a specific application benefits from using a softstarter at all, the correlation between the motor's torque characteristic during the start and the load's requirements has to be evaluated. As it can be seen from the examples above, the application will only benefit from using a softstarter if the load torque during the start is clearly below the motor's starting capacity. However, even loads with a high initial release torque may profit from a softstarter. In this case an initial torque boost can be used, thereafter the start ramp is continued reducing the starting current considerably.

The profit can be maximized when using a softstarter with torque control. To be able to configure the torque control parameters for optimal performance, the load characteristics (linear, square or constant load, need of initial release torque) must be known. In this case a proper torque control method (linear or square) can be chosen and torque boost can be enabled if needed. A description of the load characteristics of several common applications and guidelines for proper settings are found in chapter 6. page 31, Applications and Functions Selection. Optimization of the torque control parameter is explained in detail in section 8.7, page 55.

3. Mounting

This chapter describes how to mount the MSF 2.0 softstarter. Before mounting it is recommended that the installation be planned out first:

- Be sure that the softstarter suits the mounting location.
- The mounting site must support the weight of the softstarter.
- Will the softstarter continuously withstand vibrations and/or shocks?
- Consider using a vibration damper.
- Check ambient conditions, ratings, required cooling air flow, compatibility of the motor, etc.
- Do you know how the softstarter will be lifted and transported?

Make sure that the installation is performed in accordance with the local safety regulations of the electricity supply company. And in accordance with DIN VDE 0100 for setting up heavy current plants.

Care must be taken to ensure that personnel do not come into contact with live circuit components.

WARNING! Never operate the softstarter with the front cover removed.

3.1 Installation of the softstarter in a cabinet

When installing the softstarter:

- Ensure that the cabinet will be sufficiently ventilated after the installation.
- Keep the minimum free space, see the tables on page 15.
- Ensure that air can flow freely from the bottom to the top.

NOTE: When installing the softstarter, make sure it does not come into contact with live components. The heat generated must be dispersed via the cooling fins to prevent damage to the thyristors (free circulation of air).

MSF-017 to MSF-835 are all delivered as enclosed versions with front opening. The units have bottom entry for cables etc. see Fig. 20 on page 21 and Fig. 22 on page 23. MSF-1000 and MSF-1400 are delivered as open chassis.

3.1.1 Cooling

MSF-017 to MSF-250

Table 4 MSF-017 to MSF-250

MSF model	Minimum free space (mm):		
	above 1)	below	at side
-017, -030, -045	100	100	0
-060, -075, -085	100	100	0
-110, -145	100	100	0
-170, -210, -250	100	100	0
1) Above: wall-softstarter or softstarter-softstarter			

MSF-310 to MSF-1400

Table 5 MSF-310 to MSF-1400.

MSF model	Minimum free space (mm):		
	above 1)	below	at side
-310, -370, -450	100	100	0
-570, -710, -835	100	100	0
-1000, -1400	100	100	100
1) Above: Wall-softstarter or softstarter-softstarter			

3.1.2 Mounting schemes

MSF-017 to MSF-250

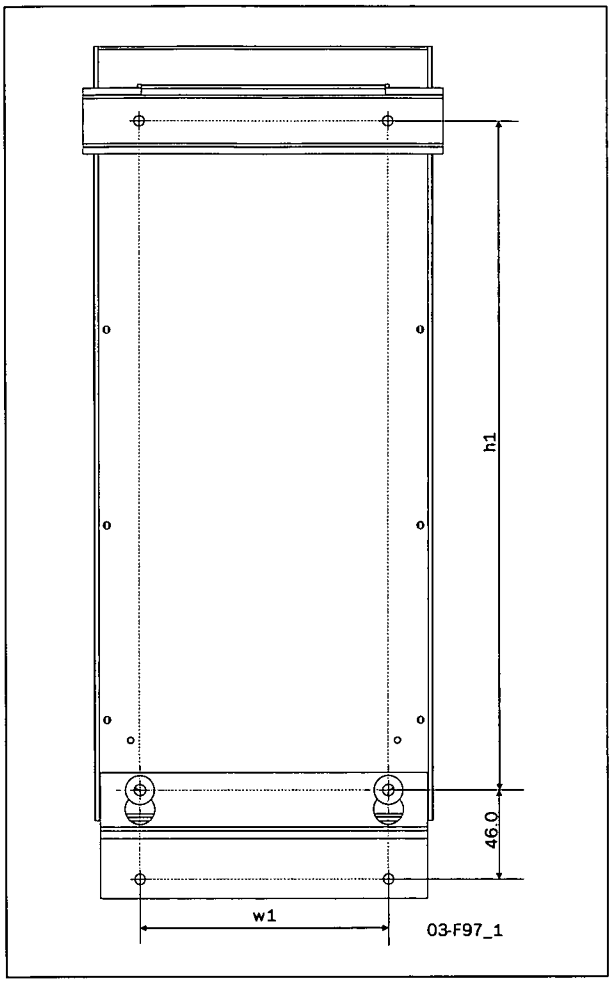


Fig. 13 Hole pattern for MSF-017 to MSF-250 (backside view).

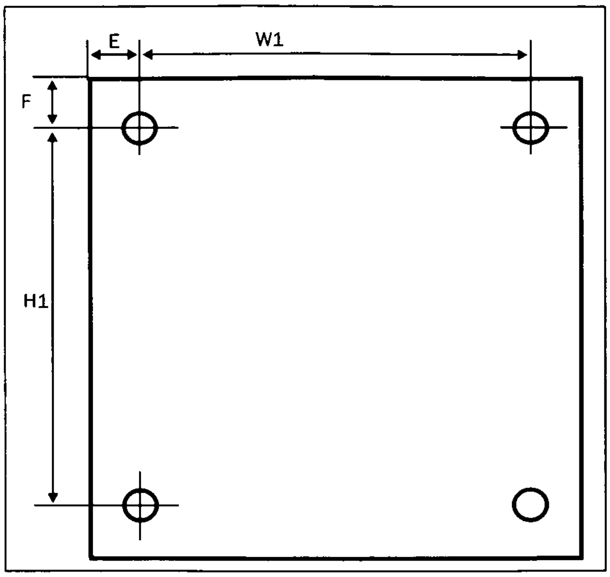


Fig. 14 Hole pattern for screw attachment, MSF-310 to MSF-835. Hole distance (mm).

Table 6

MSF Model	Hole distance w1 [mm]	Hole distance H1 [mm]	Hole distance E	Hole distance F	Diam./ screw	Tightening torque for bolt [mm]		
						Cable	PE cable	Supply and PE
-017, -030, -045	78.5	265			5.5/M5	8	8	0.6
-060, -075, -085	78.5	265			5.5/M5	12	8	0.6
-110, -145	128.5	345			5.5/M5	20	12	0.6
-170, -210, -250	208.5	445			5.5/M5	20	12	0.6
-310, -370, -450	460	450	44	39	8.5/M8	50	12	0.6
-570, -710, -835	550	600	45.5	39	8.5/M8	50	12	0.6
-1000, -1400					8.5/M8	50	12	0.6

Observe that the two mounting hooks supplied (see section 1.9, page 6 and Fig. 2 on page 7) must be used for mounting the softstarter as upper support (only MSF-310 to MSF-835).

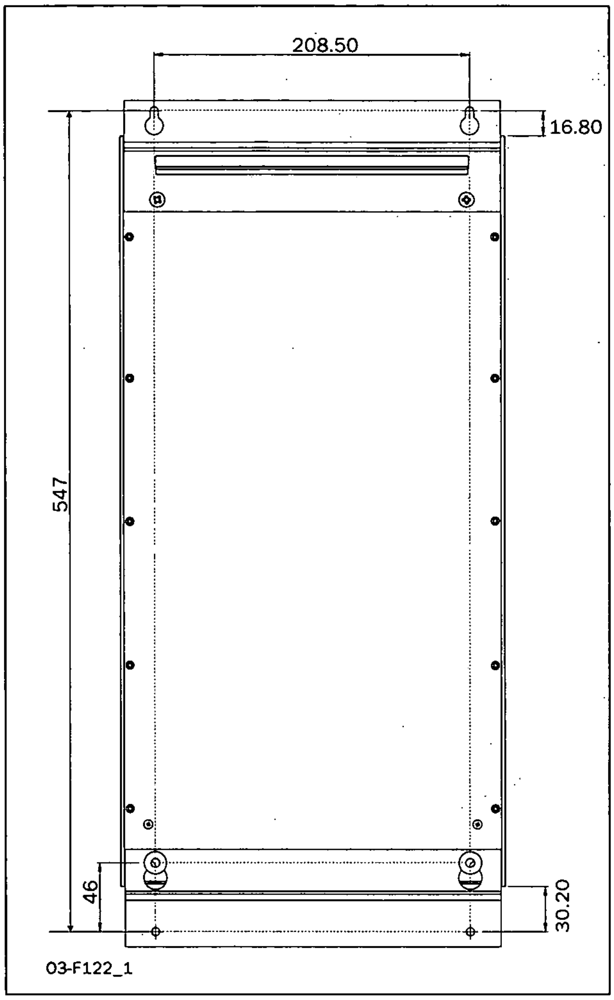


Fig. 15 Hole pattern for MSF-170 to MSF-250 with upper mounting bracket instead of DIN rail.

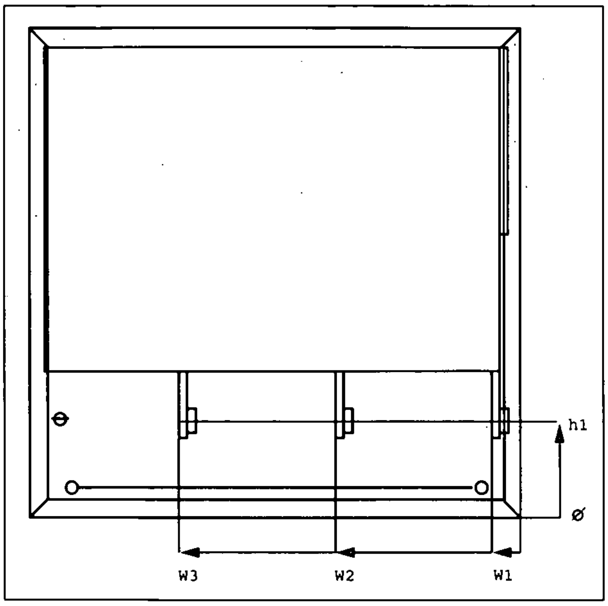


Fig. 16 Busbar distances MSF-310 to MSF-835.

Table 7 Busbar distances

MSF model	Dist. h1 (mm)	Dist. W1 (mm)	Dist.W2 (mm)	Dist.W3 (mm)
-310 to -450	104	33	206	379
-570 to -835	129	35	239.5	444
-1000 -1400		55	322.5	590.5

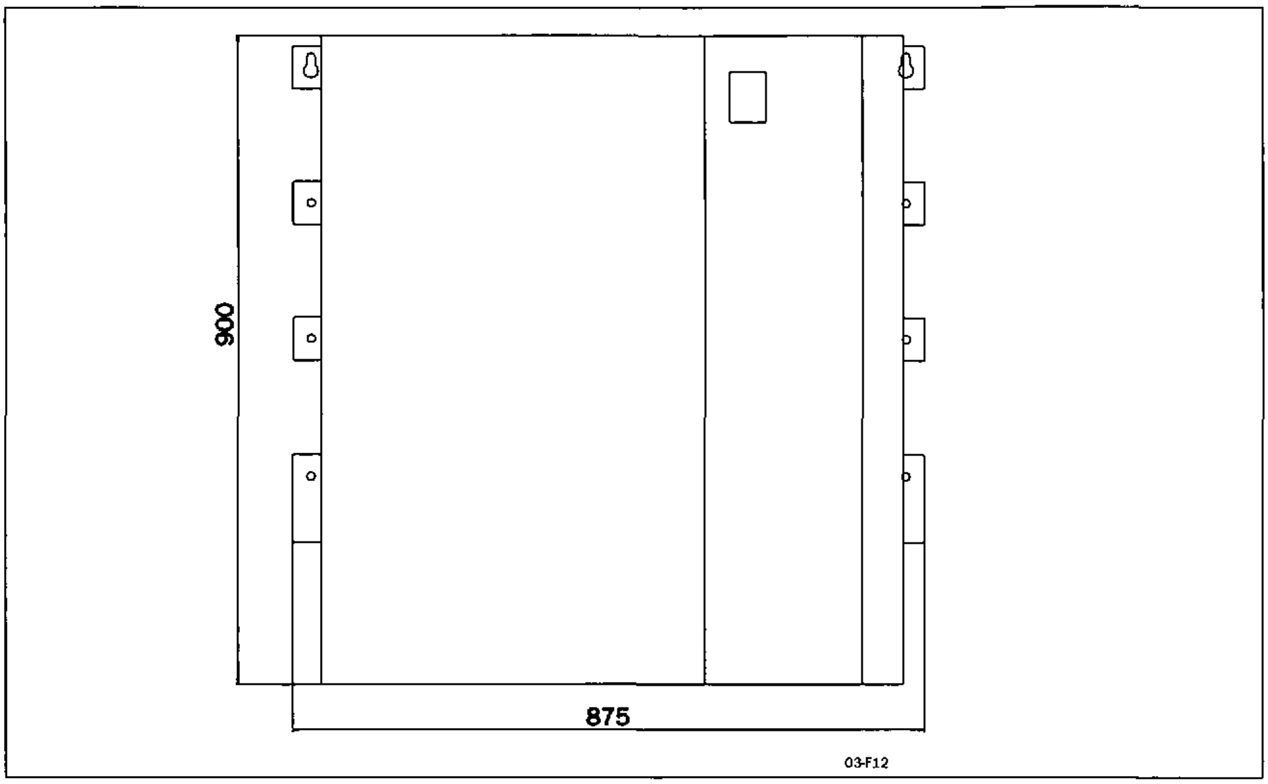


Fig. 17 MSF-1000 to MSF-1400

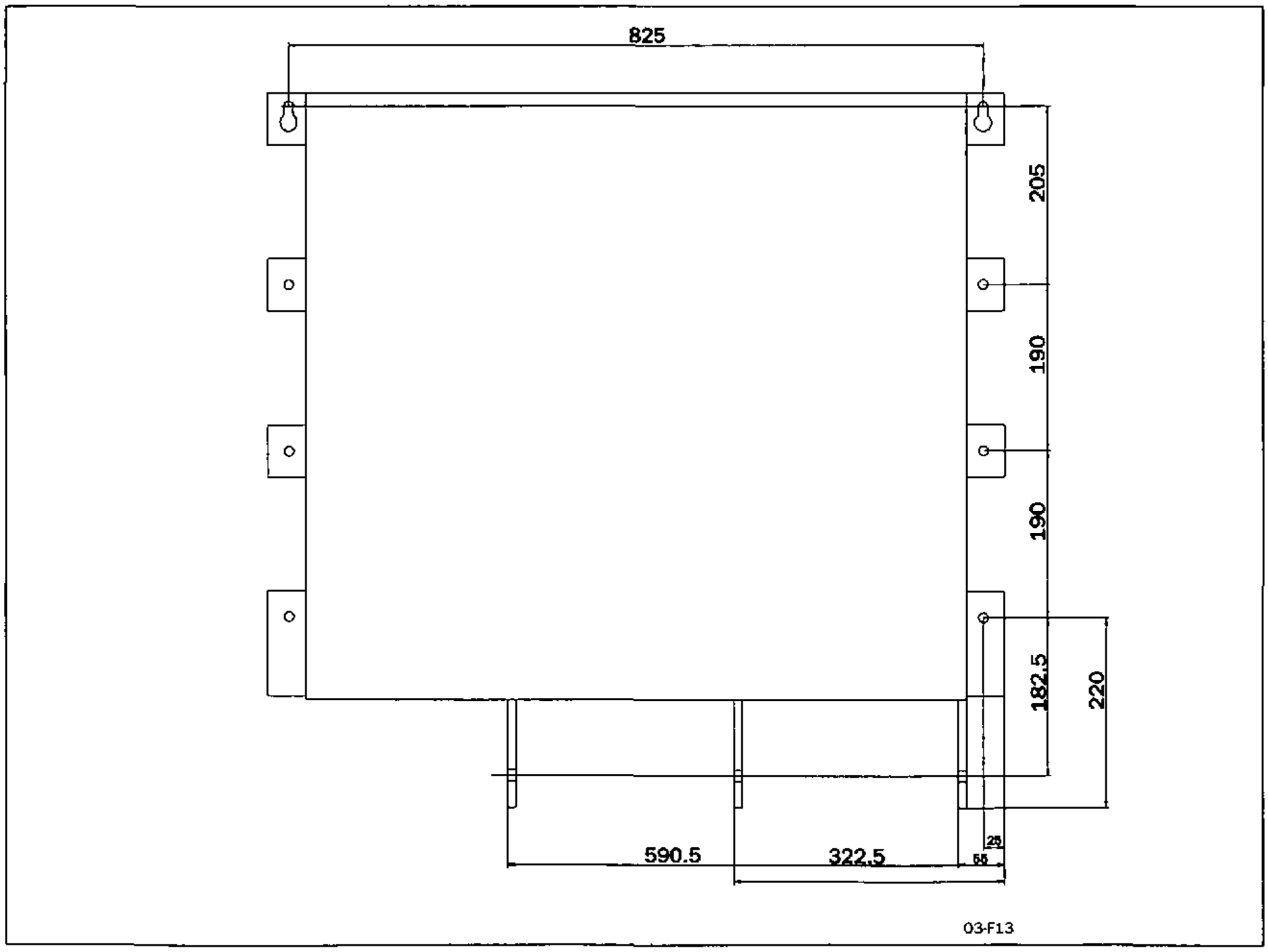


Fig. 18 Hole pattern busbar MSF-1000 to MSF-1400.

4. Connections

The description of installation in this chapter follows the EMC standards and the Machinery Directive.

If the softstarter is temporarily stored before being connected, please check the technical data for environmental conditions. If the softstarter is moved from a cold storage room to the room where it is to be installed, condensation can form on it. Allow the softstarter to become fully acclimatised and wait until any visible condensation has evaporated before connecting the mains voltage.

NOTE: The softstarter must be wired with shielded control cable to fulfil EMC regulations according to section 1.6, page 6.

NOTE: For UL-approval use 75°C Copper wire only.

4.1 Connecting mains and motor cables

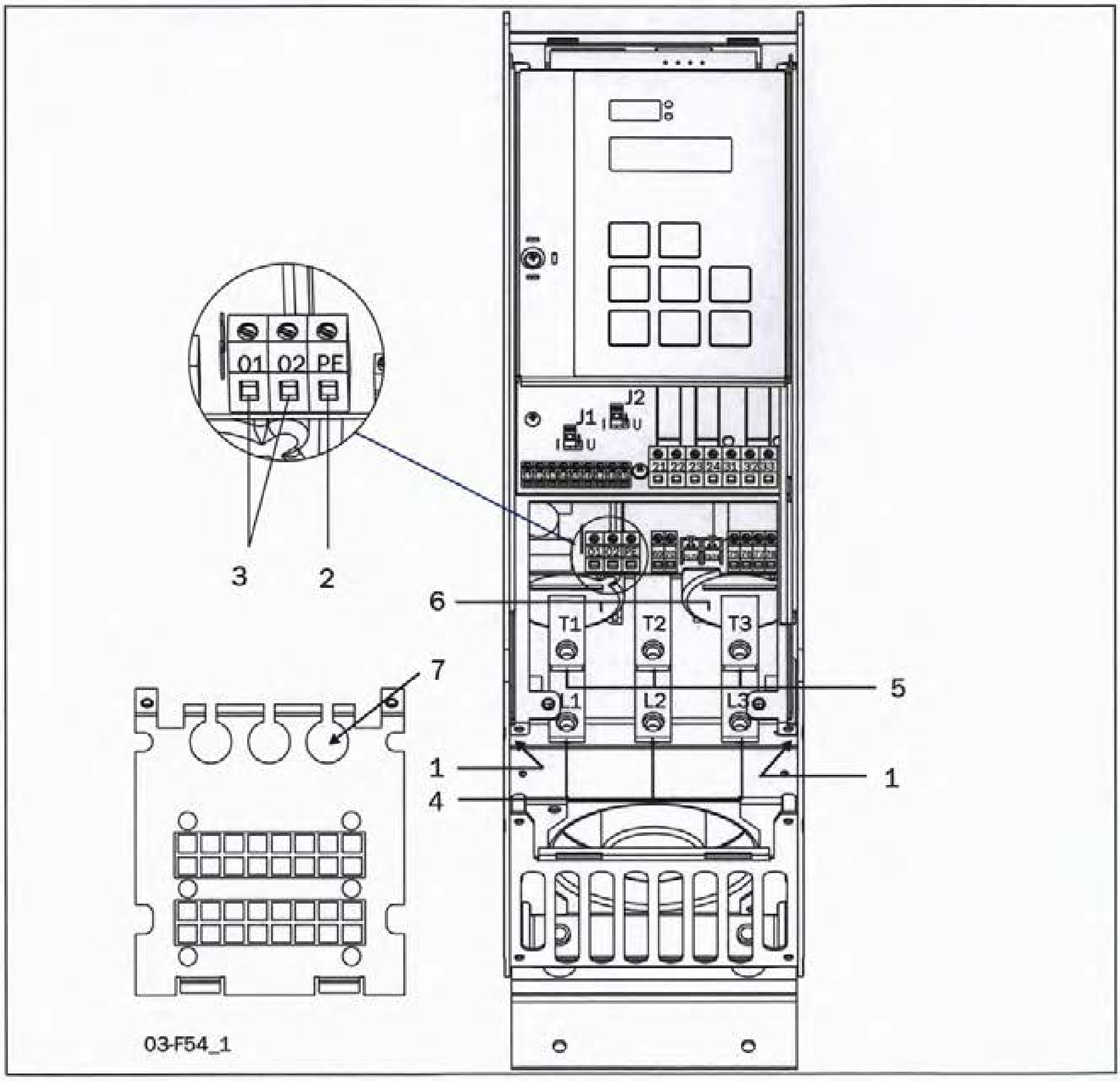


Fig. 19 Connection of MSF-017 to MSF-085.

Connection of MSF-017 to MSF-085

Device connections

1. Protective earth, ⏚ (PE), mains supply, motor (on the right and left inside of the cabinet)
2. Protective earth, ⏚ (PE), control supply voltage
3. Control supply voltage connection **01, 02**
4. Mains supply **L1, L2, L3**
5. Motor power supply **T1, T2, T3**
6. Current transformers (can be mounted outside for bypass see section 8.7.5, page 67)
7. Mounting of EMC gland for control cables

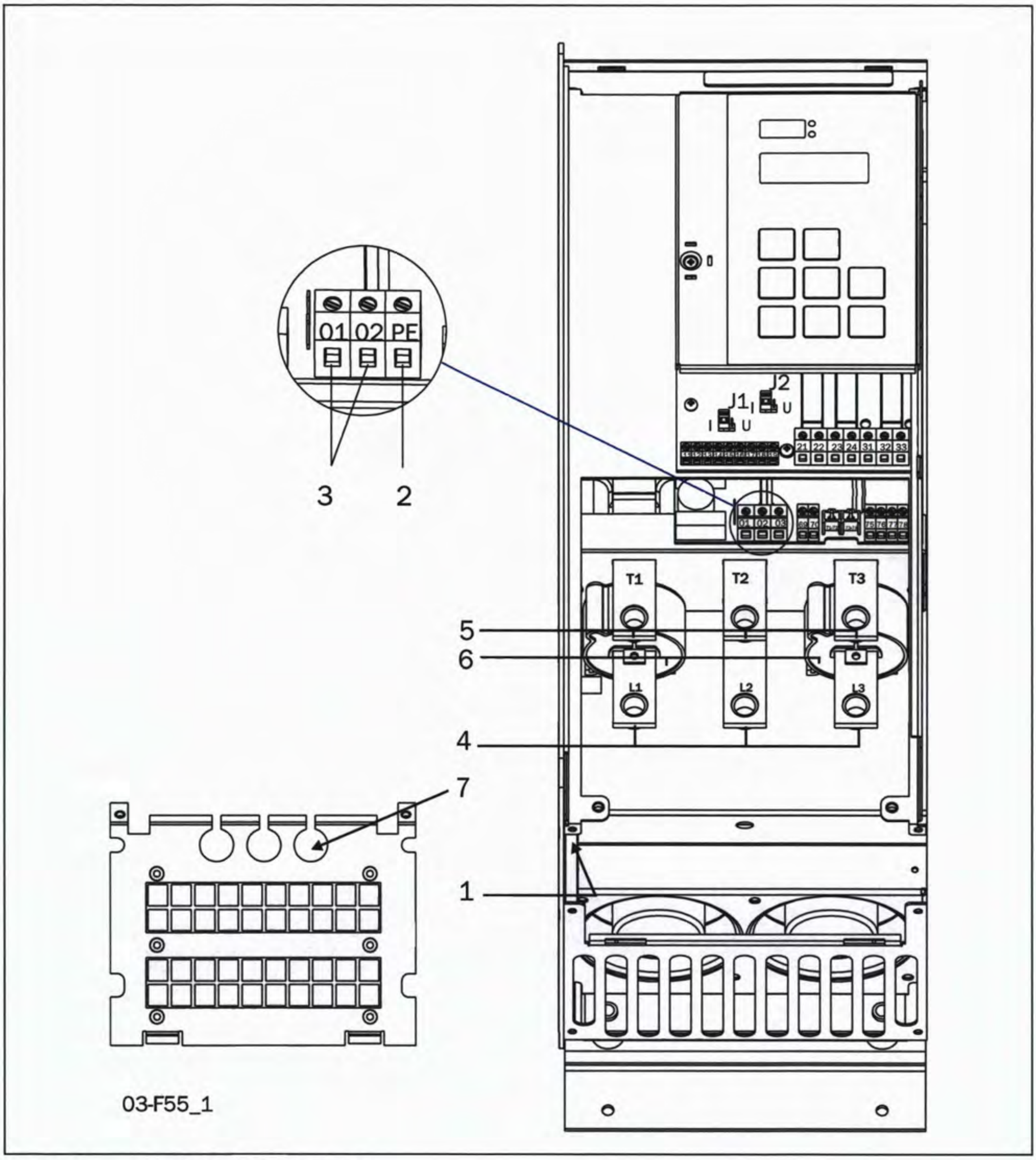


Fig. 20 Connection of MSF-110 to MSF-145.

Connection of MSF-110 to MSF-145

Device connections

1. Protective earth, ⏚ **(PE)**, mains supply, motor (on the left inside of the cabinet)
2. Protective earth ⏚ **(PE)**, control supply voltage
3. Control supply voltage connection **01, 02**
4. Mains supply **L1, L2, L3**
5. Motor power supply **T1, T2, T3**
6. Current transformers (can be mounted outside for bypass see section 8.7.5, page 67)
7. Mounting of EMC gland for control cables

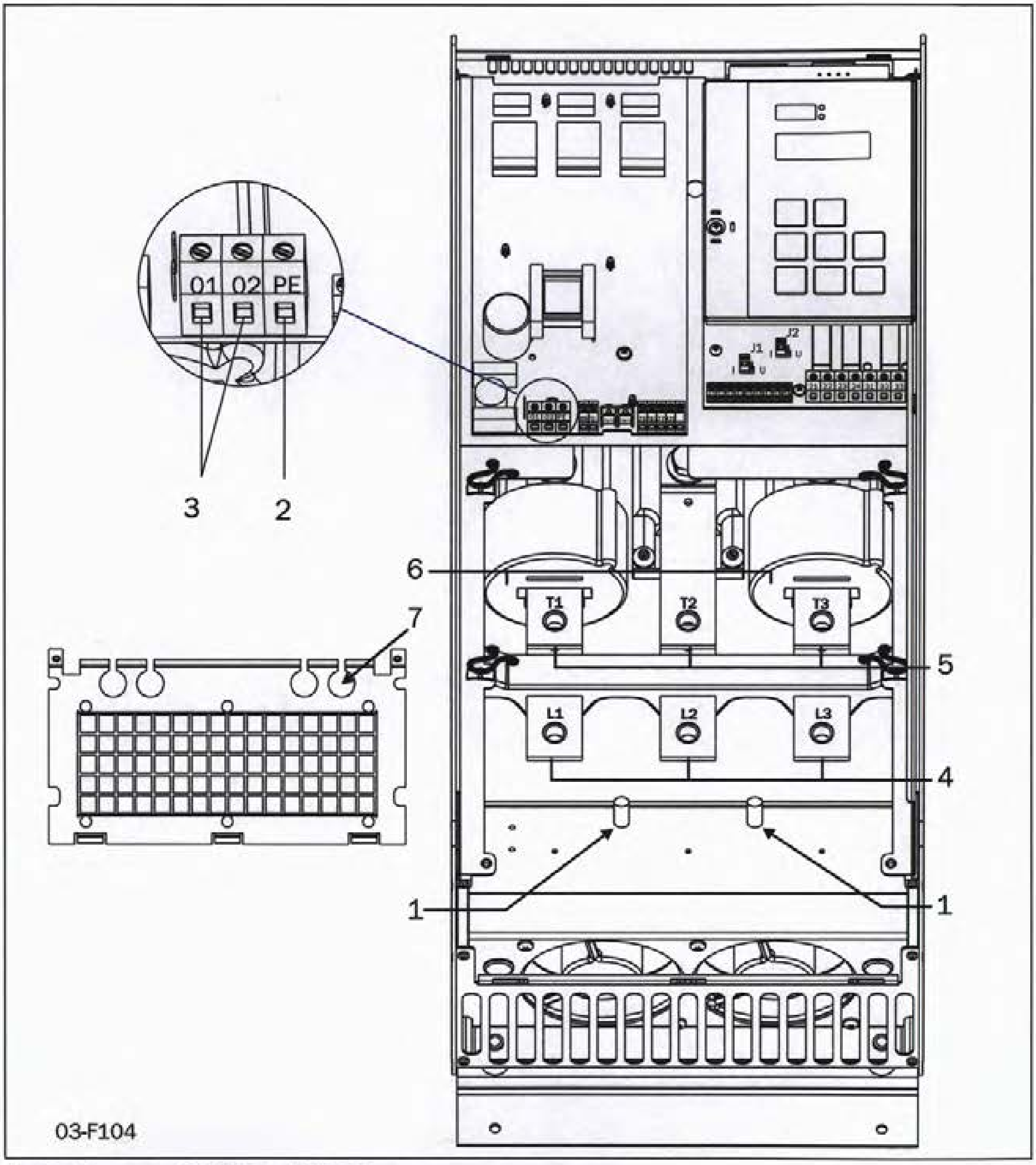


Fig. 21 Connection of MSF-170 to MSF-250.

Connection of MSF-170 to MSF-250

Device connections

1. Protective earth, ⏚ (PE), mains supply, motor (on the left inside of the cabinet)
2. Protective earth ⏚ (PE), control supply voltage
3. Control supply voltage connection **01, 02**
4. Mains supply **L1, L2, L3**
5. Motor power supply **T1, T2, T3**
6. Current transformers (can be mounted outside for bypass see section 8.7.5, page 67)
7. Mounting of EMC gland for control cables

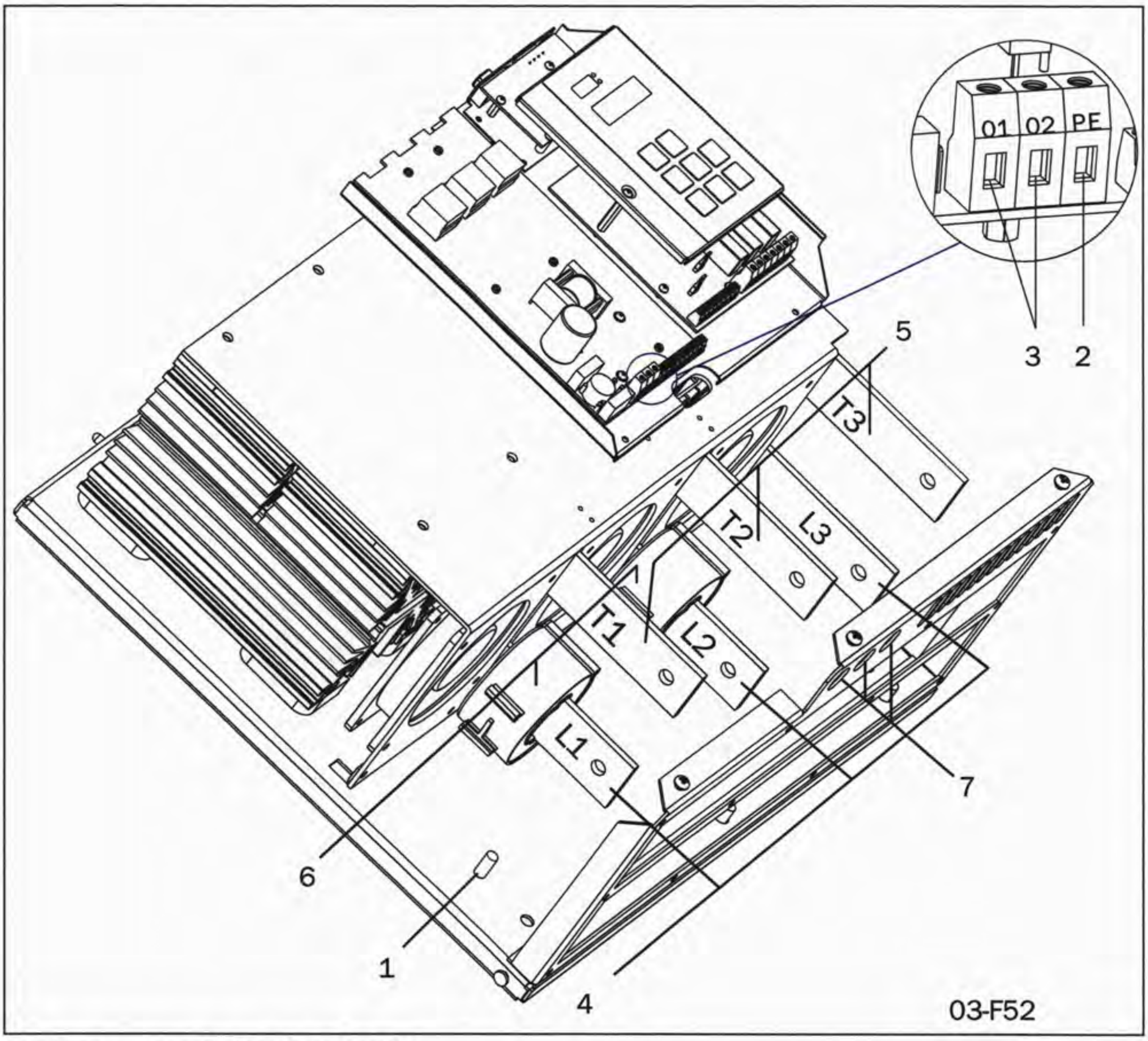


Fig. 22 Connection of MSF-310 to MSF-1400.

Connection of MSF-310 to MSF-1400

Device connections

1. Protective earth, ⏚ (PE), mains supply and motor
2. Protective earth, ⏚ (PE), control supply voltage
3. Control supply voltage connection **01, 02**
4. Mains supply **L1, L2, L3**
5. Motor power supply **T1, T2, T3**
6. Current transformers (possible to mount outside for bypass see section 8.7.5, page 67)
7. Mounting of EMC gland for control cables

4.2 Control Connection

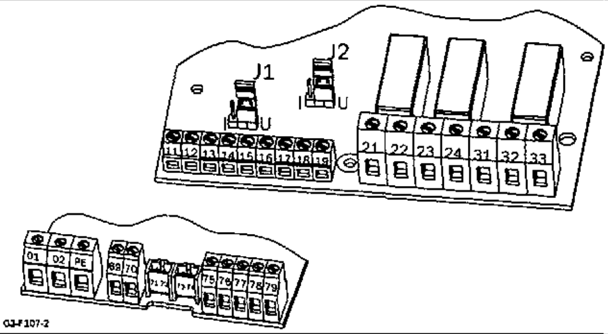


Fig. 23 PCB (control board) connections.

Table 8 PCB Terminals

Terminal	Function	Electrical characteristics
01	Control supply voltage	100-240 VAC ±10% alternative 380-500 VAC ±10% see rating plate
02		
PE	Protective Earth	⏚
11	Digital input 1	0-3 V --> 0; 8-27 V--> 1. Max. 37 V for 10 sec. Impedance to 0 VDC: 2.2 kΩ.
12	Digital input 2	
13	Control signal supply voltage to PCB terminal 11 and 12, 10 kΩ potentiometer, etc.	+12 VDC ±5%. Max. current from +12 VDC: 50 mA. Short circuit-proof but not overload-roof.
14	Analogue input, 0-10 V, 2-10 V, 0-20 mA and 4-20 mA/digital input.	Impedance to terminal 15 (0 VDC) voltage signal: 125 kΩ, current signal: 100 Ω.
15	GND (common)	0 VDC
16	Digital input 3	0-3 V --> 0; 8-27 V--> 1. Max. 37 V for 10 sec. Impedance to 0 VDC: 2.2 kΩ.
17	Digital input 4	
18	Control signal supply voltage to PCB terminal 16 and 17, 10 kΩ potentiometer, etc.	+12 VDC ±5%. Max. current from +12 VDC = 50 mA. Short circuit-proof but not overload-proof.
19	Analogue output	Analogue output contact: 0-10 V, 2-10 V; min load impedance 700Ω 0-20 mA and 4-20 mA; max load impedance 750Ω
21	Programmable relay K1. Factory setting is "Operation" with indication by closing terminal 21 to 22.	1-pole closing contact, 250 VAC 8 A or 24 VDC 8 A resistive, 250 VAC, 3 A inductive.
22		
23	Programmable relay K2. Factory setting is "Full voltage" with indication by closing terminals 23 to 24.	1-pole closing contact, 250 VAC 8 A or 24 VDC 8 A resistive, 250 VAC, 3 A inductive.
24		
31	Programmable relay K3. Factory setting is "All alarms". Indication by closing terminals 31 to 33 and opening terminals 32 to 33.	1-pole change-over contact, 250 VAC 8A or 24 VDC 8A resistive, 250 VAC, 3A inductive.
32		
33		
69-70	PTC Thermistor input	Alarm level 2.4 kΩ. Switch back level 2.2 kΩ.
71-72*	Clickson thermistor	Controlling softstarter cooling fan temperature MSF-310 - MSF-1400
73-74*	NTC thermistor	Temperature measuring of softstarter cooling fin
75	Current transformer input, cable S1 (blue)	Connection of L1 or T1 phase current transformer
76	Current transformer input, cable S1 (blue)	Connection of L3, T3 phase (MSF 017 to MSF 250) or L2, T2 phase (MSF 310 to MSF 1400)
77	Current transformer input, cable S2 (brown)	Common connection for terminals 75 and 76
78*	Fan connection	24 VDC
79*	Fan connection	0 VDC

*Internal connection, no customer use.

4.3 Minimum wiring

The figure below shows the "minimum wiring". See section 3.1.2, page 16, for tightening torque for bolts etc.

1. Connect Protective Earth (PE) to earth screw marked ⏚ (PE).
2. Connect the softstarter between the 3-phase mains supply and the motor. On the softstarter the mains side is marked L1, L2 and L3 and the motor side T1, T2 and T3.
3. Connect the control supply voltage (100-240 VAC) for the control card at terminals 01 and 02.
4. Connect PCB terminals 12 and 13 (PCB terminals 11 and 12 must be linked) e.g. to a 2-position switch (on/oFF) or a PLC, etc., to obtain control of soft start/stop (for factory configuration of the digital inputs).
5. Ensure the installation complies with the appropriate local regulations.

NOTE! The softstarter should be wired with a shielded control cable to fulfil the EMC regulations outlined in section 1.6, page 6.

NOTE! If local regulations say that a mains contactor should be used, relay K1 can control it. Always use standard commercial, slow blow fuses, e.g. gl or gG types, to protect the wiring and prevent short circuiting. To protect the thyristors against short-circuit currents, superfast semiconductor fuses can be used if preferred. The normal guarantee is valid even if superfast semiconductor fuses are not used. All signal inputs and outputs are galvanically insulated from the mains supply.

4.4 Wiring examples

Fig. 55 on page 79 gives an wiring example with the following functions:

- Analogue start/stop, see description on page 79.
- External control of parameter set, see section 8.9.6, page 90
- Analogue output, see "Analogue output" on page 82
- PTC input, see description of Thermal motor protection in section 8.3.1, page 46.

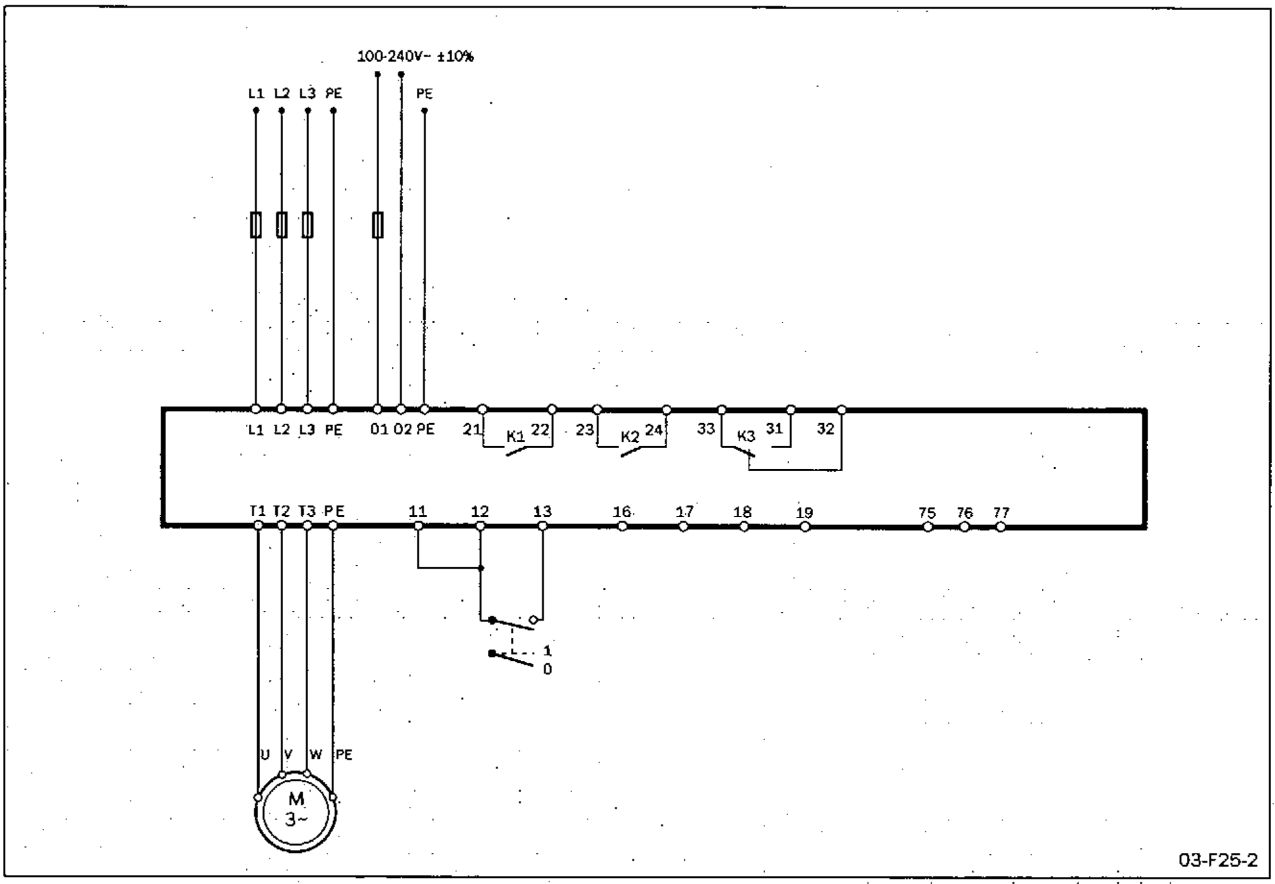


Fig. 24 Wiring circuit, "minimum wiring".

5. How to get started

This chapter briefly describes the set-up for basic soft start and soft stop using the default "Torque control" function.

WARNING! Mounting, wiring and setting the device into operation must be carried out by properly trained personnel.

5.1 Checklist

- Mount the softstarter as set out in chapter 3. page 15.
- Consider the power loss at rated current when dimensioning a cabinet, max. ambient temperature is 40°C.
- Check that the motor and supply voltage corresponds to the values on the softstarter's rating plate.
- Connect the protective earth.
- Connect the motor circuit according to Fig. 25.
- Connect the control supply to terminals 01 and 02. The control supply voltage range is 100-240 VAC or 380-500 VAC, see rating plate.
- Connect relay K1 (terminals 21 and 22 on the softstarter) to the contactor – the softstarter then controls the contactor (for factory configuration of K1).
- Connect terminals 12 and 13 to, e.g., a 2-way switch (closing non-return) or a PLC and a jumper between 11 and 12, etc., to obtain control of soft start/soft stop. (For factory configuration of digital inputs 1 and 2.)
- Ensure the installation complies with the appropriate local regulations.

5.2 Applications

WARNING! Make sure that all safety measures have been taken before switching on the power supply.

Switch on the control supply voltage (normally 1 x 230 V); all segments in the display and the two LEDs will be illuminated for a few seconds. Then the display will show menu [100]. An illuminated display indicates there is control supply voltage to the softstarter unit. Check that you have mains supply voltage to the mains contactor or to the thyristors. The settings are carried out according as follows:

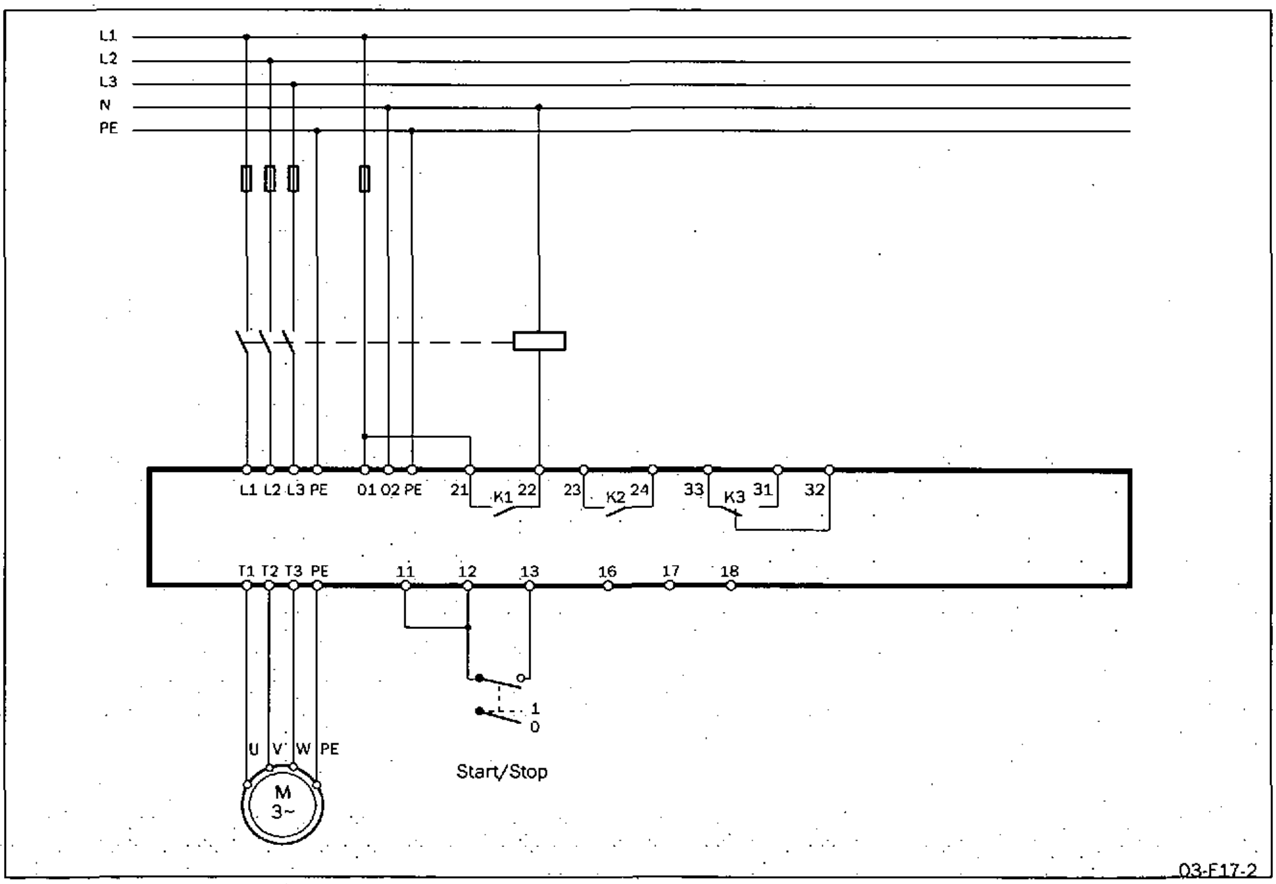


Fig. 25 Standard wiring.

5.3 Motor data

Set the data, according to the motor type plate, to obtain optimal settings for start, stop and motor protection.

NOTE! The default settings are for a standard 4-pole motor according to the nominal power of the softstarter. The softstarter will run even if no specific motor data is selected, but the performance will not be optimal.

210 Setting

Nominal motor voltage

400

Default:	400 V
Range:	200-700 V
200-700	Nominal motor voltage.

211 Setting

Nominal motor current

17

Default:	I_{nsoft} in A
Range:	25-200% of I_{nsoft} in A
25-200	Nominal motor current.

212 Setting

Nominal motor power

7.5

Default:	P_{nsoft} in kW
Range:	25-400% of P_{nsoft} in kW or HP.
25-400	Nominal motor power.

213 Setting

Nominal motor speed

1450

Default:	N_{nsoft} in rpm
Range:	500-3600 rpm
500-3600	Nominal motor speed.

214 Setting

Nominal power factor

0.86

Default:	0.86
Range:	0.50-1.00
0.50-1.00	Nominal motor power factor.

215 Setting

Nominal frequency

50

Default:	50 Hz
Range:	50 Hz, 60 Hz
50, 60	Nominal frequency.

5.4 Start and stop

315 Setting

Start time

10

Default:	10 s
Range:	1-60 s
1-60	Start time.

320 Setting

Stop method

4

Default:	4 (Coast)
Range:	1, 2, 3, 4, 5
1	Linear torque control
2	Square torque control
3	Voltage control
4	Coast
5	Brake

Default "Stop method" is Coast (freewheeling).

5.5 Setting the start command

As default the softstarter is set up for remote operation via terminals 11, 12 and 13. For easy commissioning it is possible to give start and stop signals via the control panel.

200	Setting
2	Control source
Default:	2 (Remote control)
Range:	1, 2, 3
1	Control panel.
2	Remote control.
3	Serial communication control.

Menu [200] must be set to 1 to be able to operate from control panel.

NOTE! Factory default setting is remote control (2).

To start and stop from the control panel, the "START/STOP" key is used.

To reset from the control panel, the "ENTER ↵ /RESET" key is used. A reset can be done both when the motor is running and when the motor is stopped. A reset by the control panel will not start or stop the motor.

5.6 Viewing the motor current

Set the display to menu [100]. Now the motor current can be viewed on the display.

100	Read-out
0.0	Current
Range:	0.0-9999 A

5.7 Starting

Start the motor by pressing the "START/STOP" key on the control panel or through the remote control, PCB terminals 11, 12 and 13. When the start command is given, the mains contactor will be activated by relay K1 (softstarter terminals 21 and 22), and the motor then starts softly.

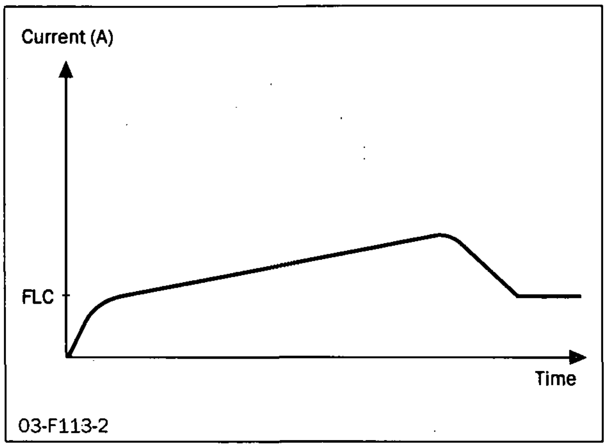


Fig. 26 Example of start current when the default torque control is used.

6. Applications and functions selection

This chapter is a guide to selecting the correct softstarter rating and softstarter functionality for different applications.

To make the right choice the following tools are used:

The norms AC53a and AC53b

These norms help select the softstarter rating with regard to duty cycle, starts per hour and maximum starting current.

The Applications Rating List

With this list the softstarter rating can be selected depending on the kind of application used. The list uses two levels, see Table 9, page 33.

The Applications Function List

This table gives an overview of the most common applications and their challenges. For each application MSF 2.0 solutions are proposed and a reference to the MSF 2.0 menus, which can be used, is given. See Table 10, page 34.

6.1 Softstarter rating according to AC53a

The IEC 60947-4-2 standard for electronic softstarters defines AC53a as a norm for dimensioning of softstarters for continuous running without bypass.

The MSF 2.0 softstarter is designed to run continuously.

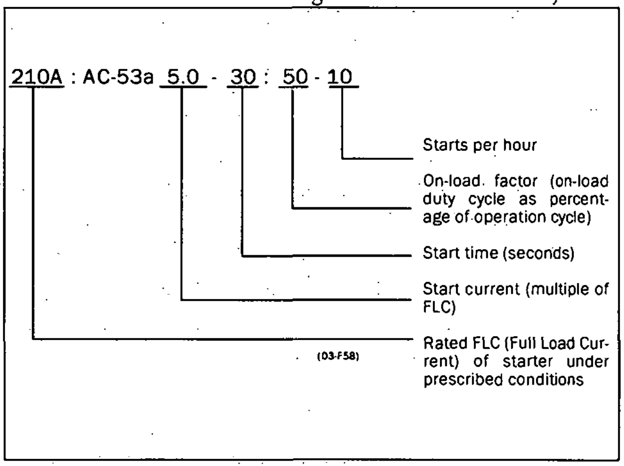


Fig. 27 AC53a rating example.

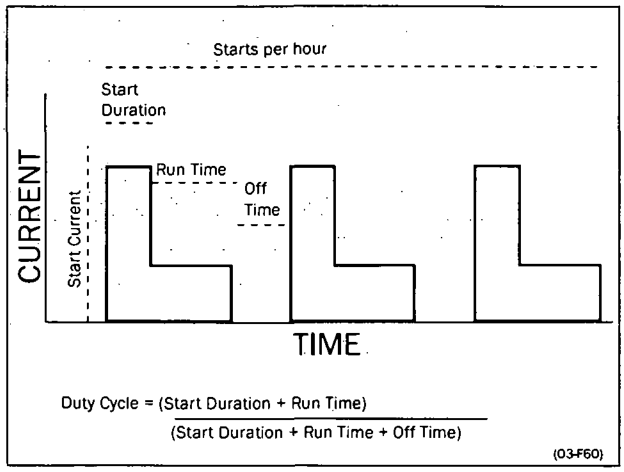


Fig. 28 Duty cycle, non-bypass.

The above example indicates a current rating of 210 Amps with a start current ratio of 5.0 x FLC (1050 A) for 30 seconds with a 50% duty cycle and 10 starts per hour.

NOTE! If more than 10 starts/hour or other duty cycles are needed, please contact your supplier.

In the Applications Rating List two commonly used levels of AC53a are specified. These are also given in the technical data tables (see chapter 13. on page 109).

6.2 Softstarter rating according to AC53b

This norm is made for bypass operation. The MSF 2.0 softstarter is designed to run continuously. In the event of high ambient temperature or for other reasons, an external bypass contactor can be used to minimize the power loss at nominal speed. In the Application Rating List, one level of AC53b is specified, normal with bypass.

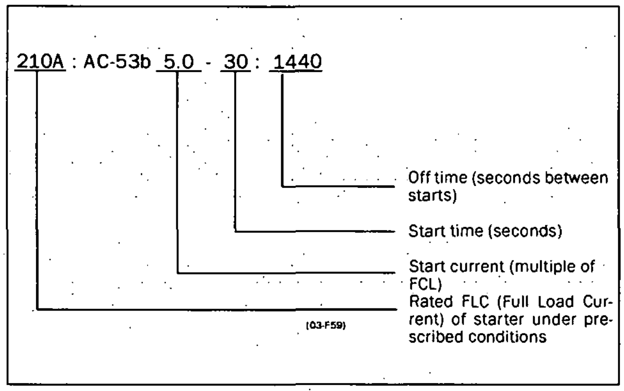


Fig. 29 AC53b rating example.

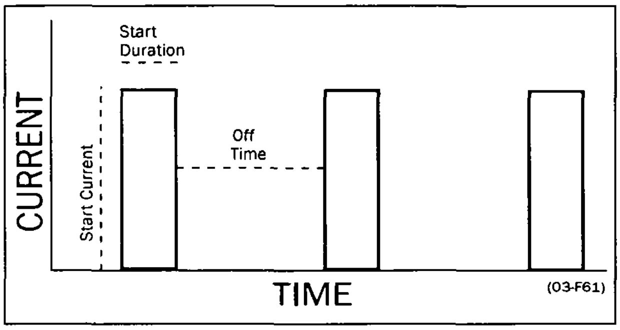


Fig. 30 Duty cycle, bypassed

The above example indicates a current rating of 210 Amps with a start current ratio of 5.0 x FLC (1050 A) for 30 seconds with a 24-minute interval between starts.

6.3 The Applications Rating List

According to the norms AC53a and AC53b a softstarter can have many current ratings.

With help of the Applications Rating List the correct rating can be chosen for most applications.

The Applications Rating List uses two levels for the AC53a norm and one level for the AC53b norm:

AC53a 5.0-30:50-10 (heavy)

This level will be able to start almost all applications and follows directly the type number of the softstarter.

Example: MSF-370 is designed for 370 A full load current (FLC) and 5 times this current for a starting time of 30 seconds.

AC 53a 3.0-30:50-10 (normal)

This level is for lighter applications and here the MSF 2.0 can manage a higher FLC.

Example: MSF-370 can be used for an application with 450 A FLC if the starting current is not more than 3 times this current for a starting time of 30 seconds.

AC53b 3.0-30:330 (normal with bypass)

This level is for lighter applications when a bypass contactor is used. The MSF 2.0 can in this case be used for applications with an even higher nominal current.

Example

An MSF-370 can be used for an application with a full load current of 555 A if the starting current is no more than three times this value and a bypass contactor is used.

NOTE! To compare softstarters it is important to ensure that not only FLC (Full Load Current) is compared but also the starting performance.

The Applications Rating List

The first column in the Applications Rating List, see Table 9, page 33 gives various applications. If the machine or application is not in this list, try to identify a similar machine or application. If in doubt please contact your supplier. The second and third columns gives typical ratings for the machine or application. The ratings are divided in Normal/Normal with by-pass and Heavy duty.

Example

The application is a Roller Mill. From the Applications Rating List a Roller Mill is rated as a Heavy duty application due to high starting current. The proper size of MSF 2.0 has to be selected from the Heavy rating column, see Technical data.

Table 9 Applications Rating List

Applications	Normal AC53a 3.0-30:50-10 and Normal with bypass AC53b 3.0-30:300	Heavy AC 53a 5.0-30:50-10
General & Water		
Centrifugal Pump	x	
Submersible Pump	x	
Conveyor		x
Compressor, Screw	x	
Compressor, Reciprocating	x	
Fan	x	
Blower	x	
Mixer		x
Agitator		x
Metals & Mining		
Belt Conveyor		x
Dust Collector	x	
Grinder	x	
Hammer Mill		x
Rock Crusher		x
Roller Conveyor		x
Roller Mill		x
Tumbler		x
Wire Draw Machine		x
Food Processing		
Bottle Washer	x	
Centrifuge		x
Dryer		x
Mill		x
Palletiser		x
Separator		x
Slicer	x	
Pulp and Paper		
Repulper		x
Shredder		x
Trolley		x
Petrochemical		
Ball Mill		x
Centrifuge		x
Extruder		x
Screw Conveyor		x
Transport & Machine Tool		
Ball Mill		x
Grinder		x
Material Conveyor		x
Palletiser		x
Press		x
Roller Mill		x
Rotary Table		x
Trolley		x
Escalator		x

Table 9 Applications Rating List

Applications	Normal AC53a 3.0-30:50-10 and Normal with bypass AC53b 3.0-30:300	Heavy AC 53a 5.0-30:50-10
Lumber & Wood Products		
Bandsaw		x
Chipper		x
Circular Saw		x
Debarker		x
Planer		x
Sander		x

6.4 The Application Functions List

This list gives an overview of many different applications with their challenges and a possible solution with one of the many MSF 2.0 functions.

Description and use of the table:

Application

This column gives the various applications. If the machine or application is not on this list, try to identify a similar machine or application. If in doubt please contact your supplier.

Challenge

This column describes possible challenges that are familiar for this kind of application.

MSF 2.0 Solution

Gives the possible solution for the challenge using one of the MSF 2.0 functions.

Menus

Gives the menu numbers and selection for the MSF 2.0 function.

"200;=1", means: program selection 1 in menu [200].

"323;=1 / 320, 324", means: program selection 1 in menu [323], menus [320] and [324] are related to this function.

Table 10 Application Functions List

Application	Challenge	MSF Solution	Menus
PUMP	Too fast starts and stops	Pre-setting for pump application	300
	Non-linear ramps	Square torque control for square loads.	310;=2, 320;=2
	Water hammer	Square torque control	320;=2
	High current and peaks during starts	Square torque control	310;=2
	Pump is going in wrong direction	Phase reversal alarm	440
	Dry running	Shaft power underload	401
	High load due to dirt in pump	Shaft power overload	400
COMPRESSOR	Mechanical shock for compressor, motor and transmissions	Linear Torque control	310;=1
	Small fuses and low current available.	Linear torque control and current limit at start.	310;=1, 314
	Screw compressor going in wrong direction	Phase sequence alarm	440
	Damaged compressor if liquid ammonia enters the compressor screw.	Shaft power overload	400
	Energy consumption due to compressor running unloaded	Shaft power underload	401
BLOWER	Mechanical shock for blower, motor and transmissions. High start current requires large cables and fuses.	Torque control ensures smooth starts that minimize mechanical stress. Start current is minimized by torque-controlled start.	310;=1

Table 10 Application Functions List

Application	Challenge	MSF Solution	Menus
CONVEYOR	Mechanical shocks for transmissions and transported goods.	Linear torque control	310;=1
	Loading or unloading conveyors	Slow speed and accurate position control.	330-333, 500,501
	Conveyor jammed	Shaft power overload	400
	Conveyor belt or chain is off but the motor is still running	Shaft power underload	401
	Starting after screw conveyor has stopped due to overload.	Jogging in reverse direction and then starting in forward.	335, 500
	Conveyor blocked when starting	Locked rotor function	228, 229
FAN	High starting current in end of ramps	Square torque control for square load characteristics	310;=2
	Slivering belts.		
	Fan is going in wrong direction when starting.	Catching the motor and going easy to zero speed and then starting in right direction.	310;=2
	Belt or coupling broken	Shaft power underload	401
	Blocked filter or closed damper.		
PLANER	High inertia load with high demands on torque and current control.	Linear torque control gives linear acceleration and low starting current.	310;=1
	Need to stop quickly both for emergency and production efficiency reasons.	Dynamic vector brake without contactor for medium loads.	320;=5 323;=1,324
		Reverse current brake with external contactor for heavy loads.	320;=5 323;=2,324
	High speed lines	Conveyor speed set from planer shaft power analogue output.	520-523
	Worn out tool	Shaft power overload	400
	Broken coupling	Shaft power underload	401
ROCK CRUSHER	High inertia	Linear torque control gives linear acceleration and low starting current.	310;=1
	Heavy load when starting with material	Torque boost	316,317
	Low power if a diesel powered generator is used.	Current limit at start	314
	Wrong material in crusher	Shaft power overload	400
	Vibrations during stop	Dynamic vector brake without contactor	320;=5 323;=1,324
BANDSAW	High inertia load with high demands on torque and current control.	Linear torque ramp gives linear acceleration and low starting current.	310;=1
	Need to stop quickly.	Dynamic vector brake without contactor for medium loads.	320;=5 323;=1,324
		Reverse current brake with external contactor for heavy loads.	320;=5 323;=2,324
	High speed lines	Conveyor speed set from bandsaw shaft power analogue output.	520-523
	Worn out saw blade	Shaft power overload	400
	Broken coupling, saw blade or belt	Shaft power underload	401
CENTRIFUGE	High inertia load	Linear torque control gives linear acceleration and low starting current.	310;=1
	Too high load or unbalanced centrifuge	Shaft power overload	400
	Controlled stop	Dynamic vector brake without contactor for medium loads.	320;=5 323;=1,324
		Reverse current brake with external contactor for heavy loads.	320;=5 323;=2,324
	Need to open centrifuge in a certain position.	Braking down to slow speed and then positioning control.	330-333, 500,501

Table 10 Application Functions List

Application	Challenge	MSF Solution	Menus
MIXER	Different materials	Linear torque control gives linear acceleration and low starting current.	310;=1
	Need to control material viscosity	Shaft power analogue output	520-523
	Broken or damaged blades	Shaft power overload	400
		Shaft power underload	401
HAMMER MILL	Heavy load with high breakaway torque	Linear torque control gives linear acceleration and low starting current.	310;=1
		Torque boost in beginning of ramp.	316,317
	Jamming	Shaft power overload	400
	Fast stop	Reverse current brake with reversing contactor for heavy loads.	320;=5 323;=2,324
	Motor blocked	Locked rotor function	228

Example

Hammer Mill:

- Linear Torque control (menu 310=1) will give the best results.
- Torque boost to overcome high breakaway torque (menus [316] and [317])
- Overload alarm function for jamming protection (menu [400])
- Stop function reverse current brake (menu [323], selection 2) can be used. Menus 324 and [325] to set the brake time and strength.

6.5 Special conditions

6.5.1 Small motor or low load

The minimum load current for the MSF 2.0 softstarter is 10% of the rated current of the softstarter, except for the MSF-017 where the min. current is 2 A. Example: MSF-210, rated current = 210 A. Min. Current 21 A. Please note that this is "minimum load current" and not minimum rated motor current.

6.5.2 Ambient temperature below 0°C

For ambient temperatures below 0°C an electric heater or similar must be installed in the cabinet. The softstarter can also be mounted somewhere else since the distance between the motor and the softstarter is not critical.

6.5.3 Phase compensation capacitor

If a phase compensation capacitor is to be used, it must be connected at the inlet of the softstarter, not between the motor and the softstarter.

6.5.4 Shielded motor cable

It is not necessary to use shielded wires together with softstarters. This is due to the very low radiated emissions.

NOTE! The softstarter should be wired with a shielded control cable to fulfil the EMC regulations outlined section 1.6, page 6.

6.5.5 Pump control with softstarter and frequency inverter together

It is possible, e.g. in a pump station with two or more pumps, to use one frequency inverter on one pump and softstarters on each of the other pumps. The flow of the pumps can then be controlled by one common control unit.

6.5.6 Starting with counter-clockwise rotating loads

It is possible to start a motor clockwise, even if the load and motor are rotating counterclockwise e.g. fans. Depending on the speed and the load "in the wrong direction" the current can be very high.

6.5.7 Running motors connected in parallel

When starting and running motors connected in parallel, the total amount of the motor current must be equal or lower than the rating of the connected softstarter. Please note that it is not possible to have individual settings for each motor or to use the internal thermal motor protection. The start ramp can only be set for an average starting ramp for all the connected motors. This means that the start time may differ from motor to motor.

For motors connected in parallel, torque control is not recommended because of the risk of oscillation between the motors. Voltage control with or without current limit is preferred instead. The use of the braking functionality is not recommended for motors connected in parallel.

6.5.8 Running motors linked together

When starting and running motors mechanically linked together but with one softstarter connected to each motor, there are two kinds of operation available. The first is to start the motors at the same time using voltage control with or without current limit. The second is to start one motor first with torque or voltage control and after the motor has reached full speed, the voltage to the other motors is ramped up using voltage control.

6.5.9 Step-up transformer for high voltage motor

A step-up transformer can be used between the MSF and the motor for controlling a motor rated at high voltage (e.g. higher than 690 V). Torque control can be used for starting and stopping. To compensate for the step-up transformer magnetization current at start, the initial torque should be set a little higher than normal. The motor data must be recalculated for the lower voltage side of the transformer.

6.5.10 How to calculate heat dissipation in cabinets

See chapter 13. on page 109 "Technical Data", "Power loss at rated motor load", "Power consumption control card" and "Power consumption fan". For further calculations please contact your local supplier of cabinets, e.g. Rittal.

6.5.11 Insulation test on motor

When testing the motor with high voltage e.g. insulation test, the softstarter must be disconnected from the motor. This is due to the fact that the softstarter will be seriously damaged by the high peak voltage.

6.5.12 Operation above 1000 m

All ratings are stated at 1000 m over sea level.

If an MSF 2.0 is placed at 3000 m for example, it must be derated.

To get information about motors and drives at higher altitudes please contact your supplier to get technical information no 151.

7. Operation of the softstarter

Fig. 31 MSF softstarter models MSF-017 to MSF-1400.

7.1 General description of user interface

WARNING! Never operate the softstarter with the front cover removed.

To obtain the required operation, a number of parameters must be set in the softstarter.

Configuration is carried out either from the control panel or by a computer/control system through the serial communication interface (option). Controlling the motor i.e. start/stop, selection of parameter set, is done either from the control panel, through the remote control inputs or through the serial communication interface (option).

Setting

WARNING! Make sure that all safety measures have been taken before switching on the power supply.

Switch on the control supply (normally 1*230 V); all segments in the display will be illuminated for a few seconds. Then the display will show menu [100]. An illuminated display indicates that there is control supply voltage to the softstarter.

Check that you have voltage on the mains contactor or on the thyristors. Set the motor data, menus [210] to [215], to achieve correct functionality and optimized performance of the build-in functions such as torque control, motor protection, shaft power monitor etc.

7.2 Control panel

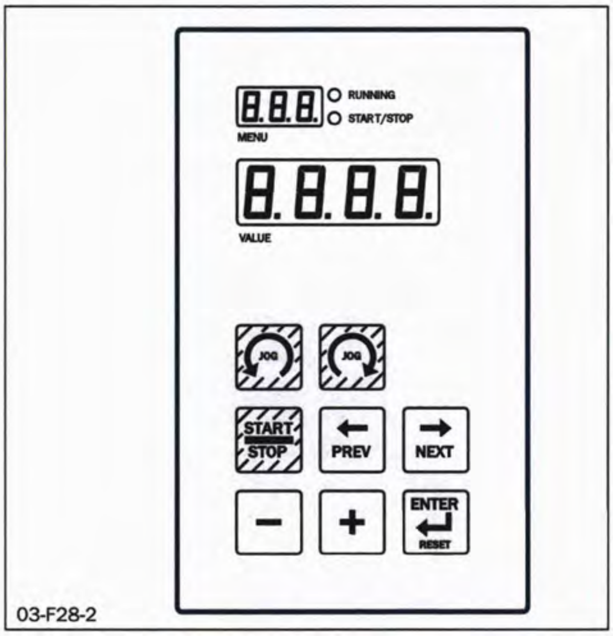


Fig. 32 Control panel.

The control panel is used for selection, programming and presentation. It consists of:

- 2 light emitting diodes (LEDs).
- 1 display with three 7-segment digits showing the actual menu number.
- 1 display with four 7-segment digits showing the actual value.
- Keyboard with eight keys.

7.3 LED indication

The two light emitting diodes indicate start/stop and running motor/machine.

When a start command is given either from the control panel, through the serial communication interface (option) or through the remote control inputs, the start/stop LED will be illuminated. At a stop command the start/stop LED will switch off. The start/stop LED flashes when the softstarter is in standby operation waiting for a start caused by autoreset or analogue start/stop.

When the motor is running, the running LED flashes during ramp up and down and is illuminated continuously at full motor voltage.

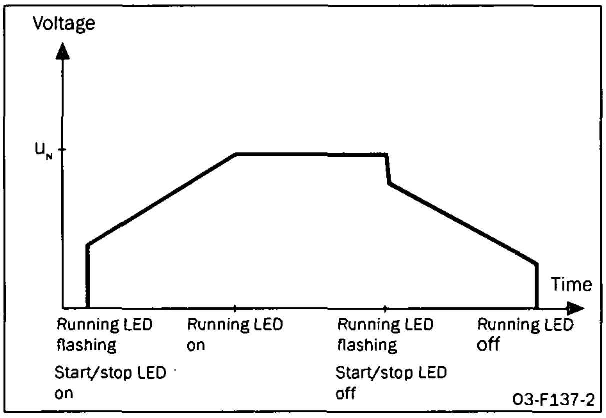


Fig. 33 LED indication at different operation situations.

7.4 The menu structure

The menus in MSF 2.0 are organized in a 1-level structure and they are divided into the groups set out in table 8.

For easier commissioning the menus are divided into three groups, Read-out, Setting and Multi Setting. Read-out menus are only for reading; Setting menus are for setting one parameter and Multi Setting menus are for setting several parameters which cannot be undone. The menus are selected by navigating backwards and forwards through the menu system. Sub-menus simplify setting but are not available when the corresponding main function is not activated.

Table 11 Menu structure of MSF 2.0.

Function	Menu number
General settings	100-101, 200-202
Motor data	210-215
Motor protection	220-231
Parameter set handling	240-243
Auto reset	250-263
Serial communication	270-273
Operation settings	300-342
Process protection	400-440
I/O settings	500-534
View operation	700-732
Alarm list	800-814
Softstarter data	900-902

7.5 The keys

The function of the control panel is based on a few simple rules.

1. At power up menu [100] is shown automatically.
2. Use the "NEXT → " and "PREV ← " keys to move between menus. To scroll through menu numbers, press and hold either the "NEXT → " or the "PREV ← " key.
3. The "+" and "–" keys are used to increase respectively decrease the value of setting. The value is flashing during setting.
4. The "ENTER ↵ " key confirms the setting just made, and the value will go from flashing to stable.
5. The "START/STOP" key is only used to start and stop the motor/machine.
6. The [JOG] and [JOG] keys are only used for JOG from the control panel. The Jog function must be enabled in menu [334] or [335].

Table 12 The keys

Start/stop motor operation.	START STOP
Display previous menu.	← PREV
Display next menu.	→ NEXT
Decrease value of setting.	−
Increase value of setting.	+
Confirm setting just made. Alarm reset.	ENTER ↵ RESET
JOG Reverse	JOG
JOG Forward	JOG

7.6 Control panel lock

The control panel can be locked to prevent parameter being set by unauthorised personnel.

- Lock control panel by simultaneously pressing both "NEXT → " and "ENTER ↵ " for at least 2 sec. The message '- Loc' will be displayed for 2 seconds when locked.
- To unlock control panel, simultaneously press the same 2 keys "NEXT → " and "ENTER ↵ " for at least 2 sec. The message 'unlo' will be displayed for 2 seconds when unlocked.

In locked mode it is possible to operate the softstarter from the control panel and to view all parameters and read-outs, but it is not possible to change any parameters.

7.7 Overview of softstarter operation and parameter set-up

Table showing how parameters can be set and operation carried out.

Table 13 Control sources

Control source	Control panel lock	Operation		Setting of parameters
		Start/Stop	**Alarm reset**	
Control panel Menu [200]=1	**Unlocked control panel**	Control panel	Control panel	Control panel
	Locked control panel	Control panel	Control panel	————
Remote Menu [200]=2	**Unlocked control panel**	Remote	Remote and control panel	Control panel
	Locked control panel	Remote	Remote and control panel	————
Serial comm. Menu [200]=3	**Unlocked control panel**	Serial comm.	Serial comm. and control panel	Serial comm.
	Locked control panel	Serial comm.	Serial comm. and control panel	Serial comm.

NOTE: If external control of parameter set is chosen in menu [240] no parameters except for parameter set [249] and control source [200] can be changed.

8. Functional description

This functional description for Softstarter MSF 2.0 describes the menus and parameters in the softstarter unit. You will find a short description of each function, their aims and settings.

The MSF 2.0 provides extensive setting possibilities via menus on the control panel, remote control or serial communication. The menus are numbered according to the menu overview in Table 10.

Table 14. Menu overview

Function	Menu number	Description	See section
General settings	100-101 200-202	General basic settings.	8.1
Motor data	210-215	For insertion of technical data for the actual motor.	8.2
Motor protection	220-231	Protection associated with the motor in the application.	8.3
Parameter set handling	240-243	Selection and programming of parameter sets.	8.4
Auto reset	250-263	Automatic reset of active alarm and restart of MSF 2.0.	8.5
Serial communication	270-273	Serial communication settings for the data transfer.	8.6
Operation settings	300-342	Settings associated with the operation, for example the start- and stop procedures.	8.7
Process protection	400-440	Protection associated with the process.	8.8
I/O settings	500-534	In- and output settings for control and monitoring.	8.9
View operation	700-732	For read-out of measured values.	8.10
Alarm list	800-814	Latest error. Available alarms.	8.11
Softstarter data	900-902	Displays softstarter type, software variant and version.	8.12

8.1 General settings

General settings for MSF 2.0 contains the following menus:

[100] Current

[101] Automatic return menu

[200] Control source

[201] Control panel locked for settings

[202] Enable US units

8.1.1 Current [100]

This read-out menu shows the actual current to the motor.

100	Read-out
0.0	**Current**
Range:	0.0-9999A

NOTE! This is the same read-out as menu [700].

8.1.2 Automatic return menu [101]

When the MSF 2.0 is powered up, menu [100] (Current read-out) is shown as default. When another menu has been selected by the user (moving through the menu list with the "NEXT" or "PREV" keys) this menu will remain active. Alternatively a specific menu can be chosen as automatic return menu. The chosen menu will be shown automatically after 60 seconds without any control panel activity.

101	Setting
oFF	**Automatic return menu**
Default:	oFF
Range:	oFF, 1-999
oFF	Automatic return menu is disabled.
1-999	Automatic return menu.

8.1.3 Control source [200]

The softstarter can be controlled either via the control panel, remote control or the serial communication interface. Remote control via terminals 11,12 and 13 is the default setting.

NOTE: Depending on the setting in this menu, the softstarter may be configured via control panel or via serial communication. See Table 13, page 42 for more information.

NOTE: If control panel (1) or remote control (2) is configured, the setting can only be changed via control panel to serial communication control (3). However, if serial communication control (3) is configured, the setting can be changed either via serial communication or via control panel.

200	Setting
2	**Control source**
Default:	2 (remote control)
Range:	1, 2, 3
1	Control panel.
2	Remote control.
3	Serial communication control.

8.1.4 Control panel lock [201]

The MSF 2.0 Control panel can be locked to prevent parameter being set by unauthorised personnel.

- Lock control panel by simultaneously pressing both keys "NEXT → " and "ENTER ↵ " for at least 2 seconds. The message "- Loc" will be displayed for 2 seconds.
- To unlock control panel, simultaneously press the same two keys "NEXT → " and "ENTER ↵ " for at least 2 seconds. The message "unlo" will be displayed for 2 seconds.

In locked mode, all parameters and read-outs (menus) can be displayed, but it is forbidden to change any parameters via the control panel.

The message '-Loc' will be displayed if someone tries to set a parameter in locked mode.

The key lock status can be read out in menu [201].

NOTE: If menu [200] is configured for serial communication control, the softstarter may still be configured via serial communication, regardless of the control panel lock status.

201	Read-out
no	**Control panel locked for settings**
Default:	no
Range:	no, YES
no	Control panel is not locked
YES	Control panel is locked

8.1.5 Enable US units [202]

By default all read-out and configuration values are given in SI units. If preferred, US customary units can be chosen instead. in this case the following units are used:

- Powers are set and shown in HP, menus [212] and [703]
- Power consumption is shown in MHph, menu [731]
- Shaft torque is shown in lbft, menu [705]
- Temperature is shown in degrees Fahrenheit, menu [707]

NOTE: When the setting for US units is changed, the motor data in menus [210-215] is reset to the default values for the chosen units (SI or US customary units) in all parameter sets.

[210] Nominal motor voltage – new default value (460 V, for US units enabled)

[211] Nominal motor current – new default value depending on softstarter size.

[212] Nominal motor power – new default value depending on softstarter size

[213] Nominal motor speed – new default value depending on softstarter size

[215] Nominal frequency – new default value (60 Hz, for US units enabled)

If the setting is changed and confirmed with "ENTER", "SEt" is displayed for 2 seconds to indicate successful selection.

202 Setting

oFF **Enable US units**

Default:	oFF
Range:	oFF, on
oFF	Values are presented in kW, Nm etc.
on	Values are presented in HP, lbft etc.

8.2 Motor data

For optimal performance the MSF 2.0 softstarter should be configured according to the motor's rating plate:

[210] to [215] Nominal motor data

NOTE: The default factory settings are for a standard 4-pole motor according to the nominal current and power of the softstarter. The softstarter will run even if no specific motor data is selected, but the performance will not be optimal.

Nominal motor voltage.

210 Setting

400 **Nominal motor voltage**

Default:	400 V
Range:	200-700 V
200-700	Nominal motor voltage.

NOTE: Make sure the softstarter's maximum voltage rating is suitable for selected motor voltage.

Nominal motor current. The current range is related to the size of the softstarter.

211 Setting

17 **Nominal motor current**

Default:	I_{nsoft} in A
Range:	25-200% of I_{nsoft} in A
25-200	Nominal motor current

Nominal motor power in kW or HP. The power range is related to the size of the softstarter.

212 Setting

7.5 **Nominal motor power**

Default:	P_{nsoft} in kW
Range:	25-400% of P_{nsoft} in kW or HP.
25-400	Nominal motor power.

Nominal motor speed.

213	Setting
1450	Nominal motor speed
Default:	N_{nsoft} in rpm
Range:	500-3600 rpm
500-3600	Nominal motor speed.

Nominal motor power factor.

214	Setting
0.86	Nominal power factor
Default:	0.86
Range:	0.50-1.00
0.50-1.00	Nominal motor power factor.

Nominal motor frequency

215	Setting
50	Nominal frequency
Default:	50 Hz
Range:	50 Hz, 60 Hz
50, 60	Nominal frequency.

8.3 Motor protection

The MSF 2.0 softstarter is equipped with different motor protection functions. The following menus are available to configure these protection methods:

[220]-[223] Thermal motor protection

[224]-[227] Start limitation

[228]-[229] Locked rotor

[230] Single phase input failure

[231] Current limit start time expired

For these protection methods the following options are available (all options may not be available for all protection methods – check the description of the relevant menu for details):

Off

The protection method is disabled.

Warning

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays). However, the motor is not stopped and operation continues. The alarm message will disappear and the relay will be reset wen the fault disappears. The alarm may also be reset manually.

Coast

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays). The motor voltage is automatically switched off. The motor freewheels until it stops.

Stop

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays). The motor is stopped according to the stop settings in menus [320] to [325].

Brake

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays). The brake function is activated according to the braking method chosen in menu [323] and the motor is stopped according to the alarm brake settings in menus [326] to [327] (braking strength and braking time).

8.3.1 Thermal motor protection

With MSF 2.0 an internal thermal model of the motor or an external signal from a PTC can be used for thermal motor protection. It is also possible to combine both protection methods. Slight overload for a long time and several overloads of short duration will be detected with both methods.

Thermal motor protection [220]

Thermal motor protection is activated by choosing an alarm action in menu [220]. After that menus [221] to [223] will be available so that the type of the protection (internal and/or PTC) can be chosen. If the operation has been interrupted due to a thermal motor protection alarm, a manual reset and a new start signal is needed to restart the motor. The reset and the start signal can be given via control panel, remote or via serial communication depending on the control source chosen in menu [200]. Regardless of the chosen control source, it is always possible to initiate a reset via the control panel.

NOTE: A reset via the control panel will never start the motor.

220	Setting
2	**Thermal motor protection (Alarm code F2)**
Default:	2 (Coast)
Range:	oFF, 1, 2, 3, 4
oFF	Thermal motor protection is disabled.
1	Warning
2	Coast
3	Stop
4	Brake

PTC input [221]

This menu is available if thermal motor protection is enabled in menu [220]. To use the PTC functionality, connect the PTC to terminals 69 and 70. See fig. 53. If the motor gets too warm (PTC resistance above 2.4 kOhm), an F2 alarm will occur. The alarm will remain active until the motor has cooled down (PTC resistance below 2.2 kOhm).

221	Setting
oFF	**PTC input**
Default:	oFF
Range:	oFF, on
oFF	Motor PTC input is disabled.
on	Motor PTC input is enabled.

NOTE: Open terminals will give an F2 alarm immediately. Make sure the PTC is always connected or the terminals are shorted.

Internal protection class [222]

This menu is available if thermal motor protection is enabled in menu [220]. In this menu an internal protection class can be chosen, which enables internal thermal motor protection. With this setting a thermal curve as set out in Fig. 34 is configured. The motor's thermal capacity is calculated continuously based on the chosen curve. If the thermal capacity exceeds 100% an F2 alarm occurs and the action chosen in menu [220] is performed. The alarm remains active until the motor model cools down to 95% of its thermal capacity. The used thermal capacity is shown in menu [223].

222	Setting
10	**Internal protection class**
Default:	10 s
Range:	oFF, 2-40 s
oFF	Internal protection class is disabled.
2-40	Selection of the thermal curve as set out in Fig. 34.

NOTE: Check that the motor current is configured properly in menu [211].

NOTE! If an external bypass contactor is used, check that the current transformers are placed and connected correctly.

CAUTION! Used thermal capacity is set to 0 if the control board loses its supply (terminal 01 and 02). This means that the internal thermal model starts with a "cold" motor, which perhaps in reality is not the case. This means that the motor can be overheated.

Used thermal capacity [223]

This menu is available if thermal motor protection is activated in menu [220] and an internal protection class is chosen in menu [222]. The menu shows the thermal capacity of the motor according to the thermal curve chosen in menu [222].

223	Read-out
0	**Used thermal capacity**
Range:	0-150%

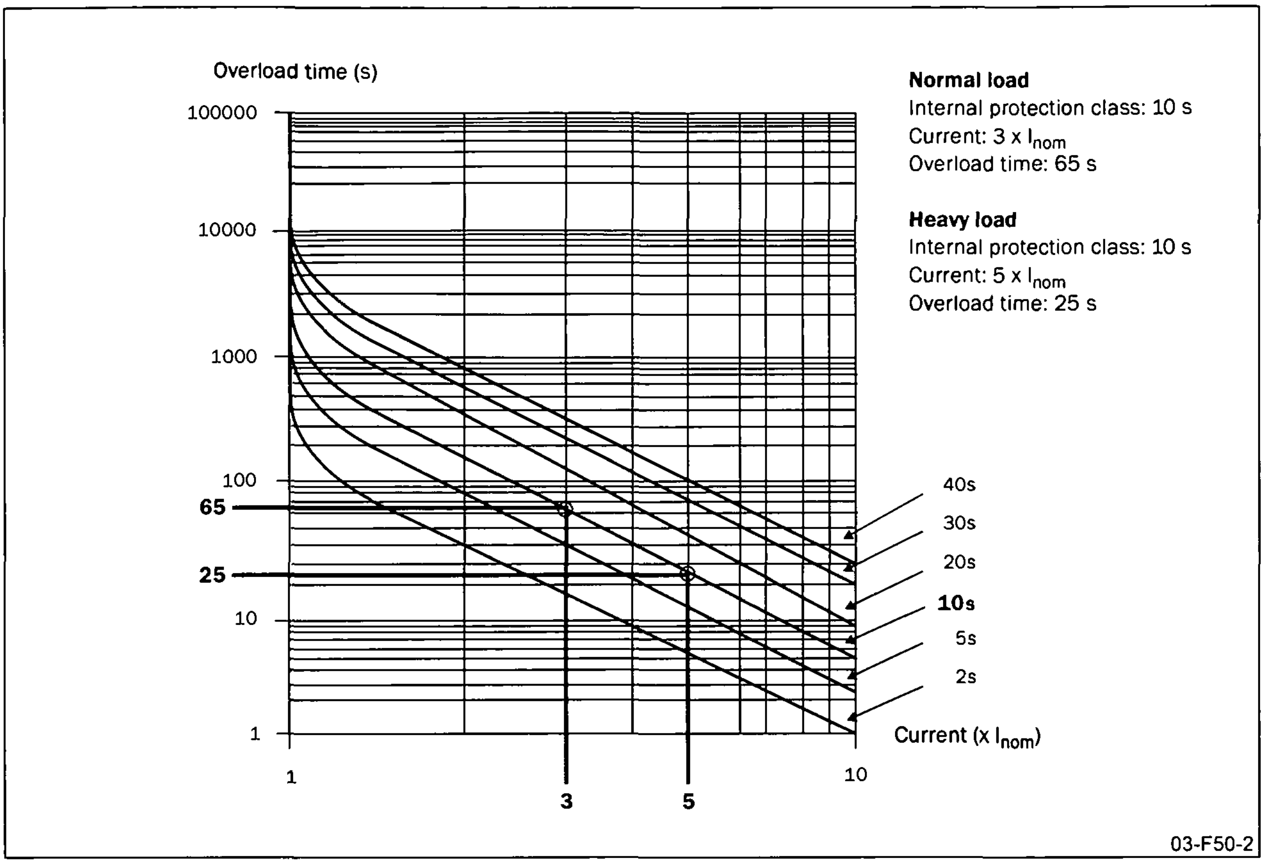


Fig. 34 The thermal curve

8.3.2 Start limitation

Start limitation is used to protect the motor by limiting the numbers of starts per hour or securing a minimum time delay between starts. Both protection methods can be used separately or in combination.

Start limitation [224]

Start limitation is enabled in this menu by choosing a proper alarm action. The available options are:

Off

The protection method is disabled.

Warning

Alarm message F11 is shown in the display and relay K3 is activated (for default configuration of the relays). However, the start will be allowed.

Coast

Alarm message F11 is shown in the display and relay K3 is activated (for default configuration of the relays). The start will not be allowed.

A Start limitation alarm is automatically reset when a new start signal is given. The start signal can be given via control panel, remote or via serial communication depending on the control source chosen in menu [200]. Regardless of the chosen control source, it is always possible to initiate a reset via the control panel.

NOTE: A reset via the control panel will never start the motor.

224	Setting
oFF	**Start limitation (Alarm code F11)**
Default:	oFF
Range:	oFF, 1, 2
oFF	Start limitation is disabled.
1	Warning
2	Coast

Number of starts per hour [225]

This menu is available if start limitation is enabled in menu [224]. In this menu the allowed number of starts per hour is configured. If this number is exceeded, an F11 alarm occurs and the action chosen in menu [224] is performed. The alarm is active until the hour has expired and a new start can be allowed.

225	Setting
oFF	**Number of starts per hour**
Default:	oFF
Range:	oFF, 1-99
oFF	Starts per hour protection is disabled
1-99	Number of starts per hour.

Min. time between starts [226]

This menu is available if start limitation is enabled in menu [224]. In this menu a minimum time between consecutive starts can be configured. If a new start attempt is made before the configured minimum time is expired an F11 alarm will occur and the action chosen in menu [224] is performed. The alarm remains active until the chosen minimum time has expired and a new start can be allowed.

226	Setting
oFF	**Min. time between starts**
Default:	oFF
Range:	oFF, 1-60 min
oFF	Min. time between starts protection is disabled.
1-60	Min. time between starts.

Time to next allowed start [227]

This menu is available if start limitation is enabled in menu [224] and at least one of the protection methods described above is configured (number of starts per hour or minimum time between starts). In this menu the remaining time to the next allowed start is shown. If both protection methods mentioned above are activated, the shown time is the total time delay to the next start, which is allowed by both methods.

227	Read-out
0	**Time to next allowed start**
Range:	0- 60 min

8.3.3 Locked rotor

This alarm is used to avoid high motor current due to a mechanically locked rotor. If the operation has been interrupted due to a locked rotor alarm, a manual reset and a new start signal is needed to restart the motor. The reset and the start signal can be given via control panel, remote or via serial communication depending on the control source chosen in menu [200]. Regardless of the chosen control source, it is always possible to initiate a reset via the control panel.

NOTE: A reset via the control panel will never start the motor.

Locked rotor [228]

Locked rotor alarm is activated in this menu by choosing a proper alarm action.

228	Setting
oFF	**Locked rotor alarm (Alarm code F5)**
Default:	oFF
Range:	oFF, 1, 2
oFF	Locked rotor alarm is disabled.
1	Warning
2	Coast

Locked rotor time [229]

This menu is available if Locked rotor alarm is enabled in menu [228]. In this menu the time delay for detection of a locked rotor is configured. If a high motor current (4.8 times the nominal motor current) is floating for a time exceeding the chosen value, an F5 alarm will occur and the action chosen in menu [228] will be performed.

229	Setting
5.0	**Locked rotor time**
Default:	5.0 s
Range:	1.0-10.0 s
1.0-10.0	Locked rotor time.

NOTE: Check that the motor current is configured properly in menu [211].

8.3.4 Phase input failure

All phase input failures shorter than 100 ms are ignored.

Multiple phase input failure

If the failure duration time is above 100 ms, operation is temporary stopped and a new soft start is made if the failure disappears within 2 s. If the failure duration time is longer than 2 s an F1 alarm occurs and the voltage to the motor remains off. During deceleration, regardless of the failure duration time, the motor voltage is automatically switched off and the motor freewheels until it stops.

Single phase input failure

During acceleration and deceleration the behaviour is the same as described above for multiple phase input failure. When running with full voltage, the softstarter can be configured for different actions in the event of a single phase input failure (menu [230]).

A phase input failure alarm is automatically reset when a new start signal is given. The start signal can be given via control panel, remote or via serial communication depending on the control source chosen in menu 200. Regardless of the chosen control source, it is always possible to initiate a reset via the control panel.

NOTE: A reset via the control panel will never start the motor.

Single phase input failure [230]

The softstarter's action on a single phase input failure occurring during full voltage running can be configured in this menu. In the event of a single phase input failure, alarm F1 is activated after 2 s (see description above) and the chosen action is performed. The alarm remains active until the failure disappears.

230 Setting

2 **Single phase input failure (alarm code F1)**

Default:	2
Range:	1, 2
1	Warning
2	Coast

8.3.5 Current limit start time expired

If current limit at start is activated in menu [314], an F4 alarm can be activated if the operation is still at current limit when the configured start time has expired. A current limit start time expired alarm is automatically reset when a new start signal is given. The start signal can be given via control panel, remote or via serial communication depending on the control source chosen in menu [200]. Regardless of the chosen control source, it is always possible to initiate a reset via control panel.

NOTE: A reset via the control panel will never start the motor.

Current limit start time expired [231]

In this menu the alarm for current limit start time expired can be enabled and a proper action can be selected.

231 Setting

2 **Current limit start time expired (alarm code F4)**

Default:	2
Range:	oFF, 1, 2, 3, 4
oFF	Current limit start time expired protection is disabled.
1	Warning
2	Coast
3	Stop
4	Brake

NOTE: If the action for current limit start time expired is configured as Warning or the protection is not activated at all, the softstarter will ramp up to full voltage with a ramp time of 6 s if the start time has expired in current limit mode. The current is then no longer controlled.

8.4 Parameter set handling

The use of different parameter sets can be helpful when using one softstarter to start different motors or when working under various load conditions. There are four parameter sets available in MSF 2.0. Parameter set handling is controlled by the following menus:

[240] Select parameter set

[241] Actual parameter set

[242] Copy parameter set

[243] Reset to factory setting

8.4.1 Select parameter set [240]

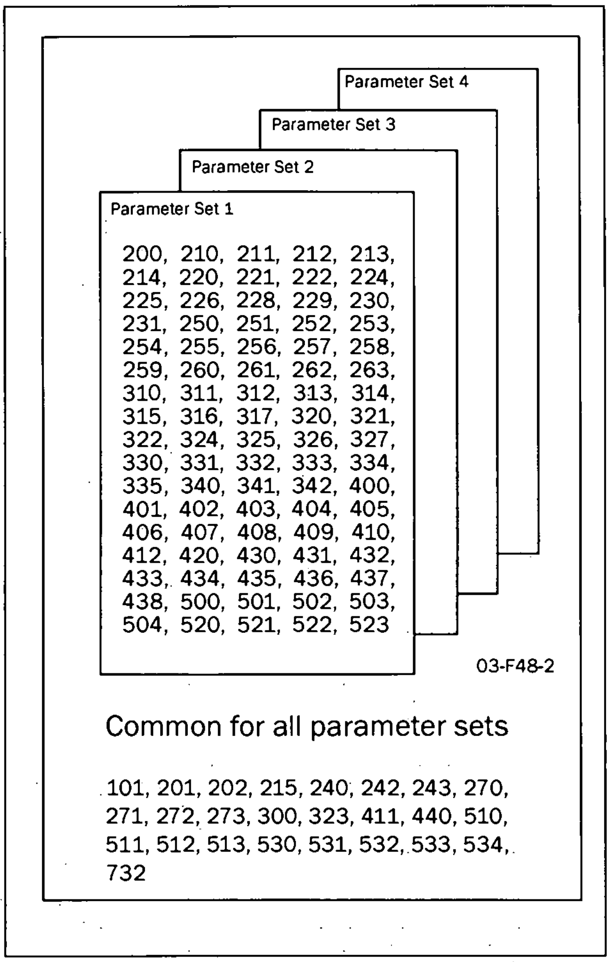


Fig. 35 Parameter overview

Select parameter set [240]

In this menu one of the parameter sets 1-4 can be selected directly or external control of parameter sets via digital inputs can be chosen. If external control of parameter sets is chosen, the digital inputs have to be configured properly (see description of menus [510] to [513]). By default digital inputs 3 and 4 (terminals 16 and 17) are configured for external control of parameter sets.

240	Setting
1	**Select parameter set**
Default:	1
Range:	0, 1, 2, 3, 4
0	External control of parameter sets.
1, 2, 3, 4	Selection of parameter sets 1-4.

Actual parameter set [241]

This menu is available when external control of parameter sets is chosen in menu [240]. This menu shows which parameter set is actually selected via the digital inputs.

241	Read-out
1	**Actual parameter set**
Range:	1, 2, 3, 4

8.4.2 Copy parameter set [242]

When programming a new parameter set, this function will simplify the procedure. It is possible to copy an already programmed parameter set into another set as follows:

- Select a copy alternative in this menu, for example P1-2. Press Enter. "CoPY" is displayed for 2 seconds to indicate successful copy process. After that, "no" is displayed.
- Go to menu [240] and select parameter set 2.
- Make the required new settings in corresponding menus for parameter set 2.

242	Multi Setting
no	**Copy parameter set**
Default:	no
Range:	no, P1-2, P1-3, P1-4, P2-1, P2-3, P2-4, P3-1, P3-2, P3-4, P4-1, P4-2, P4-3
no	No action
P1-2 etc.	Copy parameter set 1 to parameter set 2 etc.

NOTE: Copying parameter sets is only allowed when the softstarter is not running.

8.4.3 Reset to factory setting [243]

This menu enables all parameters to be reset to the default values. This includes all four parameter sets and the common parameters except for parameter [202] (enable US units). As Enable US units is not reset to default, the values loaded for the normal motor data in menus [210] to [215] correspond to the chosen units (SI or US customary), see description of menu [202] on page 45 for more information. The alarm list, the power consumption and the operation time will not be affected by resetting the parameters. When the reset of all parameters to the factory default values has been executed successfully, menu [100] is shown on the display.

243	Multi Setting
no	**Reset to factory settings**
Default:	no
Range:	no, YES
no	No action
YES	Reset all parameters to the factory default values.

NOTE! Reset to factory settings is not allowed when the softstarter is running.

8.5 Autoreset

For several non-critical application-related failure conditions, it is possible to automatically generate a reset and initiate a restart to overcome the fault condition. Autoreset functionality is configured using the following menus:

[250] Autoreset attempts.

[251] to [263] Autoreset items.

In menu [250] the maximum number of automatically generated restarts allowed can be set. When this number is exceeded and a new fault occurs, the softstarter will stay in fault condition because external assistance is required. In menus [251] to [263], autoreset is enabled for the different protection types by choosing a delay time. If a fault occurs for which autoreset is enabled, the motor is stopped according to the action chosen for the relevant protection method (see menus [220] to [231] and [400] to [440] for description of protection methods and configuration of actions on failures). When the fault has disappeared, and the configured delay time has elapsed, the motor is restarted.

Example:

The motor is protected by internal thermal protection. When a thermal protection alarm occurs, the softstarter should wait until the motor is cooled down enough before resuming normal operation. When this problem occurs several times in a short period of time, external assistance is required.

The following settings should be applied:

- Activate thermal motor protection, e.g. set menu [220] to 2 (Coast).
- Activate internal thermal motor protection, e.g. set menu [222] to 10 (thermal curve for 10 s).
- Insert maximum number of restarts: e.g. set menu [250] to 3.
- Activate thermal motor protection to be automatically reset: e.g. set menu [251] to 100.
- Configure one of the relays to give an alarm when external assistance is required: e.g. set menu [532] to 19 (all alarms which need manual reset).

The autoreset functionality is not available if control panel is chosen as control source in menu [220].

WARNING: A flashing start/stop LED indicates standby mode e.g. waiting for autoreset. The motor may be started automatically at a moment's notice.

NOTE: The autoreset cycle will be interrupted when a stop signal is given (remote or via serial communication) or if the control source is changed to control panel in menu [200].

8.5.1 Autoreset attempts [250]

In this menu the maximum allowed number of automatically generated restart attempts is set. If any number of autoreset attempts is selected in this menu the Autoreset functionality is activated and menus [251] to [263], will become available. If an alarm occurs for which autoreset is enabled (in menus [251] to [263]), the motor will automatically be restarted when the fault has disappeared and the delay time has expired. For each automatically generated restart, the internal autoreset counter (not visible) will go up one place. If no alarm occurs for more than 10 minutes, the autoreset counter will be decreased by one. When the maximum number of autoreset attempts is reached, no further restart will be allowed and the softstarter will remain in fault condition. In this case a manual reset (either via control panel, remote or serial communication, see description on page 39) is needed.

Example:

- Autoreset attempts (menu [250]=5)
- Within 10 minutes 6 alarms occur.
- At the 6th trip there is no autoreset, because the autoreset counter contains already 5 autoreset attempts.
- To reset, apply a normal reset. This will also reset the autoreset counter.

NOTE: The internal autoreset counter is reset to zero if a stop signal is given. After each new start signal (via remote or serial communication) the maximum number of restart attempts will be allowed as configured in menu [250].

250	Setting
oFF	Autoreset attempts
Default:	oFF
Range:	oFF, 1-10
oFF	Autoreset disabled.
1-10	Number of Autoreset attempts.

8.5.2 Autoreset items [251]-[263]

Menus [251] to [263] are available if autoreset is enabled in menu [250]. With these menus the delay time for autoreset is configured. The delay time starts counting when the fault is gone. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

NOTE: Enabling autoreset for an alarm has no effect if the alarm action for the respective alarm is set to oFF or Warning (1).

Thermal motor protection autoreset [251]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for thermal motor protection autoreset is configured. The delay time starts counting when the fault is gone. This means the internal thermal motor model has to cool down to a thermal capacity of 95% (if internal thermal motor protection is enabled) and the PTC resistance has to go down to 2.2 kOhm (if PTC is enabled), which indicates that the motor has cooled down. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

251	Setting
oFF	Thermal motor protection autoreset
Default	oFF
Range:	oFF, 1-3600 s
oFF	Thermal motor protection autoreset is disabled
1-3600	Delay time for thermal motor protection autoreset

Start limitation autoreset [252]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for an autoreset after a start limitation alarm (alarm code F11) is configured. The delay time starts counting when the fault is gone. This means the minimum time between starts has to be expired (if Minimum time between starts protection is enabled) and a start has to be allowed for the actual hour (if starts per hour protection is enabled). When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

Locked rotor alarm autoreset [253]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for an autoreset after a locked rotor alarm (alarm code F5) is configured. As a locked rotor cannot be detected in stopped state, the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

Current limit start time expired autoreset [254]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for an autoreset after a current limit start time expired alarm (alarm code F4) is configured. As a current limit start time expired fault condition cannot be detected in stopped state, the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

Max power alarm autoreset [255]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for an autoreset after a max power alarm (alarm code F6) is configured. As a max power fault condition cannot be detected in stopped state, the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

Min power alarm autoreset [256]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for an autoreset after a min power alarm (alarm code F7) is configured. As a min power fault condition cannot be detected in stopped state, the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

External alarm autoreset [257]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for an autoreset after a external alarm (alarm code F17) is configured. The delay time starts counting when the fault is gone. This means the external alarm signal input has to be closed. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

Phase input failure autoreset [258]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for an autoreset after a phase input failure (alarm code F1) is configured. As a phase input failure cannot be detected in stopped state, the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

Voltage unbalance alarm autoreset [259]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for an autoreset after a voltage unbalance alarm (alarm code F8) is configured. The delay time starts counting when the fault is gone. Usually, the mains voltage will not be available to the softstarter in stopped state as the mains contactor is deactivated. In this case a voltage unbalance failure cannot be detected in stopped state and the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

Over voltage alarm autoreset [260]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for an autoreset after an over voltage alarm (alarm code F9) is configured. The delay time starts counting when the fault is gone. Usually, the mains voltage will not be available to the softstarter in stopped state as the mains contactor is deactivated. In this case an over voltage failure cannot be detected in stopped state and the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

Under voltage alarm autoreset [261]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for an autoreset after an under voltage alarm (alarm code F10) is configured. The delay time starts counting when the fault is gone. Usually, the mains voltage will not be available to the softstarter in stopped state as the mains contactor is deactivated. In this case an under voltage failure cannot be detected in stopped state and the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

Serial communication autoreset [262]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for autoreset after a serial communication broken alarm (alarm code F15) is configured. The delay time starts counting when the fault is gone. This means serial communication has to be re-established. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

Softstarter overheated autoreset [263]

This menu is available if autoreset is activated in menu [250]. In this menu the delay time for autoreset after a softstarter overheated alarm (alarm code F3) is configured. The delay time starts counting when the fault is gone. This means the softstarter has to be cooled down. When the delay time has elapsed, the alarm will be reset and a restart attempt will automatically be made.

8.6 Serial communication

There are several serial communication options available for MSF 2.0 (see page 107 for more information). The softstarter can be configured and controlled via serial communication if this is configured in menu [200] (see page 44). The following parameters are available to configure serial communication:

[270] Serial comm. unit address

[271] Serial comm. baudrate

[272] Serial comm. parity

[273] Serial comm. contact broken

NOTE: The communication parameters [270] to [272] must be set up via the control panel. To enable configuration via the control panel, menu [200] must be set to 1 (control panel) or 2 (remote control).

Serial comm. unit address [270]

Serial communication unit address.

270	Setting
1	**Serial comm. unit address**
Default:	1
Range:	1-247
1-247	Unit address.

Serial comm. baudrate [271]

Serial communication baudrate.

271	Setting
9.6	**Serial comm. baudrate**
Default:	9.6 kBaud
Range:	2.4 - 38.4 kBaud
2.4-38.4	Baudrate.

Serial comm. parity [272]

Serial communication parity.

272	Setting
0	**Serial comm. parity**
Default:	0
Range:	0, 1
0	No parity
1	Even parity.

Serial comm. contact broken [273]

If the softstarter is configured for control via serial communications (menu [200] = 3) and the serial communication contact is broken during operation, an F15 alarm can be configured to occur. In this menu the alarm can be enabled and an action to be performed can be chosen. The following options are available:

Off

Serial communication contact broken alarm is disabled.

Warning

Alarm message F15 is shown in the display and relay K3 is activated (for default configuration of the relays). However, the motor is not stopped and operation continues. The alarm message will disappear and the relay will be reset when the fault disappears. The alarm may also be reset manually from the control panel.

Coast

Alarm message F15 is shown in the display and relay K3 is activated (for default configuration of the relays). The motor voltage is automatically switched off. The motor freewheels until it stops.

Stop

Alarm message F15 is shown in the display and relay K3 is activated (for default configuration of the relays). The motor is stopped according to the stop settings in menus [320] to [325].

Brake

Alarm message F15 is shown in the display and relay K3 is activated (for default configuration of the relays). The brake function is activated according to the braking method chosen in menu [323] and the motor is stopped according to the alarm brake settings in menus [326] to [327] (braking strength and braking time).

A serial communication broken alarm is automatically reset when a new start signal is given. The start signal can be given via control panel, remotely or via serial communication depending on the control source chosen in menu 200. Regardless of the chosen control source, it is always possible to initiate a reset via control panel.

NOTE: A reset via control panel will never start the motor.

273	Setting
oFF	**Serial comm. contact broken (alarm code F15)**
Default:	2
Range:	oFF, 1, 2, 3, 4
oFF	Serial comm. contact broken disabled
1	Warning
2	Coast
3	Stop
4	Brake

8.7 Operation settings

Operation settings include parameters for configuration of starting and stopping, some of these can be pre-configured for pump applications. Furthermore, some special settings for stop behaviour at alarm, parameters for slow speed and jog and additional settings such as bypass operation, power factor control and control of the internal fan are included in this section.

[300] Preset pump control parameters

[310]-[317] Start

[320]-[327] Stop including stop at alarm

[330]-[335] Slow speed/JOG

[340]-[342] Additional settings

The MSF Softstarter controls all three phases supplied to the motor. In contrast to a simple softstarter controlling only one or two phases, the three-phase control enables different starting methods, voltage, current and torque control. A current limit can even be used in combination with either voltage or torque control.

With voltage control the output voltage to the motor is linearly increased to full line voltage during the set start time. The softstarter gives a smooth start but does not get any feedback on current or torque. The typical settings to optimize a voltage controlled start are the initial voltage and the start time.

With current control the output voltage to the motor is regulated so the set current limit is not exceeded during the start. Even with this starting method the starter does not get any feedback on the motor torque. However, current control can be combined with both voltage and torque control. The typical settings to optimize a current controlled start are the current limit and the maximum starting time.

Torque control is the most sophisticated way of starting motors. The softstarter continually monitors the motor torque and controls the output voltage to the motor so the torque follows the set ramp. Both linear- and square torque ramps can be chosen according to the application requirments. In this way constant acceleration can be accomplished during start which is very important in many applications. Torque control can also be used for stopping with constant deceleration. For pumps constant deceleration is important for avoiding water hammer.

8.7.1 Preset pump control [300]

With this multi-setting parameter the MSF 2.0 softstarter can easily be configured for pump applications. The following parameters are set if preset pump control parameters are chosen.

[310] Start method is set to square torque control (2)

[312] Initial torque at start is set to 10%

[313] End torque at start is set to 125%

[315] Start time is set to 10 seconds

[314] and [316] Current limit at start and torque boost are deactivated.

[320] Stop method is set to square torque control (2)

[321] End torque at stop is set to 10%

[325] Stop time is set to 15 seconds.

These settings will lead to a smooth start with linear acceleration and a linear stop without water hammer for most pump applications. However, if the pre-set parameters need to be adapted for a specific application, the values in the relevant menus can be adapted.

The following figure shows typical current characteristics at start and speed curve at stop.

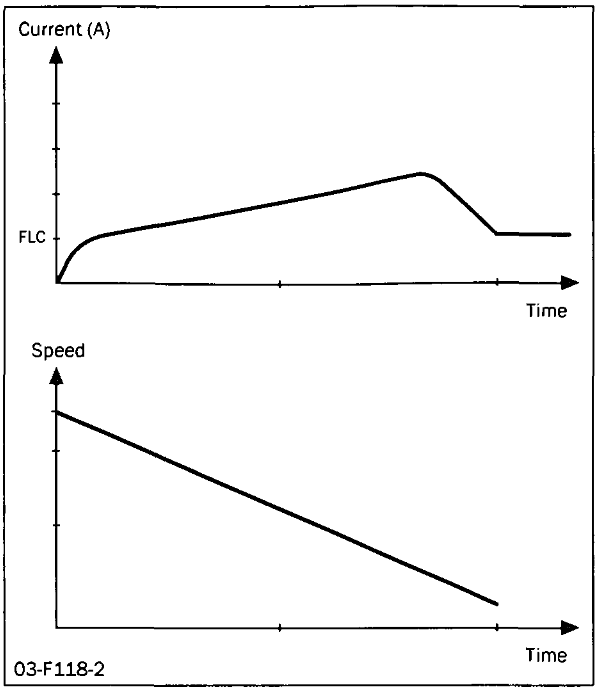


Fig. 36 Pump control. Current at start and speed at stop.

When the pre-setting of the parameters for pump control has been executed successfully, "SEt" is shown in the display for two seconds. After that "no" will be shown again.

Note: Pre-setting of parameters for pump control is not allowed when the softstarter is running.

300 — Multi Setting

Preset pump control parameters

no

Default:	no
Range:	no, YES
no	No action
YES	Preset parameters for pump control

8.7.2 Start

With MSF 2.0, torque control, voltage control and direct on-line are available as start methods. Torque control is available both for loads with a linear torque characteristic like conveyors and planers and with square torque characteristics for pumps and fans. In general torque control is recommended as a starting method; voltage control may be used when for some special reasons a linear voltage ramp is desired. With Direct on-line (DOL) as a start method, neither the current nor the voltage will be controlled; full voltage is applied to the motor immediately. DOL can be used to start the motor if the softstarter has been damaged and the thyristors are short-circuited.

All start methods can be combined with a current limit. However, only a properly configured torque-controlled start will lead to constant acceleration. For this reason it is not recommended to set a current limit for pump applications. With a proper set-up of the torque control parameters, the starting current will be very low. For applications with variable load characteristics from start to start, the current limit functionality may be useful to avoid overloading the mains fuses. However, as the motor torque is proportional to the square of the current, setting a low current limit will limit the motor torque considerably. If the current limit is set too low in relation to the application's requirements, the motor will not be able to accelerate the load.

Start method [310]

In this menu the start method is chosen. The menus necessary for configuration of the start will be available depending on the chosen start method.

310 Setting

Start method

1

Default:	1
Range:	1, 2, 3, 4
1	Linear torque control
2	Square torque control
3	Voltage control
4	Direct on-line, DOL

Torque control

The default settings for initial torque at start is 10% and for end torque at start it is 150%. In Fig. 37 the resulting torque curve is shown versus time for linear and square torque characteristics.

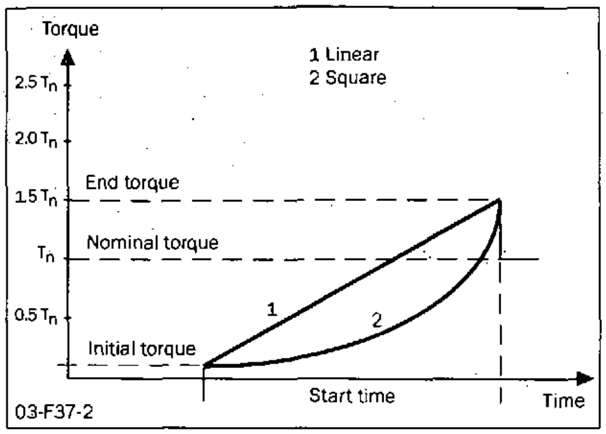


Fig. 37 Torque control at start

A Properly configured torque-controlled start will lead to a linear speed increase and low starting current without current peaks.

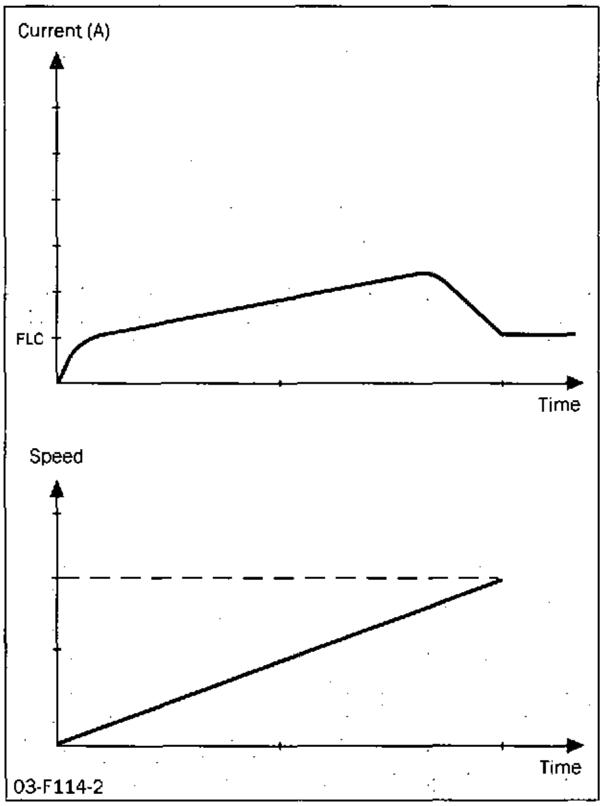


Fig. 38 Current and speed in torque control

To optimize the start, use the setting for initial torque at start, menu [311] and end torque at start, menu [312].

When the start command is given, the motor should immediately start to rotate to avoid unnecessary heat development in the motor. If required, increase the initial torque at start.

The end torque at start should be adjusted so that the time for the motor to come up to nominal speed approximately matches the start time set in menu [315]. If the actual start time is much shorter than the set start time in menu [315], the End torque at stop can be decreased. If the motor does not reach full speed before the start time set in menu [315] has expired, the end torque at stop has to be increased to avoid current peaks and jerking at the end of the ramp. This may be needed for high inertia loads such as planers, saws and centrifuges.

The read-out of shaft torque in percentage of T_n in menu [706] may be useful for fine-tuning the start ramp.

Initial torque at start [311]

This menu is available if torque control is selected in menu [310]. In this menu the initial torque at start is set.

311	Setting
10	**Initial torque at start**
Default:	10%
Range:	0-250% T_n
0-250	Initial torque at start.

End torque at start [312]

This menu is available if torque control is selected in menu [310]. In this menu the end torque at start is set.

312	Setting
150	**End torque at start**
Default:	150%
Range:	25-250% T_n
25-250	End torque at start.

Voltage control

Voltage control can be used when a linear voltage ramp is desired. The voltage to the motor will be ramped up linearly, from initial voltage up to full mains voltage.

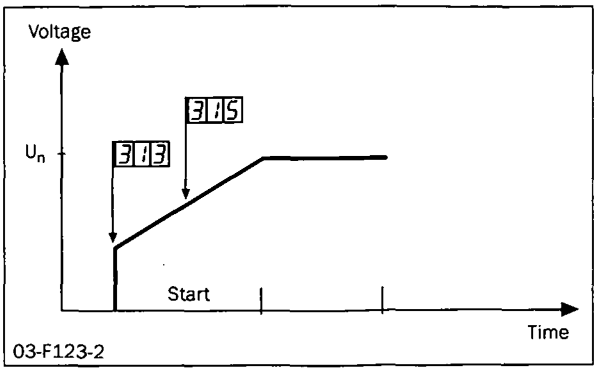


Fig. 39 Menu numbers for initial voltage and start time.

Initial voltage at start [313]

This menu is available if voltage control is chosen as start method in menu [310]. In this menu the initial voltage at start is set.

313	Setting
30	**Initial voltage at start**
Default:	30%
Range:	25-90% U
25-90	Sets initial voltage at start.

Direct on-line, DOL

If this alternative is selected in menu [310], the motor can be accelerated as if it was connected directly to the mains.

For this type of operation:

Check whether the motor can accelerate the required load (DOL start). This function can be used even with shorted thyristors.

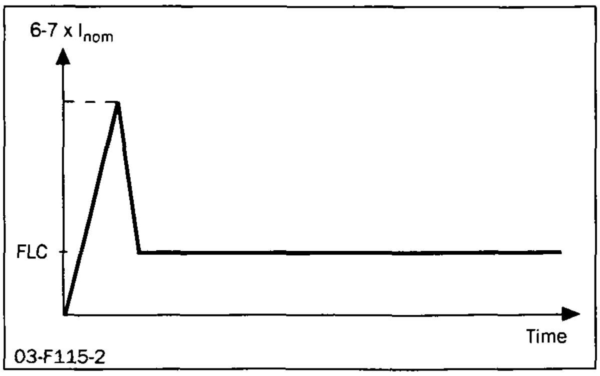


Fig. 40 DOL-start.

Current limit

Current limit at start can be used together with all start methods to limit the current to a defined max level when starting (150-500% of In). However, only a properly configured torque-controlled start will lead to linear acceleration. For this reason it is not recommended to set a current limit for pump applications. Moreover, as the motor torque is proportional to the square of the current, setting a low current limit will limit the motor torque considerably. If the current limit is set too low in relation to the application's requirements, the motor will not be able to accelerate the load.

The combination DOL start and current limit at start gives a start ramp with constant current. The softstarter will control the current up to the set current limit immediately at start, and keep it there until the start is completed or the set start-up time expires.

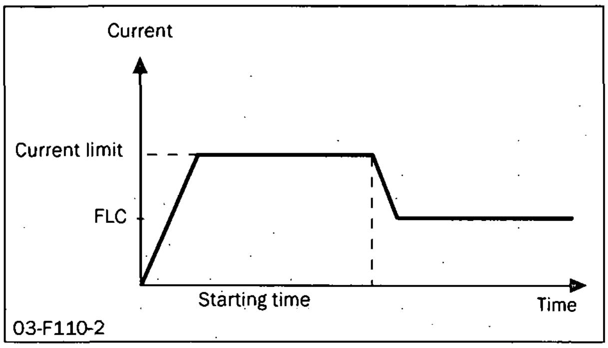


Fig. 41 Direct on-line start in combination with current limit at start.

Current limit at start [314]

In this menu the current limit at start is set.

314 — Setting

Current limit at start

oFF

Default:	oFF
Range:	oFF, 150-500% of I_n
oFF	Current limit disabled.
150-500	Current limit at start.

NOTE: Even though the current limit can be set as low as 150% of the nominal motor current value, this minimum value cannot be used generally. If the current limit is set too low in relation to the application's requirements, the motor will not be able to accelerate the load.

NOTE: Check that the nominal motor current is configured properly in menu [211] if the current limit functionality is used.

If the starting time is exceeded and the softstarter is still operating at current limit, an alarm will be activated according to "Current limit start time expired" settings for motor protection, menu [231]. Operation may be stopped or continued with a pre-defined voltage ramp. Note that the current will rise unchecked if the operation continues.

Start time [315]

In this menu the desired start time is set. This menu is not available if DOL is chosen as a start method and no current limit is configured.

315 — Setting

Start time

10

Default:	10 s
Range:	1-60 s
1-60	Start time.

Torque boost

In specific applications torque boost is required for the start. The torque boost parameter enables a high torque to be obtained by providing a high current for 0.1-2 seconds at start. This enables a soft start of the motor even if the break away torque is high at start. For example in crushing mills applications etc.

When the torque boost function has finished, starting continues according to the selected start method.

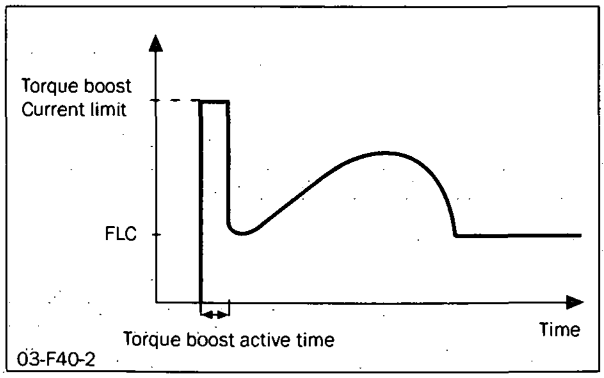


Fig. 42 The principle of the torque boost when starting the motor.

Torque boost current limit [316]

In this menu torque boost is enabled and the current limit for torque boost is configured.

316	Setting
300	**Torque boost current limit**
Default:	oFF
Range:	oFF, 300-700% of I_n
oFF	Torque boost disabled
300-700	Torque boost current limit.

Torque boost active time [317]

This menu is available if torque boost is enabled in menu [316]. In this menu the time for the torque boost to be active is selected.

317	Setting
oFF	**Torque boost active time**
Default:	1.0 s
Range:	0.1-2.0 s
0.1-2.0	Torque boost active time.

NOTE! Check whether the motor can accelerate the load with "Torque boost" without any harmful mechanical stress.

NOTE: Check that the nominal motor current is configured properly in menu [221].

8.7.3 Stop

With MSF 2.0, four stop methods are available: torque control, voltage control, coast and braking. Torque control is available for loads with linear or square torque characteristic. A torque or voltage-controlled stop is used for applications where the motor stopping suddenly could harm the application, e.g. water hammer in pump applications. In general a torque-controlled stop is recommended for these applications. The voltage-controlled stop can be used if a linear voltage ramp is desired. When coast is selected as a stop method, the voltage to the motor will be switched off and the motor will be left freewheeling. Braking may be used in applications where the motor needs to be stopped quickly, e.g for planers and bandsaws.

Any start method except for direct on-line (DOL) can be combined with any stop method, e.g. torque control can be used at start and brake for stop. The DOL start method can only be combined with coast or brake stop methods.

Stop method [320]

In this menu the stop method is chosen. The menus necessary for configuring the stop will be available depending on the chosen stop method.

320	Setting
4	**Stop method**
Default:	4
Range:	1, 2, 3, 4, 5
1	Linear torque control
2	Square torque control
3	Voltage control
4	Coast
5	Brake

Torque control

With torque control at stop, the torque to the motor will be controlled from the nominal torque down to the chosen end torque at stop (menu [321]). Examples for the torque ramps for linear and square torque control are shown in Fig. 43. The default value for end torque at stop is 0; this value may be increased if the motor is standing still before the stop is finished to avoid unnecessary heat development in the motor. With the end torque at stop set properly, the motor speed will decrease linearly down to standstill.

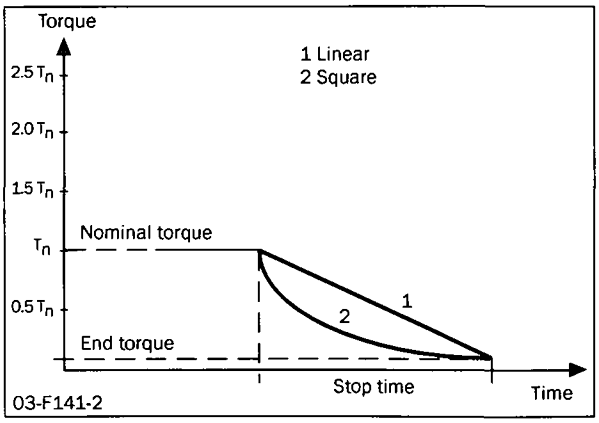


Fig. 43 Torque control at stop

End torque at stop [321]

This menu will be available if torque control is chosen as stop method in menu [320] (alternative 1 or 2). In this menu the end torque at stop is configured.

321	Setting
0	**End torque at stop**
Default:	0%
Range:	0-100% of T_n
0-100	End torque at stop.

Voltage control

With voltage control at stop, the voltage to the motor will be decreased to the chosen step down voltage at stop immediately after a stop signal. Then the voltage to the motor will follow a linear ramp down to the minimum voltage of 25% of the nominal voltage. An example of this voltage ramp is shown in Fig. 44.

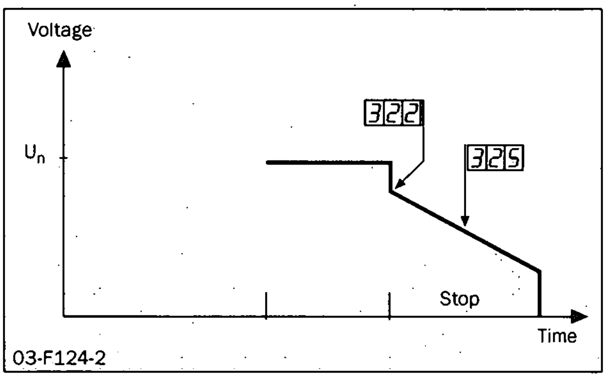


Fig. 44 Menu numbers for step down voltage at stop and stop time.

Step down voltage at stop [322]

This menu is available if voltage control is chosen as stop method in menu [320] (alternative 3). In this menu the step down voltage at stop is chosen in percentage of the nominal motor voltage.

322	Setting
100	**Step down voltage at stop**
Default:	100%
Range:	100-40% of U
100-40	Step down voltage at stop.

Braking

Braking can be used in applications where there is a need for a quick stop.

There are two built-in braking methods: dynamic vector brake for normal loads and reverse current brake for heavy loads with high inertia. In both braking methods the MSF 2.0 continuously detects the motor speed. At low speed the DC brake mode is activated until the motor is standing still. The MSF 2.0 will automatically turn off the output voltage when the motor has stopped or when the stop time has expired. Optionally an external rotation senaor can be connected via digital input, see description for menu [500] on page 77 for more information.

Dynamic vector brake

With dynamic vector brake, the braking torque applied to the motor will increase with decreasing speed. Dynamic vector brake can be used for all loads which are not rotating too close to synchronous speed when the motor voltage is switched off. This is valid for most applications as the load speed usually decreases because of frictional losses in gears or belt drives as soon as the motor voltage is switched off. However, loads with very high inertia may remain at high speed even though the motor is not supplying any torque. For these applications the reverse current brake can be used instead.

When the dynamic vector brake is used, no additional connections or contactors are needed.

Reverse current brake

With reverse current brake, a very high braking torque can be applied to the motor even close to synchronous speed. All kind of loads can be stopped quickly using reverse current brake, including loads with very high inertia. If high braking torques are needed, it should be checked carefully whether the motor, the gear or belt drive and the load can withstand the high mechanical forces. To avoid harmful vibrations, it is generally recommended to select as low a braking torque as possible which also fulfils the demands for a short braking time.

For reverse current brake, two mains contactors are needed. The connection is shown in Fig. 45. The contactors have to be controlled by the MSF's relay outputs. During start and full voltage operation contactor K1 will be closed, for braking K1 will be opened and after a time delay K2 will be closed to change the phase sequence.

NOTE: For several start/stops it is recommend that the motor temperature be monitored using the PTC input.

WARNING: When reverse current brake is selected, the relays K1 and K2 are automatically programmed for reverse current brake functionality. The relay setting remains even if reverse current brake is deactivated. Therefore it may be necessary to adapt the relay functions manually.

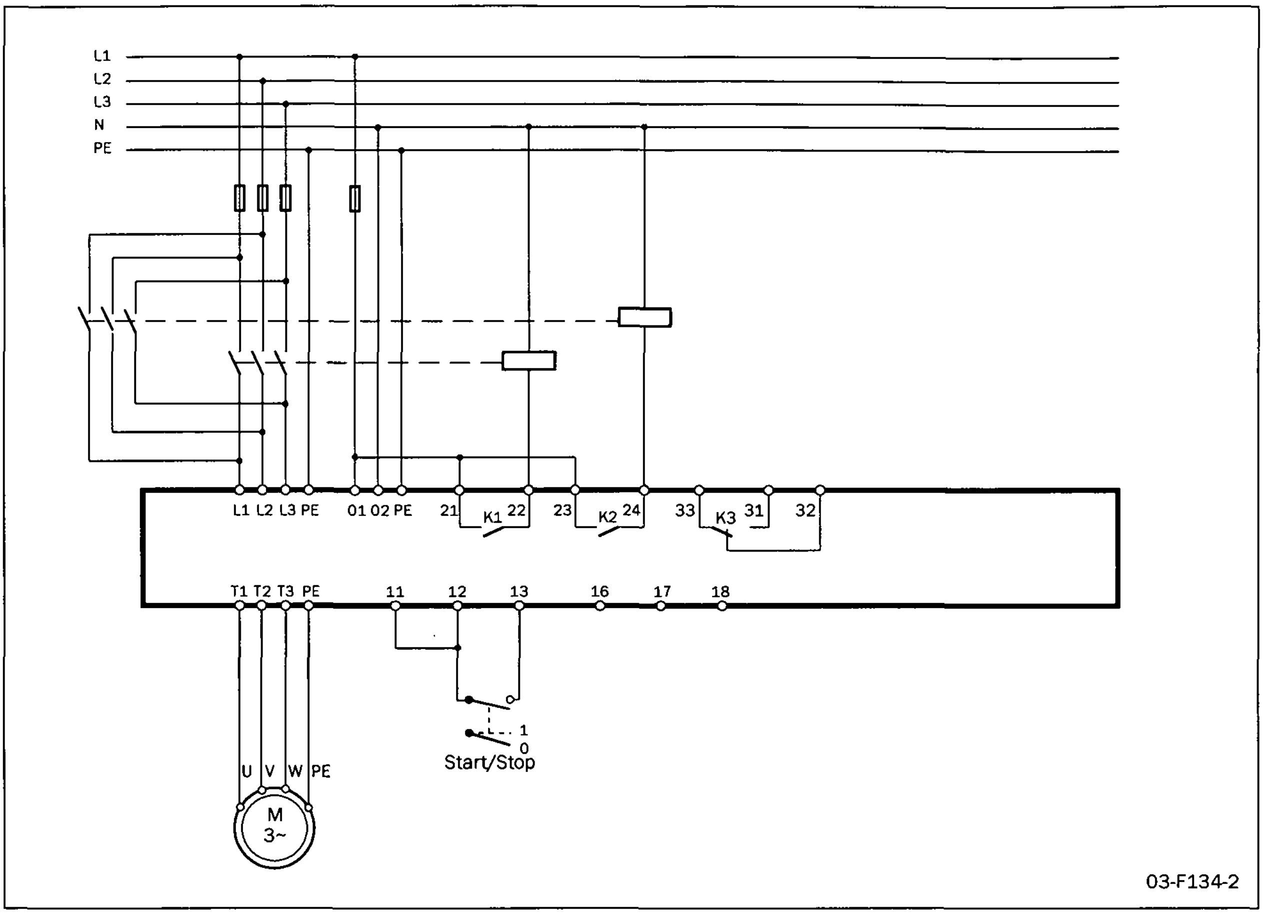


Fig. 45 Reverse current brake wiring example.

Braking method [323]

This menu is available if brake is selected as stop method in menu [320] (alternative 5) or if alarm brake is activated in menu [326] (see description of menus [326] to [327] for more information). In this menu the brake method is selected.

323	Setting
1	**Braking method**
Default:	1
Range:	1, 2
1	Dynamic vector brake
2	Reverse current brake

Braking strength [324]

This menu is available if brake is selected as stop method in menu [320] (alternative 5). In this menu the braking strength is selected. To avoid unnecessary heat development in the motor and high mechanical stress it is generally recommended to select as low a braking strength as possible which still fulfils the demands for a short braking time.

324	Setting
150	**Braking strength**
Default:	150%
Range:	150-500%
150-500	Braking strength.

Stop time [325]

This menu is available if any stop method except coast is selected in menu [320] (alternative 1, 2, 3 or 5). In this method the desired stop time is selected.

325	Setting
10	**Stop time**
Default:	10 s
Range:	1-120 s
1-120	Stop time.

Alarm braking

For most alarms it is possible to configure them so that when they are triggered either operation continues or the motor stops (see chapter 9. page 95 for more information). Brake is one of the actions available. If this option is chosen, the braking functionality is activated according to the brake method selected in menu [323] (see description of the braking functionality above for more information). While the braking strength and stop time chosen in menus [324] and [325] are used for braking on a stop signal, different braking strengths and times can be configured in menus [326] and [327] if braking is activated by an alarm. This function may mainly be used in combination with an external alarm (see description on page 73), where an external signal is used to initiate a quick stop with a higher braking strength and a shorter braking time compared to normal operation.

If alarm braking is disabled in menu [326] and brake is chosen as an alarm action, the voltage to the motor will be switched off and the motor will freewheel if the specific alarm occurs.

Alarm braking strength [326]

In this menu braking as an alarm action is enabled and the alarm braking strength is selected. If alarm braking is not activated, the motor will be left freewheeling if an alarm occurs for which brake is configured as alarm action.

326	Setting
oFF	**Alarm braking strength**
Default:	oFF
Range:	oFF, 150-500%
oFF	Coast – motor voltage is switched off.
150-500	Alarm braking strength.

NOTE: If alarm brake is enabled, the braking method chosen in menu [323] is used.

Alarm braking time [327]

This menu is available if alarm brake is enabled in menu 327. In this menu the braking time to be used in the event of braking as an alarm action is configured.

327	Setting
10	**Alarm braking time**
Default:	10 s
Range:	1-120 s
1-120	Alarm braking time.

8.7.4 Slow speed and JOG functions

MSF 2.0 is able to run the motor at a fixed slow speed for a limited period of time. The slow speed will be about 14% of the full speed in the forward direction and 9% in the reverse direction.

NOTE: As the motor torque during slow speed is limited to about 30% of the nominal torque, slow speed can not be used in applications which need a high brake-away torque to start rotating.

The following functions are possible:

Slow speed during a selected time period

Slow speed will be active for a selected time period before a start is initiated or after a stop is performed.

Slow speed controlled by an external signal

The time period during which slow speed is active before a start is initiated or after a stop is performed is controlled by an external signal via the analogue/digital input. Slow speed will be active until a selected number of pulses has been detected on the input.

Slow speed using the JOG commands

Slow speed can be activated independently from a start or stop via the control panel using the jog keys, via remote control using the analogue/digital input or via serial communication depending on the control source chosen in menu [200].

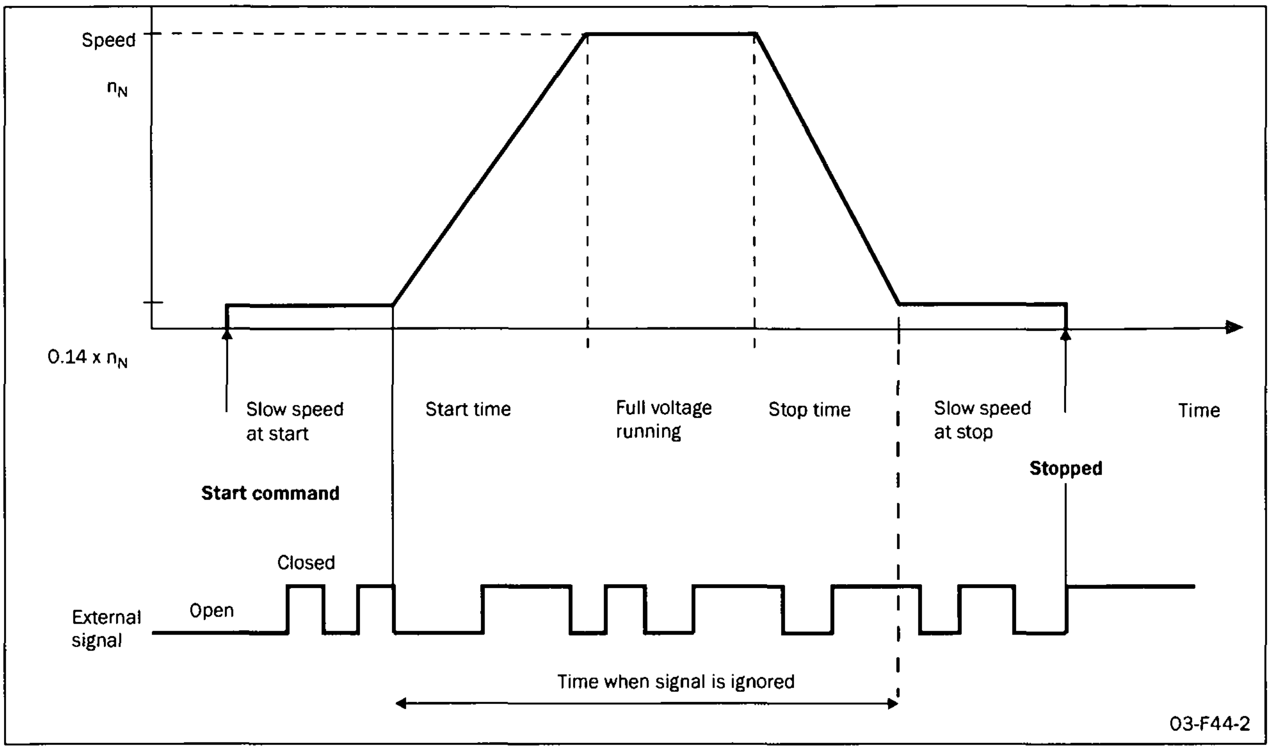


Fig. 46 Slow speed controlled by an external signal.

Slow speed for a selected time

Slow speed in forward direction can be activated before a start and/or after a stop. The resulting speed curve is shown in Fig. 47 overleaf. Slow speed will be active for the time period selected in menus [331] and [332]. Slow speed can be combined with any start and stop method. However, when slow speed at stop is used, it should be ensecured that the motor speed is decreased to a low value when slow speed is activated. If necessary, brake can be activated as stop method in menu [320].

The slow speed strength can be adapted to the application's requirements in menu [330]. Maximum available slow speed strength corresponds to about 30% of nominal motor torque.

If so desired, the DC brake can be activated after slow speed at stop. If activated, the DC brake will be active for the time period chosen in menu [333].

Slow speed during a selected time is configured using the following menus:

[330] Slow speed strength

[331] Slow speed time at start

[332] Slow speed time at stop

[333] DC-brake at slow speed

[324] Braking strength

Slow speed controlled by an external signal

Slow speed controlled by an external signal is basically the same functionality as slow speed during a selected time described above. An external signal connected to the analogue/digital input is also used to deactivate slow speed before the set time period has expired.

When slow speed at start is configured and the analogue/ digital input (menu [500]) is configured for slow speed, the motor will start rotating at slow speed in a forward direction after a start signal. When the number of edges set in menu [501] is detected on the analogue/digital input, slow speed is deactivated and a start is performed according to the start settings (menu [310] Off).

When slow speed at stop is configured and the analogue/digital input (menu [500]) is configured for slow speed, the motor will start rotating with slow speed in forward direction after a stop has performed. When the number of pulses set in menu [501] is detected on the analogue/digital input, slow speed is deactivated and the DC brake is activated if configured in menu [333].

Slow speed controlled by an external signal is configured using the following menus:

[500] Digital/analogue input

[501] Digital input pulses

[330] Slow speed strength

[331] Slow speed time at start

[332] Slow speed time at stop

[333] DC-brake at slow speed

[324] Braking strength

Slow speed strength [330]

In this menu the slow speed strength is selected. The chosen setting applies for both slow speed during a selected time period, slow speed controlled by an external signal and slow speed using the JOG commands. The maximum setting (100) for the slow speed strength corresponds to about 30% of the nominal motor torque.

330 Setting

Slow speed strength

10

Default:	10
Range:	10-100
10-100	Slow speed strength.

Slow speed time at start [331]

In this menu slow speed at start is activated and the time is set for which slow speed is active before a start. If slow speed at start is controlled by an external signal via the analogue/digital input, the set time becomes the maximum time for which slow speed is activated before a start is performed – if the number of edges set in menu [501] is not detected during the slow speed period.

331 Setting

Slow speed time at start

oFF

Default:	oFF
Range:	oFF, 1-60 s
oFF	Slow speed at start is disabled
1-60	Slow speed time at start.

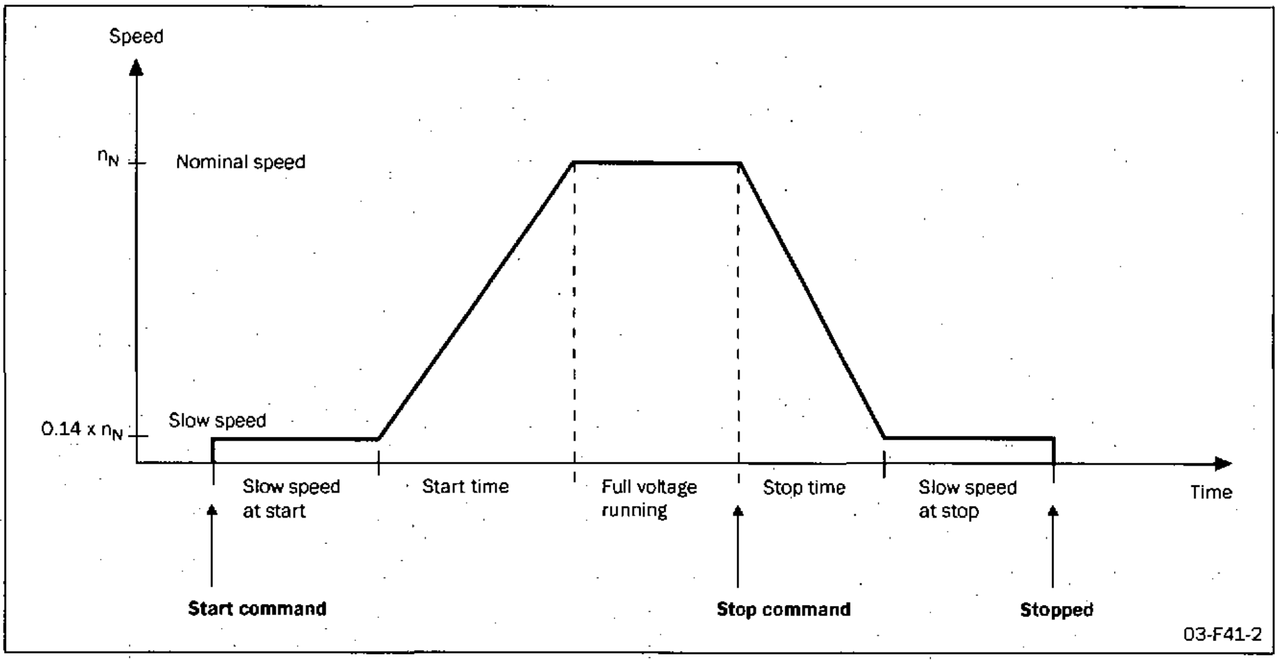


Fig. 47 Slow speed at start/stop during a selected time period.

Slow speed time at stop [332]

In this menu slow speed at stop is activated and the time is set for which slow speed is active after a stop. If slow speed at stop is controlled by an external signal via the analogue/digital input, the set time becomes the maximum time for which slow speed is activated after a stop – if the number of edges is set in menu [501] is not detected during the slow speed period.

332	Setting
oFF	**Slow speed time at stop**
Default:	oFF
Range:	oFF, 1-60 s
oFF	Slow speed at stop is disabled
1-60	Slow speed time at stop.

DC brake at slow speed [333]

In this menu the DC brake can be activated after slow speed at stop. This may be useful for loads with high interia or if an exact stop position is desired. The DC brake will be active during the time set in this menu.

NOTE: The brake strength used for DC brake after slow speed corresponds to the brake strength used for braking as stop method. The braking strength can be adjusted in menu [324].

333	Setting
oFF	**DC Brake at slow speed**
Default:	oFF
Range:	oFF, 1-60 s
oFF	DC brake at slow speed disabled.
1-60	DC brake duration time at slow speed.

Slow speed using the JOG commands

Slow speed in forward or reverse direction can be activated using the JOG commands. To use the JOG commands these have to be independently enabled for slow speed in forward or reverse direction in menus [334] and [335]. Depending on the control source chosen in menu [200], the JOG commands are accepted via control panel, remotely via analogue/digital input or via serial communications.

If the control panel is chosen as control source (menu [200]=1) and the JOG commands are enabled in menus [334] and [335], the JOG keys on the control panel can be used. Slow speed in forward or reverse direction will be active as long as the relevant button is pushed.

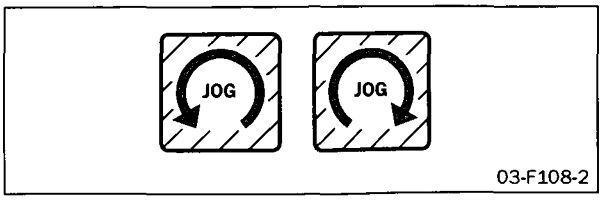


Fig. 48 Jog keys

If remote control is chosen (menu [200]=2) and the JOG commands are enabled in menus [334] and [335], the JOG commands can be given via analogue/digital input. The analogue/digital input can be configured either for jog forward or jog reverse (see description of menu [500] on page 77 for more information). Slow speed will be active as long as the signal on the analogue/digital input is active.

If serial communication control is chosen (menu [200]=3) and the JOG commands are enabled in menus [334] and [335], the JOG commands can be given via serial communication. (See separate instruction manual for serial communications options.)

JOG forward enable [334]

In this menu the command for JOG in forward direction is enabled. Depending on the control source chosen in menu [200], the JOG forward command may be accepted from the control panel, via remote control or serial communication.

NOTE! The enable functions are for all control sources.

334	Setting
oFF	**JOG forward enable**
Default:	oFF
Range:	oFF, on
oFF	JOG forward disabled
on	JOG forward enabled

JOG reverse enable [335]

In this menu the command for JOG in reverse direction is enabled. Depending on the control source chosen in menu [200,], the JOG reverse command may be accepted from the control panel, via remote control or serial communication.

335	Setting
oFF	**JOG reverse enable**
Default:	oFF
Range:	oFF, on
oFF	JOG reverse disabled
on	JOG reverse enabled

8.7.5 Additional settings [340]-[342]

In this section the bypass functionality, power factor control and the control of the internal fan are described.

Bypass [340]

As the MSF 2.0 is designed for continuous running, a by-pass contactor is not normally needed. However, where there is high ambient temperature or other special conditions, the use of a bypass contactor can be advantageous. In this case the by-pass contactor can be controlled by one of the relays. By default, relay K2 is configured to control a bypass contactor (for full voltage functionality, see description of menus [530]-[532] on page 85 for more information).

The use of a bypass contactor can be combined with any start and stop method without any connection changes being necessary. However, to use the motor protection functions, the load monitor and the viewing functions in bypassed state, the current transformers have to be moved outside the softstarter. For this purpose an optional extension cable is available, see chapter 12, page 107 (Options) for more information. Figures 49 - 51 below show a connection example.

If a bypass contactor is used, bypass operation must be enabled in menu [340] for the softstarter to work properly.

340	Setting
oFF	**Bypass**
Default:	oFF
Range:	oFF, on
oFF	Bypass disabled
on	Bypass enabled

CAUTION: If the current transformers are not moved outside the softstarter, several alarm functions will not work properly.

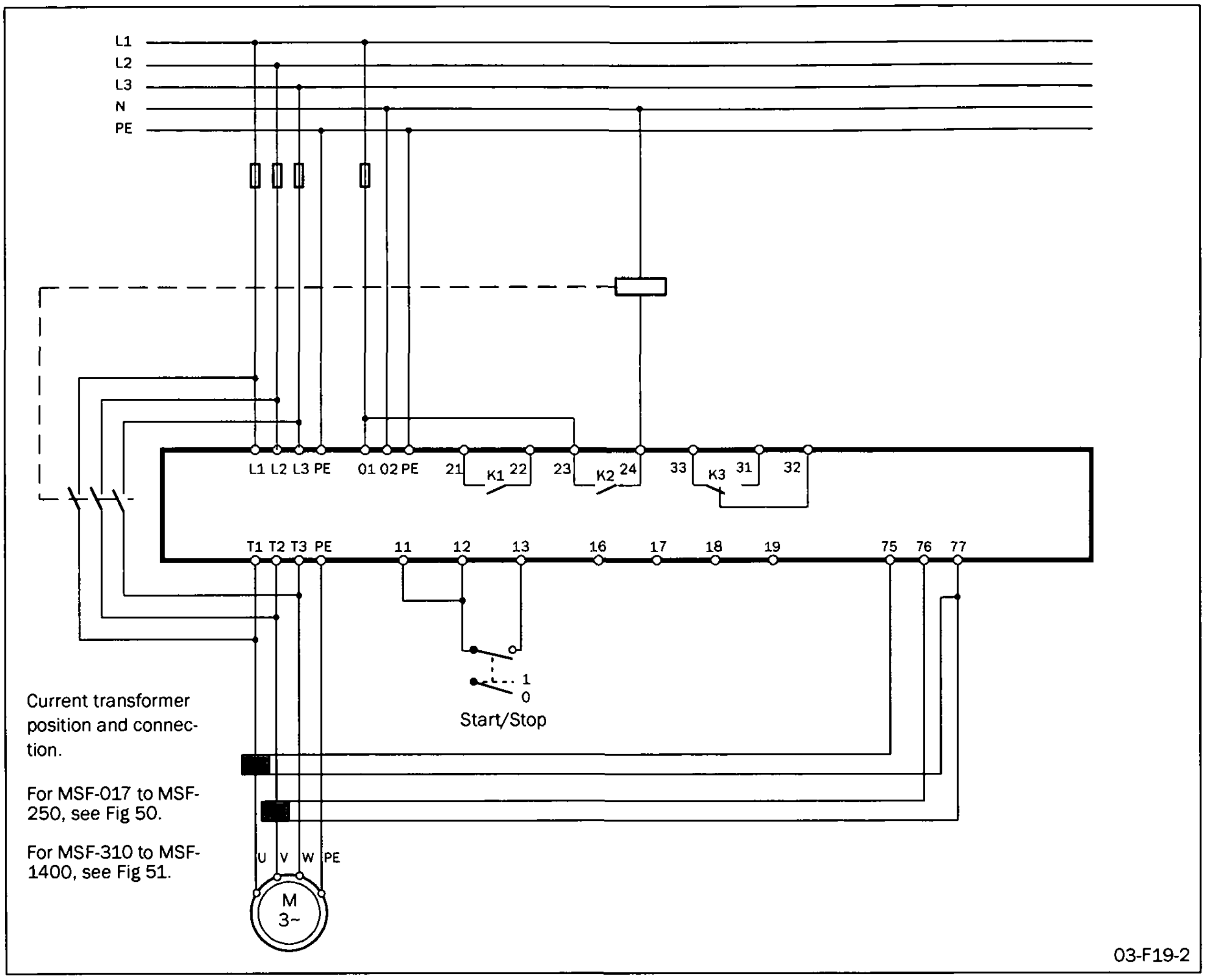


Fig. 49 Bypass wiring example MSF 310-1400.

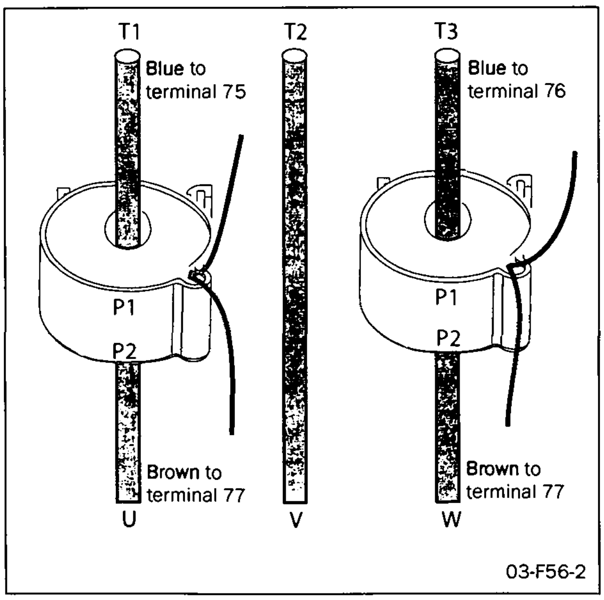


Fig. 50 Current transformer position for Bypass on MSF-017 to MSF-250.

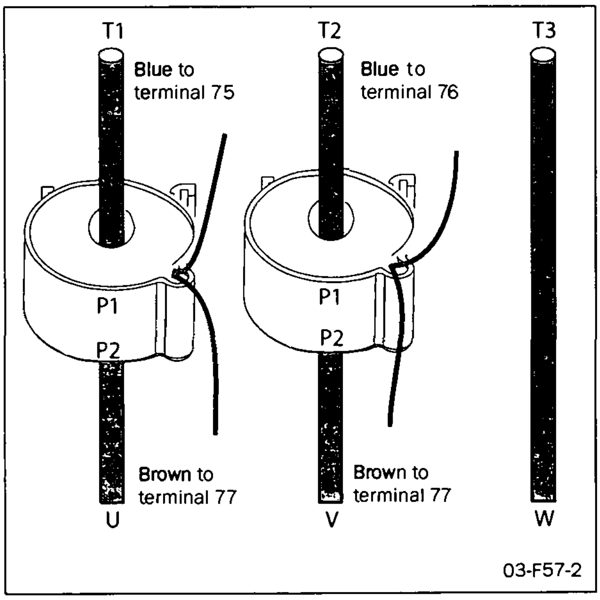


Fig. 51 Current transformer position for Bypass on MSF-310 to MSF-1400.

Power Factor Control PFC [341]

During operation, the softstarter continuously monitors the load of the motor. Particularly when idling or when only partially loaded, it is sometimes desirable to improve the power factor. If Power Factor Control (PFC) is selected, the softstarter reduces the motor voltage when the load is lower. Power consumption is reduced and the degree of efficiency improved.

341	Setting
oFF	**Power Factor Control PFC**
Default:	oFF
Range:	oFF, on
oFF	PFC disabled
on	PFC enabled.

CAUTION: If Power Factor Control is used, the EMC Directive will not be complied with. External measures will be necessary to meet the requirements of the EMC Directive.

Fan continuously on [342]

This menu enables the internal fan to be switched on continuously. the default setting is for the fan only to run when the softstarter heatsink is too warm. The lifetime of the fan is increased by only running it when needed.

342	Setting
oFF	**Fan continuously on**
Default:	oFF
Range:	oFF, on
oFF	Fan is controlled by the heatsink temperature
on	Fan is running continuously.

8.8 Process protection

The MSF 2.0 softstarter is equipped with different functions for process protection:

[400]-[413] Load monitor

[420] External alarm

[430]-[440] Mains protection

8.8.1 Load monitor

The MSF 2.0 has a built-in load monitor, which continuously supervises the motor shaft power. This means, the process can easily be protected both from overload and underload conditions. The load monitor functionality includes both alarms and pre-alarms for overload (max power) and underload (min power). While the max. and min power alarms can be configured to affect operation (OFF, Warning, Coast, Stop, Brake), the respective pre-alarms only give an indication that an over- or underload situation may be close. The pre-alarm status is available on one of the programmable relays K1 to K3 if so configured (see description of the relays, menus [530] to [532] on page 85 for more information)

All load monitor alarms and pre-alarms are configured using a delay time and an alarm margin. The alarm margin is chosen as a percentage of nominal motor load. A max power alarm will occur when the actual power exceeds the normal load plus the max power alarm margin and a min power alarm will occur when the actual load is lower than the normal load minus the min power margin. Normal load is the shaft power needed under normal operation conditions. The default normal load is considered to be 100% of the nominal motor power. Depending on the dimensioning of the motor with respect to the application, this value may need to be adapted. Normal load can easily be adapted by using the Autoset function in menu [411]. When an Autoset is performed the actual motor shaft power will be measured and stored to the Normal load.

A start delay can be configured to avoid faulty alarms due to initial over- or underload situations at start.

Fig. 52 illustrates the load monitor functionality with an example of a load curve.

If the operation has been interrupted due to a max or min power alarm, a manual reset and a new start signal is needed to continue operation. The reset and the start signal can be given via control panel, remotely or via serial communication depending on the control source chosen in menu [200]. Regardless of the chosen control source, it is always possible to initiate a reset via control panel.

NOTE: A reset via control panel will never start the motor.

NOTE! The load monitor alarms are disabled during deceleration.

NOTE: When using the load monitor, check that the nominal motor power is set properly in menu [212].

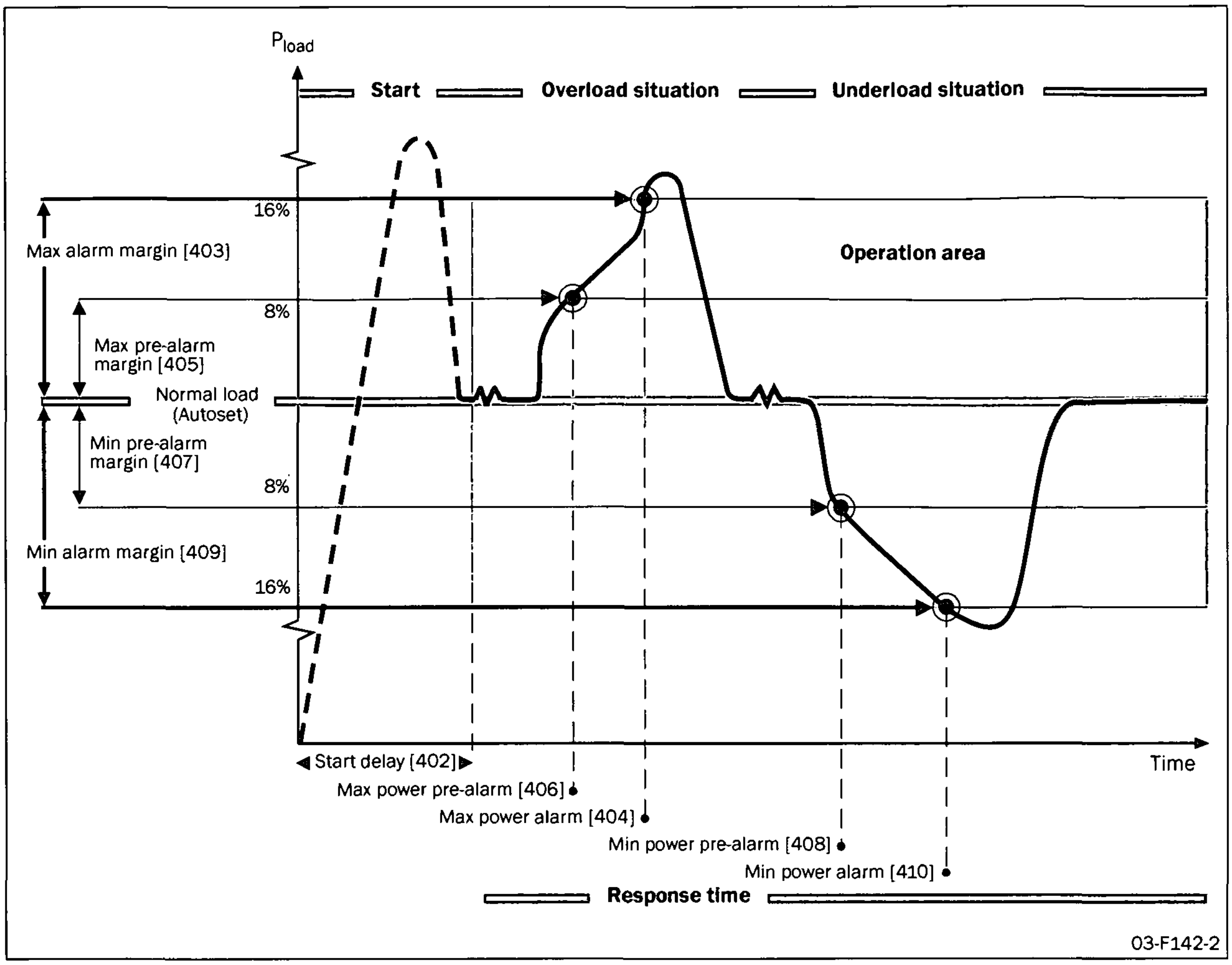


Fig. 52 Load monitor alarm functions

For max and min power alarms the following alarm actions are available:

Off

The protection method is deactivated.

Warning

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays). However, the motor is not stopped and operation continues. The alarm message will disappear and the relay will be reset when the fault disappears. The alarm may also be reset manually.

Coast

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays). The motor voltage is automatically switched off. The motor freewheels until it stops.

Stop

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays). The motor is stopped according to the stop settings in menus [320] to [325].

Brake

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays). The brake function is activated according to the braking method chosen in menu [323] and the motor is stopped according to the alarm brake settings in menus [326] to [327] (braking strength and braking time).

If the operation has been interrupted due to a max or min power alarm, a reset signal and a new start signal are needed to restart the motor. The reset and the start signal can be given via control panel, remotely or via serial communication depending on the control source chosen in menu [200]. Regardless of the chosen control source, it is always possible to initiate a reset via control panel.

NOTE: A reset via control panel will never start the motor.

Max power alarm [400]

In this menu max power alarm is enabled and a proper alarm action is selected. The pre-alarm functionality for max power is automatically enabled together with the max power alarm.

400	Setting
oFF	**Max power alarm (alarm code F6)**
Default:	oFF
Range:	oFF, 1, 2, 3, 4
oFF	Max power alarm is disabled.
1	Warning
2	Coast
3	Stop
4	Brake

Min power alarm [401]

In this menu min power alarm is enabled and a proper alarm action is selected. The pre-alarm functionality for min power is automatically enabled together with the min power alarm.

401	Setting
oFF	**Min power alarm (alarm code F7)**
Default:	oFF
Range:	oFF, 1, 2, 3, 4
oFF	Min power alarm is disabled.
1	Warning
2	Coast
3	Stop
4	Brake

Start delay power alarms [402]

This menu is available if max or min power alarm is enabled in menu [400] or [401]. In this menu the start delay for the power alarms and pre-alarms is selected. A start delay is useful for avoiding faulty alarms due to initial over- or underload situations. The start delay begins when a start of the motor is initiated.

402	Setting
10	**Start delay power alarms**
Default:	10 s
Range:	1-999 s
1-999	Start delay for power alarms and pre-alarms.

Max power alarm margin [403]

This menu is available if Max power alarm is enabled in menu [400]. In this menu the max power alarm margin is configured. The margin is selected as percentage of nominal motor power. A max power alarm will occur if the actual motor shaft power exceeds the normal load (menu [412]) plus the chosen max power alarm margin for a longer time period than the max power alarm response delay set in menu [404].

403	Setting
16	**Max power alarm margin**
Default:	16%
Range:	0-100% of P_n
0-100	Max power alarm margin

Max power alarm response delay [404]

This menu is available if max power alarm is enabled in menu [400]. In this menu the response delay for the max power alarm is configured. A max power alarm will occur if the actual motor shaft power exceeds the normal load (menu [412]) plus the max power alarm margin set in menu [403] for a longer time period than the chosen max power alarm response delay.

404	Setting
0.5	**Max power alarm response delay**
Default:	0.5 s
Range:	0.1-90.0 s
0.1-90.0	Response delay for max power alarm.

Max power pre-alarm margin [405]

This menu is available if max power alarm is enabled in menu [400]. In this menu the max power pre-alarm margin is configured. The margin is selected in percent of nominal motor power. A max power pre-alarm will occur if the actual motor shaft power exceeds the normal load (menu [412]) plus the chosen max power pre-alarm margin for a longer time period than the max power pre-alarm response delay set in menu [406]. The max power pre-alarm status is available on one of the programmable relays K1-K3 if so configured (see description of the relays, menus [530] to [532] for more information).

405 Setting

8 **Max power pre-alarm margin**

Default:	8%
Range:	0-100% of P_n
0-100	Max power pre-alarm margin.

Max power pre-alarm response delay [406]

This menu is available if max power alarm is enabled in menu [400]. In this menu the response delay for max power pre-alarm is configured. A max power pre-alarm will occur if the actual motor shaft power exceeds the normal load (menu [412]) plus the max power pre-alarm margin set in menu [405] for a longer time period than the chosen max power pre-alarm response delay.

406 Setting

0.5 **Max power pre-alarm response delay**

Default:	0.5 s
Range:	0.1-90.0 s
0.1-90.0	Response delay for Max power pre-alarm.

Min power pre-alarm margin [407]

This menu is available if min power alarm is enabled in menu [401]. In this menu the min power pre-alarm margin is configured. The margin is selected as a percentage of nominal motor power. A min power pre-alarm will occur if the actual motor load is below the nominal load (menu [412]) minus the chosen min power pre-alarm margin for a longer time period than the min power pre-alarm response delay set in menu [408]. The min power pre-alarm status is available on one of the programmable relays K2-K3 if so configured (see description of the relays, menus [530] to [532] for more information.

407 Setting

8 **Min power pre-alarm margin**

Default:	8%
Range:	0-100% of P_n
0-100	Min power pre-alarm margin.

Min power pre-alarm response delay [408]

This menu is available if min power alarm is enabled in menu [401]. In this menu the response delay for min power pre-alarm is configured. A min power pre-alarm will occur if the actual motor shaft power is below the normal load (menu [412]) minus the min power pre-alarm margin set in menu [407] for a longer time period than the chosen min power pre-alarm response delay.

408 Setting

0.5 **Min power pre-alarm response delay**

Default:	0.5 s
Range:	0.1-90.0 s
0.1-90.0	Response delay for Min power pre-alarm.

Min power alarm margin [409]

This menu is available if min power alarm is enabled in menu [401]. In this menu the min power alarm margin is configured. The margin is selected as a percentage of nominal motor power. A min power alarm will occur if the actual motor shaft power is below the normal load (menu [412]) minus the chosen min power alarm margin for a longer time period than the min power alarm response delay set in menu [410].

409 Setting

16 **Min power alarm margin**

Default:	16%
Range:	0-100% of P_n
0-100	Min power alarm margin.

Min power alarm response delay [410]

This menu is available if min power alarm is enabled in menu [401]. In this menu the response delay for min power alarm is configured. A min power alarm will occur if the actual motor shaft power is below the normal load (menu [412]) minus the min power alarm margin set in menu [409] for a longer time period than the chosen min power alarm response delay.

410	Setting
0.5	**Min power alarm response delay**
Default:	0.5 s
Range:	0.1-90.0 s
0.1-90.0	Response delay for Min power alarm.

Autoset [411]

This menu is available if max or min power alarm is enabled in menu [400] or [401]. The Autoset command performs a measurement of the actual motor load and automatically sets the normal load in menu [412].

To perform an Autoset, select YES, and press Enter during normal operation. If Autoset has been executed successfully, “SEt” is shown in the display for two seconds. After that “no” is shown again. An Autoset can also be initiated via the analogue/digital input, see description of menu [500] for more information.

NOTE: Autoset is only allowed during full voltage running.

411	Multi Setting
no	**Autoset**
Default:	no
Range:	no, YES
no	No action
YES	Autoset

Normal load [412]

This menu is available if Max or Min power alarm is enabled in menu [400] or [401]. Normal load is the shaft power needed under normal operation conditions. By default, Normal load is considered to be 100% of the nominal motor power. Depending on the dimensioning of the motor with respect to the application, this value may need to be adapted. Normal load can easily be adapted by using the Autoset function in menu [411]. Normal load is set as apercentage of nominal motor power.

NOTE: When using the load monitor, check that the nominal motor power is set properly in menu [212].

412	Setting
100	**Normal load**
Default:	100%
Range:	0-200% of P_n
0-200	Normal load

Output shaft power [413]

This menu is available if max or min power alarm is enabled in menu [400] or [401]. The menu provides a read-out of the actual shaft power. It can be used as input information when the normal load is set manually.

413	Read-out
0	**Output shaft power**
Range:	0-200% of P_n

8.8.2 External alarm [420]

The MSF 2.0 can generate an alarm according to the status of an external signal. For a detailed description of the external alarm functionality see section 8.9.5, page 89.

The following alternatives are available for external alarm:

Off

External alarm is deactivated.

Warning

Alarm message F17 is shown in the display and relay K3 is activated (for default configuration of the relays) if the external alarm input is opened. However, the motor is not stopped and operation continues. The alarm message will disappear and the relay will be reset when the external alarm input is closed again. The alarm may also be reset manually.

Coast

Alarm message F17 is shown in the display and relay K3 is activated (for default configuration of the relays) if the external alarm input is opened. The motor voltage is automatically switched off. The motor freewheels until it stops.

Stop

Alarm message F17 is shown in the display and relay K3 is activated (for default configuration of the relays) if the external alarm input is opened. The motor is stopped according to the stop settings in menus [320] to [325].

Brake

Alarm message F17 is shown in the display and relay K3 is activated (for default configuration of the relays) if the external alarm input is opened. The brake function is activated according to the braking method chosen in menu [323] and the motor is stopped according to the alarm brake settings in menus [326] to [327] (braking strength and braking time).

Spinbrake

The functionality for the spinbrake alternative is the same as described above for the brake alternative. However, if spinbrake is chosen, braking can even be initiated from an inactive state by opening the external alarm input. This means the softstarter can catch a freewheeling motor and brake it down to standstill. The spinbrake alternative is only available for external alarm.

If the operation has been interrupted due to an external alarm, a reset signal and a new start signal are needed to restart the motor. The reset and the start signal can be given via control panel, remotely or via serial communication depending on the control source chosen in menu [200]. Regardless of the chosen control source, it is always possible to initiate a reset via control panel..

NOTE: A reset via control panel will never start the motor.

420 Setting

oFF

External alarm (alarm code F17)

Default:	oFF
Range:	oFF, 1, 2, 3, 4, 5
oFF	External alarm is disabled.
1	Warning
2	Coast
3	Stop
4	Brake
5	Spinbrake

8.8.3 Mains protection

The MSF 2.0 continuously monitors the mains voltage. This means the motor can easily be protected from over- and undervoltages as well as from voltage unbalance conditions. A phase reversal alarm is also available.

For mains protection the following alternatives are available:

Off

The protection method is deactivated.

Warning

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays). However, the motor is not stopped and operation continues. The alarm message will disappear and the relay will be reset when the fault disappears. The alarm may also be reset manually.

Coast

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays). The motor voltage is automatically switched off. The motor freewheels until it stops.

Stop

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays). The motor is stopped according to the stop settings in menus [320] to [325].

Brake

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays). The brake function is activated according to the braking method chosen in menu [323] and the motor is stopped according to the alarm brake settings in menus [326] to [327] (braking strength and braking time).

An overvoltage, undervoltage or voltage unbalance alarm is automatically reset when a new start signal is given. If the operation has been interrupted due to a phase reversal alarm, a reset signal and a new start signal are needed to restart the motor. The reset and the start signal can be given via control panel, remotely or via serial communication depending on the control source chosen in menu [200]. Regardless of the chosen control source, it is always possible to initiate a reset via control panel.

NOTE: A reset via control panel will never start the motor.

Voltage unbalance alarm [430]

In this menu voltage unbalance alarm is enabled and a proper action is selected.

430 Setting

oFF

Voltage unbalance alarm (alarm code F8)

Default:	oFF
Range:	oFF, 1, 2, 3, 4
oFF	Voltage unbalance alarm is disabled.
1	Warning
2	Coast
3	Stop
4	Brake

Unbalance voltage level [431]

This menu is available if voltage unbalance alarm is enabled in menu [430]. In this menu the maximum allowed voltage unbalance level is selected. If the difference between any two line voltages exceeds the chosen level for the response delay time set in menu [432], a voltage unbalance alarm will occur and the action selected in menu [430] will be executed.

431 Setting

10 **Voltage unbalance level**

Default:	10%
Range:	2-25% of U_n
2-25	Voltage unbalance level.

Response delay voltage level unbalance alarm [432]

This menu is available if voltage unbalance alarm is enabled in menu [430]. In this menu the response delay for voltage unbalance alarm is selected. If the difference between any two line voltages exceeds the level set in menu [431] for the chosen response delay time, a voltage unbalance alarm will occur and the action selected in menu [430] will be executed.

432 Setting

1 **Response delay voltage unbalance alarm**

Default:	1 s
Range:	1-90 s
1-90	Response delay for voltage unbalance alarm.

Overvoltage alarm [433]

In this menu overvoltage alarm is enabled and a proper action is selected.

433 Setting

oFF **Overvoltage alarm (alarm code F9)**

Default:	oFF
Range:	oFF, 1, 2, 3, 4
oFF	Overvoltage alarm is disabled.
1	Warning
2	Coast
3	Stop
4	Brake

Overvoltage level [434]

This menu is available if overvoltage alarm is enabled in menu [433]. In this menu the voltage level for an overvoltage alarm is selected. If any line voltage exceeds the chosen level for the response delay time set in menu [435], an overvoltage alarm will occur and the action selected in menu [433] will be executed.

434 Setting

115 **Overvoltage level**

Default:	115%
Range:	100-150% of U_n
100-150	Overvoltage level

Response delay overvoltage alarm [435]

This menu is available if overvoltage alarm is enabled in menu [433]. In this menu the response delay for overvoltage alarm is selected. If any line voltage exceeds the level set in menu [434] for the chosen response delay time, an overvoltage alarm will occur and the action selected in menu [433] will be executed.

435 Setting

1 **Response delay overvoltage alarm**

Default:	1 s
Range:	1-90 s
1-90	Response delay for overvoltage alarm.

Undervoltage alarm [436]

In this menu undervoltage alarm is enabled and a proper action is selected.

436 Setting

oFF **Undervoltage alarm (alarm code F10)**

Default:	oFF
Range:	oFF, 1, 2, 3, 4
oFF	Undervoltage alarm is disabled.
1	Warning
2	Coast
3	Stop
4	Brake

Undervoltage level [437]

This menu is available if undervoltage alarm is enabled in menu [436]. In this menu the voltage level for an undervoltage alarm is selected. If any line voltage is below the chosen level for the response delay time set in menu [438], an undervoltage alarm will occur and the action selected in menu [436] will be executed.

437	Setting
85	**Undervoltage level**
Default:	85%
Range:	75-100% of U_n
75-100	Undervoltage level

Response delay undervoltage alarm [438]

This menu is available if undervoltage alarm is enabled in menu [436]. In this menu the response delay for undervoltage alarm is selected. If any line voltage is below the level set in menu [437] for the chosen response delay time, an undervoltage alarm will occur and the action selected in menu [436] will be executed.

438	Setting
1	**Response delay undervoltage alarm**
Default:	1 s
Range:	1-90 s
1-90	Response delay for undervoltage alarm

Phase sequence [439]

In this menu the actual phase sequence is shown.

NOTE! The actual phase sequence can only be shown with a motor connected.

439	Read-out
L- - -	**Phase sequence**
Range:	L123, L321
L123	Phase sequence L1, L2, L3
L321	Phase sequence L3, L2, L1
L- - -	Phase sequence can not be detected

Phase reversal alarm [440]

In this menu phase reversal alarm is enabled and a proper action can be chosen. The softstarter will detect the phase sequence prior to each start attempt. If the actual phase sequence does not match the phase sequence stored during activation of phase reversal alarm, the action chosen in this menu will be executed. If alternative 2 (Coast) is chosen, no start will be performed if the wrong phase sequence is detected.

To activate phase reversal alarm, a motor has to be connected and the mains voltage has to be switched on. This means activation of phase reversal alarm can either be done in stopped state with the mains contactor switched on manually or during full voltage running.

440	Setting
oFF	**Phase reversal alarm (alarm code F16)**
Default:	oFF
Range:	oFF, 1, 2
oFF	Phase reversal alarm is disabled.
1	Warning
2	Coast

NOTE! The actual phase sequence can be viewed in menu [439].

8.9 I/O settings

In this section the programmable inputs and outputs are described.

[500]-[513] Input signals

[520]-[534] Output signals

A connection example using most of the available in- and outputs is shown in Fig. 53.

This section includes also detailed descriptions of the following functions:

- Start/stop/reset command functionality
- Start right/left functionality
- External alarm functionality
- External control of parameter set

8.9.1 Input signals

The MSF 2.0 has one programmable analogue/digital input and four programmable digital inputs for remote control.

Analogue/digital input [500]

The analogue/digital input can either be programmed for analog or digital functionality. The following alternatives are available when using the input for digital signals:

Rotation sensor

An external rotation sensor can be used for the braking functions. If the analogue/digital input is configured for rotation sensor functionality in menu [500], braking will be deactivated if the number of edges chosen in menu [501] is detected on the input.

Slow speed

This alternative is used for slow speed controlled by an external signal (see the description of slow speed and jog functions in section 8.7.4, page 63 for more information). If the number of edges set in menu [501] is detected on the input, slow speed at start or stop will be finished.

Jog Forward

With this alternative, slow speed in forward direction can be activated via the analogue/digital input. Slow speed will be active as long as the input signal is high. See the description of slow speed and jog functions in section 8.7.4, page 63 for more information. Note that "JOG" forward has to be enabled in menu [334] to use this function.

Jog reverse

With this alternative, slow speed in reverse direction can be activated via the analogue/digital input. Slow speed will be active as long as the input signal is high. See the description of slow speed and jog functions in section 8.7.4, page 63 for more information. Note that "JOG" reverse has to be enabled in menu [335] to use this function.

Autoset

When the analogue/digital input is configured for Autoset, a rising edge on the input will initiate an Autoset. Note that an Autoset only can be performed during full voltage running. See description of load monitor functionality in section 8.8.1, page 69 for more information

The following alternatives are available when using the input for analogue signals:

Analogue start/stop: 0-10 V/0-20 mA or 2-10 V/4-20 mA:

The analogue/digital input is used for the reference signal which controls analogue start stop. Two signal ranges (0-10 V/0-20 mA or 2-10 V/4-20 mA) can be chosen. Analogue start/stop is activated if alternative 6 or 7 is chosen in menu [500]. See the description of Analogue start/stop on page 79 for more information.

500	Setting
oFF	**Analogue/digital input**
Default:	oFF
Range:	oFF, 1-7
oFF	Analogue/digital input disabled
1	Digital, Rotation sensor
2	Digital, Slow speed
3	Digital, Jog forward
4	Digital, Jog reverse
5	Digital, Autoset
6	Analogue start/stop: 0-10 V/0-20 mA
7	Analogue start/stop: 2-10 V/4-20 mA

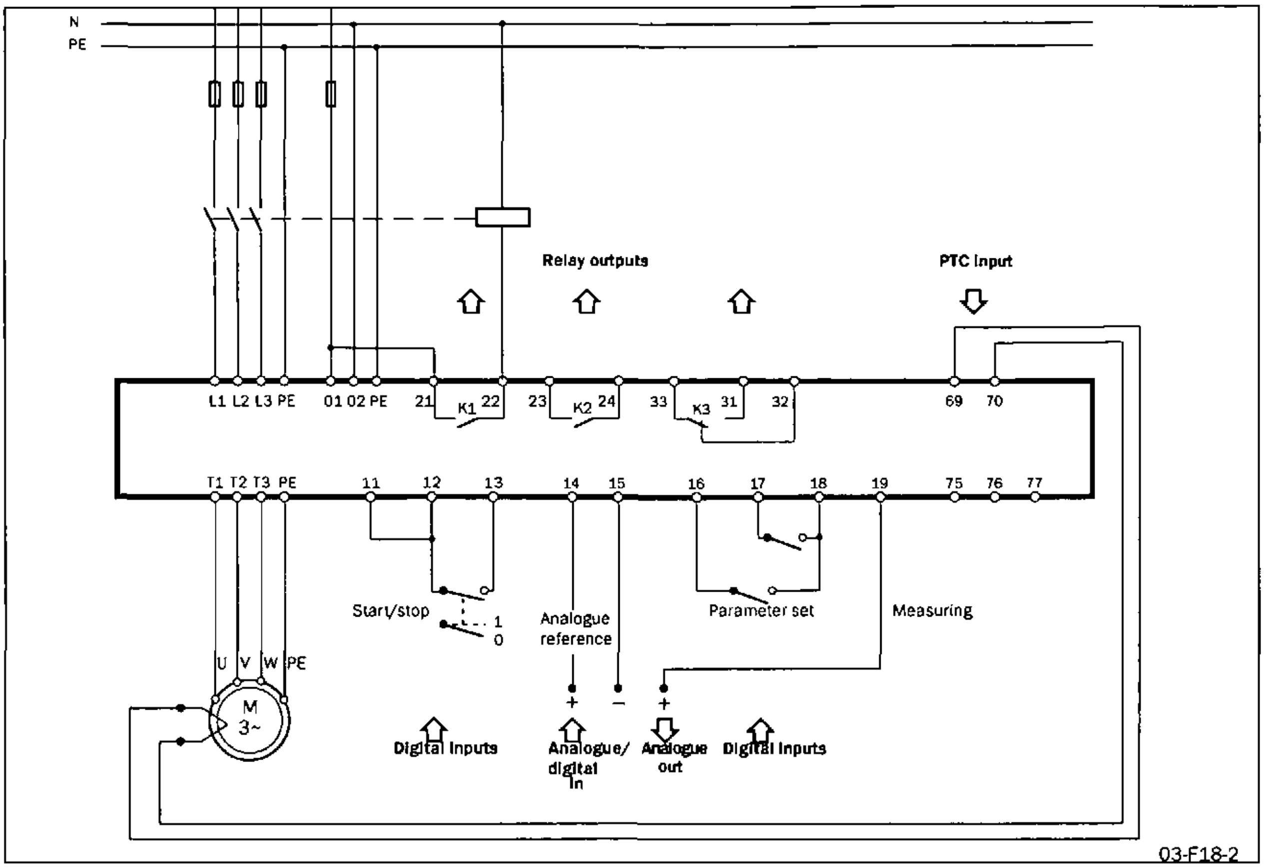


Fig. 53 Connection example when using the digital and analogue inputs and outputs

Digital input

The analogue/digital input is used as a digital input if one of alternatives 1-5 in menu [500] is selected. Jumper J1 has to be set for voltage control, which is the default setting.

The input signal is interpreted as 1 (high) when the input voltage exceeds 5 V. When the input voltage is below 5 V the input signal is interpreted as 0 (low). The input signal can be generated using the internal control supply voltage by connecting a switch between terminal 14 (analogue/digital input) and 18 (supply voltage to terminals 14, 16 and 17).

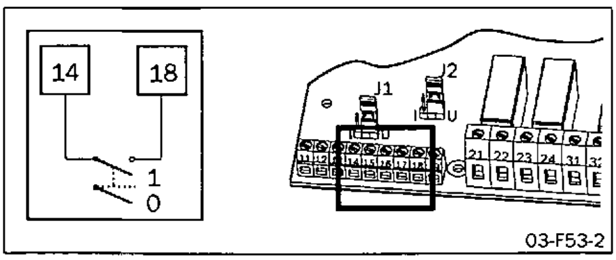


Fig. 54 Wiring for digital input signal.

Digital input pulses [501]

This menu is available if the analogue/digital input is programmed for digital input signals for rotation sensor (alternative 1) or for slow speed (alternative 2) in menu [500]. In this menu the number of edges is chosen to deactivate the braking function or the slow speed function respectively. .

NOTE: All edges, both positive and negative transitions, will be counted.

501	Setting
Digital input pulses	1
Default:	1
Range:	1-100
1-100	Number of edges

Analogue input

The analogue/digital input is used as an analogue input if one of alternatives 6-7 in menu [500] is selected. In this case, the input can be configured for voltage or current signal using jumper J1 (see Fig. 55). By default jumper J1 is set to voltage signal. According to the chosen alternative in menu [500], the signal will be interpreted as 0-10 V/ 0-20 mA or 2-10 V/4-20 mA (see Fig. 56).

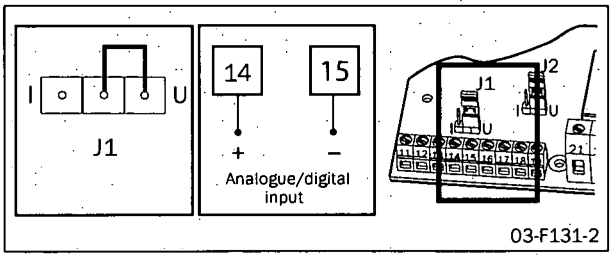


Fig. 55 Wiring for analogue/digital input and setting of J1 for analogue current or voltage control.

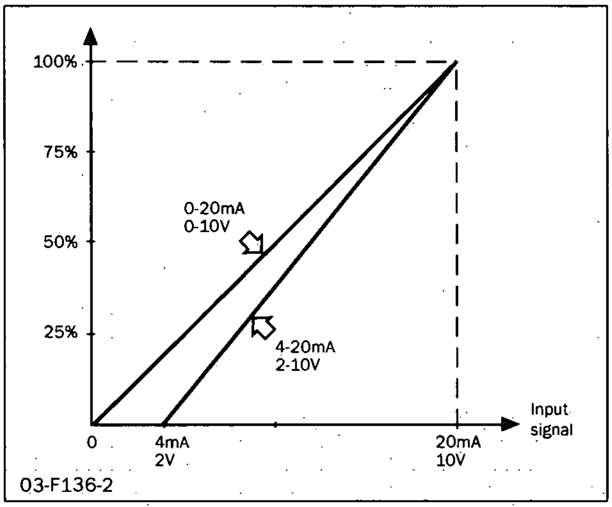


Fig. 56 Analogue input

Analogue start/stop

Starts and stops can be performed according to a process signal on the analogue/digital input. This means that e.g. the operation of a pump may be controlled according to a flow signal.

Analogue start/stop is available if remote control or serial communication control is chosen in menu [200] (alternatives 2 or 3).

NOTE: Analogue start/stop is not available if control panel is chosen as control source in menu [200] (alternative 1).

If a start signal is given via remote or serial communication (according to the setting in menu [200]), the softstarter will check the reference signal on the analogue/digital signal. A start will be performed if the level of the reference signal is below the analogue start/stop on-value chosen in menu [502] for a longer time than the analogue start/stop delay time set in menu [504]. A stop will be performed if the reference signal exceeds the analogue start/stop off-value chosen in menu [503] for a longer time than the analogue start/stop delay time set in menu [504].

NOTE: If the selected analogue start/stop on-value is bigger than or equal to the off-value, a level above the on-value at the analogue input will cause a start. A value below the off-value will in this case cause a stop.

The start/stop LED on the front of the MSF will be flashing if the softstarter is in standby mode waiting for an analogue start.

Warning: A flashing start/stop LED is indicating standby mode - e.g. waiting for an analogue start. The motor may be started automatically at a moment's notice

Analogue start/stop on-value [502]

This menu is available if analogue start/stop is activated in menu [500] (alternative 6 or 7). If the reference signal on the analogue/digital input is below the chosen on-level for a longer time than the analogue start/stop delay time chosen in menu [504], a start will be performed..

NOTE: If the selected analogue start/stop on-value is bigger than or equal to the off-value, a level above the on-value at the analogue/digital input will cause a start.

NOTE: An analogue start will only be performed if the softstarter has been set to standby mode by a valid start signal via remote control or serial communication.

The analogue start/stop on-value is chosen as a percentage of the input signal range. This means, if the analogue/digital input is configured for 0-10 VDC/0-20 mA (alternative 6 in menu [500]), 25% corresponds to 2.5 V or 5 mA. If the analogue/digital input is configured for 2-10 VDC/4-20 mA (alternative 7 in menu [500]), 25% corresponds to 4 V or 8 mA.

502 | Setting

Analogue start/stop on-value

25

Default:	25%
Range:	0-100% of input signal range
0-100	Analogue start/stop on-value.

Analogue start/stop off-value [503]

This menu is available if analogue start/stop is activated in menu [500] (alternatives 6 or 7). If the reference signal on the analogue/digital input exceeds the chosen off-level for a longer time than the analogue start/stop delay time chosen in menu [504], a stop will be performed.

NOTE: If the selected analogue start/stop off-value is less than or equal to the on-value, a level below the off-value at the analogue/digital input will cause a stop.

NOTE: A stop will also be performed if the softstarter receives a stop signal via remote control or serial communication.

The analogue start/stop off-value is chosen as a percentage of the input signal range. This means if the analogue/digital input is configured for 0-10 V / 0-20 mA (alternative 6 in menu [500]), 25% corresponds to 2.5 V or 5 mA. If the analogue/digital input is configured for 2-10 V / 4-20 mA (alternative 7 in menu [500]), 25% corresponds to 4 V or 8 mA.

503 Setting

Analogue start/stop off-value

75

Default:	75%
Range:	0-100% of input signal range
0-100	Analogue start/stop off-value.

Analogue start/stop delay time [504]

This menu is available if analogue start/stop is activated in menu [500] (alternatives 6 or 7). In this menu the delay time for starts and stops caused by the analogue reference signal is set.

504 Setting

Analogue start/stop delay time

1 s

Default:	1 s
Range:	1-999 s
1-999	Delay time for analogue start/stop

Digital inputs

The MSF 2.0 has four programmable digital inputs. The four inputs and their corresponding control supply terminals are shown overleaf in Fig. 57.

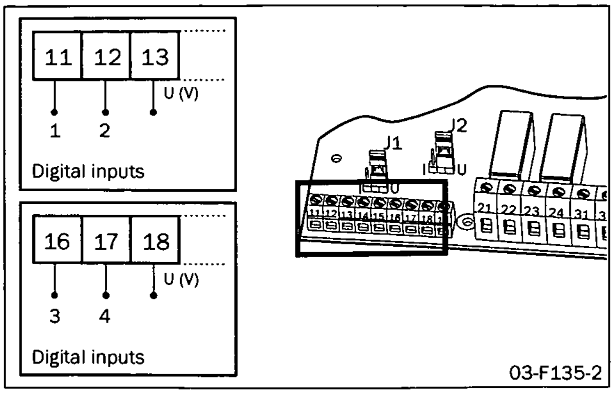


Fig. 57 Wiring for digital inputs 1-4.

The four digital inputs are electrically identical.The digital inputs can be used for remote control of start, stop and reset, for choice of parameter set and for external alarm.

Stop signal

If remote control is chosen in menu [200] (alternative 2), one digital input has to be programmed as stop signal.

NOTE: No starts will be allowed if the input set for stop signal is open or if no input is configured for stop signal.

If the motor is running a stop will be performed according to the stop settings in menus [320] to [325] as soon as the input configured for stop signal is opened. If more than one input is configured for stop signal, opening one of these will lead to a stop. Accordingly no starts will be allowed if any of these inputs is open.

Start and reset signal

The digital inputs can be configured for several different start signals (start, start R or start L signal). Closing any input, which is configured for start, will start the motor. Moreover, a rising edge on any input configured for start is interpreted as a reset signal.

NOTE: If more than one digital input is configured for any of the start signals (start, start R or start L), closing more than one of these inputs at the same time will lead to a stop. However, if several digital inputs are configured for the same start functionality, e.g. start R, closing any of these inputs will lead to a start.

Naturally the softstarter has no way of controlling the motor's running direction internally. However, if two mains contactors – one for each phase sequence – are used, these can be controlled by the softstarter using the programmable relays. The settings for the programmable relays in menus [530] to [532] correspond to the different start signals, which can be chosen for the digital inputs. In this way different running directions for the motor can be chosen.

Example

1. If only one running direction is used, digital input 1 can be configured for start signal and digital input 2 for stop signal (default setting). In this case relay K1 may be configured for operation (default setting) and can control the mains relay. When digital inputs 1 and 2 are closed, the mains contactor will be activated and the motor will start. When digital input 2 is opened the motor will stop. The mains contactor will be deactivated after the stop has been finished.
2. If two running directions are desired, digital input 1 can be configured for start R, digital input 2 for stop and digital input 3 for start L. Relay K1 controls the mains contactor for running in right direction and may be configured for Operation R. Relay K2 controls the mains contactor with the opposite phase sequence for running in left direction and may be configured for Operation L. In this case closing digital inputs 1 and 2 (start right command) will lead to activation of the mains contactor for running in right direction and the motor will start in right direction. Opening digital input 2 will lead to a stop; the mains contactor for running right will be deactivated after the stop has been finished. Closing digital inputs 2 and 3 (while digital input 1 is open) will lead to activation of the mains contactor for running in left direction and the motor will start in left direction.

For more information see the description of the start right/ left functionality in section 8.9.4, page 87.

External alarm

The digital inputs can be configured as external alarm inputs. If an input configured for external alarm is opened, the action chosen in menu [420] for external alarm is performed. See description of the external alarm functionality in section 8.9.5, page 89 for more information.

NOTE: If more than one digital input is configured for external alarm, opening any of these will lead to an external alarm.

Parameter set

This configuration enables choice of parameter set by an external signal. See description of external control of parameter set in section 8.9.6, page 90 for more information.

Digital input 1 function [510]

In this menu the function for digital input 1 (terminal 11) is selected.

510 Setting

Digital input 1 function

1

Default:	1
Range:	oFF, 1, 2, 3, 4, 5, 6, 7
oFF	Digital input 1 is disabled
1	Start signal
2	Stop signal
3	Parameter set, input 1
4	Parameter set, input 2
5	External alarm signal
6	Start R signal
7	Start L signal

Digital input 2 function [511]

In this menu the function for digital input 2 (terminal 12) is selected.

511 Setting

Digital input 2 function

2

Default:	2
Range:	Off, 1, 2, 3, 4, 5, 6, 7
oFF	Digital input 2 is disabled.
1	Start signal
2	Stop signal
3	Parameter set, input 1
4	Parameter set, input 2
5	External alarm signal
6	Start R signal
7	Start L signal

Digital input 3 function [512]

In this menu the function for digital input 3 (terminal 16) is selected.

512	Setting
3	**Digital input 3 function**
Default:	3
Range:	oFF, 1, 2, 3, 4, 5, 6, 7
oFF	Digital input 3 is disabled.
1	Start signal
2	Stop signal
3	Parameter set, input 1
4	Parameter set, input 2
5	External alarm signal
6	Start R signal
7	Start L signal

Digital input 4 function [513]

In this menu the function for digital input 4 (terminal 17) is selected.

513	Setting
4	**Digital input 4 function**
Default:	4
Range:	oFF, 1, 2, 3, 4, 5, 6, 7
oFF	Digital input 4 is disabled.
1	Start signal
2	Stop signal
3	Parameter set, input 1
4	Parameter set, input 2
5	External alarm signal
6	Start R signal
7	Start L signal

8.9.2 Output signals

The MSF 2.0 has one programmable analogue output and three programmable relays.

Analogue output

The analogue output can present current, voltage, shaft power and torque for connection to a recording instrument, PLC etc. The external device is connected to terminals 19 (+) and 15 (-) according to Fig. 58 below. The analogue output can be configured for voltage or current signal. The selection is made by jumper J2 on the control board. The default setting for J2 is voltage signal according to Fig. 58.

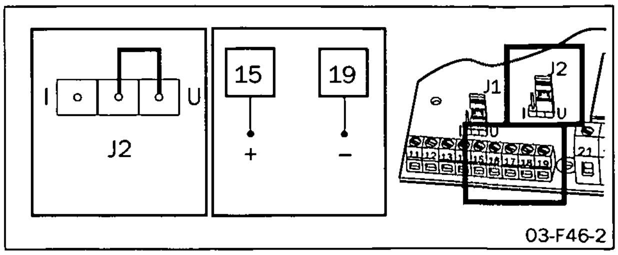


Fig. 58 Wiring for analogue output and setting of J2 for analogue current or voltage signal.

Analogue output [520]

In this menu the analogue output can be set to provide either one of the signal ranges shown in Fig. 59.

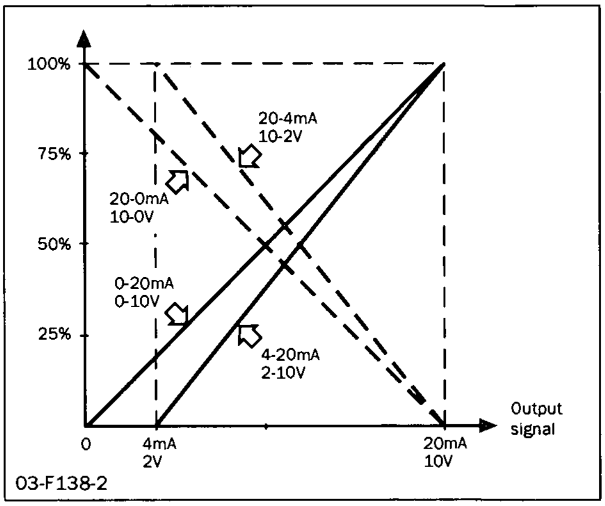


Fig. 59 Analogue output

520	Setting
oFF	**Analogue output**
Default:	oFF
Range:	oFF, 1, 2, 3, 4
oFF	Analogue output is disabled.
1	Analogue signal 0-10 V/0-20 mA
2	Analogue signal 2-10 V/4-20 mA
3	Analogue signal 10-0 V/20-0 mA
4	Analogue signal 10-2 V/20-4 mA

Analogue output function [521]

This menu is available if the analogue output is enabled in menu [520] (alternatives 1-4). In this menu the desired output function is chosen.

521	Setting
1	**Analogue output function**
Default:	1
Range:	1, 2, 3, 4
1	RMS current
2	Line voltage
3	Shaft power
4	Torque

The scaling of the analogue output is reset to the default values (0-100%) if a new output value is chosen in menu [521].

Analogue output scaling

By default the scaling of the analogue output corresponds to Fig. 60. In this case the signal range of the analogue output chosen in menu [520] corresponds to 0 to 100% of the nominal motor current I_n, the nominal motor voltage U_n, the nominal motor power P_n or the nominal motor torque T_n respectively.

Example

If 0-10 V / 0-20 mA is chosen in menu [520] (alternative 1) and RMS current is chosen as output value in menu [521] (alternative 1), a current of 100% of the nominal motor current gives 10 V or 20 mA at the analogue output. A current of 25% of the nominal motor current gives 2.5 V or 5 mA at the analogue output.

The scaling of the analogue output may be adapted for higher resolution or if values above the nominal values are to be monitored. The scaling is done by choosing a minimum scaling value in menu [522] and a maximum value in menu [523]. An example for a different scaling is shown in Fig. 60.

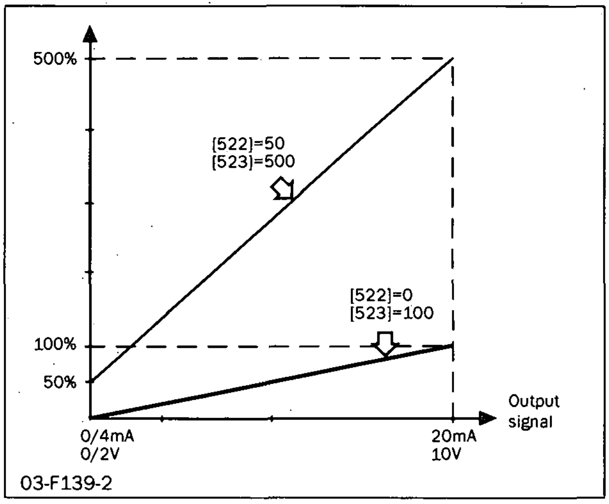


Fig. 60 Scaling of analogue output

With the scaling for wide range (menu [522]=50 and menu [523]=500) according to the example in Fig. 60 the following will apply.

If 0-10 V/0-20 mA is chosen in menu [520] (alternative 1) and RMS current is chosen as output value in menu [521] (alternative 1), a current of 100% of the nominal motor current gives approximately 1.1 V or 2.2 mA at the analogue output.

Scaling analogue output, min [522]

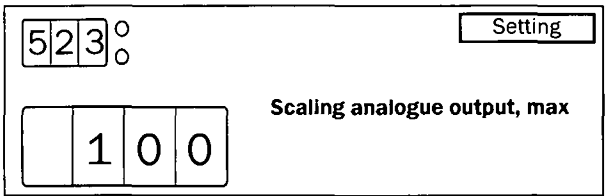
This menu is available if the analogue output is enabled in menu [520]. In this menu the minimum value to be shown at the analogue output is chosen. The value is chosen in percent of I_n, U_n, P_n or T_n according to the output value chosen in menu [521].

522	Setting
0	**Scaling analogue output, min**
Default:	0%
Range:	0-500%
0-500	Minimum output value

NOTE: The minimum value for scaling the analogue output is reset to the default value 0% if a new output value is chosen in menu [521].

Scaling analogue output, max [523]

This menu is available if the analogue output is enabled in menu [520]. In this menu the maximum value to be shown at the analogue output is chosen. The value is chosen as a percentage of I_n, U_n, P_n or T_n according to the output value chosen in menu [521].



Default:	100%
Range:	0-500%
0-500	Maximum output value.

NOTE: The maximum value for scaling the analogue output is reset to the default value 100% if a new output value is chosen in menu [521].

Programmable relay outputs

The softstarter has three built-in relays, K1, K2 and K3. All three relays are programmable.

For relay K1 (terminals 21 and 22) and K2 (terminals 23 and 24) the contact function can be programmed in menus [533] and [534] respectively to be normally open (NO) or normally closed (NC). Relay K3 is a change-over relay with three terminals (31-33), the NO functionality is available between terminals 31 and 32, NC functionality between terminals 32 and 33.

The relays can be used to control mains contactors or a bypass contactor or to indicate alarm conditions. As illustrated in Fig. 61 overleaf, the Operation setting (alternative 1) should be chosen to activate the mains contactor both during start, full voltage operation and stop. If a by-pass contactor is used, this can be controlled by a relay with the setting Full voltage (2). The settings Run (5) and Brake (4) are used when reverse current brake is chosen as stop method. In this case one relay has to be configured for Run and will control the mains contactor during the start and during full voltage operation. Another relay has to be configured for Brake and will control the contactor with reversed phase sequence during braking. For security reasons the relay configured for Brake will not be activated until after a time delay of 500 ms after deactivation of the relay configured for Run.

The settings Run R, Run L, Operation R and Operation L are used for the start right/left functionality. Consult section 8.9.4, page 87 for more information.

Different alarms can also be indicated on the relay outputs. With the setting Power pre-alarms (alternative 3), both a Max power pre-alarm or a Min power pre-alarm occurring will activate the relay. When Power alarms (10) is chosen as a setting, both a Max power alarm or a Min power alarm will activate the relay. If so desired, the relays can instead be programmed to react only to one specific power alarm or pre-alarm (11 - 14).

With setting All alarms (15) the relay will be activated for any alarm. As the power pre-alarms are not considered to be real alarms, the relay will not react to those. With alternative 16 chosen, even the power alarms are excluded. When External alarm (17) is chosen, only an External alarm will activate the relay. With setting 18, Autoreset expired, the relay will be activated when an additional fault occurs after the maximum allowed number of autoreset attempts have been executed. This may indicate that external help is needed to rectify a re-occurring fault (see description of Autoreset in section 8.5, page 52 for detailed information). With alternative 19 the relay will indicate all alarms which need a manual reset. This includes all alarms which are not solved with an automatic Autoreset, e.g. all alarms for which Autoreset is not enabled and each alarm occurring after the maximum allowed number of autoreset attempts has been executed.

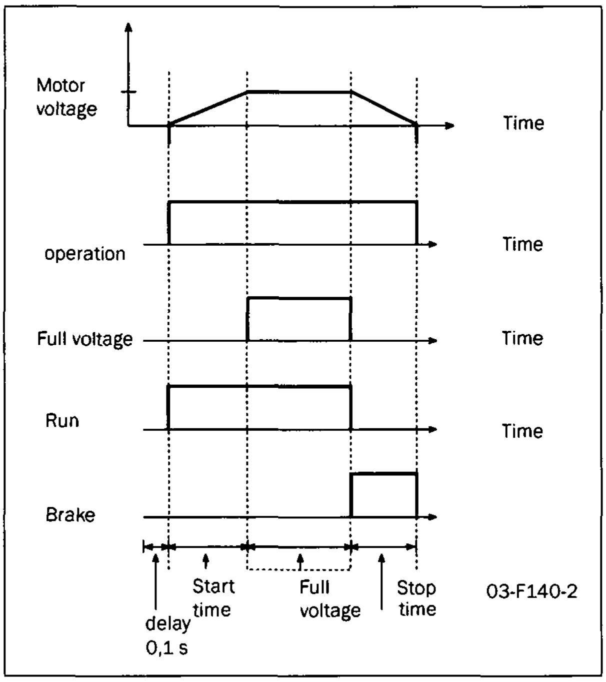


Fig. 61 The relay functions for operation, run and full voltage.

Relay K1 [530]

In this menu the function for relay K1 (terminals 21 and 22) is chosen.

530	Setting
Relay K1	1
Default:	1
Range:	oFF, 1 - 19
oFF	Relay inactive
1	Operation
2	Full voltage
3	Power pre-alarms
4	Brake
5	Run
6	Run R
7	Run L
8	Operation R
9	Operation L
10	Power alarms
11	Max power alarm
12	Max power pre-alarm
13	Min power alarm
14	Min power pre-alarm
15	All alarms (except power pre-alarms)
16	All alarms (except power alarms and pre-alarms)
17	External alarm
18	Autoreset expired
19	All alarms which need manual reset

NOTE: If relay K1 is chosen to be inactive (oFF), the relay state is determined by the contact function in menu [533].

WARNING: When reverse current brake is activated by changing the settings in menu [320] (stop method), [323] (braking method) or [326] (alarm brake strength), relay K1 is automatically set for Run (5). If a different setting is desired for the specific application, the relay setting has to be changed afterwards.

Relay K2 [531]

In this menu the function for relay K2 (terminals 23 and 24) is chosen.

531	Setting
Relay K2	2
Default:	2
Range:	oFF, 1-19
oFF	Relay inactive
1-19	See menu "Relay K1 [530]" for setting alternatives.

NOTE: If relay K2 is chosen to be inactive (oFF), the relay state is determined by the contact function in menu [534].

WARNING: When reverse current brake is activated by changing the settings in menu [320] (stop method), [323] (braking method) or [326] (alarm brake strength), relay K2 is automatically set for Brake (4). If a different setting is desired for the specific application, the relay setting has to be changed afterwards.

Relay K3 [532]

In this menu the function for relay K3 (terminals 31-33) is chosen.

532	Setting
Relay K3	15
Default:	15
Range:	oFF, 1-19
oFF	Relay inactive
1-19	See menu "Relay K1 [530]" for setting alternatives.

K1 contact function [533]

In this menu the contact function for relay K1 can be chosen. The available alternatives are Normally open (1=Closing on relay activation) and Normally closed (2=Opening on relay activation).

533 Setting

K1 contact function

1

Default:	1
Range:	1, 2
1	Normally open (N.O.)
2	Normally closed (N.C.)

K2 contact function [534]

In this menu the contact function for relay K2 can be chosen. The available alternatives are Normally open (1=Closing on relay activation) and Normally closed (2=Opening on relay activation).

534 Setting

K2 contact function

1

Default:	1
Range:	1, 2
1	Normally open (N.O.)
2	Normally closed (N.C.)

8.9.3 Start/stop/reset command functionality

Starting/stopping of the motor and alarm reset is done either from the control panel, through the remote control inputs or through the serial communication interface depending on the control source chosen in menu [200].

Control panel

To start and stop from the control panel, the "START/STOP" key is used.

To reset from the control panel, the "ENTER ↵ /RESET" key is used.

Regardless of the chosen control source, it is always possible to initiate a reset via the control panel.

NOTE! A reset via the control panel will never start the motor.

Serial communication

For description of the start, stop and reset commands via serial communication see the operation instruction supplied with this option.

Remote control

When remote control is chosen in menu [200], the digital inputs are used to start and stop the motor and to reset upcoming alarms. In the following sections different possibilities for connecting the digital inputs are described. For the following explanations the following settings are assumed:

Menu	Description	Setting
510	Digital input 1 (terminal 11)	Start signal (1)
511	Digital input 2 (terminal 12)	Stop signal (2)

2-wire start/stop with automatic reset at start

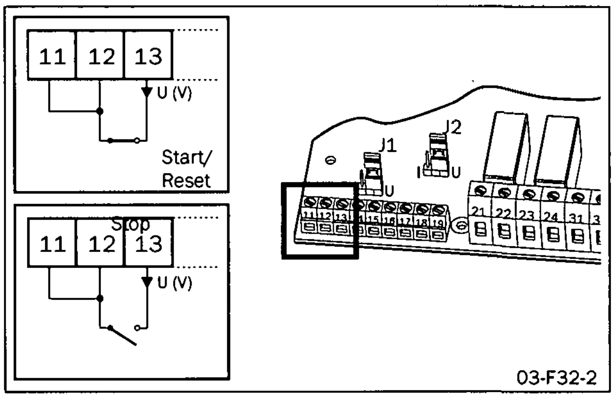


Fig. 62 2-wire connection of terminals for start/stop/automatic reset at start

An external switch is connected between terminals 12 and 13 and a jumper is connected between terminals 11 and 12.

Start

Closing terminal 12 to terminal 13 will give a start command. If terminal 12 is closed to terminal 13 at power up, a start command is given immediately (automatic start at power up).

Stop

Opening terminal 12 will give a stop command.

Reset

When a start command is given there will automatically be a reset.

2-wire start/stop with separate reset

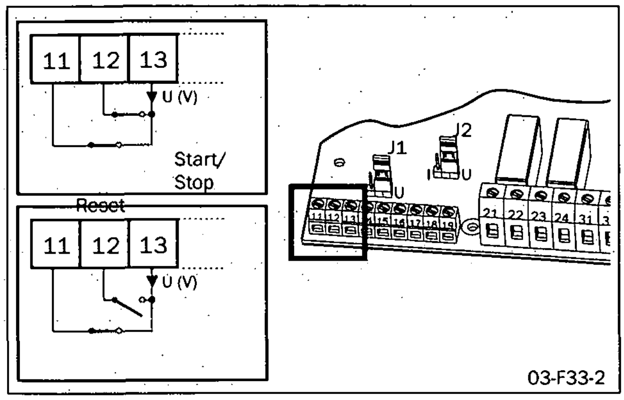


Fig. 63 2-wire connection of terminals for start/stop/separate reset

One external switch is connected between terminals 11 and 13 and a second switch is connected between terminals 12 and 13.

Start

Closing terminals 11 and 12 to terminal 13 will give a start command. If terminals 11 and 12 are closed at power up, a start command is given immediately (automatic start at power up).

Stop

Opening terminal 12 will give a stop command.

Reset

When terminal 11 is opened and closed again a reset is given. A reset can be given both when the motor is running and when it is stopped.

3-wire start/stop with automatic reset at start

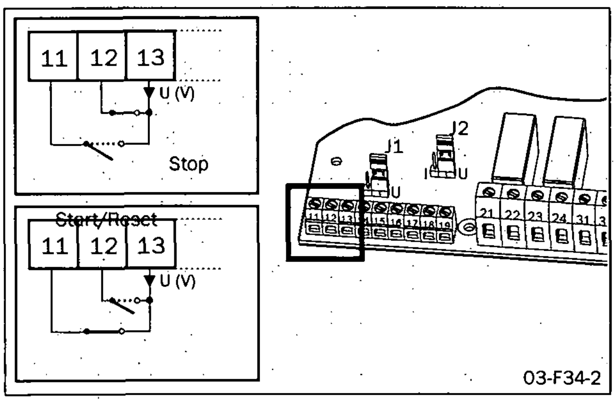


Fig. 64 Connection of terminals for start/stop/reset

An external switch is connected between terminals 11 and 13 and a second switch is connected between terminals 12 and 13.

The connection between terminal 11 and 13 is normally open and the connection between terminal 12 and 13 is normally closed.

Start

Closing terminal 11 momentarily to terminal 13, will give a start command. There will not be an automatic start at power up as long as terminal 11 is open.

Stop

To stop, terminal 12 is momentarily opened.

Reset

When a start command is given there will automatically be a reset.

8.9.4 Start right/left functionality

The digital inputs can be configured to enable starting a motor in two different directions in combination with the programmable relays K1 and K2. A connection example is shown in Fig. 65. For the following description of the start right/left functionality, the following settings for the digital inputs are assumed.

Menu	Description	Setting
510	Digital input 1 (terminal 11)	Start R signal (6)
511	Digital input 2 (terminal 12)	Stop signal (2)
512	Digital input 3 (terminal 16)	Start L signal (7)

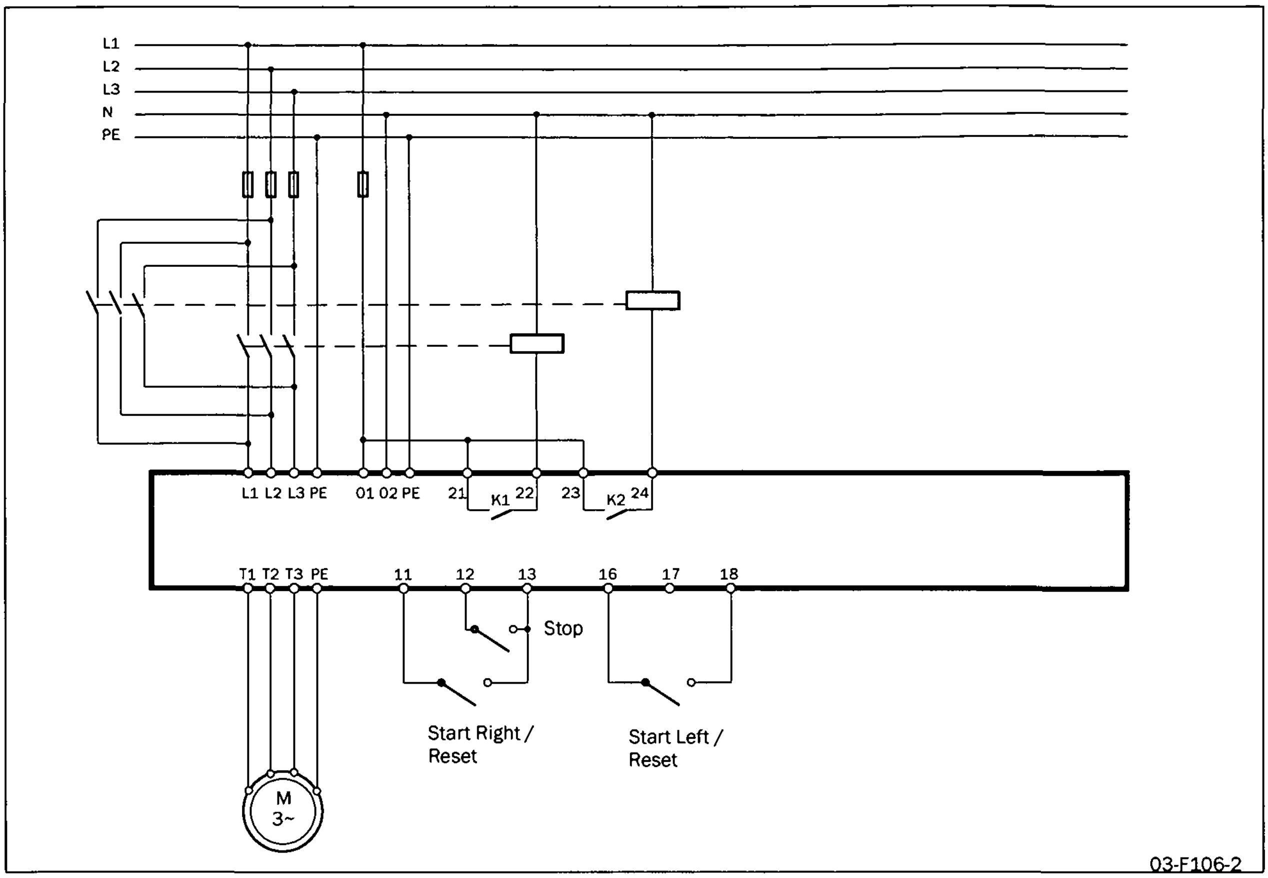


Fig. 65 Connection for start right/left

The configuration of the relays depends on the application's requirements. For applications which **do not** use the reverse current brake functionality, the following settings may be used.

Menu	Description	Setting
530	Relay K1 (terminals 21 and 22)	Operation R (8)
531	Relay K2 (terminals 23 and 24)	Operation L (9)

With these settings the functionality is as follows:

If terminals 11and 12 are closed to terminal 13 while terminal 16 is open, the mains contactor for running in right direction will be activated by relay K1 and the motor will start in right direction. If terminal 12 is opened, a stop according to the stop settings in menus [320] to [325] will be performed. When the stop is finished, the mains contactor for running right will be deactivated by relay K1.

If terminal 12 is closed to terminal 13 and terminal 16 is closed to terminal 18 while terminal 11 is open, the mains contactor for running in left direction will be activated by relay K2 and the motor will start in left direction. If terminal 12 is opened, a stop according to the stop settings in menus [320] to [325] will be performed. When the stop is finished, the mains contactor for running left will be deactivated by relay K2.

If both start terminals (11 and 16) are closed to their respective supply voltage at the same time, a stop is performed in the same way as described above. In this case no start will be allowed.

A motor can be reversed from right to left direction as follows: When the motor is running in right direction, terminal 11 is opened. Terminal 16 is then closed to terminal 18. In this case the voltage to the motor is switched off and the mains contactor for running right is deactivated by relay K1. After a time delay of 500 ms the mains contactor for running left will be activated by relay K2 and a start in left direction will be performed. The motor can be reversed from running left to running right in the same way by opening terminal 16 while running left and then closing terminal 11.

CAUTION: Very high currents can arise when the motor is reversed from running at full speed in one direction to running at full speed in the opposite direction.

WARNING: If configured according to the description above, relays K1 and K2 will never be activated at the same time. There is a time delay of 500 ms for the change-over between the relays. However, if the relays are not configured properly, they may be activated at the same time.

For applications which use the reverse current brake functionality, the following settings for the relays may be used.

Menu	Description	Setting
530	Relay K1 (terminals 21 and 22)	Run R (6)
531	Relay K2 (terminals 23 and 24)	Run L (7)

With these settings the functionality is as follows:

If terminals 11and 12 are closed to terminal 13 while terminal 16 is open, the mains contactor for running in right direction will be activated by relay K1 and the motor will start in right direction. If terminal 12 is opened the voltage to the motor is switched off and the mains contactor for running right is deactivated by relay K1. After a time delay of 500 ms the mains contactor for running left will be activated by relay K2 and the reverse current brake will brake the motor to standstill. When the stop is finished, the mains contactor for running left will be deactivated by relay K2.

If terminal 12 is closed to terminal 13 and terminal 16 is closed to terminal 18 while terminal 11 is open, the mains contactor for running in left direction will be activated by relay K2 and the motor will start in left direction. If terminal 12 is opened the voltage to the motor is switched off and the mains contactor for running left is deactivated by relay K2. After a time delay of 500 ms the mains contactor for running right will be activated by relay K1 and the reverse current brake will brake the motor to standstill. When the stop is finished, the mains contactor for running right will be deactivated by relay K1.

If both start terminals (11 and 16) are closed to their respective supply voltage at the same time, a stop is performed in the same way as described above. In this case no start will be allowed.

A motor can be reversed in the same way as described above for applications which do not use the reverse current brake functionality.

WARNING: If configured according to the description above, relays K1 and K2 will never be activated at the same time. There is a time delay of 500 ms for the change-over between the relays. However, if the relays are not configured properly, they may be activated at the same time.

NOTE: When reverse current brake is activated by changing the settings in menu [320] (stop method), [323] (braking method) or [326] (alarm brake strength), relay K1 is automatically set for Run (5) and relay K2 is automatically set for Brake (4). To use the start right/ left functionality in combination with reverse brake, the relay settings have to be adapted as described above once reverse current brake has been enabled.

8.9.5 External alarm functionality

The external alarm functionality is used to generate an alarm depending on the state of an external alarm signal. Each of the digital inputs can be configured for external alarm signal. Fig. 66 shows a connection example with digital input 3 (terminal 16) configured for external alarm signal.

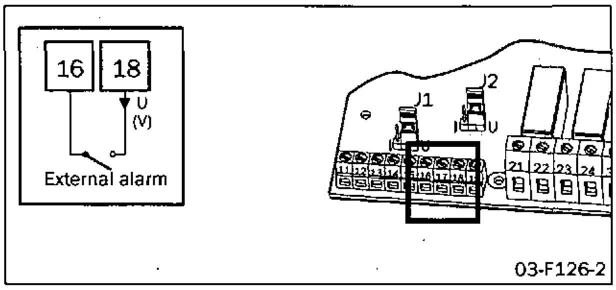


Fig. 66 Connection of terminals for external alarm

If any digital input is configured for external alarm signal, opening this input will cause an external alarm to occur if external alarm is enabled in menu [420].

NOTE: If more than one digital input is configured for external alarm signal, opening any of these inputs will generate an external alarm if external alarm is enabled in menu [420].

The following alarm actions are available for external alarm:

Off

External alarm is disabled.

Warning

An F17 alarm message is shown in the display and relay K3 is activated (for default configuration of the relays) if the external alarm input is opened. However, the motor is not stopped and operation continues. The alarm message will disappear and the relay will be reset when the external alarm input is closed again. The alarm may also be reset manually.

Coast

An F17 alarm message is shown in the display and relay K3 is activated (for default configuration of the relays) if the external alarm input is opened. The motor voltage is automatically switched off. The motor freewheels until it stops.

Stop

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays) if the external alarm input is opened. The motor is stopped according to the stop settings in menus [320] to [325].

Brake

The appropriate alarm message is shown in the display and relay K3 is activated (for default configuration of the relays) if the external alarm input is opened. The brake function is activated according to the braking method chosen in menu [323] and the motor is stopped according to the alarm brake settings in menu [326] - [327] (Braking strength and braking time).

Spinbrake

The functionality for the spinbrake alternative is the same as described above for the brake alternative. However, if spinbrake is chosen, braking can even be initiated from an inactive state by opening the external alarm input. This means the softstarter can catch a freewheeling motor and brake it down to standstill. The Spinbrake alternative is only available for external alarm.

External alarm can be used together with any setting for the control source chosen in menu [200].

If the operation has been interrupted due to an external alarm, a reset signal and a new start signal are needed to restart the motor. The reset and the start signal can be given via control panel, remote or via serial communication depending on the control source chosen in menu [200]. Regardless of the chosen control source, it is always possible to initiate a reset via control panel.

NOTE: A reset via control panel will never start the motor.

8.9.6 External control of parameter set

The parameter set can be chosen via the digital inputs if external control of parameter set is chosen in menu [240] (alternative 0). For this purpose any of the digital inputs can be configured for parameter set input 1 (PS1, alternative 3 in menus [510] to [513]) or parameter set input 2 (PS2, alternative 4 in menus [510] to [513]). Fig. 67 shows a connection example for external control of parameter set, in this example digital inputs 3 and 4 are configured for PS1 and PS2.

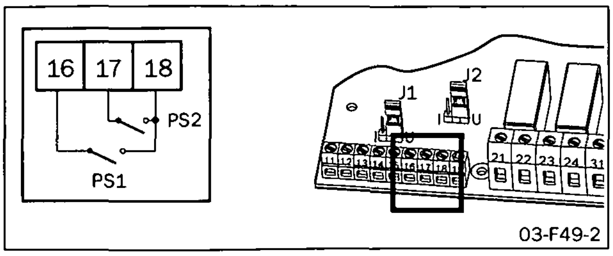


Fig. 67 Connection of external control inputs.

Table 15 How parameter set inputs are evaluated

Parameter Set	PS1 (16-18)	PS2 (17-18)
1	Open	Open
2	Closed	Open
3	Open	Closed
4	Closed	Closed

It is possible to use just one digital input to change between two parameter sets. According to the example above, digital input 3 is configured for PS1. If no digital input is configured for PS2, PS2 is considered to be open. In this case digital input 3 can be used to change between parameter set 1 and 2.

Changing the parameter set via external signal is only executed in stopped mode and at full voltage operation. If the input signals for PS1 and PS2 are changed during acceleration or deceleration, only the new parameters for the control source (menu [200]), the analogue/digital input (menu [500]), the digital input pulses (menu [501]), the analogue start/stop on- and off-value (menus [502] and [503]) and the analogue start/stop delay (menu [504]) are loaded immediately. All other parameters will not change until the softstarter is in stopped mode or at full voltage running. In this way a change of the control source will take effect immediately, which can be useful for changing from remote to manual operation for maintenance.

NOTE: No parameters, except for the control source in menu [200] and the parameter set in menu [240], may be changed if external control of parameter set is activated in menu [240] (alternative 0).

8.10 View operation

MSF 2.0 includes numerous viewing functions which eliminate the need for additional transducers and meters for monitoring the operation.

[700] to [716] Operation (current, voltage, power etc.)

[720] to [725] Status (softstart status, input/output status)

[730] to [732] Stored values (operation time etc.)

8.10.1 Operation

RMS current

700	Read-out
0.0	**Current**
Range:	0.0-9999 A

NOTE! This is the same read-out as menu [100].

Line main voltage

701	Read-out
0	**Line main voltage**
Range:	0-720 V

Power factor

702	Read-out
0.00	**Power factor**
Range:	0.00-1.00

Output shaftpower

The output shaft power is shown in kW or in HP depending on the setting for Enable US units in menu [202].

703	Read-out
0.0	**Output shaftpower**
Range:	-999-9999 kW or HP

Output shaftpower in percentage unit

704	Read-out
0	**Output shaftpower in percentage units**
Range:	0-200% of P_n

NOTE: This is the same read-out as menu [413].

Shaft torque

The shaft torque is shown in Nm or in lbft depending on the setting for Enable US units in menu [202].

705	Read-out
0.0	**Shaft torque**
Range:	-999-9999 Nm or lbft

Shaft torque in percentage unit

706	Read-out
0	**Shaft torque in percentage units**
Range:	0-250% of T_n

Softstarter temperature

The softstart temperature is shown in degrees Celsius or in degrees Fahrenheit depending on the setting for Enable US units in menu [202].

707	Read-out
Lo	**Softstarter temperature**
Range:	Low, 30-96°C or low, 85-204°F

Current phase l1

708	Read-out
0.0	**Current phase L1**
Range:	0.0-9999 A

Current phase L2

709	Read-out
0.0	**Current phase L2**
Range:	0.0-9999 A

Current phase L3

710	Read-out
0.0	**Current phase L3**
Range:	0.0-9999 A

Line main voltage L1-L2

711	Read-out
0	**Line main voltage L1-L2**
Range:	0-720 V

Line main voltage L1-L3

712	Read-out
0	**Line main voltage L1-L3**
Range:	0-720 V

Line main voltage L2-L3

713	Read-out
0	**Line main voltage L2-L3**
Range:	0-720 V

Phase sequence

714	Read-out
L - - -	**Phase sequence**
Range:	L- -, L123, L321

Used thermal capacity

715	Read-out
0	**Used thermal capacity**
Range:	0-150%

Time to next allowed start

716	Read-out
0	**Time to next allowed start**
Range:	0-60 min

8.10.2 Status

Softstarter status

720	Read-out
0	**Softstarter status**
Range:	1-12
1	Stopped, no alarm
2	Stopped, alarm
3	Run with alarm
4	Acceleration
5	Full voltage
6	Deceleration
7	Bypassed
8	PFC
9	Braking
10	Slow speed forward
11	Slow speed reverse
12	Standby (waiting for Analogue start/stop or Autoreset)

Digital Input Status

Status of the digital inputs 1- 4 from left to right. L or H are displayed for input status low (open) or high (closed).

721	Read-out
LLLL	**Digital input status**
Range:	LLLL-HHHH

Analogue/digital Input status

Status of the analogue/digital input when it is used as digital input. L and H are displayed for input status low (open) and high (closed).

722	Read-out
L	**Analogue/digital input status**
Range:	L, H

Analogue/digital input value

Value on the analogue/digital input as a percentage of the input range. This read-out depends on the configuration of the analogue/digital input in menu [500], e.g. if the analogue/digital input is configured for analogue start/stop 0-10 V/0-20 mA (alternative 6), an input signal of 4 V or 8 mA will be shown as 40%. However, if the analogue/digital input is configured for analogue start/stop 2.10 V/4-20 mA (alternative 7), an input signal of 4 V or 8 mA will be shown as 25%.

723	Read-out
0	**Analogue/digital input value**
Range:	0-100%

Relay status

Status of the relays K1 to K3 from the left to the right. L or H are displayed for relay status low (opened) or high (closed). The status described for relay K3 corresponds to the status of terminal 3.

724	Read-out
LLL	**Relay status**
Range:	LLL-HHH

Analogue Output value

Value on the analogue output as a percentage of the output range. This read-out depends on the configuration of the analogue output in menu [520], e.g. if the analogue/digital input is configured for 0-10 V/0-20 mA (alternative 1) or for 10-0 V/20-0 mA (alternative 3), an output signal of 4 V or 8 mA will be shown as 40%. However, if the analogue output is configured for 2-10 V/4-20 mA (alternative 2) or 10-2 V/20-4 mA (alternative 4), an output signal of 4 V or 8 mA will be shown as 25%.

725	Read-out
0	**Analogue Output value**
Range:	0-100%

8.10.3 Stored values

Operation time. The operation time is the time during which the motor connected to the softstarter is running, not the time during which the supply power is on.

If the actual value for the operation time exceeds 9999 hours the display will alternate between the four lower digits and the higher digits.

Example

If the actual operation time is 12467, 1 will be shown for 1 s, then 2467 will be shown for 5 s and so on.

730	Read-out
0	**Operation time**
Range:	0-9 999 999 h

Energy consumption

731	Read-out
0.000	**Energy consumption**
Range:	0.000-2000 MWh

Reset energy consumption

In this menu the stored power consumption (menu [713]) can be reset to 0.

732	Multi Setting
no	**Reset energy consumption**
Default:	no
Range:	no, YES
no	No action
YES	Reset power consumption

8.11 Alarm list

The alarm list is generated automatically. It shows the latest 15 alarms (F1-F17). The alarm list can be useful for tracking failures in the softstarter or its control circuit. In the alarm list both the alarm message and the operation time is saved for each alarms that occurs. In menu [800] the latest alarm message and the corresponding operation time are shown alternately, in the same way, older alarms are shown in menus [801] to [814].

Example

- If the latest alarm was a phase input failure (F1), which occurred at operation time 524. F1 is shown for 4 s then 524 is shown for 2 s and so on.
- If the latest alarm was a thermal motor protection alarm (F2), which occurred at operation time 17852. F2 is shown for 3 s, after that 1 is shown for 1 s, then 7852 is shown for 2 s and so on.

Alarm list, latest error

800	Read-out
F1	**Alarm list, latest error**
Range:	F1-F17

Alarm list, error

801	Read-out
F1	**Alarm list, error 14**
Range:	F1-F17

Menu	Function
802	Alarm list, error 13
803	Alarm list, error 12
804	Alarm list, error 11
805	Alarm list, error 10
806	Alarm list, error 9
807	Alarm list, error 8
808	Alarm list, error 7
809	Alarm list, error 6
810	Alarm list, error 5
811	Alarm list, error 4
812	Alarm list, error 3
813	Alarm list, error 2
814	Alarm list, error 1

8.12 Softstarter data

In menus [900] to [902] the softstarter type is shown and the softstarter's software version is specified.

Softstarter type

900 | Read-out

17 | **Softstarter type**

Range:	17-1400 A

Software variant

901 | Read-out

V220 | **Software variant text**

Range:	Same as label

Software version

902 | Read-out

R15 | **Software version text**

Range:	Same as label

9. Protection and alarm

MSF 2.0 is equipped with functions for motor protection, process protection and protection of the softstarter itself.

9.1 Alarm codes

Different alarm codes are used for the different errors, see Table 16 for a description of the alarm codes used. When an alarm occurs, this is indicated with the appropriate alarm message flashing in the display. If more than one alarm is active at the same time, the alarm code for the last alarm is presented on the display. The alarm code for each occurring alarm is also saved in the alarm list in menus [800] to [814].

9.2 Alarm actions

For most protection methods a proper action can be chosen to be performed if the relevant alarm occurs. The following alternatives are available as alarm actions (all alternatives may not be available for all protection methods - check Table 16):

Off

The alarm is deactivated.

Warning

The appropriate alarm code is flashing in the display and relay K3 is activated (for default configuration of the relays) if an the alarm occurs. However, the motor is not stopped ans operation continues. The alarm message in the display will disappear and the relay will be reset when the alarm has disappeared. The alarm may also be reset manually. This setting alternative may be useful if it is desired to control operation in alarm state by an external control unit.

Coast

The appropriate alarm code is flashing in the display and relay K3 is activated (for default configuration of the relays) if an the alarm occurs. The motor voltage is automatically switched off. The motor is freewheels until it stops.

This setting alternative is useful if continuous running or active stopping could harm the process or the motor. This may be appplicable for applications with very high inertia that use braking as the normal stop method. In this case it may be a good idea to choose Coast as alarm action on thermal motor protection alarm, because continuous running or braking could harm the motor seriously when this alarm has occurred.

Stop

The appropriate alarm code is flashing in the display and relay K3 is activated (for default configuration of the relays) if an alarm occurs. The motor is stopped according to the stop settings in menus [320] to [325].

This setting is useful for applications where a correct stop is important. This may apply to most pump applications, as Coast as an alarm action could cause water hammer.

Brake

The appropriate alarm code is flashing in the display and relay K3 is activated (for default configuration of the relays) if an alarm occurs. The brake function is activated according to the braking method chosen in menu [323] and the motor is stopped according to the alarm brake settings in menus [326] to [327] (braking strength and braking time). If alarm braking is deactivated in menu [326] and Brake is chosen as an alarm action, the action will be the same as described above for Coast.

Brake as an alarm action may mainly be used in combination with External alarm, where an external signal is used to initiate a quick stop with a higher braking strength and a shorter braking time compared to normal operation.

Spinbrake

The functionality for the Spinbrake alternative is the same as described above for the Brake alternative. However, if Spinbrake is chosen, braking can even be initiated from an inactive state. This means the softstarter can catch a freewheeling motor and brake it down to standstill.

The Spinbrake alternative is only available for External alarm. It may be useful e.g. for test running of planers and bandsaws after tool exchange. It may be desirable to accelerate the tool up to a specific speed and then leave it coasting to check if there is any unbalance. In this case it is possible to activate braking immediately by opening the external input.

In Table 16 below the alarm actions available for each alarm type are specified in detail.

9.3 Reset

For the following explanations it is important to distinguish between Reset and Restart. Reset means that the alarm message on the display disappears and the alarm relay K3 (for default configuration of the relays) is deactivated. If the operation has been interrupted due to an alarm the softstarter is prepared for a Restart. However, giving a Reset signal without giving a new start signal will never lead to a start.

The Reset signal can be given via control panel, remotely or via serial communication depending on the control source chosen in menu [200]. Regardless of the chosen control method, it is always possible to give a Reset signal via control panel.

If an alarm occurs whose alarm action is configured for Warning (see description of alarm actions above), the alarm will automatically be reset as soon as the failure disappears. The alarm may also be reset manually by giving a Reset signal as described above.

If operation has been interrupted due to an alarm, a Reset signal and a new start signal may be needed to Restart the motor. However, some alarms are automatically reset when a new start signal is given. Table 16 covers all alarm types and whether they need a Reset signal (manual reset) or if they are reset automatically when a new start signal is given.

An alarm can always be reset by giving a Reset signal, even if the failure that caused the alarm has not disappeared yet. Giving a Reset will cause the alarm message on the display to disappear and the alarm relay K3 to be deactivated (for default configuration of the relays). However, if operation has been interrupted due to an alarm, a Restart will not be possible until the failure has disappeared. If a new start signal is given while the failure still is active, the alarm message will appear flashing in the display and the alarm relay K3 will be activated again (for default configuration of the relays).

MSF 2.0 is also provided with an Autoreset function. This functionality is described in detail in section 8.5, page 52.

9.4 Alarm overview

Table 16 Alarm overview

Alarm code	Alarm description	Alarm action	Protection system	Reset
F1	Phase input failure.	Warning Coast	Motor protection (menu [230])	Automatic Reset when new start signal is given.
F2	Thermal motor protection	Off Warning Coast Stop Brake	Motor protection (menu [220])	Separate Reset signal needed.
F3	Soft start overheated	Coast		Separate Reset signal needed.
F4	Current limit start time expired.	Off Warning Coast Stop Brake	Motor protection (menu [231])	Automatic Reset when new start signal is given.
F5	Locked rotor alarm.	Off Warning Coast	Motor protection (menu [228])	Separate Reset signal needed.
F6	Max power alarm.	Off Warning Coast Stop Brake	Process protection (menu [400])	Separate Reset signal needed.
F7	Min power alarm.	Off Warning Coast Stop Brake	Process protection (menu [401])	Separate Reset signal needed.
F8	Voltage unbalance alarm.	Off Warning Coast Stop Brake	Process protection (menu [430])	Automatic Reset when new start signal is given.
F9	Overvoltage alarm.	Off Warning Coast Stop Brake	Process protection (menu [433])	Automatic Reset when new start signal is given.
F10	Undervoltage alarm.	Off Warning Coast Stop Brake	Process protection (menu [436])	Automatic Reset when new start signal is given.

Table 16 Alarm overview

Alarm code	Alarm description	Alarm action	Protection system	Reset
F11	Start limitation.	Off Warning Coast	Motor protection (menu [224])	Automatic Reset when new start signal is given.
F12	Shorted thyristor.	Coast		Separate Reset signal needed.
F13	Open thyristor.	Coast		Separate Reset signal needed.
F14	Motor terminal open.	Coast		Separate Reset signal needed.
F15	Serial communication contact broken.	Off Warning Coast Stop Brake	Control source protection (menu [273])	Automatic Reset when new start signal is given.
F16	Phase reversal alarm.	Off Warning Coast	Process protection (menu [440])	Separate Reset signal needed.
F17	External alarm.	Off Warning Coast Stop Brake Spinbrake	Process protection (menu [420])	Separate Reset signal needed.

10. Troubleshooting

10.1 Fault, cause and solution

Observation	Fault indication	Cause	Solution
The display is not illuminated.	None	No control supply voltage.	Switch on the control supply voltage.
The motor does not run.	F1 (Phase input failure)	Fuse defective.	Renew the fuse.
		No mains supply.	Switch on the mains supply.
	F2 (Thermal motor protection)	PTC connection could be open. Incorrect nominal motor current could be entered in menu [211].	Check the PTC input if PTC protection is used. If internal thermal motor protection is used, perhaps an other internal thermal protection class could be used (menu [222]). Cool down the motor and restart.
	F3 (Softstarter overheated)	Ambient temperature too high. Softstarter duty cycle exceeded. Could be fan failure.	Check ventilation of cabinet. Check the size of the cabinet. Clean the cooling fins. If the fan(s) is (are) not working correctly, contact your local MSF sales outlet.
	F4 (Current limit start time expired)	Current limit parameters are perhaps not matched to the load and motor.	Increase the start time (menu [315]) and/or the current limit at start (menu [314]).
	F5 (Locked rotor)	Something stuck in the machine or perhaps motor bearing failure.	Check the machine and motor bearings. Perhaps the Locked rotor time can be set longer (menu [229]).
	F6 (Max power alarm)	Overload	Check the machine. Perhaps the Max power alarm response delay can be set longer menu [404].
	F7 (Mn power alarm)	Underload	Check the machine. Perhaps the Min power alarm response delay can be set longer menu [410].
	F8 (Voltage unbalance)	Mains supply voltage unbalance.	Check mains supply.
	F9 (Overvoltage)	Mains supply overvoltage.	Check mains supply.
	F10 (Undervoltage)	Mains supply undervoltage.	Check mains supply.
	F11 (Start limitation)	Number of starts per hour exceeded, min time between starts not kept.	Wait and start again. Perhaps the number of starts per hour could be increased in menu [225] or the min time between starts could be decreased (menu [226]).
	F13 (Open thyristor)	Perhaps a damaged thyristor.	Initiate a reset and a restart. If the same alarm appears immediately, contact your local MSF sales outlet.
	F14 (Motor terminal open)	Open motor contact, cable or motor winding.	If the fault is not found, reset the alarm and inspect the alarm list. If alarm F12 is found, a thyristor is probably shorted. Initiate a restart. If alarm F14 appears immediately, contact your local MSF sales outlet.

Observation	Fault indication	Cause	Solution
The motor does not run.	F15 (Serial communication contact broken)	Serial communication contact broken.	Initiate a reset and try to establish contact. Check contacts, cables and option board. Verify - Serial communication unit address [270]. - Baudrate menu [271]. - Parity menu [272]. If the fault is not found, run the motor from the control panel if urgent set menu [200] to 1. See also manual for serial communication.
	F16 (Phase reversal)	Incorrect phase sequence on main supply.	Switch L2 and L3 input phases.
	F17 (External alarm)	External alarm signal input open	Check the digital input configured for External alarm. Check the configuration of the digital inputs (menus [510] to [513]).
	----	Start command comes perhaps from incorrect control source. (I.e. start from control panel when remote control is selected).	Give start command from correct control source menu [200].
The motor is running but an alarm is given.	F1 (Phase input failure)	Failure in one phase. Perhaps fuse is defective.	Check fuses and mains supply. Select a different alarm action for Single phase input failure in menu [230] if stop is desired at single phase loss.
	F4 (Current limit start time expired)	Current limit parameters are perhaps not matched to the load and motor.	Increase the start time (menu [315]) and/or the current limit at start (menu [314]). Select a different action for Current limit start time expired alarm in menu [231], if stop is desired at current limit time-out.
	F12 (Shorted thyristor)	Perhaps a damaged thyristor.	When stop command is given, a free-wheel stop is made. Initiate a reset and a restart. If alarm F14 appears immediately, contact your local MSF sales outlet. If the motor must be started urgently, the softstarter can start the motor direct on-line (DOL). Set the start method to DOL in this case (menu [310]=4).
		Bypass contactor is used but menu [340] 'Bypass' is not set to "on".	Set menu [340] Bypass to on.
	F15 (Serial communication contact broken)	Serial communication contact broken.	Initiate a reset and try to establish contact. Check contacts, cables and option board. Verify - Serial communication unit address [270]. - Baudrate menu [271]. - Parity menu [272]. If the fault is not found, run the motor from the control panel if urgent, see also manual for serial communication.

Observation	Fault indication	Cause	Solution
The motor jerks etc.	When starting, motor reaches full speed but it jerks or vibrates.	If "Torque control" or "Pump control" is selected, it is necessary to input motor data into the system.	Input nominal motor data in menus [210]-[215]. Select the proper torque control alternative in menu [310] (linear or square) according to the load characteristic. Select a correct initial- and end torque at start in menus [311] and [312]. If 'Bypass' is selected, check that the current transformers are correctly connected.
		Start time too short.	Increase start time [315].
		If voltage control is used as start method, the initial voltage at start may be too low. Starting voltage incorrectly set.	Adjust initial voltage at start [311].
		Motor too small in relation to rated current of softstarter.	Use a smaller model of the softstarter.
		Motor too large in relation to load of softstarter.	Use larger model of softstarter.
		Starting voltage not set correctly.	Readjust the start ramp.
			Select the current limit function.
	Starting or stopping time too long.	Ramp times not set correctly.	Readjust the start and/or stop ramp time.
		Motor too large or too small in relation to load.	Change to another motor size.
The monitor function does not work.	No alarm or pre-alarm	It is necessary to input nominal motor data for this function. Incorrect alarm margins or normal load.	Input nominal motor data in menus [210]-[215]. Adjust alarm margins and normal load in menus [402] - [412]. Use Autoset [411] if needed. If a Bypass contactor is used, check that the current transformers are correctly connected.
Unexplainable alarm.	F5, F6, F7, F8, F9, F10	Alarm delay time is too short.	Adjust the response delay times for the alarms in menus [229], [404], [410], [432], [435] and [438].
The system seems locked in an alarm.	F2 (Thermal motor protection)	PTC input terminal could be open. Motor could still be too warm. If internal motor protection is used, the cooling in the internal model may take some time.	PTC input terminal should be short circuit if not used. Wait until motor PTC gives an OK (not overheated) signal. Wait until the internal cooling is done. Try to restart after a while.
	F3 (Softstarter overheated)	Ambient temperature to high. Perhaps fan failure.	Check that cables from power part are connected in terminals 71 to 74. MSF-017 to MSF-250 should have a jumper between terminals 71 and 72. Check also that the fan(s) is(are) rotating.

Observation	Fault indication	Cause	Solution
Parameter will not be accepted.		If menu 240, "Parameter set" is set to "0", the system is configured for external control of parameter set. Most parameters are not allowed to be changed in this mode.	Set the menu 240, "Parameter set" to a value between "1" - "4" and then any parameter can be changed.
		During start, stop and slow speed changing parameters is not permitted.	Set parameters during standstill or full voltage running.
		If control source is serial comm., it is impossible to change parameters from keyboard and vice versa.	Change parameters from the actual control source.
		Some menus include only read-out values and not parameters.	Read-out values cannot be altered. In Table 14, read-out menus have '—' in the factory setting column.
	-Loc	Control panel is locked for settings.	Unlock control panel by pressing the keys "NEXT" and "ENTER"for at least 3 sec.

11. Maintenance

In general the softstarter is maintenance-free. There are however some things which should be checked regularly. In particular, if the surroundings are dusty the unit should be cleaned regularly.

WARNING! Do not touch parts inside the enclosure of the unit when the control supply voltage or the mains supply voltage is switched on.

11.1 Regular maintenance

- Check that nothing in the softstarter has been damaged by vibration (loose screws or connections).
- Check external wiring, connections and control signals. Tighten terminal screws and busbar bolts if necessary.
- Check that printed circuit boards, thyristors and cooling fins are free from dust. Clean with compressed air if necessary. Make sure the printed circuit boards and the thyristors are undamaged.
- Check for signs of overheating (changes in colour on printed circuit boards, oxidation of solder points etc.). Check that the temperature is within permissible limits.
- Check that the cooling fan(s) permit free air flow. Clean any external air filters if necessary.

12. Options

The following options are available. Please contact your supplier for more detailed information.

12.1 Serial communication

For serial communication the MODBUS RTU (RS232/RS485) option board is available, order part number: 01-1733-00.

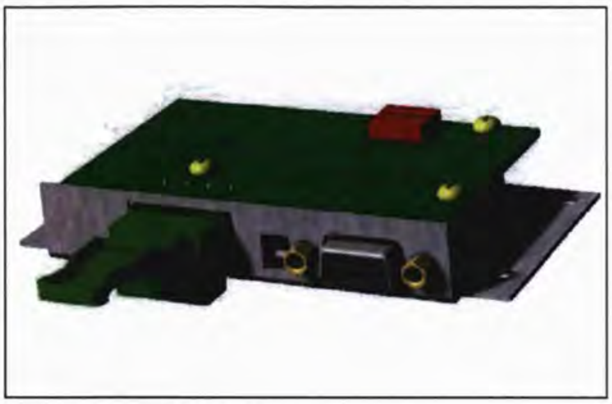


Fig. 68 Option RS232/485

12.2 Fieldbus systems

Various option boards are available for the following bus systems:

- PROFIBUS DP order part number: 01-1734-01
- Device NET, order part number: 01-1736-01

Each system has its own board. The option is delivered with an instruction manual containing all the details for the installation and set-up of the board and the protocol for programming.

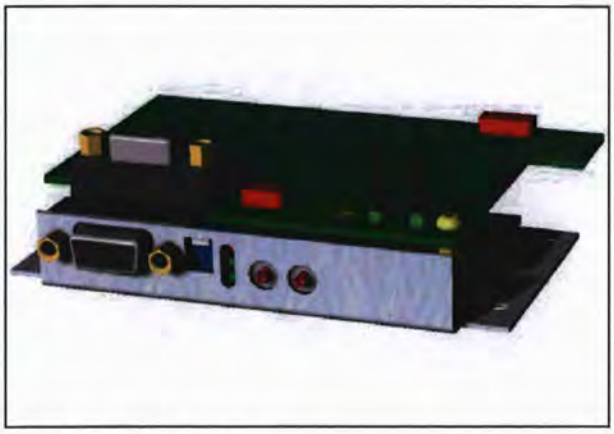


Fig. 69 Profibus Option

12.3 External control panel

The external control panel option is used to move the control panel from the softstarter to the front of a panel door or control cabinet.

The maximum distance between the softstarter and the external control panel is 3 m.

The part number to order for the external control panel is 01-2138-00. A separate data sheet for this option is available.

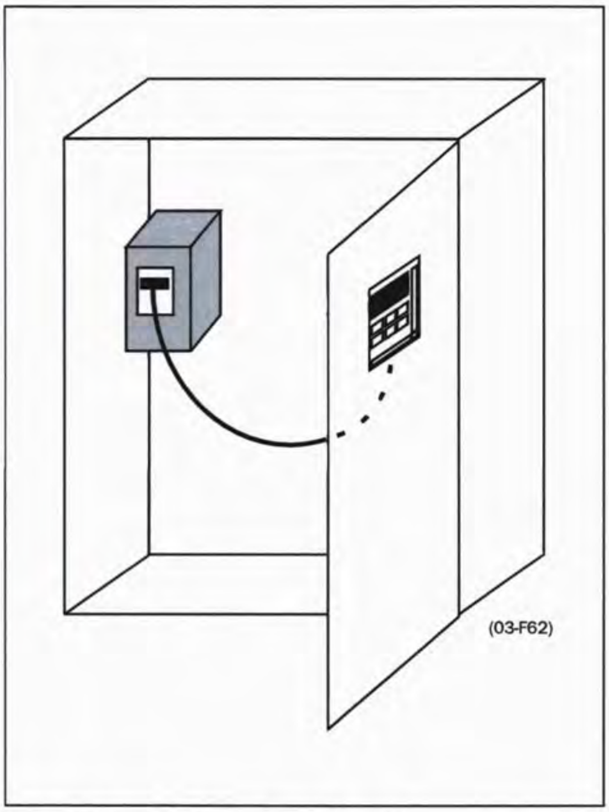


Fig. 70 Use of the external control panel.

12.3.1 Cable kit for external current transformers

This kit is used for the bypass function, to connect the current transformers externally. order part number: 01-2020-00.

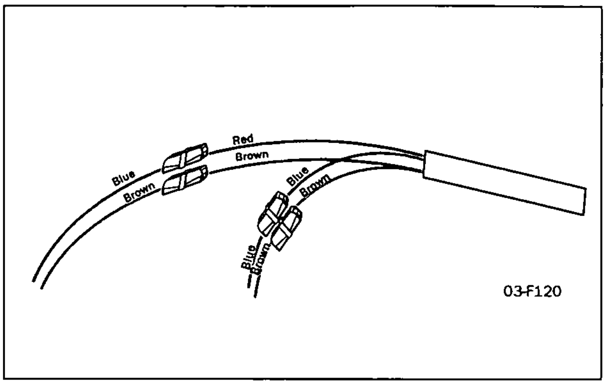


Fig. 71 Cable kit

12.4 Terminal clamp

Data: Single cables, Cu or Al	
Cables	95-300 mm^2
MSF type Cu Cable	310
Bolt for connection to busbar	M10
Dimensions in mm	33x84x47 mm
Part no. single	9350
Data: Parallel cables, Cu or Al	
Cables	2x95-300 mm^2
MSF type and Cu Cable	310 to 835
Bolt for connection to busbar	M10
Dimensions in mm	35x87x65
Part no. parallel	9351

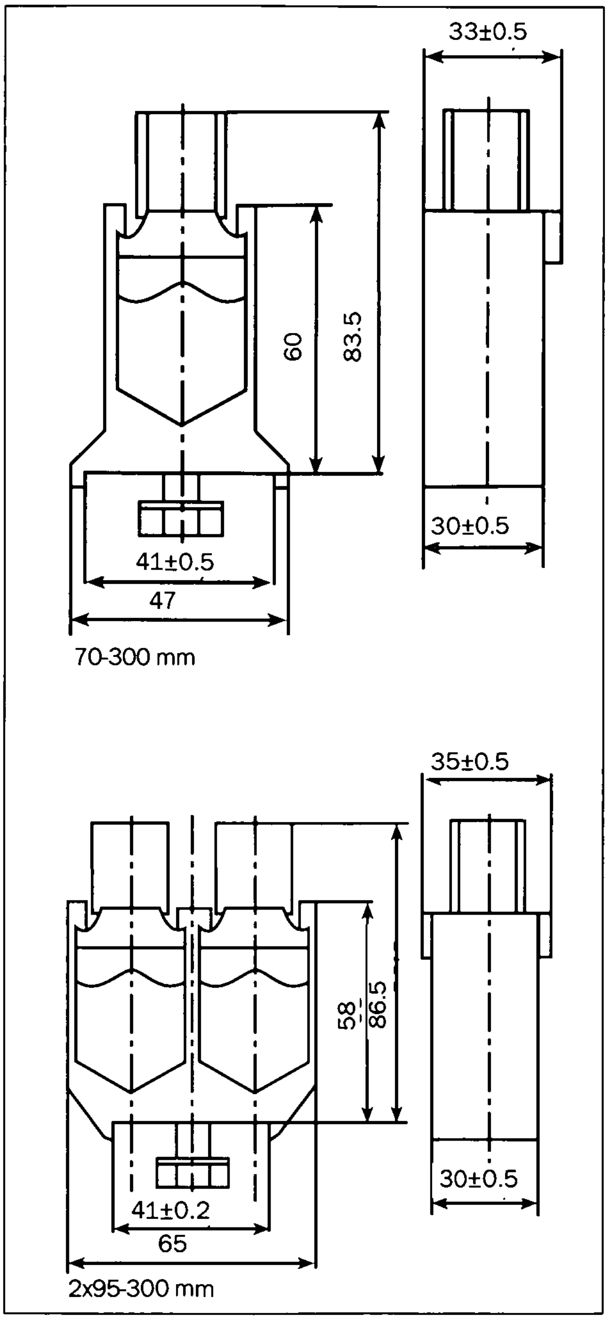


Fig. 72 The terminal clamp.

13. Technical data

13.1 Electrical specifications

Table 17 Typical motor power at mains voltage 400 V

MSF model	Heavy AC-53a 5.0-30:50-10		Normal AC-53a 3.0-30:50-10		Normal with bypass AC-53b 3.0-30:300	
	Power @400V [kW]	Rated current [A]	Power @400V [kW]	Rated current [A]	Power @400V [kW]	Rated current [A]
MSF-017	7.5	17	11	22	11	25
-030	15	30	18.5	37	22	45
-045	22	45	30	60	37	67
-060	30	60	37	72	45	85
-075	37	75	45	85	55	103
-085	45	85	45	96	55	120
-110	55	110	75	134	90	165
-145	75	145	75	156	110	210
-170	90	170	110	210	132	255
-210	110	210	132	250	160	300
-250	132	250	132	262	200	360
-310	160	310	200	370	250	450
-370	200	370	250	450	315	555
-450	250	450	315	549	355	675
-570	315	570	400	710	450	820
-710	400	710	450	835	500	945
-835	450	835	500	960	630	1125
-1000	560	1 000	630	1125	800	1400
-1400	800	1 400	900	1650	1000	1800

Table 18 Typical motor power at mains voltage 460 V

MSF model	Heavy AC-53a 5.0-30:50-10		Normal AC-53a 3.0-30:50-10		Normal with bypass AC-53b 3.0-30:300	
	Power @460V [hp]	Rated current [A]	Power @460V [hp]	Rated current [A]	Power @460V [hp]	Rated current [A]
MSF-017	10	17	15	22	20	25
-030	20	30	25	37	30	45
-045	30	45	40	60	50	68
-060	40	60	50	72	60	85
-075	60	75	60	85	75	103
-085	60	85	75	96	100	120
-110	75	110	100	134	125	165
-145	100	145	125	156	150	210
-170	125	170	150	210	200	255
-210	150	210	200	250	250	300
-250	200	250	200	262	300	360
-310	250	310	300	370	350	450
-370	300	370	350	450	450	555
-450	350	450	450	549	500	675
-570	500	570	600	710	650	820
-710	600	710	700	835	800	945
-835	700	835	800	960	900	1125
-1000	800	1 000	900	1125	1000	1400
-1400	1000	1 400	1250	1650	1500	1800

Table 19 Typical motor power at mains voltage 525 V

MSF model	Heavy AC-53a 5.0-30:50-10		Normal AC-53a 3.0-30:50-10		Normal with bypass AC-53b 3.0-30:300	
	Power @525V [kW]	Rated current [A]	Power @525V [kW]	Rated current [A]	Power @525V [kW]	Rated current [A]
MSF-017	11	17	15	22	15	25
-030	18,5	30	22	37	30	45
-045	30	45	37	60	45	68
-060	37	60	45	72	55	85
-075	45	75	55	85	75	103
-085	55	85	55	96	75	120
-110	75	110	90	134	110	165
-145	90	145	110	156	132	210
-170	110	170	132	210	160	255
-210	132	210	160	250	200	300
-250	160	250	160	262	250	360
-310	200	310	250	370	315	450
-370	250	370	315	450	355	555
-450	315	450	400	549	450	675
-570	400	570	500	710	560	820
-710	500	710	560	835	630	945
-835	560	835	710	960	800	1125
-1000	710	1 000	800	1125	1000	1400
-1400	1000	1 400	1250	1650	1400	1800

Table 20 Typical motor power at mains voltage 575 V

MSF model	Heavy AC-53a 5.0-30:50-10		Normal AC-53a 3.0-30:50-10		Normal with bypass AC-53b 3.0-30:300	
	Power @575V [hp]	Rated current [A]	Power @575V [hp]	Rated current [A]	Power @575V [hp]	Rated current [A]
MSF-017	15	17	20	22	25	25
-030	25	30	30	37	40	45
-045	40	45	50	60	60	68
-060	50	60	60	72	75	85
-075	75	75	75	85	100	103
-085	75	85	75	90	125	120
-110	100	110	125	134	150	165
-145	150	145	150	156	200	210
-170	150	170	200	210	250	255
-210	200	210	250	250	300	300
-250	250	250	250	262	350	360
-310	300	310	400	370	450	450
-370	400	370	500	450	600	555
-450	500	450	600	549	700	675
-570	600	570	700	640	800	820
-710	700	710	800	835	1000	945
-835	800	835	900	880	1250	1125
-1000	1000	1 000	1250	1125	1500	1400
-1400	1500	1 400	1500	1524	2000	1800

Table 21 Typical motor power at mains voltage 690 V

MSF model	Heavy AC-53a 5.0-30:50-10		Normal AC-53a 3.0-30:50-10		Normal with bypass AC-53b 3.0-30:300	
	Power @690V [kW]	Rated current [A]	Power @690V [kW]	Rated current [A]	Power @690V [kW]	Rated current [A]
MSF-017	15	17	18,5	22	22	25
-030	22	30	30	37	37	45
-045	37	45	55	60	55	68
-060	55	60	55	72	75	85
-075	55	75	75	85	90	103
-085	75	85	90	90	110	120
-110	90	110	110	134	160	165
-145	132	145	132	156	200	210
-170	160	170	200	210	250	255
-210	200	210	250	250	250	300
-250	250	250	250	262	355	360
-310	315	310	355	370	400	450
-370	355	370	400	450	500	555
-450	400	450	560	549	630	675
-570	560	570	630	640	800	820
-710	710	710	800	835	900	945
-835	800	835	900	880	1120	1125
-1000	1000	1 000	1120	1125	1400	1400
-1400	1400	1 400	1600	1524	1800	1800

13.2 General electrical specifications

Table 22 General electrical specifications

Parameter	Description
General	
Mains supply voltage	200-525 V ±10% 200-690 V +5%, -10%
Control supply voltage	100-240 V ±10% 380-500 V ±10%
Mains and Control supply frequency	50/60 Hz ±10%
Number of fully controlled phases	3
Recommended fuse for control supply	Max 10 A
Control signal inputs	
Digital input voltage	0-3 V→0, 8-27 V→1. Max 37 V for 10 sec.
Digital input impedance to GND (0 VDC)	2.2 kΩ
Analoueg input voltage/current	0-10 V, 2-10 V, 0-20 mA, 4-20 mA
Analoueg input impedance to GND (0 VDC)	Voltage signal 125 kΩ, current signal 100 Ω
Control signal outputs	
Output relays contact	8 A, 250 VAC or 24 VDC resistive load; 3 A, 250 VAC inductive load (PF 0.4)
Analogue output voltage/current	0-10 V, 2-10 V, 0-20 mA, 4-20 mA
Analogue output load impedance	Voltage signal min load 700Ω, current signal max load 750Ω
Control signal supply	
+12 VDC	+12 VDC ±5%. Max current 50 mA. Short circuit proof.

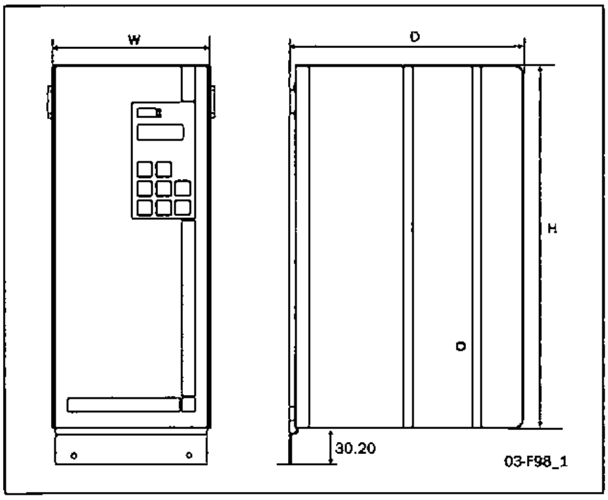
13.3 Fuses and power losses

Table 23 Fuses, power losses

Model	Recommended wiring fuses [A] First column Ramp start/second column Direct-on-line start		Power loss at rated motor load [W] No losses with bypass		Power consumption control card [VA]
	Heavy	**Normal**	**Heavy**	**Normal**	
MSF-017	25/50	32	50	70	20
-030	35/80	50	90	120	20
-045	50/125	80	140	180	25
-060	63/160	100	180	215	25
-075	80/200	100	230	260	25
-085	100/250	125	260	290	25
-110	125/315	180	330	400	25
-145	160/400	200	440	470	25
-170	200/400	200	510	630	35
-210	250/400	315	630	750	35
-250	250/500	315	750	750	35
-310	315/630	400	930	1100	35
-370	400/800	500	1100	1535	35
-450	500/1000	630	1400	1730	35
-570	630/1000	800	1700	2100	35
-710	800/1000	1000	2100	2500	35
-835	1000/1200	1000	2500	2875	35
-1000	1000/1400	1200	3000	3375	35
-1400	1400/1800	1800	4200	4950	35

13.4 Mechanical specifications including mechanical drawings

MSF Model	Dimensions H*W*D [mm]	Mounting position [Vertical/ Horizontal]	Weight [kg]	Connection busbars [mm]	PE screw	Cooling system	Protection class
-017, -030	320*126*260	Vertical	6.7	15*4, Cu (M6)	M6	Convection	IP20
-045, -060, -075, -085	320*126*260	Vert. or Horiz.	6.9	15*4, Cu (M6)	M6	Fan	IP20
-110, -145	400*176*260	Vert. or Horiz.	12	20*4, Cu (M10)	M8	Fan	IP20
-170, -210, -250	500*260*260	Vert. or Horiz.	20	30*4, Cu (M10)	M8	Fan	IP20
-310, -370, -450	532*547*278	Vert. or Horiz	46	40*8, Al (M12)	M8	Fan	IP20
-570, -710, -835	687*640*302	Vert. or Horiz	80	40*10, Al (M12)	M8	Fan	IP20
-1000, -1400	900*875*336	Vert. or Horiz	175	75*10, Al (M12)		Fan	IP00



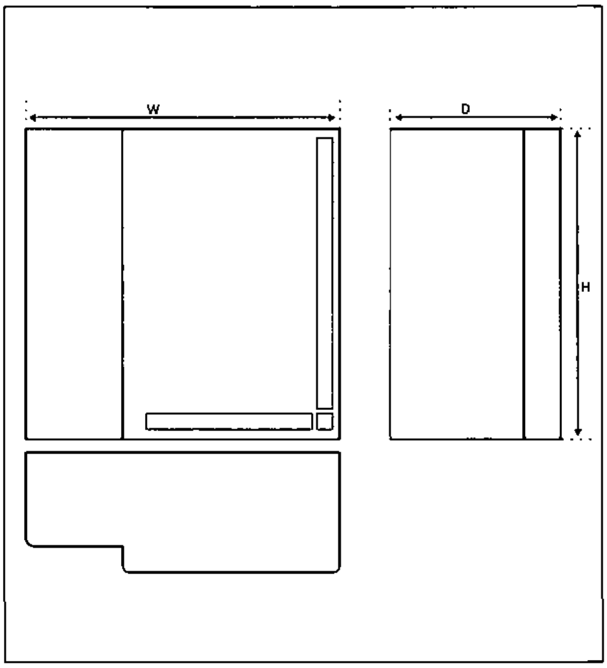


Fig. 73 MSF -310 to MSF -835.

13.5 Derating at higher temperature

By derating the current to 80% of nominal current, the MSF can be operated at an ambient temperature of up to 50 °C. E.g. a MSF-045 can operate a heavy load of 36 A (45 A*0.8).

13.6 Environmental conditions

Normal operation	
Temperature	0 - 40°C
Relative humidity	95%, non-condensing
Max altitude without derating	1000 m
Storage	
Temperature	-25 - +70°C
Relative humidity	95%, non-condensing

13.7 Standards

Market	Standard	Description
All	IEC 60947-1	Low-voltage switch gear and control gear. General part.
	IEC 60947-4-2	AC semiconductors motor controller and starters
	EN 60204-1	Safety of machinery - Electrical equipment of machines
European	Machinery Directive	89/392/ECC, Amendment 98/37/ECC
	EMC Directive	89/336/ECC, Amendment 91/263/ECC, 93/68/ECC
	Low Voltage Directive	73/23/ECC, Amendment 93/68/ECC
Russian	GOST R	Russia certificate of conformity
American	UL 508	Outline of investigation for power conversion equipment. Only models MSF-017 to MSF-250 up to 600 VAC

13.8 Power- and signal connectors.

Table 24 PCB Terminals

Terminal	Function	Electrical characteristics
01	Control supply voltage	100-240 VAC ±10% alternative
02		380-500 VAC ±10% see rating plate
PE	Protective Earth	⏚
11	Digital input 1	0-3 V --> 0; 8-27 V--> 1.
12	Digital input 2	Max. 37 V for 10 sec. Impedance to 0 VDC: 2.2 kΩ.
13	Control signal supply voltage to PCB terminal 11 and 12, 10 kΩ potentiometer, etc.	+12 VDC ±5%. Max. current from +12 VDC: 50 mA. Short circuit-proof but not overload-roof.
14	Analogue input, 0-10 V, 2-10 V, 0-20 mA and 4-20 mA/digital input.	Impedance to terminal 15 (0 VDC) voltage signal: 125 kΩ, current signal: 100 Ω.
15	GND (common)	0 VDC
16	Digital input 3	0-3 V --> 0; 8-27 V--> 1.
17	Digital input 4	Max. 37 V for 10 sec. Impedance to 0 VDC: 2.2 kΩ.
18	Control signal supply voltage to PCB terminal 16 and 17, 10 kΩ potentiometer, etc.	+12 VDC ±5%. Max. current from +12 VDC = 50 mA. Short circuit-proof but not overload-proof.
19	Analogue output	Analogue output contact: 0-10 V, 2-10 V; min load impedance 700Ω 0-20 mA and 4-20 mA; max load impedance 750Ω
21	Programmable relay K1. Factory setting is "Operation" with indication by closing terminal 21 to 22.	1-pole closing contact, 250 VAC 8 A or 24 VDC 8 A resistive, 250 VAC, 3 A inductive.
22		
23	Programmable relay K2. Factory setting is "Full voltage" with indication by closing terminals 23 to 24.	1-pole closing contact, 250 VAC 8 A or 24 VDC 8 A resistive, 250 VAC, 3 A inductive.
24		
31	Programmable relay K3. Factory setting is "All alarms". Indication by closing terminals 31 to 33 and opening terminals 32 to 33.	1-pole change-over contact, 250 VAC 8A or 24 VDC 8A resistive, 250 VAC, 3A inductive.
32		
33		
69-70	PTC Thermistor input	Alarm level 2.4 kΩ. Switch back level 2.2 kΩ.
71-72*	Clickson thermistor	Controlling softstarter cooling fan temperature MSF-310 - MSF-1400
73-74*	NTC thermistor	Temperature measuring of softstarter cooling fin
75	Current transformer input, cable S1 (blue)	Connection of L1 or T1 phase current transformer
76	Current transformer input, cable S1 (blue)	Connection of L3, T3 phase (MSF 017 to MSF 250) or L2, T2 phase (MSF 310 to MSF 1400)
77	Current transformer input, cable S2 (brown)	Common connection for terminals 75 and 76
78*	Fan connection	24 VDC
79*	Fan connection	0 VDC

*Internal connection, no customer use.

13.9 Semi-conductor fuses

Always use standard commercial fuses to protect the wiring and prevent short circuiting. To protect the thyristors against short-circuit currents, superfast semiconductor fuses can be used if preferred (e.g. Bussmann type FWP or similar, see table below).

The normal guarantee is valid even if superfast semiconductor fuses are not used.

Type	FWP Bussmann fuse	
	A	I^2t (fuse) x 1000
MSF-017	80	2.4
MSF-030	125	7.3
MSF-045	150	11.7
MSF-060	200	22
MSF-075	250	42.5
MSF-085	300	71.2
MSF-110	350	95.6
MSF-145	450	137
MSF-170	700	300
MSF-210	700	300
MSF-250	800	450

NOTE: Short circuit withstand MSF017-MSF060 5000 rms A when used with K5 or RK5 fuses.

NOTE: Short circuit withstand MSF075-MSF145 10000 rms A when used with K5 or RK5 fuses.

NOTE! Short circuit withstand MSF170-250 18000 rms A when used with K5 or RK5 fuses.

14. Set-up menu list

Menu	Function/Parameter	Range	Parameter alt. Alarm codes	Param. set	Factory setting	Value	Page
	General settings						
100	Current	0.0-9999 A		—	—		page 44
101	Automatic return menu	oFF, 1-999		—	oFF		page 44
200	Control source	1, 2, 3	1. Control panel 2. Remote control 3. Serial comm.	1-4	2		page 44
201	Control panel locked for settings	no, YES		—	—		page 44
202	Enable US units	oFF, on		—	oFF		page 45
	Motor data						
210	Nominal motor voltage	200-700 V		1-4	400		page 45
211	Nominal motor current	25-200% of I_{nsoft} in A		1-4	I_{nsoft}		page 45
212	Nominal motor power	25-400% of P_{nsoft} in kW resp. hp		1-4	P_{nsoft}		page 45
213	Nominal speed	500-3600 rpm		1-4	N_{nsoft}		page 45
214	Nominal power factor	0.50-1.00		1-4	0.86		page 45
215	Nominal frequency	50, 60 Hz		—	50		page 45
	Motor protection						
	THERMAL MOTOR PROTECTION						
220	Thermal motor protection	oFF, 1, 2, 3, 4	oFF 1. Warning 2. Coast 3. Stop 4. Brake	1-4	2		page 46
221	PTC input	oFF, on		1-4	oFF		page 47
222	Internal protection class	oFF, 2-40 s		1-4	10		page 47
223	Used thermal capacity	0-150%		—	—		page 47
	START LIMITATION						
224	Start limitation	oFF, 1, 2	oFF 1. Warning 2. Coast	1-4	oFF		page 48
225	Number of starts per hour	oFF, 1-99		1-4	oFF		page 49
226	Min time between starts	oFF, 1-60 min		1-4	oFF		page 49
227	Time to next allowed start	0-60 min		—	—		page 49
	LOCKED ROTOR						
228	Locked rotor alarm	oFF, 1, 2	oFF 1. Warning 2. Coast	1-4	oFF		page 49
229	Locked rotor time	1,0-10,0 s		1-4	5,0 s		page 49
	SINGLE PHASE INPUT FAILURE						
230	Single phase input failure	1, 2	1. Warning 2. Coast	1-4	2		page 50
	CURRENT LIMIT START TIME EXPIRED						

Menu	Function/Parameter	Range	Parameter alt. Alarm codes	Param. set	Factory setting	Value	Page
231	Current limit start time expired	oFF, 1, 2, 3, 4	oFF 1. Warning 2. Coast 3. Stop 4. Brake	1-4	2		page 50
	Parameter set handling						
240	Select parameter set	0, 1, 2, 3, 4	0 - External control of parameter set 1-4 - Parameter set 1-4	—	1		page 51
241	Actual parameter set	1, 2, 3, 4		—	—		page 51
242	Copy parameter set	no, P1-2, P1-3, P1-4, P2-1, P2-3, P2-4, P3-1, P3-2, P3-4, P4-1, P4-2, P4-3	no - no action P1-2 - Copy parameter set 1 to parameter set 2 etc.	—	no		page 51
243	Reset to factory settings	no, YES		—	no		page 52
	Autoreset						
250	Autoreset attempts	oFF, 0-10		1-4	oFF		page 52
251	Thermal motor protection autoreset	oFF, 0-3600 s		1-4	oFF		page 53
252	Start limitation autoreset	oFF, 0-3600 s		1-4	oFF		page 53
253	Locked rotor alarm autoreset	oFF, 0-3600 s		1-4	oFF		page 53
254	Current limit start time expired autoreset	oFF, 0-3600 s		1-4	oFF		page 53
255	Max power alarm autoreset	oFF, 0-3600 s		1-4	oFF		page 53
256	Min power alarm autoreset	oFF, 0-3600 s		1-4	oFF		page 53
257	External alarm autoreset	oFF, 0-3600 s		1-4	oFF		page 53
258	Phase input failure autoreset	oFF, 0-3600 s		1-4	oFF		page 53
259	Voltage unbalance alarm autoreset	oFF, 0-3600 s		1-4	oFF		page 53
260	Overvoltage alarm autoreset	oFF, 0-3600 s		1-4	oFF		page 53
261	Undervoltage alarm autoreset	oFF, 0-3600 s		1-4	oFF		page 53
262	Serial communication autoreset	oFF, 0-3600 s		1-4	oFF		page 53
263	Softstarter overheated autoreset	oFF, 0-3600 s		1-4	oFF		page 53
	Serial communication						
270	Serial comm. unit address	1-247		—	1		page 54
271	Serial comm. baudrate	2.4-38.4 kBaud		—	9.6		page 55
272	Serial comm. parity	0, 1	0. No parity 1. Even parity	—	0		page 55
273	Serial comm. contact broken	oFF, 1, 2, 3, 4	oFF 1. Warning 2. Coast 3. Stop 4. Brake	—	3		page 55
	Operation settings						
	PRE-SETTING						
300	Preset pump control parameters	no, yes		—	no		page 55
	START						

Menu	Function/Parameter	Range	Parameter alt. Alarm codes	Param. set	Factory setting	Value	Page
310	Start method	1, 2, 3, 4	1. Linear torque control 2. Square torque control 3. Voltage control 4. DOL	1-4	1		page 57
311	Initial torque at start	0-250% of T_n		1-4	10		page 58
312	End torque at start	25-250% of T_n		1-4	150		page 58
313	Initial voltage at start	25-80% of U		1-4	30		page 58
314	Current limit at start	off, 150-500% of I_n		1-4	oFF		page 59
315	Start time	1-60 s		1-4	10		page 59
316	Torque boost current limit	off, 300-700% of I_n		1-4	oFF		page 60
317	Torque boost active time	0.1-2.0 s		1-4	1.0		page 60
	STOP						
320	Stop method	1, 2, 3, 4, 5	1. Linear torque control 2. Square torque control 3. Voltage control 4. Coast 5. Brake	1-4	4		page 60
321	End torque at stop	0-100% of T_n		1-4	0		page 61
322	Step down voltage at stop	100-40% of U		1-4	100		page 61
323	Braking method	1, 2	1. Dynamic vector brake 2. Reverse current brake	----	1		page 62
324	Braking strength	150-500%		1-4	150		page 62
325	Stop time	1-120 s		1-4	10		page 63
326	Alarm braking strength	oFF, 150-500%		1-4	oFF		page 63
327	Alarm braking time	1-120 s		1-4	10		page 63
	SLOW SPEED / JOG						
330	Slow speed strength	10-100		1-4	10		page 65
331	Slow speed time at start	oFF, 1-60 s		1-4	oFF		page 65
332	Slow speed time at stop	oFF, 1-60 s		1-4	oFF		page 66
333	DC brake at slow speed	oFF, 1-60 s		1-4	oFF		page 66
334	Jog forward enable	oFF, on		1-4	oFF		page 66
335	Jog reverse enable	oFF, on		1-4	oFF		page 66
	ADDITIONAL SETTINGS						
340	Bypass	oFF, on		1-4	oFF		page 67
341	Power Factor Control (PFC)	oFF, on		1-4	oFF		page 69
342	Fan continuously on	oFF, on		1-4	oFF		page 69
	Process protection						
	LOAD MONITOR						
400	Max power alarm	oFF, 1, 2, 3, 4	oFF 1. Warning 2. Coast 3. Stop 4. Brake	1-4	oFF		page 71
401	Min power alarm	oFF, 1, 2, 3, 4	oFF 1. Warning 2. Coast 3. Stop 4. Brake	1-4	oFF		page 71
402	Start delay power alarms	1-999 s		1-4	10		page 71

Menu	Function/Parameter	Range	Parameter alt. Alarm codes	Param. set	Factory setting	Value	Page
403	Max power alarm margin	0-100% of P_n		1-4	16		page 71
404	Max power alarm response delay	0.1-90.0 s		1-4	0.5		page 71
405	Max power pre-alarm margin	0-100% of P_n		1-4	8		page 72
406	Max power pre-alarm response delay	0.1-90.0 s		1-4	0.5		page 72
407	Min power pre-alarm margin	0-100% of P_n		1-4	8		page 72
408	Min power pre-alarm response delay	0.1-90.0 s		1-4	0.5		page 72
409	Min power alarm margin	0-100% of P_n		1-4	16		page 72
410	Min power alarm response delay	0.1-90.0 s		1-4	0.5		page 73

411	Autoset power limits	no, YES		—	no		page 73
412	Normal load	0-200% of P_n		1 - 4	100		page 73
413	Output shaft power	0.0-200.0% of P_n		—	—		page 73
	EXTERNAL ALARM						
420	External alarm	oFF, 1, 2, 3, 4, 5	oFF 1. Warning 2. Coast 3. Stop 4. Brake 5. Spinbrake	1-4	oFF		page 73
	MAINS PROTECTION						
430	Voltage unbalance alarm	oFF, 1, 2, 3, 4	oFF 1. Warning 2. Coast 3. Stop 4. Brake	1-4	oFF		page 74
431	Voltage unbalance level	2-25% of U_n		1-4	10		page 75
432	Response delay voltage unbalance alarm	1-90 s		1-4	1		page 75
433	Overvoltage alarm	oFF, 1, 2, 3, 4	oFF 1. Warning 2. Coast 3. Stop 4. Brake	1-4	oFF		page 75
434	Overvoltage level	100-150% of U_n		1-4	115		page 75
435	Response delay overvoltage alarm	1-90 s		1-4	1		page 75
436	Undervoltage alarm	oFF, 1, 2, 3, 4	oFF 1. Warning 2. Coast 3. Stop 4. Brake	1-4	oFF		page 75
437	Undervoltage level	75-100% of U_n		1-4	85		page 76
438	Response delay undervoltage alarm	1-90 s		1-4	1		page 76
439	Phase sequence	L123, L321		—	—		page 76
440	Phase reversal alarm	oFF, 1, 2	oFF 1. Warning 2. Coast	—	oFF		page 76

	I/O settings						
	INPUT SIGNALS						

Menu	Function/Parameter	Range	Parameter alt. Alarm codes	Param. set	Factory setting	Value	Page
500	Digital/analogue input	oFF, 1, 2, 3, 4, 5, 6, 7	oFF 1. Digital, Rotation sensor 2. Digital, Slow speed 3. Digital, Jog fwd 4. Digital, Jog rev 5. Digital, Autoset 6. Analogue start-stop, 0-10V/0-20mA 7. Analogue start-stop, 2-10V/4-20 mA	1-4	oFF		page 77
501	Digital input pulses	1-100		1-4	1		page 78
502	Analogue start-stop on-value	0-100% of signal range		1-4	25		page 79
503	Analogue start-stop off-value	0-100% of signal range		1-4	75		page 80
504	Analogue start-stop delay time	1-999 s		1-4	1		page 80

510	Digital input 1 function	oFF, 1, 2, 3, 4, 5, 6, 7	oFF 1. Start signal 2. Stop signal 3. Parameter set input 1 4. Parameter set input 2 5. External alarm signal 6. Start R signal 7. Start L signal	—	1		page 81
511	Digital input 2 function	oFF, 1, 2, 3, 4, 5, 6, 7	See 510	—	2		page 81
512	Digital input 3 function	oFF, 1, 2, 3, 4, 5, 6, 7	See 510	—	3		page 82
513	Digital input 4 function	oFF, 1, 2, 3, 4, 5, 6, 7	See 510	—	4		page 82
	OUTPUT SIGNALS						
520	Analogue output	oFF, 1, 2, 3, 4	oFF 1. 0-10V/0-20mA 2. 2-10V/4-20mA 3. 10-0V/20-0mA 4. 10-2V/20-4mA	1-4	oFF		page 82
521	Analogue output function	1, 2, 3, 4	1. RMS current 2. Line voltage 3. Shaft power 4. Torque	1-4	1		page 82
522	Scaling analogue output, min	0-500% of value range		1-4	0		page 83
523	Scaling analogue output, max	0-500% of value range		1-4	100		page 84

Menu	Function/Parameter	Range	Parameter alt. Alarm codes	Param. set	Factory setting	Value	Page
530	Relay K1	off, 1-19	oFF 1. Operation 2. Full voltage 3. Power pre-alarms 4. Brake 5. Run 6. Run R 7. Run L 8. Operation R 9. Operation L 10. Power alarms 11. Max power alarm 12. Max power pre-alarm 13. Min power alarm 14. Min power pre-alarm 15. All alarms (except power pre-alarms) 16. All alarms (except power alarm and pre-alarms) 17. External alarm 18. Autoreset expired 19. All alarms which need manual reset	—	1		page 85
531	Relay K2	off, 1-19	Same as 530	—	2		page 85
532	Relay K3	off, 1-19	Same as 530	—	15		page 85
533	K1 contact function	1, 2	1. N.O. 2. N.C.	—	1		page 85
534	K2 contact function	1, 2	1. N.O. 2. N.C.	—	1		page 86
	View operation						
	OPERATION						
700	Current	0.0-9999 A		—	—		page 91
701	Line main voltage	0-720 V		—	—		page 91
702	Power factor	0.00-1.00		—	—		page 91
703	Output shaft power	-999-9999 kW		—	—		page 91
704	Output shaft power in percentage units	0-200% of P_n		—	—		page 91
705	Shaft torque	-999-9999 Nm		—	—		page 91
706	Shaft torque in percentage units	0-250% of T_n		—	—		page 91
707	Softstarter temperature	low, 30-96°C low, 85-204°F		—	—		page 92
708	Current phase L1	0.0-9999 A		—	—		page 92
709	Current phase L2	0.0-9999 A		—	—		page 92
710	Current phase L3	0.0-9999 A		—	—		page 92
711	Line main voltage L1-L2	0-720 V		—	—		page 92
712	Line main voltage L1-L3	0-720 V		—	—		page 92
713	Line main voltage L2-L3	0-720 V		—	—		page 92
714	Phase sequence	L—, L123, L321		—	—		page 92
715	Used thermal capacity	0-150%		—	—		page 92
716	Time to next allowed start	0-60 min		—	—		page 92

Menu	Function/Parameter	Range	Parameter alt. Alarm codes	Param. set	Factory setting	Value	Page
	STATUS						
720	Softstarter status	1-12	1. Stopped, no alarm 2. Stopped, alarm 3. Run with alarm 4. Acceleration 5. Full voltage 6. Deceleration 7. Bypassed 8. PFC 9. Braking 10. Slow speed forward 11. Slow speed reverse 12. Standby (waiting for analogue start/stop or autoreset)	—	—		page 93
721	Digital input status	LLLL-HHHH		—	—		page 93
722	Analogue/digital input status	L, H		—	—		page 93
723	Analogue/digital input value	0-100% of signal range		—	—		page 93
724	Relay status	LLL-HHH		—	—		page 93
725	Analogue output value	0-100% of signal range		—	—		page 93

	STORED VALUES						
730	Operation time	0-9 999 999 h		—	—		page 94
731	Energy consumption	0.000-2000 MWh		—	—		page 94
732	Reset energy consumption	no, YES		—	no		page 94

	Alarm list						
800	Alarm list, latest error	F1-F17, h		—	—		page 94
801	Alarm list, error 14	F1-F17, h		—	—		page 94
802	Alarm list, error 13	F1-F17, h		—	—		page 94
803	Alarm list, error 12	F1-F17, h		—	—		page 94
804	Alarm list, error 11	F1-F17, h		—	—		page 94
805	Alarm list, error 10	F1-F17, h		—	—		page 94
806	Alarm list, error 9	F1-F17, h		—	—		page 94
807	Alarm list, error 8	F1-F17, h		—	—		page 94
808	Alarm list, error 7	F1-F17, h		—	—		page 94
809	Alarm list, error 6	F1-F17, h		—	—		page 94
810	Alarm list, error 5	F1-F17, h		—	—		page 94
811	Alarm list, error 4	F1-F17, h		—	—		page 94
812	Alarm list, error 3	F1-F17, h		—	—		page 94
813	Alarm list, error 2	F1-F17, h		—	—		page 94
814	Alarm list, error 1	F1-F17, h		—	—		page 94

	Softstarter data						
900	Softstarter type	17-1400 A		—	17		page 95
901	Software variant text	Same as label		—	V220		page 95
902	Software version text	Same as label		—	R15		page 95

Explanation of units:

U	Input line voltage
U_n	Nominal motor voltage.
I_n	Nominal motor current.
P_n	Nominal motor power.
N_n	Nominal motor speed.
T_n	Nominal shaft torque.
I_{nsoft}	Nominal current softstarter.
P_{nsoft}	Nominal power softstarter.
N_{nsoft}	Nominal speed softstarter.

Calculation shaft torque

$$T_n = \frac{P_n}{\left(\frac{N_n}{60} x 2\pi\right)}$$

Index

emotron

DEDICATED DRIVE

Emotron AB, Mörsaregatan 12, SE-250 24 Helsingborg, Sweden
Tel: +46 42 16 99 00, Fax: +46 42 16 99 49
E-mail: info@emotron.se
Internet: www.emotron.com

Emotron AB 01-4135-01r1 30-06-2007

TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type: Delivery Pressure Transmitter

Location: Common Control

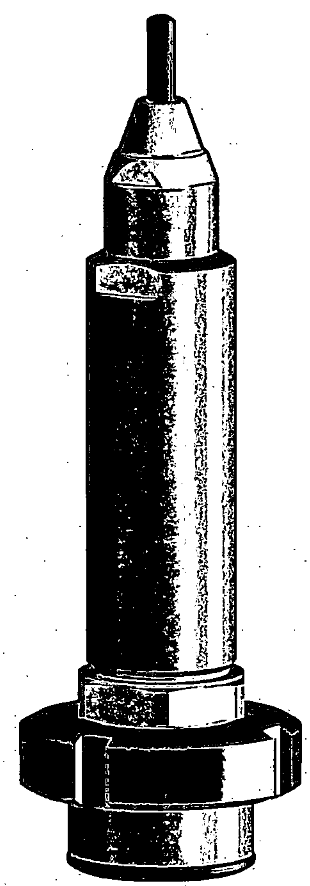
Model Numbers: VEGABAR 74

Manufacturer: Vega

Supplier: Vega
398 The Boulevard
Kirrawee
NSW
2232

VEGA

Operating Instructions
VEGABAR 74
4 … 20 mA/HART



Process pressure/
Hydrostatic

Contents

28432-EN 0718

Supplementary documentation

Information:
Depending on the ordered version, supplementary documentation belongs to the scope of delivery. You find this documentation in chapter "*Product description*".

Instructions manuals for accessories and replacement parts

Tip:
To ensure reliable setup and operation of your VEGABAR 74, we offer accessories and replacement parts. The associated documents are:

- Supplementary instructions manual 32036 "*Welded socket and seals*"
- Operating instructions manual 32798 "*Breather housing VEGABOX 02*"
- Operating instructions manual 20591 "*External indicating and adjustment unit VEGADIS 12*"

1 About this document

1.1 Function

This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance and fault rectification. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group

This operating instructions manual is directed to trained personnel. The contents of this manual should be made available to these personnel and put into practice by them.

1.3 Symbolism used

Information, tip, note
This symbol indicates helpful additional information.

Caution: If this warning is ignored, faults or malfunctions can result.
Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.
Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

Ex applications
This symbol indicates special instructions for Ex applications.

• **List**
The dot set in front indicates a list with no implied sequence.

→ **Action**
This arrow indicates a single action.

1 **Sequence**
Numbers set in front indicate successive steps in a procedure.

28432-EN 0718

2 For your safety

2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the operator.

During work on and with the device the required personal protection equipment must always be worn.

2.2 Appropriate use

VEGABAR 74 is a pressure transmitter for measurement of gauge pressure, absolute pressure and vacuum.

You can find detailed information on the application range in chapter "*Product description*".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

Due to safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

2.3 Warning about misuse

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment.

2.4 General safety instructions

This is a high-tech instrument requiring the strict observance of standard regulations and guidelines. The user must take note of the safety instructions in this operating instructions manual, the country-specific installation standards as well as all prevailing safety regulations and accident prevention rules.

The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for trouble-free operation of the instrument.

During the entire duration of use, the user is obliged to determine the compliance of the required occupational safety measures with the current valid rules and regulations and also take note of new regulations.

2.5 Safety approval markings and safety tips

The safety approval markings and safety tips on the device must be observed.

2.6 CE conformity

VEGABAR 74 is in CE conformity with EMC (89/336/EWG), fulfils NAMUR recommendation NE 21 and is in CE conformity with LVD (73/23/EWG).

Conformity has been judged according to the following standards:

- EMC:
  - Emission EN 61326: 2004 (class B)
  - Susceptibility EN 61326: 2004 including supplement A
- LVD: EN 61010-1: 2001

VEGABAR 74 is not subject to the pressure device guideline.[1)]

2.7 Fulfilling NAMUR recommendations

VEGABAR 74 fulfills the following NAMUR recommendations:

- NE 21 (interference resistane and emitted interference)
- NE 43 (signal level for failure information)
- NE 53 (compatibility sensor and indicating/adjustment components)

VEGA instruments are generally upward and downward compatible:

- Sensor software to DTM VEGABAR 74 HART
- DTM VEGABAR 74 for adjustment software PACTware™

The parameter adjustment of the basic sensor functions is independent of the software version. The range of available functions depends on the respective software version of the individual components.

The software version of VEGABAR 74 HART can be read out via PACTware™.

1) Due to the flush diaphragm, no own pressure compartment is formed.

You can view all software histories on our website www.vega.com. Make use of this advantage and get registered for update information via e-mail.

2.8 Safety instructions for Ex areas

Please note the Ex-specific safety information for installation and operation in Ex areas. These safety instructions are part of the operating instructions manual and come with the Ex-approved instruments.

2.9 Environmental instructions

Protection of the environment is one of our most important duties. That is why we have introduced an environment management system with the goal of continuously improving company environmental protection. The environment management system is certified according to DIN EN ISO 14001.

Please help us fulfil this obligation by observing the environmental instructions in this manual:

- Chapter "*Packaging, transport and storage*"
- Chapter "*Disposal*"

3 Product description

3.1 Configuration

Scope of delivery

The scope of delivery encompasses:

- VEGABAR 74 pressure transmitter
- Documentation
  - this operating instructions manual
  - Test certificate for pressure transmitters
  - Ex-specific "*Safety instructions*" (with Ex-versions)
  - if necessary, further certificates

Components

VEGABAR 74 consists of the following components:

- Process fitting with measuring cell
- Housing with electronics
- Connection cable (direct cable outlet)

The components are available in different versions.

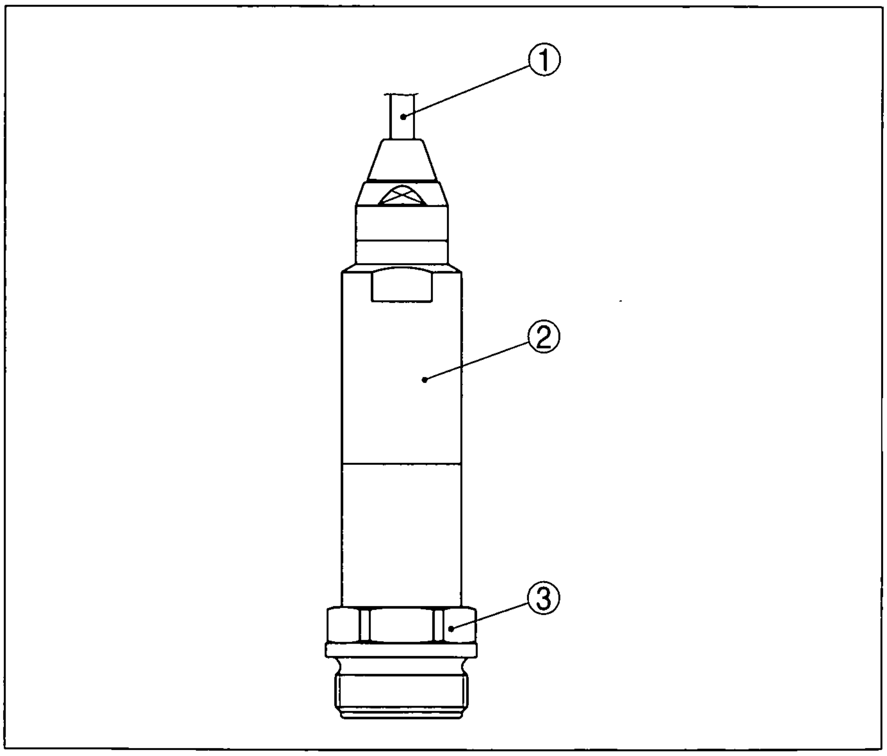


Fig. 1: Example of a VEGABAR 74 with process fitting G1½ A
1 Connection cable
2 Housing with electronics
3 Process fitting with measuring cell

28432-EN 0718

3.2 Principle of operation

Area of application

VEGABAR 74 is a pressure transmitter for use in the paper, food processing and pharmaceutical industry. Thanks to the high protection class IP 68/IP 69K it is particularly suitable for use in humid environment. Depending on the version, it is used for level, gauge pressure, absolute pressure or vacuum measurements. Measured products are gases, vapours and liquids, also with abrasive contents.

Functional principle

The sensor element is the CERTEC® measuring cell with flush, abrasion resistant ceramic diaphragm. The hydrostatic pressure of the medium or the process pressure causes a capacitance change in the measuring cell via the diaphragm. This change is converted into an appropriate output signal and outputted as measured value.

The CERTEC® measuring cell is also equipped with a temperature sensor. The temperature value can be processed via the signal output.

Supply

Two-wire electronics 4 … 20 mA/HART for power supply and measured value transmission over the same cable.

The supply voltage range can differ depending on the instrument version.

The data for power supply are stated in chapter "*Technical data*" in the "*Supplement*".

3.3 Operation

VEGABAR 74 4 … 20 mA/HART can be adjusted with different adjustment media:

- with external adjustment/indication VEGADIS 12
- an adjustment software according to FDT/DTM standard, e.g. PACTware™ and PC
- with a HART handheld

The kind of adjustment and the adjustment options depend on the selected adjustment component. The entered parameters are generally saved in the respecitive sensor, when adjusting with PACTware™ and PC optionally also in the PC.

3.4 Packaging, transport and storage

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test according to DIN EN 24180.

The packaging of standard instruments consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport

Transport must be carried out under consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

- Storage and transport temperature see "*Supplement - Technical data - Ambient conditions*"
- Relative humidity 20 … 85 %

28432-EN 0718

4 Mounting

4.1 General instructions

Materials, wetted parts

Make sure that the wetted parts of VEGABAR 74, especially the seal and process fitting, are suitable for the existing process conditions such as pressure, temperature etc. as well as the chemical properties of the medium.

You can find the specifications in chapter "*Technical data*" in the "*Supplement*".

Temperature limits

Higher process temperatures often mean also higher ambient temperatures. Make sure that the upper temperature limits stated in chapter "*Technical data*" for the environment of the electronics housing and connection cable are not exceeded.

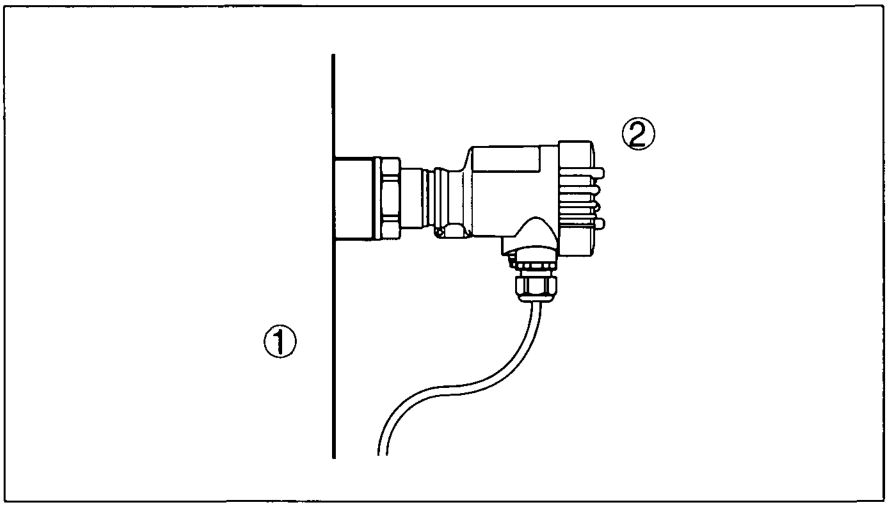


Fig. 2: Temperature ranges
1 Process temperature
2 Ambient temperature

Connection

- The connection cable has a capillary for atmospheric pressure compensation

→ Lead the cable end into a dry space or into a suitable terminal housing.

Information:
VEGA recommends the breather housing VEGABOX 02 or the indication/adjustment VEGADIS 12. Both contain terminals and a ventilation filter for pressure compensation. For mounting outdoors, a suitable protective cover is available.

4.2 Mounting steps

Sealing/Screwing in threaded versions

Seal the thread with teflon, hemp or a similar resistant seal material on the process fitting thread 1½ NPT.

→ Screw VEGABAR 74 into the welded socket. Tighten the hexagon on the process fitting with a suitable wrench. Wrench size, see chapter "*Dimensions*".

Sealing/Screwing in flange versions

Seal the flange connections according to DIN/ANSI with a suitable, resistant seal and mount VEGABAR 74 with suitable screws.

Sealing/Screwing in hygienic fittings

Use the seal suitable for the respective process fitting. You can find the components in the line of VEGA accessories in the supplementary instructions manual "*Welded socket and seals*".

5 Connecting to power supply

5.1 Preparing the connection

Note safety instructions

Always keep in mind the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltage surges are expected, versions with integrated overvoltage arresters should be used or external overvoltage arresters should be installed

Tip:
We recommend the version of VEGABAR 74 with integrated overvoltage arrester or VEGA type ÜSB62-36G.X as external overvoltage arreaster.

Take note of safety instructions for Ex applications

In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units.

Select power supply

Power supply and current signal are carried on the same two-wire cable. The voltage supply range can differ depending on the instrument version.

The data for power supply are stated in chapter "*Technical data*" in the "*Supplement*".

Provide a reliable separation of the supply circuit from the mains circuits according to DIN VDE 0106 part 101.

VEGA power supply units VEGATRENN 149AEx, VEGASTAB 690, VEGADIS 371 as well as all VEGAMETs meet this requirement. When using one of these instruments, protection class III is ensured for VEGABAR 74.

Bear in mind the following factors regarding supply voltage:

- Output voltage of the power supply unit can be lower under nominal load (with a sensor current of 20.5 mA or 22 mA in case of fault message)
- Influence of additional instruments in the circuit (see load values in chapter "*Technical data*")

Selecting connection cable

VEGABAR 74 is connected with standard two-wire cable without screen. An outer cable diameter of 5 … 9 mm ensures the seal effect of the cable gland when connecting via VEGABOX 02 or VEGADIS 12. If electromagnetic interference is expected which is above the test values of EN 61326 for

28432-1-070718

industrial areas, screened cable should be used. For HART multidrop operation we recommend as standard practice the use of screened cable.

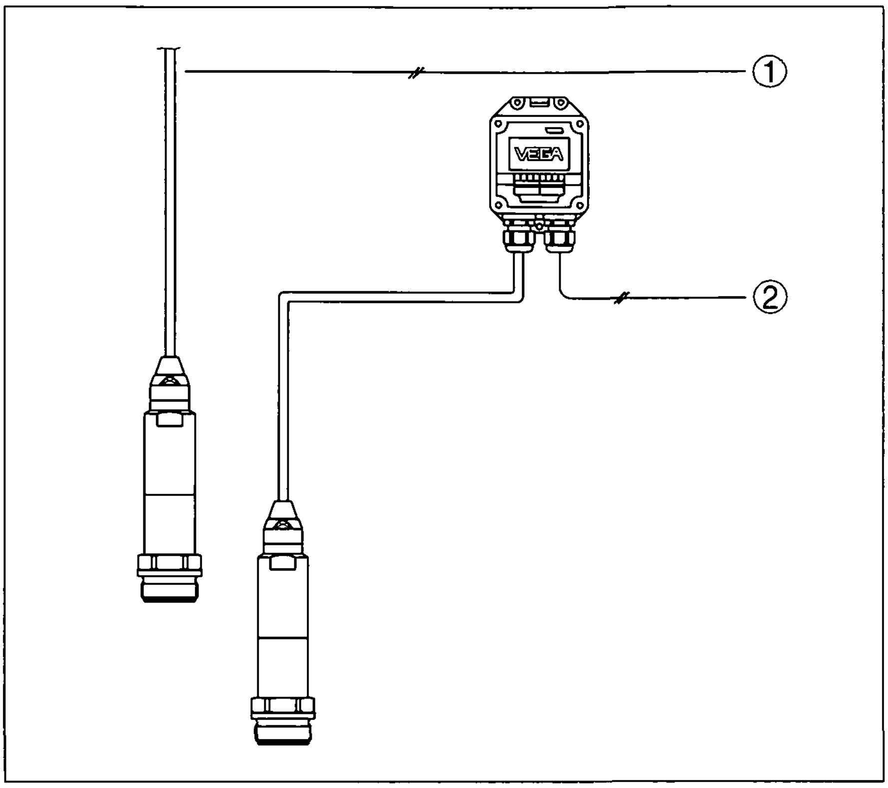


Fig. 3: Connection of VEGABAR 74
1 Direct connection
2 Connection via VEGABOX 02 or VEGADIS 12

Cable screening and grounding

If screened cable is necessary, connect the cable screen on both ends to ground potential. In the VEGABOX 02 or VEGADIS 12, the screen must be connected directly to the internal ground terminal. The ground terminal on the outside of the housing must be connected to the potential equalisation (low impedance).

If potential equalisation currents are expected, the connection on the processing side must be made via a ceramic capacitor (e.g. 1 nF, 1500 V). The low frequency potential equalisation currents are thus suppressed, but the protective effect against high frequency interference signals remains.

Select connection cable for Ex applications

Take note of the corresponding installation regulations for Ex applications. In particular, make sure that no potential equalisation currents flow over the cable screen. In case of grounding on both sides this can be achieved by the use of a capacitor or a separate potential equalisation.

28432-EN 0718

5.2 Connection procedure

Direct connection

Proceed as follows:

1 Wire the connection cable up to the connection compartment. The bending radius must be at least 25 mm.[2]

2 Connect the wire ends to the screw terminals according to the wiring plan

Via VEGABOX 01 or VEGADIS 12

Proceed as follows:

1 Snap connection housing onto the carrier rail or screw it to the mounting plate

2 Loosen the cover screws and remove the cover

3 Insert the cable through the cable entry into the connection housing housing

4 Loosen the screws with a screwdriver

5 Insert the wire ends into the open terminals according to the wiring plan

6 Tighten the screws with a screwdriver

7 Check the hold of the wires in the terminals by lightly pulling on them

8 Tighten the compression nut of the cable entry. The seal ring must completely encircle the cable

9 Connect the supply cable according to steps 3 to 8

10 Screw the housing cover back on

The electrical connection is finished.

2) The connection cable is already preconfectioned. After shortening the cable, fasten the type plate with support again to the cable.

5.3 Wiring plan

Direct connection

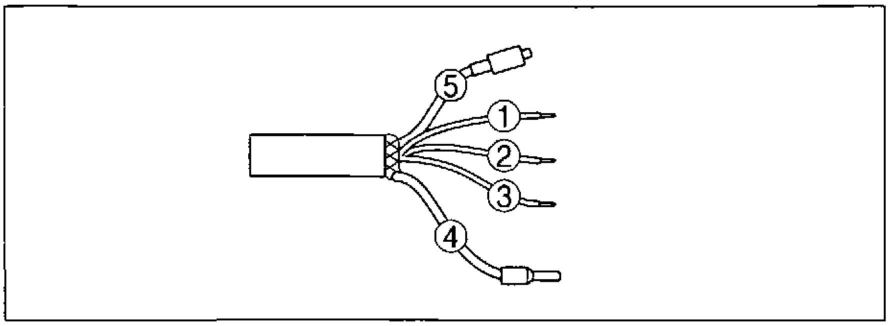


Fig. 4: Wire assignment, connection cable
1 *brown (+): to power supply or to the processing system*
2 *blue (-): to power supply or to the processing system*
3 *yellow: is only required with VEGADIS 12, otherwise connect to minus or with VEGABOX 01 to terminal 3*[3]
4 *Screen*
5 *Breather capillaries with filter element*

Connection via VEGABOX 02

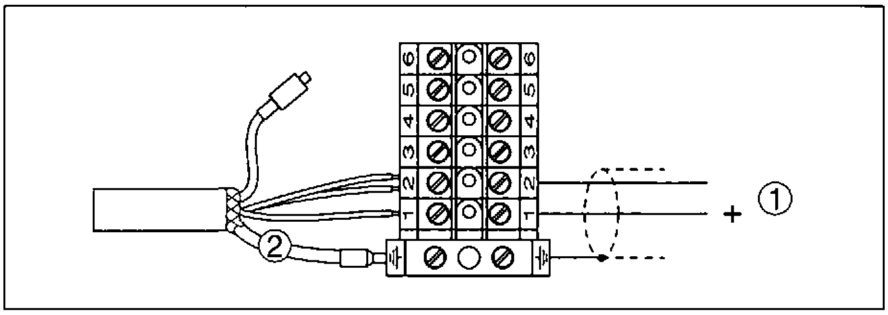


Fig. 5: Terminal assignment VEGABAR 74
1 *To power supply or the processing system*
2 *Screen*[4]

Wire number	Wire colour/Polarity	VEGABAR 74 terminal
1	brown (+)	1
2	blue (-)	2
3	Yellow	2
	Screen	Ground

28432-EN 0718

[3] For customer-specific versions already connected with blue (-) when being shipped.
[4] Connect screen to ground terminal. Connect ground terminal on the outside of the housing as prescribed. The two terminals are galvanically connected.

Connection via VEGADIS 12

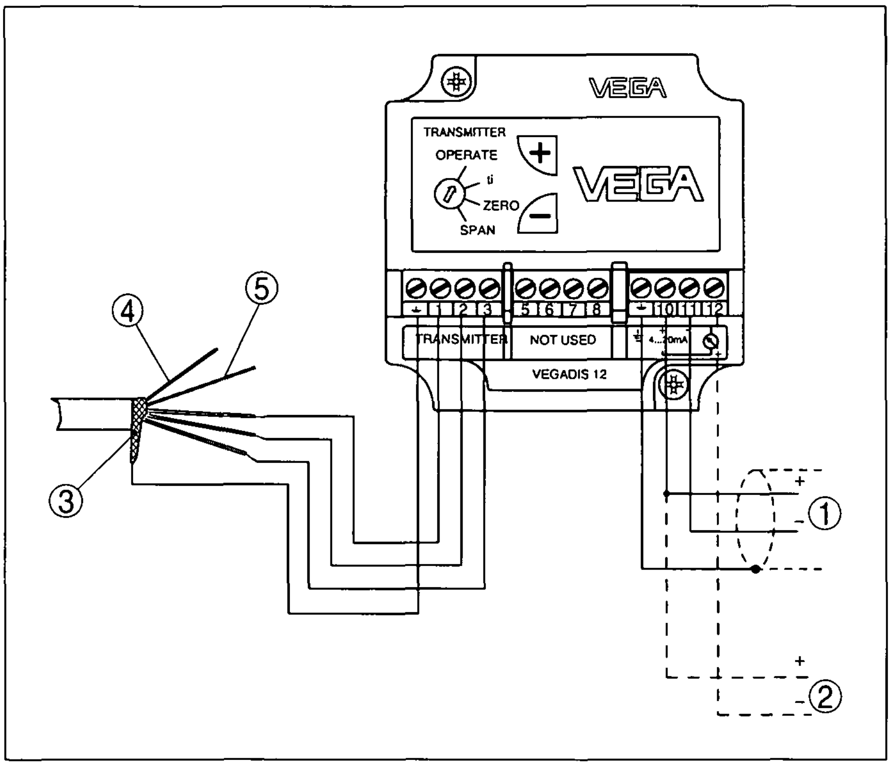


Fig. 6: Terminal assignment, VEGADIS 12
1 *To power supply or the processing system*
2 *Control instrument (4 … 20 mA measurement)*
3 *Screen*[5)]
4 *Breather capillaries*
5 *Suspension cable*

Wire number	Wire colour/Polarity	Terminal VEGADIS 12
1	brown (+)	1
2	blue (-)	2
3	Yellow	3

28432-EN-070718

5) Connect screen to ground terminal. Connect ground terminal on the outside of the housing as prescribed. The two terminals are galvanically connected.

6 Set up

6.1 Setup steps without VEGADIS 12

After mounting and electrical connection, VEGABAR 74 is ready for operation.

→ Switch on voltage

The electronics now carries out a self-check for approx. 2 seconds. Then VEGABAR 74 delivers a current of 4 … 20 mA according to the actual level.

6.2 Setup steps with VEGADIS 12

Adjustment volume

- zero - measuring range begin
- span - measuring range end
- ti - Integration time

Adjustment system

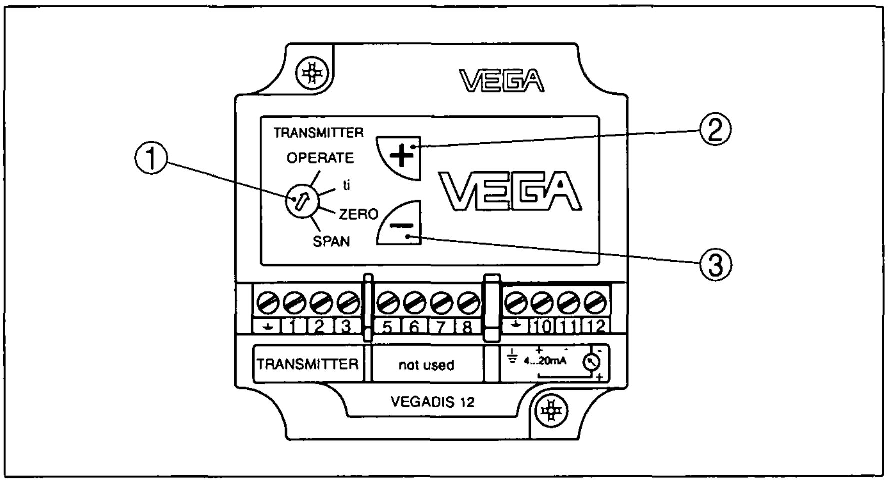


Fig. 7: Adjustment elements of VEGADIS 12
1 *Rotary switch: choose the requested function*
2 *[+] key, change value (rising)*
3 *[-] key, change value (falling)*

- With the rotary switch the requested function is selected
- With the *[+]* and *[-]* keys, the signal current or the integration time are adjusted
- Finally the rotary switch is set to position "*OPERATE*"

The set values are transmitted to the EEPROM memory and remain there even in case of voltage loss.

Adjustment steps, adjustment

Proceed as follows for adjustment with VEGADIS 12:

1 Open housing cover
2 Connect hand multimeter to terminals 10 and 12
3 Meas. range begin: Set rotary switch to "*zero*"

4 Empty the vessel or reduce process pressure
5 Set a current of 4 mA with the ***[+]*** and ***[-]*** keys
6 Meas. range end: Set rotary switch to "*span*"
7 Fill the vessel or increase process pressure
8 Set a current of 20 mA with the ***[+]*** and ***[-]*** keys
9 Operation: Set rotary switch to "*OPERATE*"
10 Close housing cover

The adjustment data are effective, the output current 4 … 20 mA corresponds to the actual level.

Adjustment steps, integration time

Proceed as follows for the adjustment of the integration time with VEGADIS 12:

1 Open housing cover
2 Set rotary switch to "*ti*"
3 By pushing the ***[-]*** key 10-times, make sure that the integration time is set to 0 sec.
4 For every 1 sec. requested integration time, push the ***[+]*** key once.
5 The integration time is the time required by the output current signal to reach 90 % of the actual height after a sudden level change.
6 Set rotary switch to "*OPERATE*"
7 Close housing cover

Adjustment steps, scaling

The display outputs the current 4 … 20 mA as bar graph and digital value.

With 4 mA no segment of the bar graph appears, with 20 mA all segments appear. This assignment is fix.

You can scale the digital value to any value between -9999 … +9999 via the adjustment module.

Proceed as follows for scaling the indication of VEGADIS 12:

1 Open housing cover
2 Initial value: Set rotary switch to "*zero*"
3 Set the requested value, e.g. 0 with the ***[+]*** and ***[-]*** keys
4 Final value: Set the rotary switch to "*span*"
5 Set the requested value, e.g. 1000 with the ***[+]*** and ***[-]*** keys
6 Decimal point: Set the rotary switch to "*point*"
7 With the ***[+]*** and ***[-]*** keys you can adjust the requested value, e.g. 8888 (no decimal point)

8 Set rotary switch to "*OPERATE*"

9 Close housing cover

The adjustment data are effective, the output current 4 … 20 mA corresponds to the actual level.

7 Setup with PACTware™

7.1 Connect the PC with VEGACONNECT 3

Connecting the PC to the signal cable

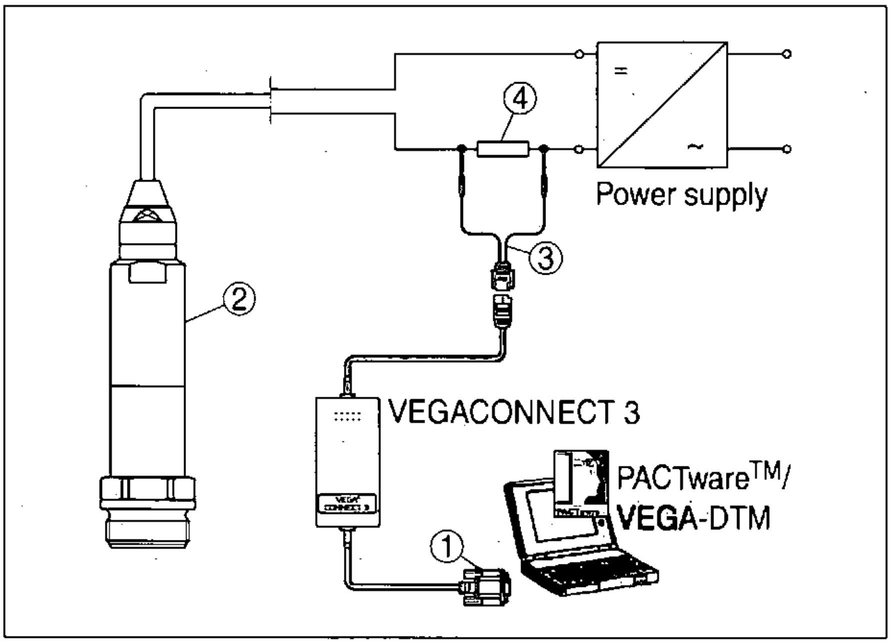


Fig. 8: Connecting the PC to the signal cable
1 *RS232 connection (with VEGACONNECT 3) or USB connection (with VEGACONNECT 4)*
2 *VEGABAR 74*
3 *HART adapter cable*
4 *HART resistance 250 Ohm (optional depending on the processing)*

Necessary components:

- VEGABAR 74
- PC with PACTware™ and suitable VEGA DTM
- VEGACONNECT 3 or 4 with HART adapter cable (art. no. 2.25397)
- HART resistance approx. 250 Ohm
- Power supply unit

Note:
With power supply units with integrated HART resistance (internal resistance approx. 250 Ohm), an additional external resistance is not necessary (e.g. VEGATRENN 149A, VEGADIS 371, VEGAMET 381/624/625, VEGASCAN 693). In such cases, VEGACONNECT 3 can be connected parallel to the 4 ... 20 mA cable.

28432-EN-070718

7.2 Connect the PC with VEGACONNECT 4

Connection via HART

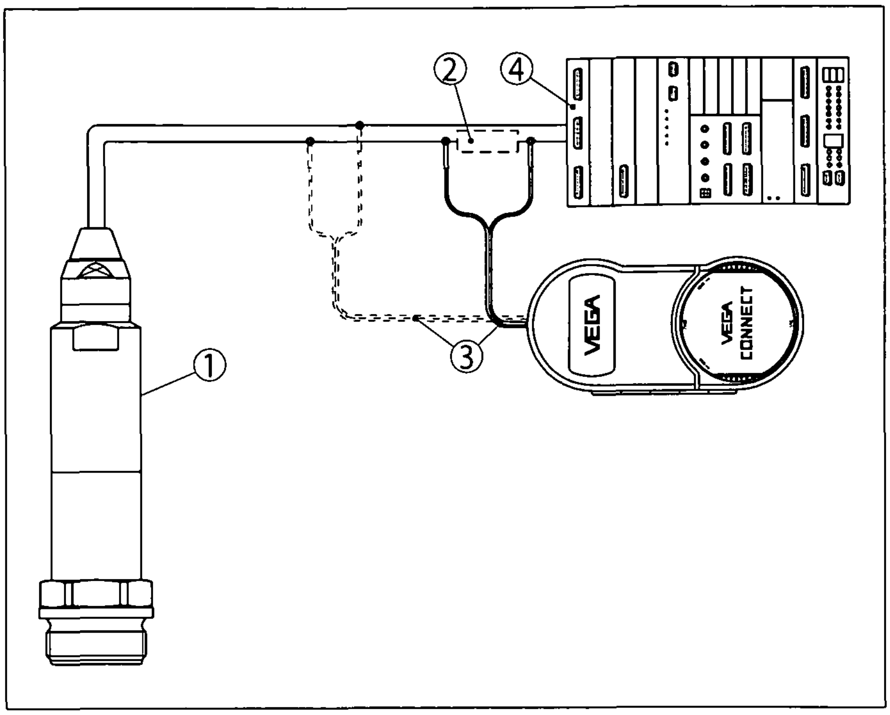


Fig. 9: Connecting the PC via HART to the signal cable
1 VEGABAR 74
2 HART resistance 250 Ohm (optional depending on the processing)
3 Connection cable with 2 mm pins and terminals
4 Processing system/PLC/Voltage supply

Necessary components:

- VEGABAR 74
- PC with PACTware™ and suitable VEGA DTM
- VEGACONNECT 4
- HART resistance 250 Ohm (optional depending on the processing)
- Power supply unit or processing system

Note:
With power supply units with integrated HART resistance (internal resistance approx. 250 Ohm), an additional external resistance is not necessary. This applies, e.g. to the VEGA instruments VEGATRENN 149A, VEGADIS 371, VEGAMET 381). Also usual Ex separators are most of the time equipped with a sufficient current limitation resistor. In such cases, VEGACONNECT 4 can be connected parallel to the 4 … 20 mA cable.

28432-EN 0718

7.3 Parameter adjustment with PACTware™

Further setup steps are described in the operating instructions manual "*DTM Collection/PACTware™*" attached to each CD and which can also be downloaded from our homepage. A detailed description is available in the online help of PACTware™ and the VEGA DTMs.

Note:
Keep in mind that for setup of VEGABAR 74, DTM-Collection in the actual version must be used.

All currently available VEGA DTMs are provided in the DTM Collection on CD and can be obtained from the responsible VEGA agency for a token fee. This CD includes also the up-to-date PACTware™ version. The basic version of this DTM Collection incl. PACTware™ is also available as a free-of-charge download from the Internet.

Go via www.vega.com and "*Downloads*" to the item "*Software*".

7.4 Parameter adjustment with AMS™ and PDM

For VEGA sensors, instrument descriptions for the adjustment programs AMS™ and PDM are available as DD or EDD. The instrument descriptions are already implemented in the current versions of AMS™ and PDM. For older versions of AMS™ and PDM, a free-of-charge download is available via Internet.

Go via www.vega.com and "*Downloads*" to the item "*Software*".

7.5 Saving the parameter adjustment data

It is recommended to document or save the parameter adjustment data. They are hence available for multiple use or service purposes.

The VEGA DTM Collection and PACTware™ in the licensed, professional version provide suitable tools for systematic project documentation and storage.

8 Maintenance and fault rectification

8.1 Maintenance

When used as directed in normal operation, VEGABAR 74 is completely maintenance free.

8.2 Fault clearance

Reaction in case of failures

The operator of the system is responsible for taken suitable measures to remove interferences.

Causes of malfunction

VEGABAR 74 offers maximum reliability. Nevertheless faults can occur during operation. These may be caused by the following, e.g.:

- Sensor
- Process
- Supply
- Signal processing

Fault rectification

The first measures to be taken are to check the output signals as well as to evaluate the error messages via the indicating and adjustment module. The procedure is described below. Further comprehensive diagnostics can be carried out on a PC with the software PACTware™ and the suitable DTM. In many cases, the causes can be determined in this way and faults can be rectified.

24 hour service hotline

However, if these measures are not successful, call the VEGA service hotline in urgent cases under the phone no. **+49 1805 858550**.

The hotline is available to you 7 days a week round-the-clock. Since we offer this service world-wide, the support is only available in the English language. The service is free of charge, only the standard telephone costs will be charged.

Checking the 4 ... 20 mA signal

Connect a handheld multimeter in the suitable measuring range according to the wiring plan.

? 4 ... 20 mA signal not stable

- Level fluctuations

→ Adjust integration time via PACTware™

- no atmospheric pressure compensation

→ Check the capillaries and cut them clean

28432-EN 0718

→ Check the pressure compensation in the housing and clean the filter element, if necessary

? 4 … 20 mA signal missing

- Wrong connection to power supply

→ Check connection according to chapter "*Connection steps*" and if necessary, correct according to chapter "*Wiring plan*"

- No voltage supply

→ Check cables for breaks; repair if necessary

- supply voltage too low or load resistance too high

→ Check, adapt if necessary

? Current signal 3.6 mA; 22 mA

- electronics module or measuring cell defective

→ Exchange instrument or return instrument for repair

In Ex applications, the regulations for the wiring of intrinsically safe circuits must be observed.

Reaction after fault rectification

Depending on the failure reason and measures taken, the steps described in chapter "*Set up*" must be carried out again, if necessary.

8.3 Instrument repair

If a repair is necessary, please proceed as follows:

You can download a return form (23 KB) from the Internet on our homepage www.vega.com under: "*Downloads - Forms and certificates - Repair form*".

By doing this you help us carry out the repair quickly and without having to call back for needed information.

- Print and fill out one form per instrument
- Clean the instrument and pack it damage-proof
- Attach the completed form and, if need be, also a safety data sheet outside on the packaging
- Please ask the agency serving you for the address of your return shipment. You can find the respective agency on our website www.vega.com under: "*Company - VEGA worldwide*"

9 Dismounting

9.1 Dismounting steps

Warning:
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel, high temperatures, corrosive or toxic products etc.

Take note of chapters "*Mounting*" and "*Connecting to power supply*" and carry out the listed steps in reverse order.

9.2 Disposal

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the electronics to be easily separable.

WEEE directive 2002/96/EG
This instrument is not subject to the WEEE directive 2002/96/EG and the respective national laws (in Germany, e.g. ElektroG). Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

Correct disposal avoids negative effects to persons and environment and ensures recycling of useful raw materials.

Materials: see chapter "*Technical data*"

If you cannot dispose of the instrument properly, please contact us about disposal methods or return.

10 Supplement

10.1 Technical data

General data

Manufacturer	VEGA Grieshaber KG, D-77761 Schiltach
Type name	VEGABAR 74
Parameter, pressure	Gauge pressure, absolute pressure, vacuum
Measuring principle	Ceramic-capacitive, dry measuring cell
Communication interface	None

Materials and weights

Material 316L corresponds to 1.4404 or 1.4435

Materials, wetted parts	
– Process fitting	316L
– Diaphragm	sapphire ceramic® (99.9 % oxide ceramic)
– Seal	FKM (e.g. Viton), Kalrez 6375, EPDM, Chemraz 535
– Seal process fitting thread G½ A, G1½ A	Klingersil C-4400
Materials, non-wetted parts	
– Housing	316L
– Ground terminal	316Ti/316L
– Connection cable	PUR, FEP, PE
– type label support on cable	PE-HART
Weight	0.8 … 8 kg (1.8 … 17.6 lbs), depending on process fitting

Output variable

Output signal	4 … 20 mA/HART
Failure signal	22 mA (3.6 mA), adjustable
Max. output current	22.5 mA
Damping (63 % of the input variable)	0 … 10 s, adjustable
Step response or adjustment time	70 ms (ti: 0 s, 0 … 63 %)
Fulfilled NAMUR recommendations	NE 43

Additional output parameter - temperature

Processing is made via HART-Multidrop

28432-EN-070718

Range	-50 … +150 °C (-58 … +302 °F)
Resolution	1 °C (1.8 °F)
Accuracy	
– in the range of 0 … +100°C (+32 … +212 °F)	±3 K
– in the range of -50 … 0 °C (-58 … +32 °F) and +100 … +150 °C (+212 … +302 °F)	typ. ±4 K

Input variable

Adjustment

Zero adjustable	-20 … +95 % of the nominal measuring range
Span adjustable	3.3 … +120 % of the nominal measuring range
Recommended max. turn down	10:1

Nominal measuring ranges and overload resistance

Nominal range	Overload, max. pressure[6]	Overload, min. pressure
Gauge pressure		
0 … 0.1 bar/0 … 10 kPa	15 bar/1500 kPa	-0.2 bar/-20 kPa
0 … 0.2 bar/0 … 20 kPa	20 bar/2000 kPa	-0.4 bar/-40 kPa
0 … 0.4 bar/0 … 40 kPa	30 bar/3000 kPa	-0.8 bar/-80 kPa
0 … 1 bar/0 … 100 kPa	35 bar/3500 kPa	-1 bar/-100 kPa
0 … 2.5 bar/0 … 250 kPa	50 bar/5000 kPa	-1 bar/-100 kPa
0 … 5 bar/0 … 500 kPa	65 bar/6500 kPa	-1 bar/-100 kPa
0 … 10 bar/0 … 1000 kPa	90 bar/9000 kPa	-1 bar/-100 kPa
0 … 25 bar/0 … 2500 kPa	130 bar/13000 kPa	-1 bar/-100 kPa
0 … 60 bar/0 … 6000 kPa	200 bar/20000 kPa	-1 bar/-100 kPa
-1 … 0 bar/-100 … 0 kPa	35 bar/3500 kPa	-1 bar/-100 kPa
-1 … 1.5 bar/-100 … 150 kPa	50 bar/5000 kPa	-1 bar/-100 kPa
-1 … 5 bar/-100 … 500 kPa	65 bar/6500 kPa	-1 bar/-100 kPa
-1 … 10 bar/-100 … 1000 kPa	90 bar/9000 kPa	-1 bar/-100 kPa
-1 … 25 bar/-100 … 2500 kPa	130 bar/13000 kPa	-1 bar/-100 kPa
-1 … 60 bar/-100 … 6000 kPa	300 bar/30000 kPa	-1 bar/-100 kPa
-0.05 … 0.05 bar/-5 … 5 kPa	15 bar/1500 kPa	-0.2 bar/-20 kPa
-0.1 … 0.1 bar/-10 … 10 kPa	20 bar/2000 kPa	-0.4 bar/-40 kPa

[6] Limited to 200 bar according to the pressure device directive.

Nominal range	Overload, max. pressure6)	Overload, min. pressure
-0.2 … 0.2 bar/-20 … 20 kPa	30 bar/3000 kPa	-0.8 bar/-80 kPa
-0.5 … 0.5 bar/-50 … 50 kPa	35 bar/3500 kPa	-1 bar/-100 kPa
Absolute pressure		
0 … 0.1 bar/0 … 10 kPa	15 bar/1500 kPa	
0 … 1 bar/0 … 100 kPa	35 bar/3500 kPa	
0 … 2.5 bar/0 … 250 kPa	50 bar/5000 kPa	
0 … 5 bar/0 … 500 kPa	65 bar/6500 kPa	
0 … 10 bar/0 … 1000 kPa	90 bar/9000 kPa	
0 … 25 bar/0 … 2500 kPa	130 bar/13000 kPa	
0 … 60 bar/0 … 6000 kPa	200 bar/20000 kPa	

Reference conditions and influencing variables (similar to DIN EN 60770-1)

Reference conditions according to DIN EN 61298-1

- Temperature: +15 … +25 °C (+59 … +77 °F)
- Relative humidity: 45 … 75 %
- Air pressure: 860 … 1060 mbar/86 … 106 kPa (12.5 … 15.4 psi)

Determination of characteristics: Limit point adjustment according to IEC 61298-2

Characteristics: linear

Reference installation position: upright, diaphragm points downward

Influence of the installation position: <0.2 mbar/20 Pa (0.003 psi)

Deviation determined according to the limit point method according to IEC 60770[7]

Applies to **digital** HART interface as well as to **analogue** current output 4 … 20 mA. Specifications refer to the set span. Turn down (TD) = nominal measuring range/set span.

Deviation

- Turn down 1:1 up to 5:1: <0.075 %
- Turn down up to 10:1: <0.015 % x TD

Deviation with absolutely flush process fittings EV, FT

- Turn down 1:1 up to 5:1: <0.05 %
- Turn down up to 10:1: <0.01 % x TD

[7] Incl. non-linearity, hysteresis and non-repeatability.

28432-01-070718

Deviation with absolute pressure measuring range 0.1 bar

– Turn down 1:1 up to 5:1	<0.25 % x TD
– Turn down up to 10:1	<0.05 % x TD

Influence of the product or ambient temperature

Applies to **digital** HART interface as well as to **analogue** current output 4 … 20 mA. Specifications refer to the set span. Turn down (TD) = nominal measuring range/set span.

Average temperature coefficient of the zero signal

In the compensated temperature range of 0 … +100 °C (+212 °F), reference temperature 20 °C (68 °F):

Average temperature coefficient of the zero signal

– Turn down 1:1	<0.05 %/10 K
– Turn down 1:1 up to 5:1	<0.1 %/10 K
– Turn down up to 10:1	<0.15 %/10 K

Outside the compensated temperature range:

Average temperature coefficient of the zero signal

– Turn down 1:1	typ. <0.05 %/10 K

Thermal change of the current output

Applies also to the **analogue** 4 … 20 mA current output and refers to the set span.

Thermal change, current output	<0.15 % at -40 … +80 °C (-40 … +176 °F)

Long-term stability (similar to DIN 16086, DINV 19259-1 and IEC 60770-1)

Applies to **digital** HART interface as well as to **analogue** current output 4 … 20 mA. Specifications refer to the set span. Turn down (TD) = nominal measuring range/set span.

Long-term drift of the zero signal	<(0.1 % x TD)/1 year

Total deviation (similar to DIN 16086)

The total deviation (max. practical deviation) is the sum of basic accuracy and long-term stability:

$F_{total} = F_{perf} + F_{stab}$

$F_{perf} = \sqrt{((F_T)^2 + (F_{Kl})^2)}$

With

- F_{total}: Total deviation
- F_{perf}: Basic accuracy
- F_{stab}: Long-term drift

- F_T: Temperature coefficient (influence of medium or ambient temperature)
- F_{Kl}: Deviation

Ambient conditions

Ambient, storage and transport temperature

– Connection cable PE	-40 … +60 °C (-40 … +140 °F)
– Connection cable PUR, FEP	-40 … +85 °C (-40 … +185 °F)

Process conditions

The specifications of the pressure stage are used as an overview. The specifications on the type plate are applicable.

Pressure stage, process fitting

– Thread 316L	PN 60
– Thread Alu	PN 25
– Hygienic fittings 316L	PN 10, PN 16, PN 25, PN 40
– Flange 316L, flange with extension 316L	PN 40 or 150 lbs, 300 lbs

Product temperature depending on the measuring cell seal

– FKM (e.g. Viton)	-20 … +100 °C (-4 … +212 °F)
– EPDM	-40 … +100 °C (-40 … +212 °F), 1 h: 140 °C/ 284 °F cleaning temperature
– Kalrez 6375 (FFKM)	-10 … +100 °C (+14 … +212 °F)
– Chemraz 535	-30 … +100 °C (-22 … +212 °F)
Vibration resistance	mechanical vibrations with 4 g and 5 … 100 Hz[8]
Shock resistance	Acceleration 100 g/6 ms[9]

Electromechanical data

Connection cable

– Configuration	four wires, one suspension cable, one breather capillary, screen braiding, metal foil, mantle
– Wire cross-section	0.5 mm^2 (AWG no. 20)
– wire resistance	<0.036 Ohm/m (0.011 Ohm/ft)
– Standard length	6 m (19.685 ft)
– max. length with VEGADIS 12	200 m (656.168 ft)

[8] Tested according to the regulations of German Lloyd, GL directive 2.
[9] Tested according to EN 60068-2-27.

28435-EN-070718

– Min. bending radius at 25 °C/77 °F	25 mm (0.985 in)
– Diameter	approx. 8 mm (0.315 in)
– Colour - standard PE	Black
– Colour - standard PUR	Blue
– Colour - Ex-version	Blue

Voltage supply

Supply voltage	
– Non-Ex instrument	12 … 36 V DC
– EEx ia instrument	12 … 29 V DC
Permissible residual ripple	
– <100 Hz	U_{ss} <1 V
– 100 Hz … 10 kHz	U_{ss} <10 mV
Load	see diagram

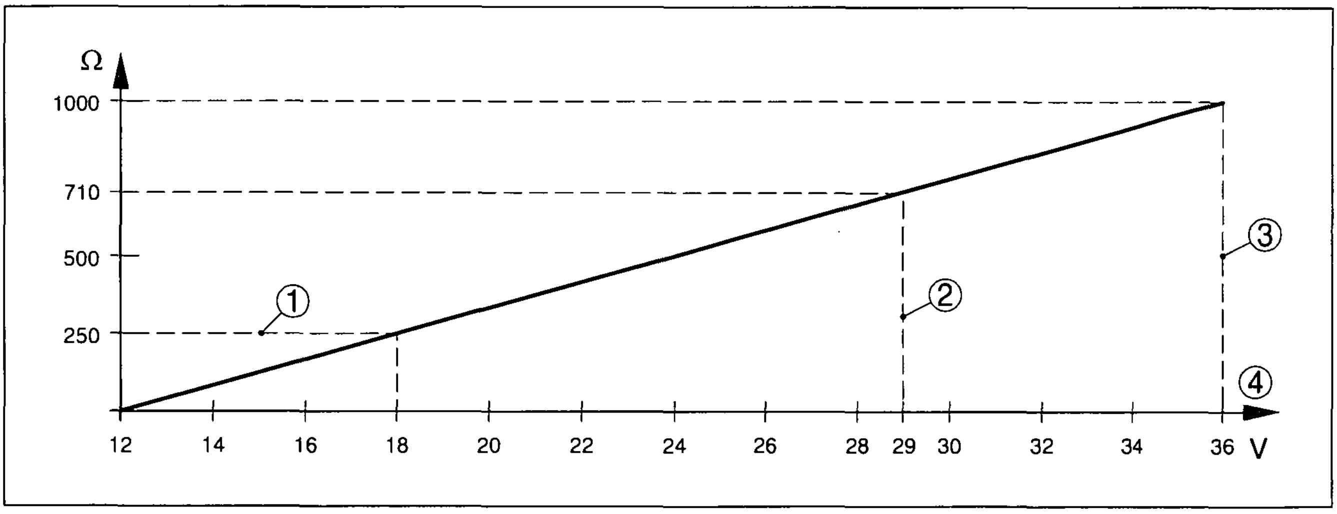


Fig. 10: Voltage diagram VEGABAR 74
1 HART load
2 Voltage limit Ex instrument
3 Voltage limit non-Ex instrument
4 Voltage supply

Load in conjunction with VEGADIS 12	see diagram

28432-EN 0718

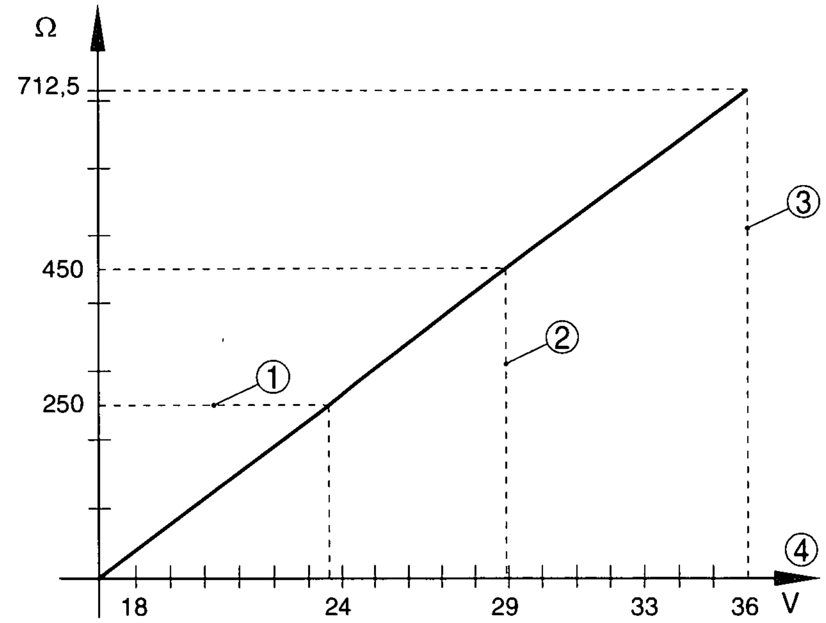


Fig. 11: Voltage diagram VEGABAR 74 with VEGADIS 12
1 HART load
2 Voltage limit Ex instrument
3 Voltage limit non-Ex instrument
4 Voltage supply

Integrated overvoltage protection

Nominal leakage current (8/20 µs)	10 kA
Min. response time	<25 ns

Electrical protective measures

Protection	IP 68 (25 bar)/IP 69K
Overvoltage category	III
Protection class	III

Approvals[10)]

ATEX ia	ATEX II 1G EEx ia IIC T6; ATEX II 2G EEx ia IIC T6
Ship approvals	GL, LRS, ABS, CCS, RINA, DNV
Others	WHG

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10) Deviating data in Ex applications: see separate safety instructions.

10.2 Dimensions

VEGABAR 74 - threaded fitting

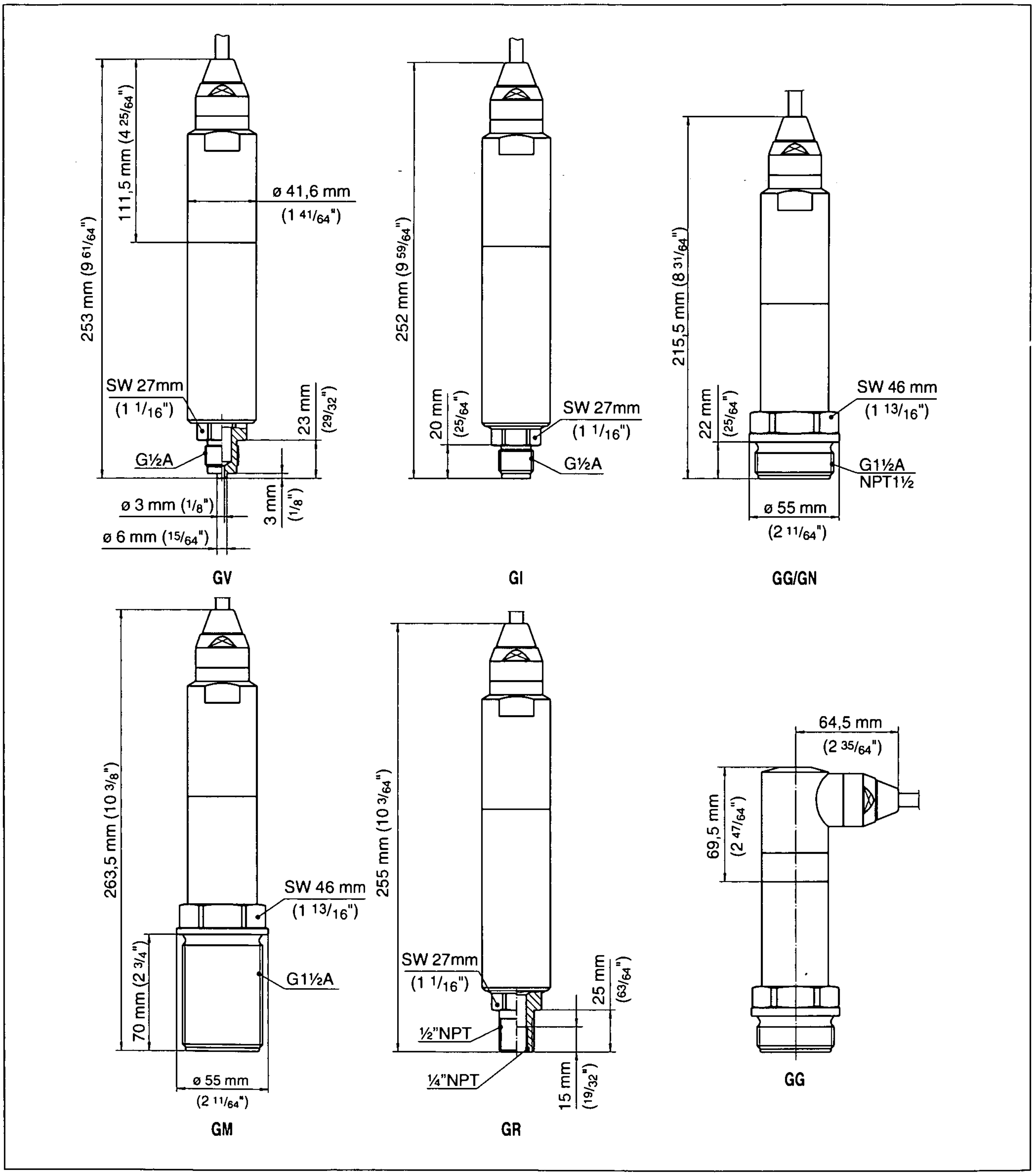


Fig. 12: VEGABAR 74 threaded fitting: GV = G½ A manometer connection EN 837, GI = G½ A inner G¼ A, GG = G1½ A, GN = 1½ NPT, GM = G1½ A 70 mm, GR = ½ NPT inner ¼ NPT

28432-EN 0718

VEGABAR 74 - hygienic fitting 1

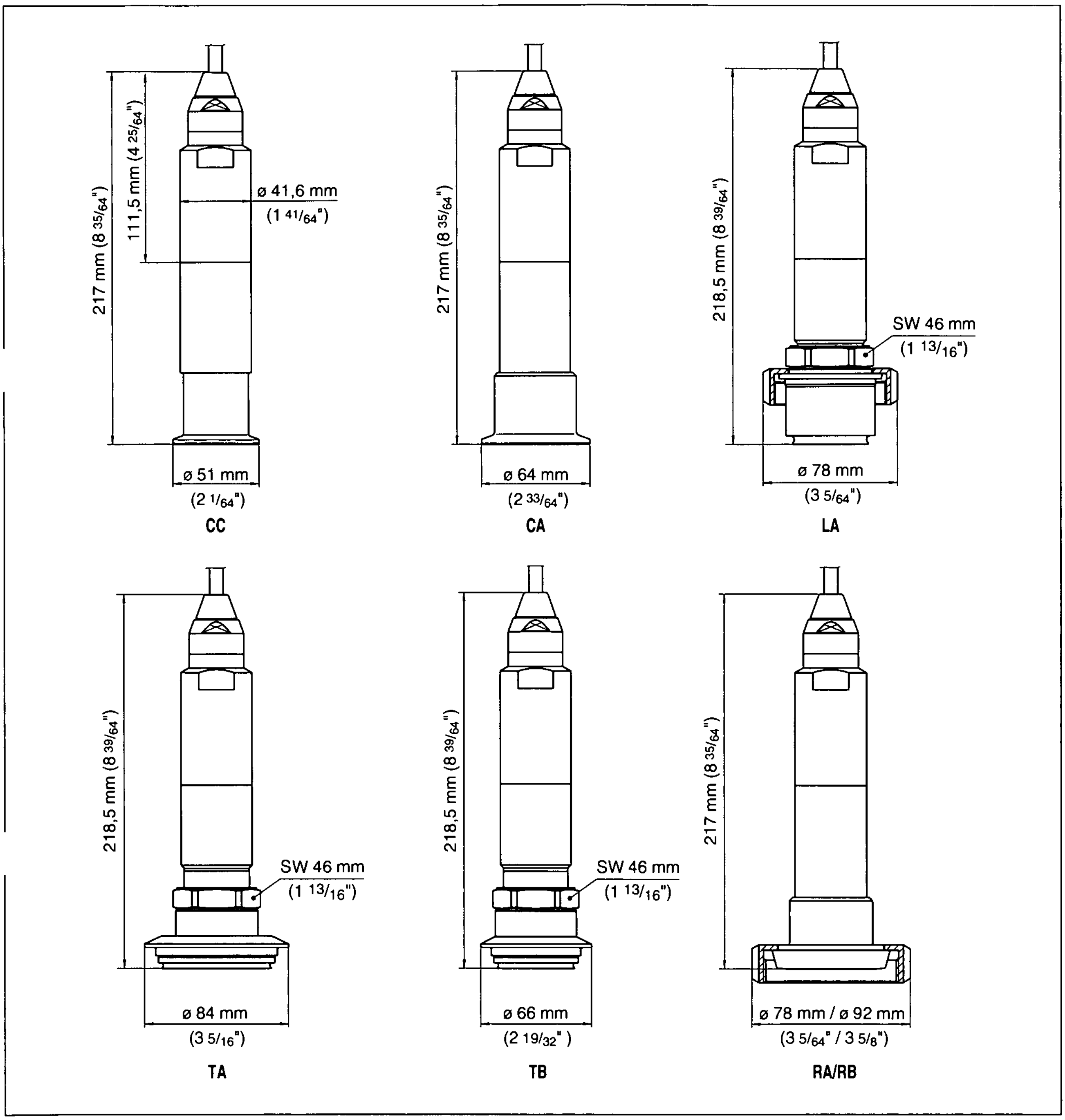


Fig. 13: VEGABAR 74 hygienic fitting: CC = Tri-Clamp 1½", CA = Tri-Clamp 2", LA = hygienic fitting with compression nut F40, TA = Tuchenhagen Varivent DN 32, TB = Tuchenhagen Varivent DN 25, RA/RB = bolting DN 40/DN 50 according to DIN 11851

28432-EN-070718

VEGABAR 74 - hygienic fitting 2

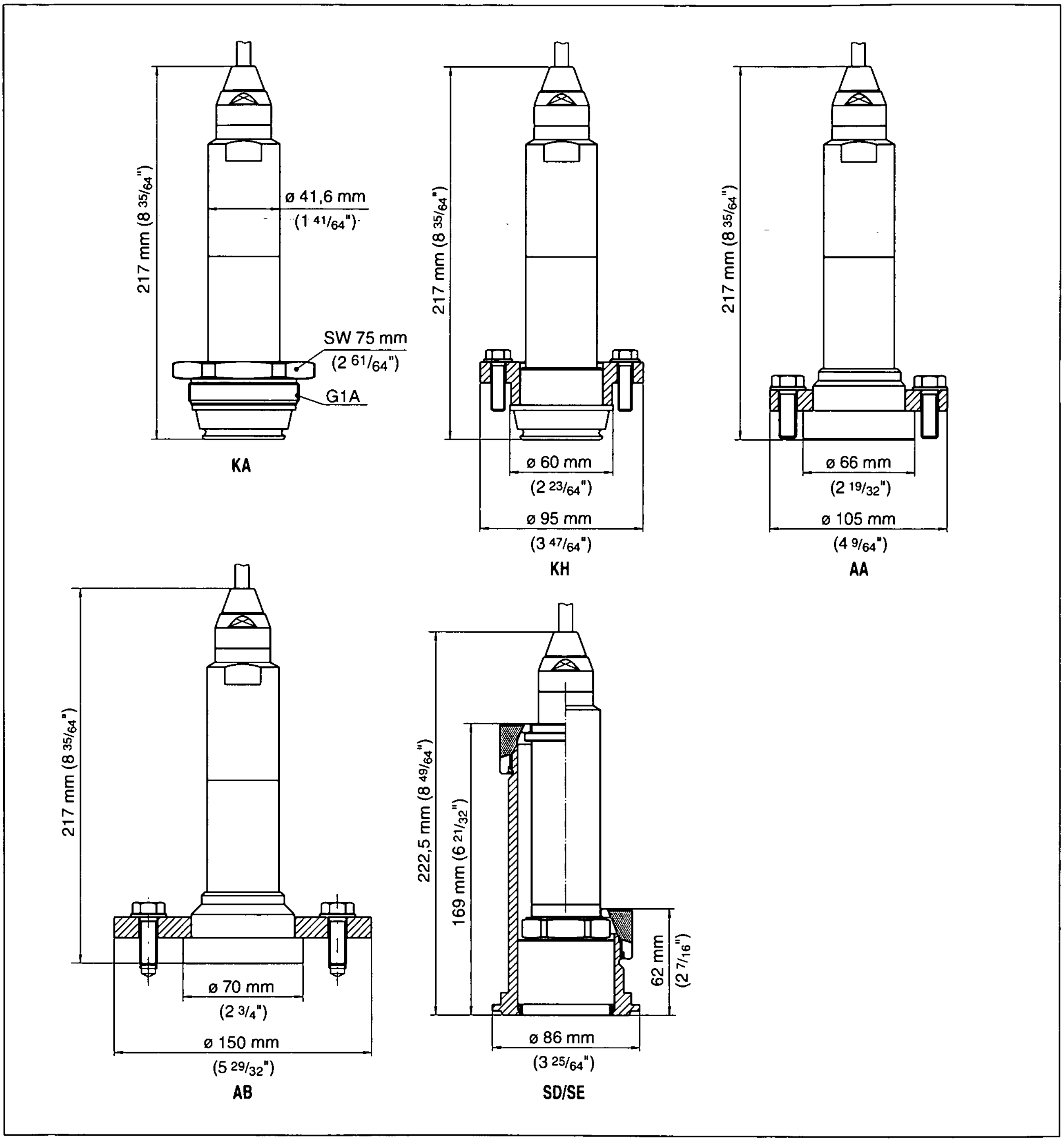
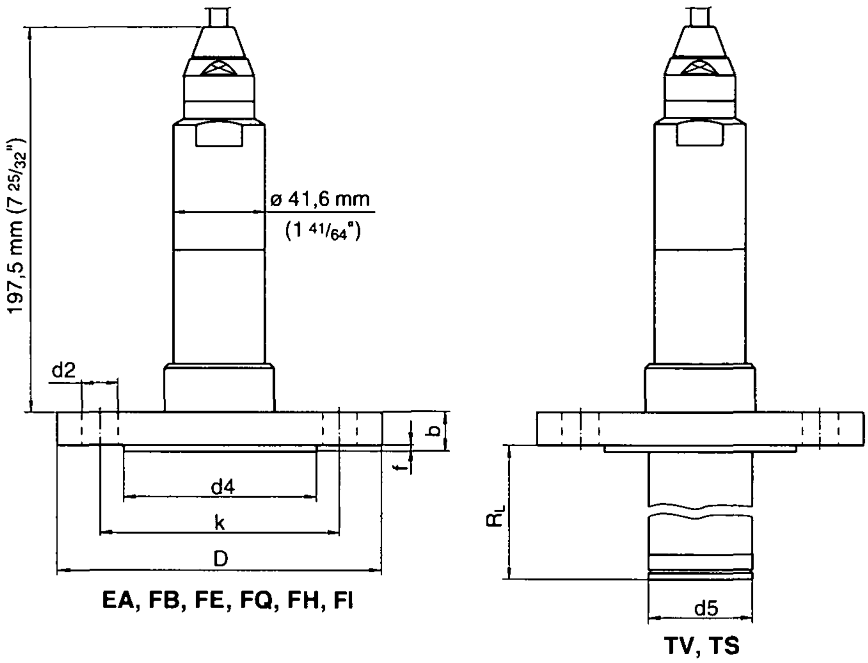


Fig. 14: VEGABAR 74 KA/KH = cone DN 40, AA = DRD, SD/SE = Anderson 3" long/short fitting

28432-EN 0718

VEGABAR 74 - flange connection



①	DN	PN	D	b	k	d2	d4	f	RL	d5
EA	40	40	5 29/32"	45/64"	4 21/64"	4xø 45/64"	3 15/32"	1/8"	-	-
FB	50	40	6 1/2"	25/32"	4 59/64"	4xø 45/64"	4 1/64"	1/8"	-	-
FE	80	40	7 7/8"	15/16"	6 19/64"	8xø 45/64"	5 7/16"	1/8"	-	-

②	"	lbs	D	b	k	d2	d4	f	RL	d5
FQ	1 ½"	150	5"	11/16"	3 14/16"	4xø 5/8"	2 7/8"	1/8"	-	-
FH	2"	150	6"	3/4"	4 3/4"	4xø 5/8"	3 5/8"	1/8"	-	-
FI	3"	150	7 1/2"	3/4"	6	4xø 5/8"	6	1/8"	-	-

③	DN	PN	D	b	k	d2	d4	f	RL	d5
TV	50	40	6 1/2"	25/32"	4 59/64"	4xø 45/64"	4 1/64"	1/8"	④	1 1/2"
TS	80	40	7 7/8"	15/16"	6 19/64"	8xø 45/64"	5 7/16"	1/8"		1 1/2"

Fig. 15: VEGABAR 74 - flange connection

1. *Flange connection according to DIN 2501*
2. *Flange fitting according to ANSI B16.5*
3. *Flange with extension*
4. *Order-specific*

28432-EN-070718

VEGABAR 74 - threaded fitting for paper industry

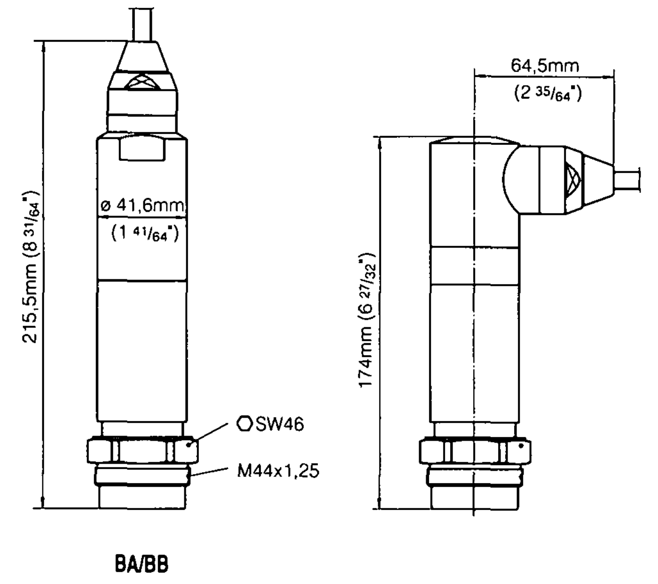


Fig. 16: VEGABAR 74 - connection for paper industry: BA/BB = M44x1.25

VEGABAR 74 - extension fitting for paper industry

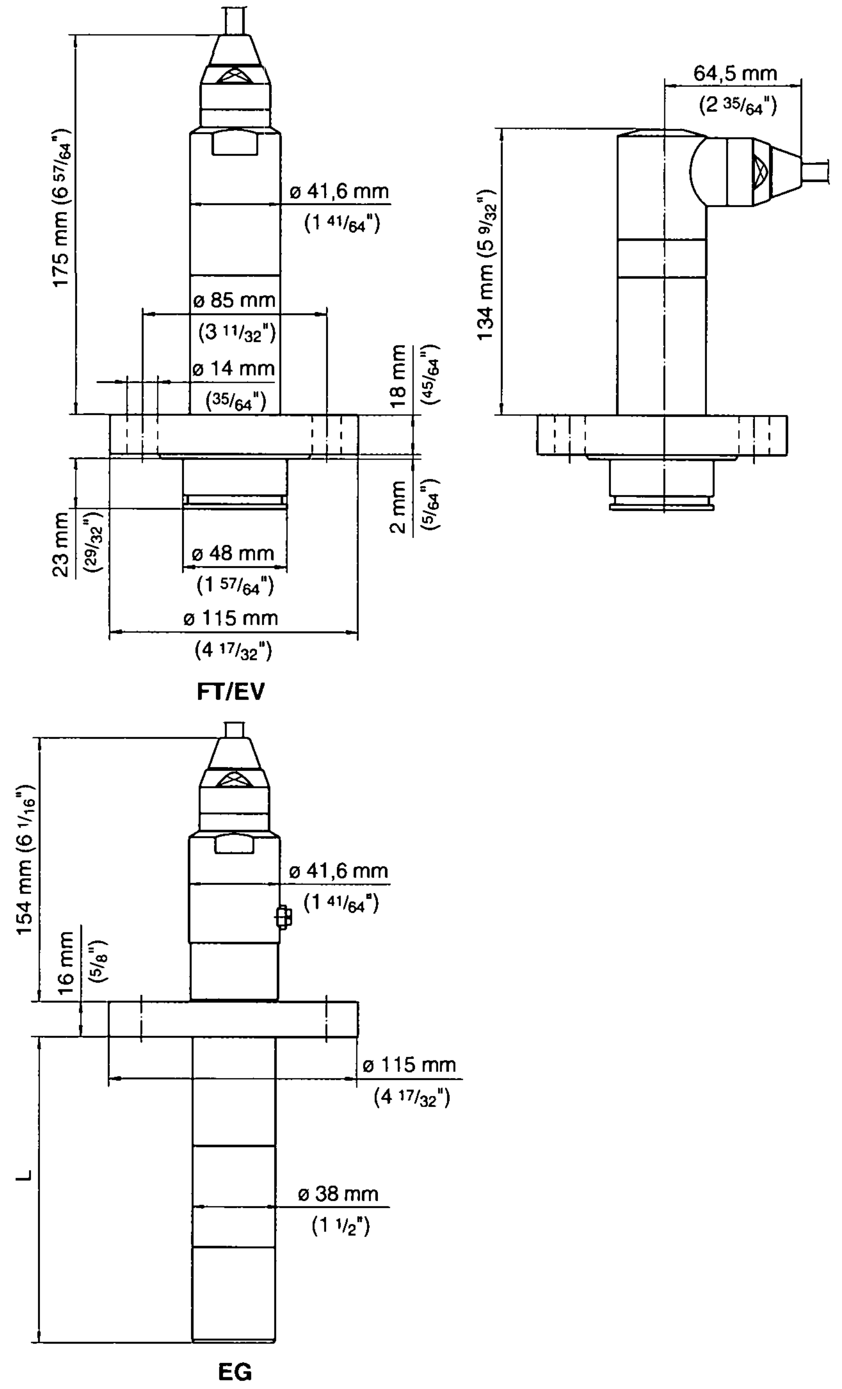


Fig. 17: VEGABAR 74 - extension fitting for paper industry: EV/FT = absolutely flush for pulper (EV 2-times flattened), EG = extension for ball valve fitting (L = order-specific)

28432-EN-070718

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VEGA Grieshaber KG
Am Hohenstein 113
77761 Schiltach
Germany
Phone +49 7836 50-0
Fax +49 7836 50-201
E-mail: info@de.vega.com
www.vega.com

ISO 9001

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.

Subject to change without prior notice 28432-EN-070718

TECHNICAL DATA SHEET

For

SEWAGE PUMP STATION SP117
Saltash St

Equipment Type: Wet Well Level Transmitter

Location: Common Control

Model Numbers: FMX167

Manufacturer: Endress & Hauser

Supplier: Unit 8/277 Lane Cove Rd
North Ryde
NSW
2113
Tel: 02 8877 7000
Fax: 02 8877 7099

Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Technical Information

Waterpilot FMX167

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

Applications

The Waterpilot FMX167 is a pressure sensor for hydrostatic level measurement. Three versions of FMX167 are available at Endress+Hauser:

- FMX167 with an outer diameter = 22 mm (0.87 inch): Version very suitable for drinking water applications and for use in probe tubes with small diameters
- FMX167 with an outer diameter = 42 mm (1.66 inch): Heavy version and very easy to clean thanks to the flush-mounted diaphragm. Very suitable for wastewater and sewage treatment plants
- FMX167 with an outer diameter = 29 mm (1.15 inch): Resistant version for use in saltwater and very suitable for applications on ships (e.g. ballast water tanks)

Your benefits

- High mechanical resistance to overload and aggressive media
- High-precision and long-term stability ceramic measuring cell
- Resistant to climatic changes thanks to potted electronics and 2-filter pressure compensation system
- 4...20 mA output signal with integrated overvoltage protection
- Simultaneous level and temperature measurement by optional integrated temperature sensor Pt 100
- Drinking water approval: KTW, NSF, ACS
- Certified to ATEX, FM and CSA
- Marine approval: GL, ABS
- Complete measuring point solutions through comprehensive accessories

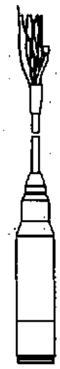
TI351P/00/en/02.08

Endress+Hauser
People for Process Automation

Table of contents

Function and system design

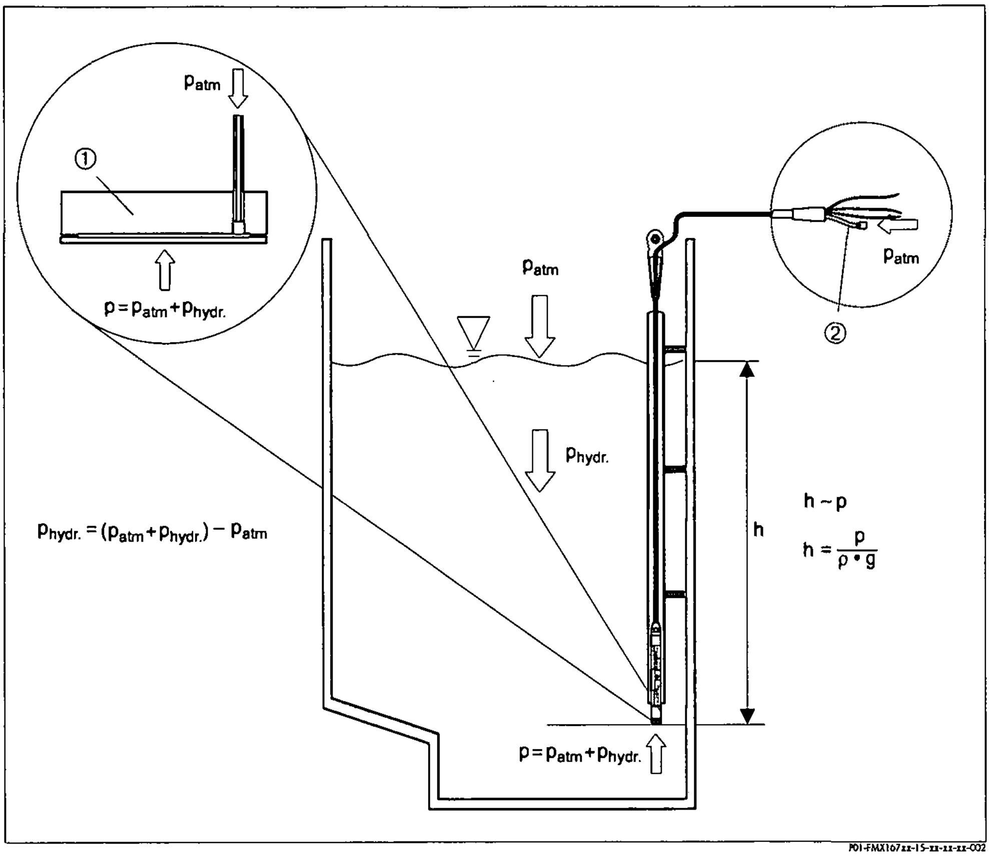
Device selection

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

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

Measuring principle

The ceramic measuring cell is dry, i.e. pressure acts directly on the rugged ceramic diaphragm of Waterpilot FMX167 and causes it to move by max. 0.005 mm.
The effects of air pressure on the liquid surface are transferred via a pressure compensation tube through the extension cable to the rear of the ceramic diaphragm and compensated. Pressure-dependent changes in capacitance caused by diaphragm movement are measured at the electrodes of the ceramic carrier. The electronics convert the movement into a pressure-proportional signal which is linear to the medium level.



FMX167 measuring principle

1 *Ceramic measuring cell*
2 *Pressure compensation tube*
h *Level height*
p *Total pressure = hydrostatic pressure + atmospheric pressure*
ρ *Medium density*
g *Gravitational acceleration*
$p_{hydr.}$ *Hydrostatic pressure*
p_{atm} *Atmospheric pressure*

Temperature measurement with optional Pt 100

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

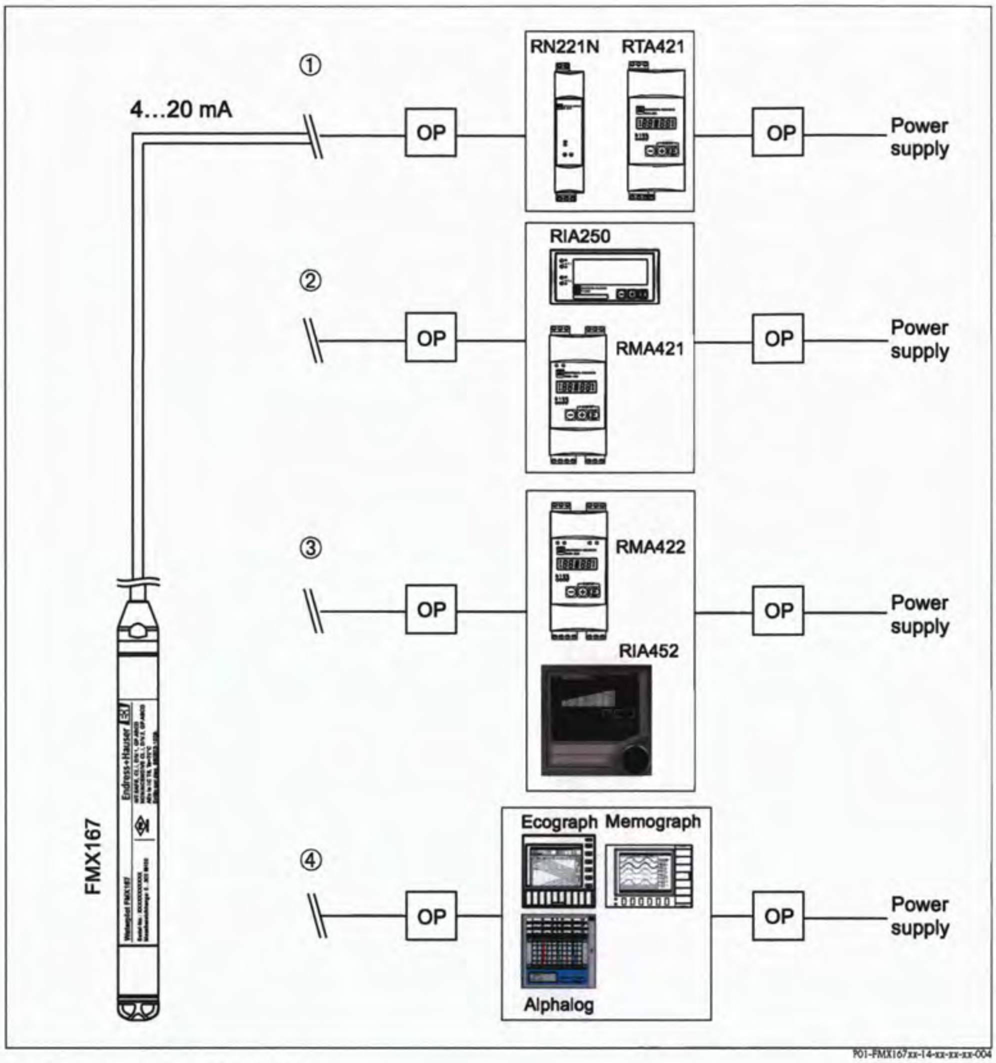
Temperature measurement with optional Pt 100 and temperature transmitter TMT181

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

Measuring system

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

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

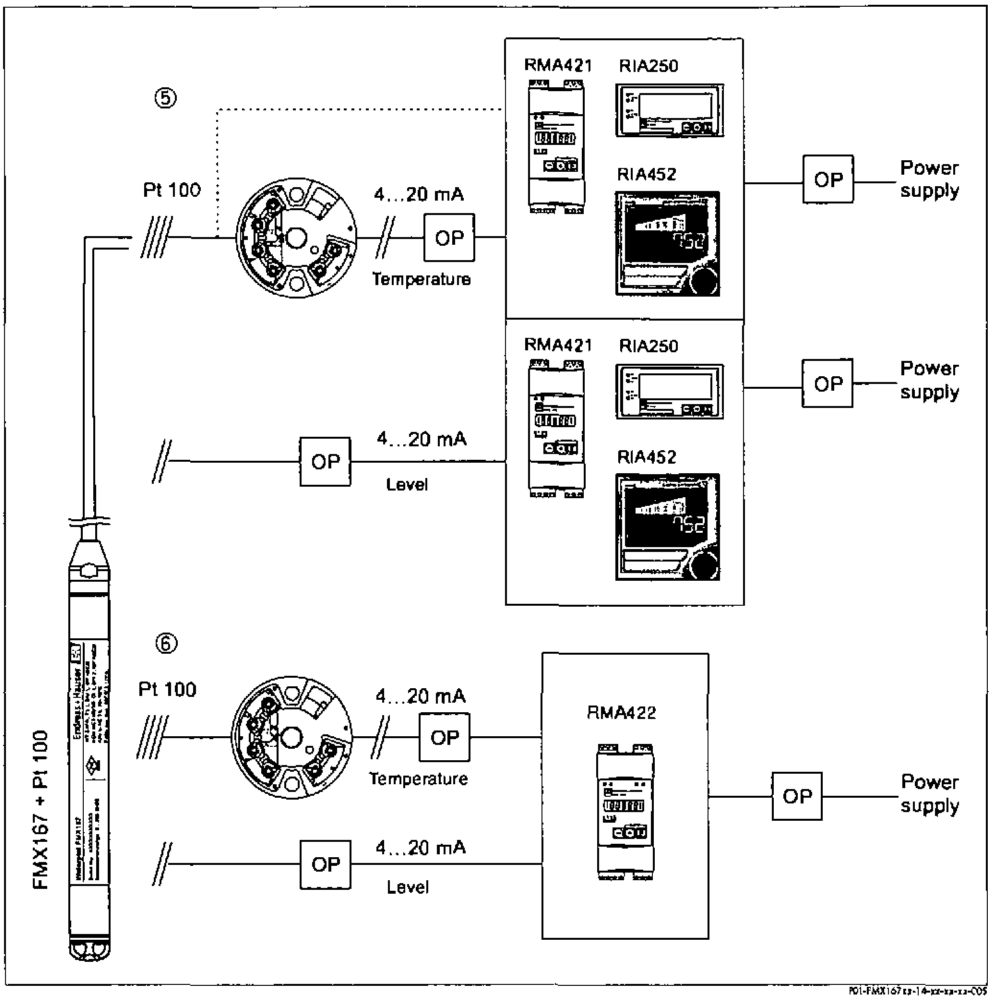


P01-FMX167xx-14-xx-xx-xx-004

Application examples with FMX167

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

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



Application examples with FMX167 with Pt 100

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

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

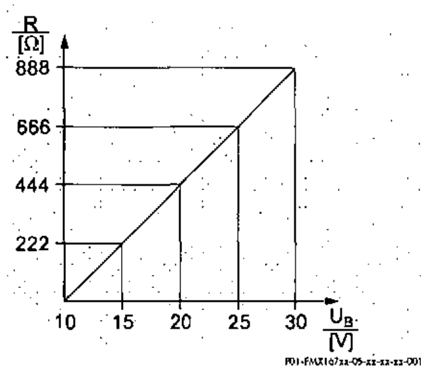
Input

Measured variable	**FMX167 + Pt 100 (optional)** ▪ Hydrostatic pressure of a liquid ▪ Pt 100: Temperature of a liquid	**Temperature transmitter (optional)** ▪ Temperature
Measuring range	▪ Nine fixed pressure measuring ranges in bar, mH_2O, psi and ftH_2O; → Page 18, "Ordering information" Section ▪ Customer-specific measuring ranges; factory-calibrated ▪ Temperature measurement from –10...+70°C (+14...+158°F) (optional with Pt 100)	
Input signal	**FMX167 + Pt 100 (optional)** ▪ Change in capacitance ▪ Pt 100: Change in resistance	**Temperature transmitter (optional)** ▪ Pt 100 resistance signal, 4-wire

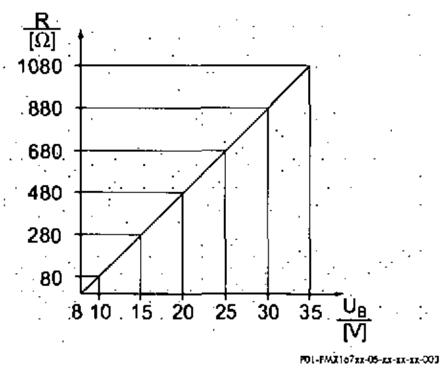
Output

Output signal	**FMX167 + Pt 100 (optional)** ▪ FMX167: 4...20 mA for hydrostatic pressure measured value, two-wire ▪ Pt 100: Temperature-dependent resistance of Pt 100	**Temperature transmitter (optional)** ▪ 4...20 mA for temperature measured value, two-wire
Load	**FMX167 + Pt 100 (optional)** $R_{tot} \leq \frac{U_b - 10\,V}{0.0225\,A} - 2 \cdot 0.09\frac{\Omega}{m} \cdot l - R_{add}$ P01-FMX167xx-16-xx-xx-xx-000	**Temperature transmitter (optional)** $R_{tot} \leq \frac{U_b - 8\,V}{0.025\,A} - R_{add}$ P01-FMX167xx-16-xx-xx-xx-001

R_{tot} = *Max. load resistance [Ω]*
R_{add} = *Additional resistances such as resistance of evaluating device and/or display instrument, line resistance [Ω]*
U_b = *Supply voltage [V]*
l = *Simple length of extension cable [m] (cable resistance per wire ≤ 0.09 /Ωm)*



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



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

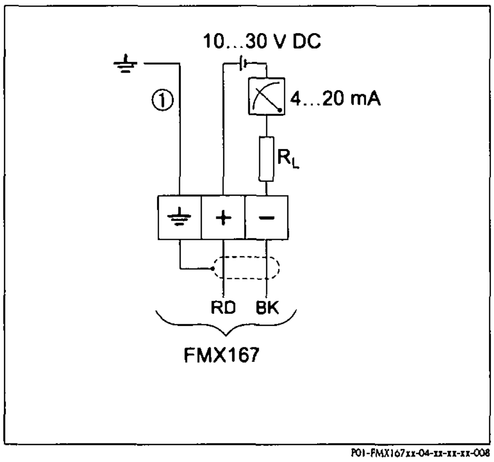
Power supply

Electrical connection

Note!

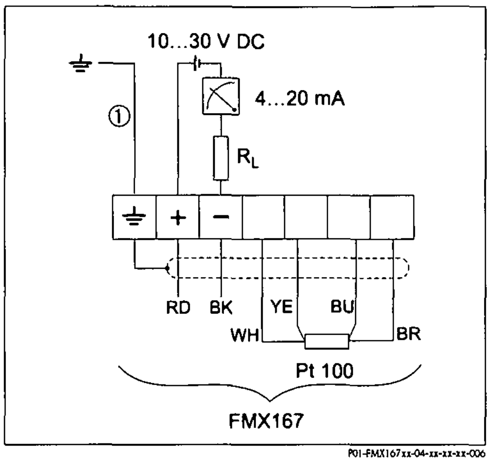
- When using the measuring device in hazardous areas, national standards and regulations as well as the Safety Instructions (XAs) or Installation or Control Drawings (ZDs) have to be observed. → See also Page 20, "Safety Instructions" and "Installation/Control Drawings" Sections.
- Reverse polarity protection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

Waterpilot FMX167, standard



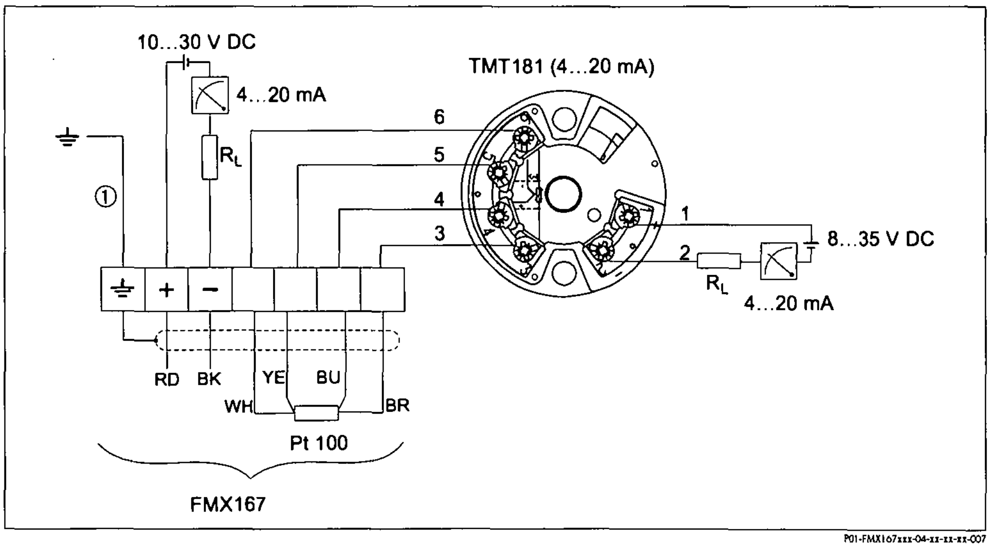
FMX167 electrical connection, versions "7" or "3" for Feature 70 "Additional options" in the order code (→ see Page 18).

Waterpilot FMX167 with Pt 100



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

Waterpilot FMX167 with Pt 100 and TMT181 temperature transmitter (4...20 mA)



FMX167 with Pt 100 and TMT181 temperature transmitter (4...20 mA), version "5" for Feature 70 in the order code (→ see Page 18).

1 Not for FMX167 with outer diameter = 29 mm (1.15 inch)

Wire colors: RD = red, BK = black, WH = white, YE = yellow, BU = blue, BR = brown

Supply voltage

Note!

- When using the measuring device in hazardous areas, national standards and regulations as well as the safety instructions (XAs) or Installation or Control Drawings (ZDs) have to be observed. → See also Page 20, "Safety Instructions" and "Installation/Control Drawings" Sections.

	FMX167 + Pt 100 (optional)	Temperature transmitter (optional)
Supply voltage	■ FMX167: 10...30 V DC ■ Pt 100: 10...30 V DC	■ 8...35 V DC
Cable specifications	■ Commercially available instrument cable ■ Terminals, terminal housing FMX167: 0.08...2.5 mm^2 ■ If the Pt 100 signal is directly connected to a display and/or evaluation unit, we recommend the use of a shielded cable.	■ Commercially available instrument cable ■ Terminals, terminal housing FMX167: 0.08...2.5 mm^2 ■ Connection, transmitter: Max. 1.75 mm^2
Power consumption	≤ 0.675 W at 30 V DC	≤ 0.875 W at 35 V DC
Current consumption	■ Max. current consumption: ≤ 22.5 mA Min. current consumption: ≥ 3.5 mA ■ Pt 100: ≤ 0.6 mA	■ Max. current consumption: ≤ 25 mA Min. current consumption: ≥ 3.5 mA ■ Pt 100 via temperature transmitter: ≤ 0.6 mA
Residual ripple	No effect for 4...20 mA signal up to ±5 % residual ripple within permissible range	$U_{ss} \geq 5$ V at $U_B \geq 13$ V, $f_{max.} = 1$ kHz

Performance characteristics

	FMX167 + Pt 100 (optional)	Temperature transmitter (optional)
Reference operating conditions	DIN EN 60770 T_U = 25°C (77°F)	Calibration temperature 23°C ± 5 K (73°F ± 5 K)
Maximum measured error	■ Non-linearity including hysteresis and non-repeatability as per DIN EN 60770: ±0.2% of upper range value (URV) ■ Pt 100: Max. ±0.7 K (Class B to DIN EN 60751)	■ ±0.2 K ■ With Pt 100: Max. ±0.9 K
Long-term stability	±0.1% of upper range value (URL) per year	≤ 0.1 K per year

Influence of medium temperature on the hydrostatic level measurement of FMX167

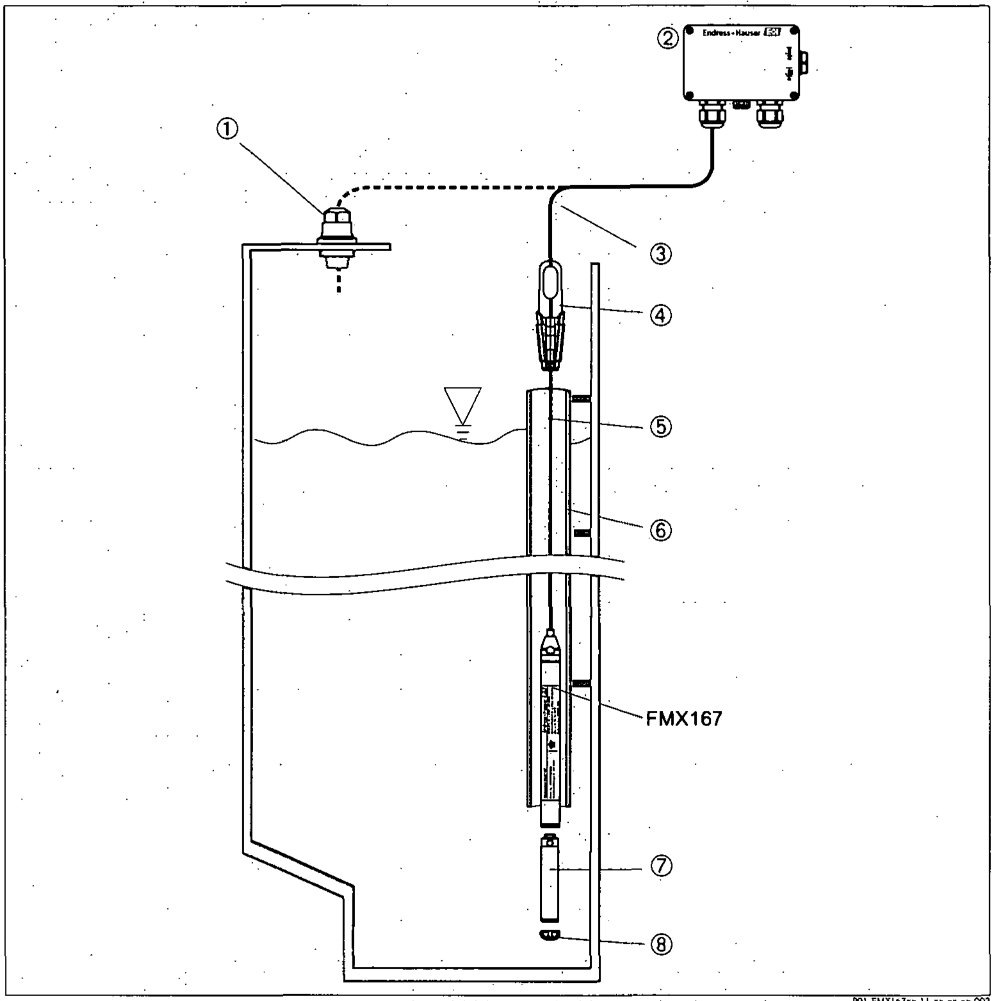
- Thermal change in zero signal and output span for typical application temperature range 0…+30°C (+32...+86°F): ±0.4% (±0.5%)* of the upper range limit (URL)
- Thermal change in zero signal and output span for the entire medium temperature range −10…+70°C (+14...+158°F): ±1.0% (±1.5%)* of the upper range limit (URL)
- Temperature coefficient (T_K) of zero signal and output span: 0.15%/10 K (0.3%/10 K)* of the upper range limit (URL)

* Specifications for sensors 0.1 bar (1 mH_2O, 1.5 psi, 3 ftH_2O) and 0.6 bar (6 mH_2O, 10 psi, 20 ftH_2O)

	FMX167 + Pt 100 (optional)	Temperature transmitter (optional)
Warm-up period	20 ms	4 s
Rise time	■ FMX167: 80 ms ■ Pt 100: 160 s	
Settling time	■ FMX167: 150 ms ■ Pt 100: 300 s	

Installation

Installation instructions



Installation examples, here shown with FMX167 with an outer diameter = 22 mm (0.87 inch)

1 *Extension cable mounting screw can be ordered via order code or as an accessory, → see Page 14 and 19*
2 *Terminal housing can be ordered via order code or as an accessory, → see Page 15 and 19*
3 *Extension cable bending radius > 120 mm (4.72 inch)*
4 *Suspension clamp can be ordered via order code or as an accessory, → see Page 14 and 19*
5 *Extension cable up to 300 m (384 ft); for max. length → see Page 16, "Extension cable" Section*
6 *Guide tube for FMX167 with outer diameter = 22 mm (0.87 inch) internal diameter > 23 mm (0.91 inch)*
7 *Additional weight can be ordered as an accessory for FMX167 with outer diameter = 22 mm (0.87 inch) and 29 mm (1.15 inch), → see Page 19*
8 *Protection cap*

Note!

- A sideways movement of the level probe can lead to measuring errors. Therefore install the probe at a point free from flow and turbulence, or use a guide tube. The internal diameter of the guide tube should be at least 1 mm (0.04 inch) bigger than the outer diameter of the selected FMX167.
- The cable must end in a dry room or in a proper terminal box. The terminal box from Endress+Hauser provides optimum humidity and climatic protection and is suitable for outdoor installation.
- Protective cap: to avoid mechanical damage to the measuring cell, the device is provided with a protective cap, which should not be removed during transport and installation.
- After shortening of the cable, the filter must be re-fitted on the pressure compensation hose.

Environment

	FMX167 + Pt 100 (optional)	Temperature transmitter (optional)
Ambient temperature range	■ FMX167 with outer diameter = 22 mm (0.87 inch) and 42 mm (1.66 inch): −10...+70°C (+14...+158°F) (= medium temperature) ■ FMX167 with outer diameter = 29 mm (1.15 inch): 0...+50°C (+32...+122°F) (= medium temperature)	−40...+85°C (−40...+185°F)
Storage temperature	−40...+80°C (−40...+185°F)	−40...+100°C (−40...+212°F)
Degree of protection	■ IP 68, permanently hermetically sealed ■ Optional terminal box: IP 66/IP 67	■ IP 00, moisture condensation permissible ■ When mounted in the optional terminal boxes: IP 66/IP67
Electromagnetic compatibility (EMC)	■ Interference emission to EN 61326 Class B equipment, interference immunity to EN 61326 Appendix A (Industrial) ■ Maximum deviation: < 0.5% of span	■ Interference emission to EN 61326 Class B equipment, interference immunity to EN 61326 Appendix A (Industrial)
Overvoltage protection	Integrated overvoltage protection to EN 61000-4-5 ≤ 1.2kV Install overvoltage protection ≥ 1.2 kV, external if necessary	Install overvoltage protection, external if necessary.

Process

	FMX167 + Pt 100 (optional)	Temperature transmitter (optional)
Medium temperature range	■ FMX167 with outer diameter = 22 mm (0.87 inch) and 42 mm (1.66 inch): −10...+70°C (+14...+158°F) ■ FMX167 with outer diameter = 29 mm (1.15 inch): 0...+50°C (+32...+122°F)	−40...+85°C (−40...+185°C) (= ambient temperature), install temperature transmitter outside medium.

Medium temperature limits

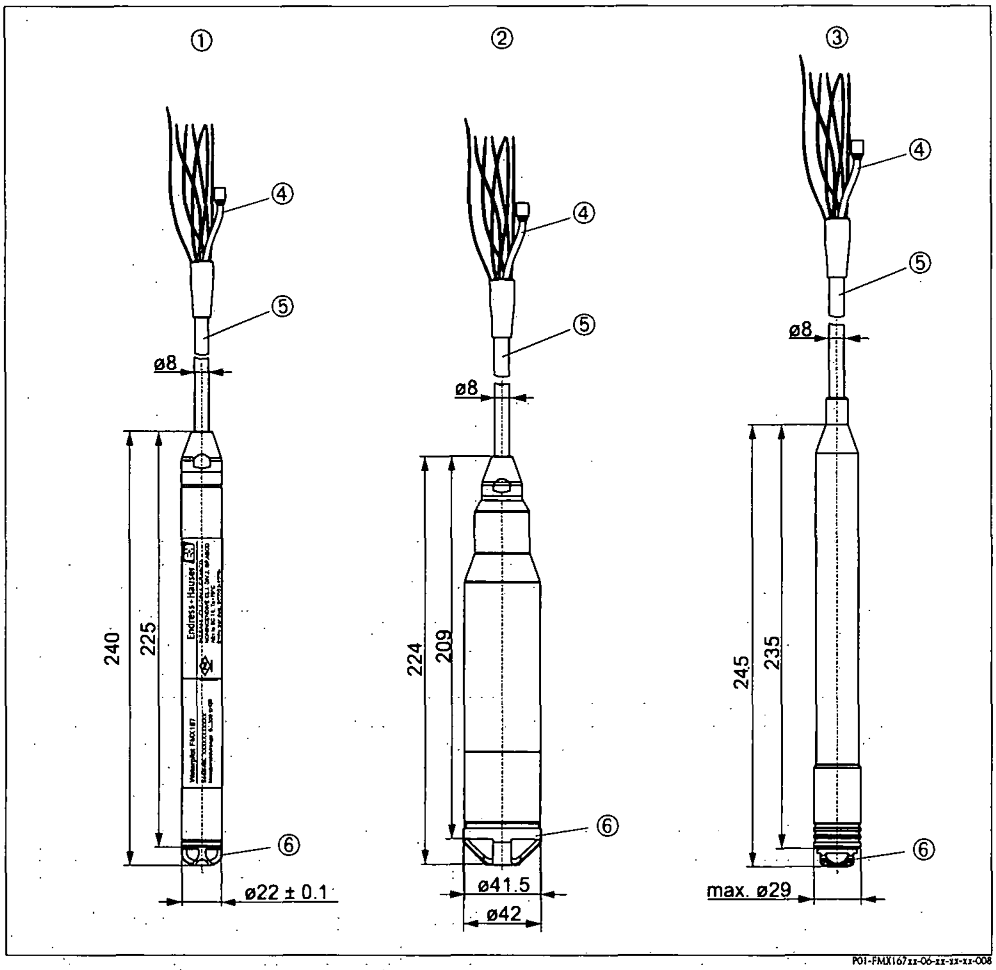
FMX167 + Pt 100 (optional)

- FMX167 with outer diameter = 22 mm (0.87 inch) and 42 mm (1.66 inch): –20...+70°C (–4...+158°F)
- FMX167 with outer diameter = 29 mm (1.15 inch): 0...+50°C (+32...+122°F)

(You may operate the FMX167 in this temperature range. The specification can then be exceeded, e.g. measuring accuracy).

Mechanical construction

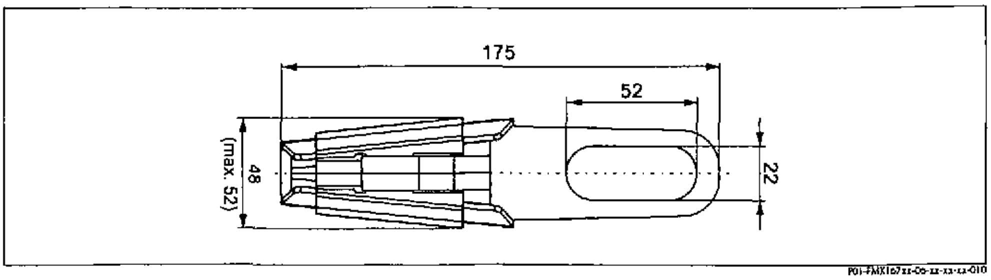
Dimensions of level probe



Versions of FMX167

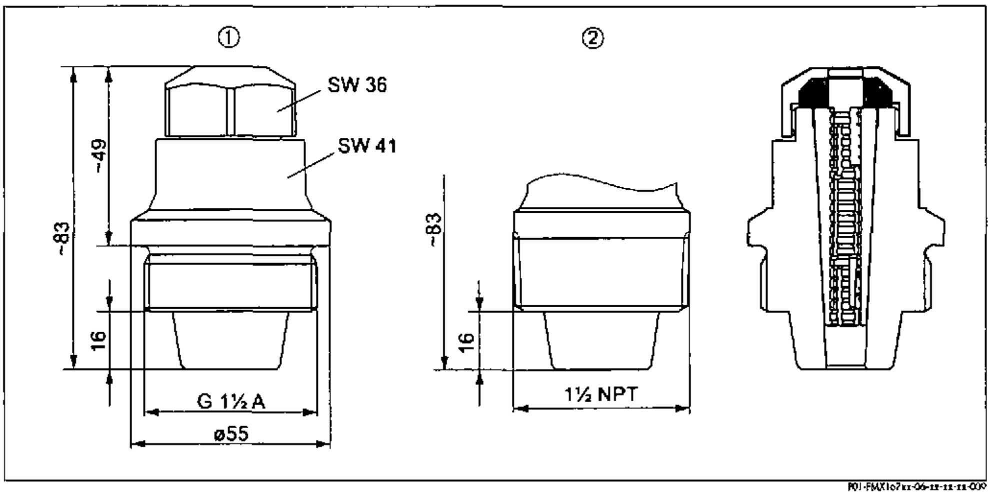
1 FMX167, version "A" or "D" for Feature 30 "Probe tube" in the order code (→ see Page 18)
2 FMX167, version "B" for Feature 30 "Probe tube" in the order code (→ see Page 18)
3 FMX167, version "C" for Feature 30 "Probe tube" in the order code (→ see Page 18)
4 Pressure compensation tube
5 Extension cable
6 Protection cap

Dimensions of suspension clamp



Suspension clamp, version 2 for Feature 20 "Connection" in the order code (→ see Page 18)

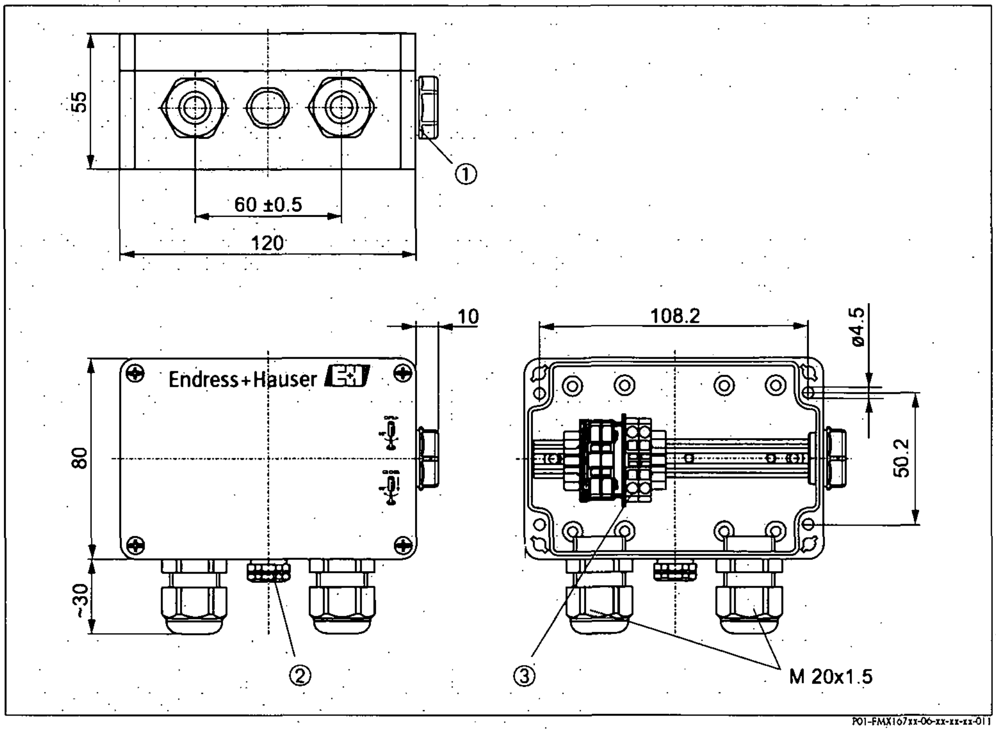
Dimensions of extension cable mounting screws



Extension cable mounting screws

1. *Extension cable mounting screw G 1 1/2 A, version "3" for Feature 20 "Connection" in the order code (→ see Page 18)*
2. *Extension cable mounting screw 1 1/2 NPT, version "4" for Feature 20 "Connection" in the order code (→ see Page 18)*

Dimensions of the terminal box IP 66/IP 67 with filter

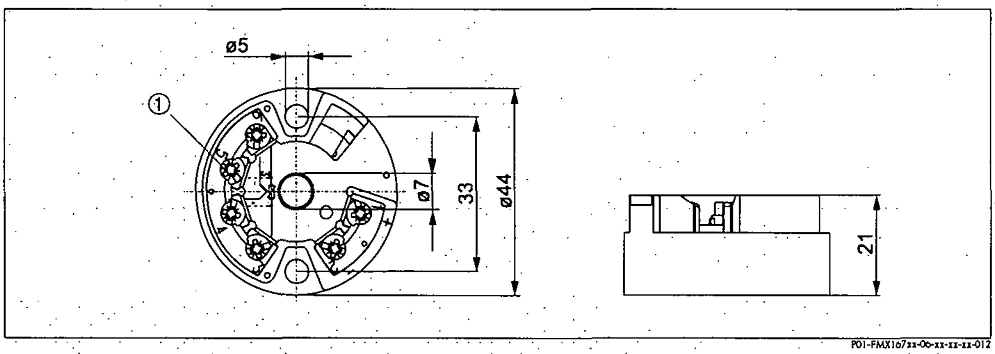


Terminal box

Version "3", "4" or "5" for Feature 70 "Additional options" in the order code (→ see Page 18)

1	*Dummy plug M 20x1.5*
2	*GORE-TEX® filter*
3	*Terminals for 0.08...2.5 mm²*

Dimensions of temperature transmitter TMT181



Temperature transmitter TMT181 (4...20 mA)

Version "5" for Feature 70 "Additional options" in the order code (→ see Page 18). The temperature transmitter can be used in non-hazardous areas and for EEx nA.

Weight

- Level probe, outer diameter = 22 mm (0.87 inch): 290 g
- Level probe, outer diameter = 42 mm (1.66 inch): 1150 g
- Level probe, outer diameter = 29 mm (1.15 inch): 340 g
- Extension cable PE: 52 g/m
- Extension cable FEP: 108 g/m
- Suspension clamp: 170 g
- Extension cable mounting screw G 1 1/2 A: 770 g
- Extension cable mounting screw 1 1/2 NPT: 724 g
- Terminal box: 235 g
- Temperature transmitter: 40 g
- Additional weight: 300 g

Material

Level probe
- Level probe, outer diameter = 22 mm (0.87 inch): 1.4435 (AISI 316L)
- Level probe, outer diameter = 42 mm (1.66 inch): 1.4435 (AISI 316L)
- Level probe, outer diameter = 29 mm (1.15 inch):
  - Level probe: 1.4435 (AISI 316L)
  - Sensor sleeve: PPS (polyphenylene sulfide)
  - Heat-shrink sleeve/cover: Polyolefin

  Metal does not come into contact with the medium.
- Process ceramic: Al_2O_3 aluminium oxide ceramic
- Seal (internal): EPDM or Viton
- Protective cap:
  - PE-HD (high-density polyethylene) for FMX167 with outer diameter = 22 mm and 29 mm (0.87 inch and 1.15 inch).
  - PFA (perfluoralkoxy) for FMX167 with outer diameter = 42 mm (1.66 inch).
- Extension cable insulation: Either PE-LD (low density polyethylene) or FEP (fluorinated ethylene propylene). For more information, see the next Section - "Extension cable"
- Suspension clamp: 1.4404 (AISI 316L) and glass fiber reinforced PA (polyamide)
- Extension cable mounting screw G 1 1/2 A: 1.4301 (AISI 304)
- Extension cable mounting screw 1 1/2 NPT: 1.4301 (AISI 304)
- Terminal box: PC (polycarbonate)
- Temperature transmitter: Housing PC (polycarbonate)

Extension cable

PE extension cable
- Slip-resistant extension cable with strain-relief members made of Dynemo; shielded using aluminium-coated film; insulated with polyethylene (PE), black; copper wires, twisted
- Pressure compensation tube with Teflon filter

FEP extension cable
- Slip-resistant extension cable; shielded using galvanized steel wire netting; insulated with fluorinated ethylene propylene (FEP), black; copper wires, twisted
- Pressure compensation tube with Teflon filter

Cross-section of PE and FEP extension cable
- Total outer diameter: 8.0 mm ± 0.25 mm (0.315 inch ± 0.0098 inch)
- FMX167: 3 x 0.227 mm^2 + pressure compensation tube with Teflon filter
- FMX167 with Pt 100 (optional): 7 x 0.227 mm^2 + pressure compensation tube with Teflon filter
- Pressure compensation tube with Teflon filter:
  Outer diameter = 2.5 mm (0.098 inch), internal diameter = 1.5 mm (0.059 inch)

Cable resistance of PE and FEP extension cable
- Cable resistance per wire: ≤ 0.09 Ω/m

Cable length of PE and FEP extension cable
- Please also refer to Page 7, "Load" Section.
- When using the measuring device in hazardous areas, national standards and regulations as well as the safety instructions (XAs) or Installation or Control Drawings (ZDs) have to be observed. → See also Page 20, "Safety Instructions" and "Installation/Control Drawings" Sections.

Further technical data of PE and FEP extension cable
- Minimum bending radius: 120 mm (4.72 inch)
- Tensile strength: max. 950 N
- Cable extraction force: ≥ 450 N
  (The extension cable could be extracted from the level probe at a tensile force of ≥ 450 N.)
- Resistance to UV light
- PE: approved for use with drinking water

Terminals

- 3 standard terminals in terminal box
- 4-terminal strip can be ordered as accessory, Order No. 52008938
  Wire cross-section 0.08...2.5 mm^2

Certificates and approvals

CE approval	By attaching the CE symbol, Endress+Hauser confirms that the instrument fulfills all the requirements of the relevant EC directives.
Ex approval, type of protection	■ ATEX II 2 G EEx ia IIC T6[1] ■ ATEX II 3 G EEx nA II T6 ■ FM: IS, Class I, Division 1, Groups A–D[1] ■ CSA: IS, Class I, Division 1, Groups A–D[1] 1 Only for Waterpilot FMX167 without Pt 100 Waterpilot FMX167 with outer diameter = 22 mm (0.87 inch) is only suitable for use in hazardous areas with the FKM Viton seal. All explosion protection data are contained in separate explosion protection documentation which you can also request. Explosion protection documents are supplied as standard for all devices approved for use in explosion hazardous areas. → See also Page 20, "Safety Instructions" and "Installation/Control Drawings" Sections.
Drinking water approval (for FMX167 with d_O = 22 mm (0.87 inch))	■ KTW certificate ■ NSF 61 approval ■ ACS approval
Marine approval	■ GL approval ■ ABS approval
External standards and guidelines	DIN EN 60770 (IEC 60770): Transmitters for use in industrial-control systems Part 1: Methods for performance evaluation DIN 16086: Electrical pressure measuring instruments, pressure sensors, pressure transmitters, pressure measuring instruments, concepts, specifications on data sheets EN 61326 (IEC 61326-1): Electrical equipment for measurement, control and laboratory use – EMC requirements
Registered trademarks	GORE-TEX® Registered trademark of W.L. Gore & Associates, Inc., USA

Ordering information

FMX167

10	**Approval**	
	A	Version for non-hazardous area
	B	ATEX II 2 G EEx ia IIC T6
	C	ATEX II 3 G EEx nA II T6
	S	FM IS, Class I, Division 1, Groups A – D
	E	CSA IS, Class I, Division 1, Groups A – D
	F	CSA General Purpose

20	**Connection**	
	1	Probe cable
	2	Suspension clamp, AISI 316L
	3	Cable mounting screw G 1 1/2, AISI 304
	4	Cable mounting screw NPT 1 1/2, AISI 304

30	**Probe tube:**	
	A	Outer diameter d = 22 mm (0.87 inch), AISI 316L
	B	Outer diameter d = 42 mm (1.66 inch), flush mount, AISI 316L
	C	Outer diameter d = 29 mm (1.15 inch), AISI 316L with heat-shrink sleeve PPS/polyolefin for saltwater applications
	D	Outer diameter d = 22 mm (0.87 inch), AISI 316L + drinking water approval KTW/NSF/ACS (can only be selected in conjunction with EPDM seal and PE probe cable)

40	**Measuring range:**					
	Measuring range		**Measuring range**		**Max. overload**	**Vacuum resistance**
	BA	0...0.1 bar	MA	0...1 mH_2O	5 bar	0 bar_{abs}
	BB	0...0.2 bar	MB	0...2 mH_2O	5 bar	0 bar_{abs}
	BC	0...0.4 bar	MC	0...4 mH_2O	7 bar	0 bar_{abs}
	BD	0...0.6 bar	MD	0...6 mH_2O	10 bar	0 bar_{abs}
	BE	0...1.0 bar	ME	0...10 mH_2O	10 bar	0 bar_{abs}
	BF	0...2.0 bar	MF	0...20 mH_2O	18 bar	0 bar_{abs}
	BG	0...4.0 bar	MG	0...40 mH_2O	25 bar	0 bar_{abs}
	BH	0...10.0 bar	MH	0...100 mH_2O	40 bar	0 bar_{abs}
	BK	0...20.0 bar	MK	0...200 mH_2O	40 bar	0 bar_{abs}
	PA	0...1.5 psi	FA	0...3 ftH_2O	73 psi	0 bar_{abs}
	PB	0...3 psi	FB	0...6 ftH_2O	73 psi	0 bar_{abs}
	PC	0...6 psi	FC	0...15 ftH_2O	101 psi	0 bar_{abs}
	PD	0...10 psi	FD	0...20 ftH_2O	145 psi	0 bar_{abs}
	PE	0...15 psi	FE	0...30 ftH_2O	145 psi	0 bar_{abs}
	PF	0...30 psi	FF	0...60 ftH_2O	261 psi	0 bar_{abs}
	PG	0...60 psi	FG	0...150 ftH_2O	362 psi	0 bar_{abs}
	PH	0...150 psi	FH	0...300 ftH_2O	580 psi	0 bar_{abs}
	PK	0...300 psi	FK	0...600 ftH_2O	580 psi	0 bar_{abs}
	VV	Adjusted to customer specifications from 0 to ___ (upper range value) in ___ (unit), upper range value: 0.1 bar (1 mH_2O, 1.5 psi, 3 ftH_2O) to 20 bar (200 m_2HO, 300 psi, 600 ft_2HO)				

50	**Sensor seal:**	
	1	FKM Viton
	2	EPDM

60	**Probe cable:**	
	A	... m, shortable, PE
	B	10 m, shortable, PE
	C	20 m, shortable, PE
	E	30 ft, shortable, PE
	F	60 ft, shortable, PE
	G	... ft, shortable, PE
	I	... m, shortable, FEP
	K	10 m, shortable, FEP
	L	20 m, shortable, FEP
	M	30 ft, shortable, FEP
	N	60 ft, shortable, FEP
	P	... ft, shortable, FEP

FMX167								Complete order code

→ Ordering information for FMX167 continued on next page.

FMX167 (continued)

70								Additional option:
							7	Basic version
							S	GL/ABS marine certificate
							1	Pt 100, 4-wire
							3	Terminal box IP66/67
							4	Terminal box IP66/67 + Pt 100, 4-wire
							5	Pt 100 + temperature transmitter TMT181, 2-wire, 4...20 mA = –20...+80°C (–4...+176°F)
FMX167								Complete order code

Accessories

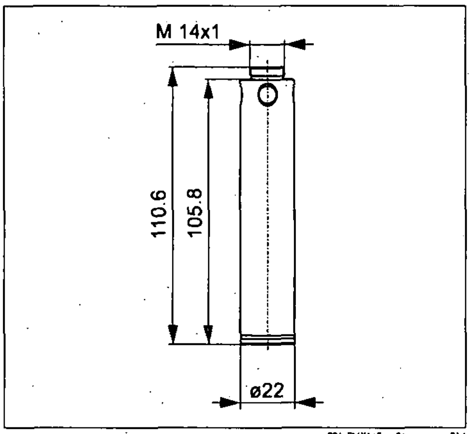
Suspension clamp

- Endress+Hauser offers a suspension clamp for simple FMX167 mounting. → See also Page 14.
- Material: 1.4404 (AISI 316L) and glass fiber reinforced PA (polyamide)
- Order number: 52006151

Terminal box

- Terminal box IP 66/IP 67 with GORE-TEX® filter incl. 3 mounted terminals.
  The terminal box is also suitable for installing a temperature transmitter (Order No. 52008794) or for four additional terminals (Order No. 52008938). → See also Page 15.
- Order number: 52006152

Additional weight (for FMX167 with d_O = 22 mm (0.87 inch) and d_O = 29 mm (1.15 inch))



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- To prevent sideways movement leading to measuring errors or to ensure that the device lowers into a guide tube, Endress+Hauser provides additional weights.
  You can screw several weights together. The weights are then attached directly to the FMX167. For FMX167 with outer diameter = 29 mm (1.15 inch), a maximum of 5 weights may be screwed on to FMX167.
- Material: 1.4435 (AISI 316L)
- Weight: 300 g
- Order number: 52006153

Temperature transmitter

- Temperature transmitter, 2-wire, preset for measuring range from –20...+80°C (–4...+176°F).
  This setting offers an easily displayable temperature range of 100 K. Note that the Pt 100 resistance thermometer is designed for a temperature range of –10...+70°C (+14...+158°F). → See also Page 15.
- Order number: 52008794

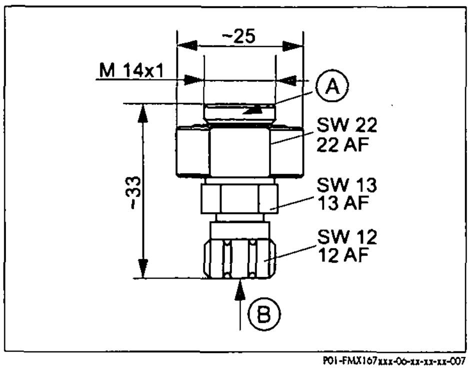
Extension cable mounting screw

- Endress+Hauser offers extension cable mounting screws to simplify the installation of the FMX167 and to close the measuring open. → See also Page 14.
- Material: 1.4301 (AISI 304)
- Order number for extension cable mounting screw with G 1 1/2 A thread: 52008264
- Order number for extension cable mounting screw with 1 1/2 NPT thread: 52009311

Terminals

- Four terminals in strip for FMX167 terminal box, suitable for wire cross-section of 0.08...2.5 mm^2
- Order number: 52008938

Test adapter (for FMX167 with d_O = 22 mm (0.87 inch) and d_O = 29 mm (1.15 inch))



Test adapter

A Connection suitable for level probe FMX167
B Connection compressed air hose, internal diameter, quick hose gland 4 mm (0.157 inch)

- Endress+Hauser offers a test adapter to simplify the function test of level probes.
- Note the maximum pressure for the compressed air hose and the maximum level probe overload. → See also Page 18.
- The maximum pressure for the supplied quick hose gland is 10 bar (145 psi).
- Adapter material: 1.4301 (AISI 304)
- Quick hose gland material: Anodized aluminium
- Adapter weight: 39 g
- Order number: 52011868

Documentation

Field of Activities	▪ Pressure Measurement: FA004P/00/en ▪ Recording Technology: FA014R/09/de ▪ System Components: FA016K/09/en
Technical Information	▪ Temperature Head Transmitter iTEMP PCP TMT181: TI070R/09/en
Operating Instructions	▪ Waterpilot FMX167: BA231P/00/en
Safety Instructions	▪ ATEX II 2 G EEx ia IIC T6: XA131P/00/a3 ▪ ATEX II 3 G EEx nA II T6: XA132P/00/a3
Installation/ Control Drawings	▪ FM IS Class I, Div. 1, Groups A – D: ZD063P/00/en ▪ CSA IS Class I, Div. 1, Groups A – D: ZD064P/00/en
Drinking water approval	▪ SD126P/00/a3

Instruments International

Endress+Hauser
Instruments International AG
Kaegenstrasse 2
4153 Reinach
Switzerland

Tel.+41 61 715 81 00
Fax+41 61 715 25 00
www.endress.com
info@ii.endress.com

Endress+Hauser
People for Process Automation

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