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Emotron FlowDrive
Dedicated drive

Emotron FLD48/52/69, frame sizes B - F and C2 - F2

0.75 - 200 kW

Installation & Getting started instruction

FlowDrive™

emotron
DEDICATED DRIVE
A CG Product

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Safety Instructions

Congratulations for choosing a product from CG Drives & Automation!

Before you begin with installation, commissioning or powering up the unit for the first time it is very important that you carefully study this Instruction manual. Following symbols can appear in this manual or on the product itself. Always read these first before continuing.

NOTE: Additional information as an aid to avoid problems.

CAUTION!
Failure to follow these instructions can result in malfunction or damage to the AC drive.

Warning!
Failure to follow these instructions can result in serious injury to the user in addition to serious damage to the AC drive.

HOT SURFACE!
Failure to follow these instructions can result in injury to the user.

Handling the AC drive

Installation, commissioning, demounting, taking measurements, etc, of or on the AC drive may only be carried out by personnel technically qualified for the task. A number of national, regional and local regulations govern handling, storage and installation of the equipment. Always observe current rules and legislation.

Opening the AC drive

WARNING!
Always switch off the mains voltage before opening the AC drive and wait at least 7 minutes to allow the capacitors to discharge.

Always take adequate precautions before opening the AC drive. Although the connections for the control signals and the switches are isolated from the main voltage, do not touch the control board when the AC drive is switched on.

Precautions to be taken with a connected motor

If work must be carried out on a connected motor or on the driven machine, the mains voltage must always be disconnected from the AC drive first. Wait at least minutes before starting work.

Earthing

The AC drive must always be earthed via the mains safety earth connection.

Earth leakage current

CAUTION!
This AC drive has an earth leakage current which does exceed 3.5 mA AC. Therefore the minimum size of the protective earth conductor must comply with the local safety regulations for high leakage current equipment which means that according the standard IEC61800-5-1 the protective earth connection must be assured by one of following conditions:
PE conductor cross-sectional area shall for cable size ≤ 16 mm^2 (6 AWG) be equal to the used phase conductors, for cable size above 16 mm^2 (6 AWG) but smaller or equal to 35mm^2(2 AWG) the PE conductor cross-sectional area shall be at least 16mm^2(6 AWG). For cables >35 mm^2 (2 AWG) the PE conductor cross-sectional area should be at least 50 % of the used phase conductor.
When the PE conductor in the used cable type is not in accordance with the above mentioned cross-sectional area requirements, a separate PE conductor should be used to establish this.

Residual current device (RCD) compatibility

This product cause a DC current in the protective conductor. Where a residual current device (RCD) is used for protection in case of direct or indirect contact, only a Type B RCD is allowed on the supply side of this product. Use RCD of 300 mA minimum.

EMC Regulations

In order to comply with the EMC Directive, it is absolutely necessary to follow the installation instructions. All installation descriptions in this manual follow the EMC Directive.

Mains voltage selection

The AC drive may be ordered for use with the mains voltage range listed below.

FLD48: 230-480 V
FLD52: 440-525 V
FLD69: 500-690 V

Voltage tests (Megger)

Do not carry out voltage tests (Megger) on the motor, before all the motor cables have been disconnected from the AC drive.

Condensation

If the AC drive is moved from a cold (storage) room to a room where it will be installed, condensation can occur. This can result in sensitive components becoming damp. Do not connect the mains voltage until all visible dampness has evaporated.

Incorrect connection

The AC drive is not protected against incorrect connection of the mains voltage, and in particular against connection of the mains voltage to the motor outlets U, V and W. The AC drive can be damaged in this way.

Power factor capacitors for improving cosφ

Remove all capacitors from the motor and the motor outlet.

Precautions during Autoreset

When the automatic reset is active, the motor will restart automatically provided that the cause of the trip has been removed. If necessary take the appropriate precautions.

Transport

To avoid damage, keep the AC drive in its original packaging during transport. This packaging is specially designed to absorb shocks during transport.

IT Mains supply

The AC drives can be modified for an IT mains supply, (non-earthed neutral), please contact your supplier for details.

Alarms

Never disregard an alarm. Always check and remedy the cause of an alarm.

Heat warning

HOT SURFACE!
Be aware of specific parts on the AC drive having high temperature.

DC-link residual voltage

WARNING!
After switching off the mains supply, dangerous voltage can still be present in the AC drive. When opening the AC drive for installing and/or commissioning activities wait at least 7 minutes. In case of malfunction a qualified technician should check the DC-link or wait for one hour before dismantling the AC drive for repair.

Contents

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1. Introduction

Emotron FlowDrive is an AC drive dedicated for controlling wastewater pumps with focus on continuous pumping with best economy (lowest cost).
FlowDrive can operate as a Standalone unit (1 drive) or in a Master-Follower configuration (2 drives).

Prerequisites

In order to utilize the FlowDrive, following is required:

- Analog level sensor for automatic level control, preferably 4-20mA
- Master-Follower control cable (only required in a Master-Follower configuration)
- One switch per drive for manual control; Auto, forced run or off (optional but highly recommended)
- Digital switch for redundant overflow detection (optional, can be disabled)
- 1 pump per drive (if dual pumps are used, equal pump performance is required)

Several options are available, listed in chapter 7. page 47, that enable you to customize the AC drive for your specific needs.

NOTE: Read this instruction manual carefully before starting installation, connection or working with the AC drive.

Motors

The AC drive is suitable for use with standard 3-phase asynchronous motors. Under certain conditions it is possible to use other types of motors. Contact your supplier for details.

1.1 Delivery and unpacking

Check for any visible signs of damage. Inform your supplier immediately of any damage found. Do not install the AC drive if damage is found.
Check that all items are present and that the type number is correct.

1.2 Using of the instruction manual

This installation and getting started instruction is intended for persons who dimension, install, commission Emotron FlowDrive units.
More detailed information about using the FlowDrive is found in the “Emotron FlowDrive Software manual” to be found in the file archive on www.emoton.com.

Within this instruction manual the abbreviation “AC drive” is used to indicate the complete variable speed drive as a single unit.

With help of the index and the table of contents it is easy to track individual functions and to find out how to use and set them.

This instruction can be put in a cabinet door, so that it is always easy to access in case of an emergency.

1.2.1 Instruction manuals for optional equipment

In the following table we have listed available options and the name of the Instruction manual or data sheet/ Instruction plus document number. Further in this main manual we are often referring to these instructions.

Table 1 Available options and documents

Option	Valid instruction manual/ document number
I/O board	I/O board 2.0, instruction manual / 01-5916-01
PTC/PT100 board	PTC/PT100 board 2.0, instruction manual / 01-5920-01
Fieldbus - Profibus	Fieldbus Option, Instruction manual / 01-3698-01
Fieldbus - DeviceNet	
Ethernet - Modbus TCP	
Ethernet - EtherCAT	
Ethernet - Profinet IO 1-port	
Ethernet - Profinet IO 2-port	
Ethernet - EtherNet/IP 2-port	
RS232/RS485 isolated	Emotron isolated RS232 / 485 2.0 option Instruction manual / 01-5919-01
Control panel kit, Incl blank panel	Emotron FDU/VFX 2.0 External Control Panel, instruction manual / 01-5928-01
Control panel kit, Incl control panel	
Handheld Control Panel HCP2.0	Emotron HCP 2.0, instrucion manual / 01-5925-01
Safe stop	Option Safe Stop (STO – Safe Torque Off), Technical description / 01-5921-01
Overshoot clamp	Overshoot clamp Datasheet/Instruction / 01-5933-11
Liquid cooling	Emotron FDU/VFX 2.0 Liquid Cooling, instruction manual / 01-4636-01
Output choke	Output coils Datasheet/Instruction / 01-3132-11

1.3 Warranty

The warranty applies when the equipment is installed, operated and maintained according to instructions in this instruction manual. Duration of warranty as per contract. Faults that arise due to faulty installation or operation are not covered by the warranty.

1.4 Type code number

Fig. 1 gives an example of the type code numbering used on all AC drives. With this code number the exact type of the drive 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 unit.

Type code	FLD	48	-017	-20	C	E	–	–	–	A	V	N	N	N	N	A	N	–	–
Position No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Fig. 1 Type code number

Position for 003-074	Position for 090-293	Configuration	
1	1	AC drive type	FLD
2	2	Supply voltage	48=480 V mains 52=525 V mains 69=690 V mains
3	3	Rated current (A) continuous	-003=2.5 A - -293=293 A
4	4	Protection class	20=IP20 21=IP21 54=IP54
5	5	Control panel	–=Blank panel C=Standard panel
6	6	EMC option	E=Standard EMC (Category C3) F=Extended EMC (Category C2) I=IT-Net
7	7	Brake chopper option	–=No chopper B=Chopper built in D=DC+/- interface
8	8	Stand-by power supply option	–=No SBS S=SBS included
-	9	Safe stop option (Only valid for 090-293)	–=No safe stop T=Safe stop incl.
9	10	Brand label	A=Standard
10	-	Painted AC drive	A=Standard paint
11	11	Coated boards	V=Coated boards, standard
12	12	Option position 1	N=No option P=PTC/PT100 (max. 1) I=Extended I/O (max. 3) S=Safe Stop (only 003-074/IP54) (max. 1) U= RTC- Real time clock (max. 1)
13	13	Option position 2	
14	14	Option position 3	

Position for 003-074	Position for 090-293	Configuration	
15	15	Option position, communication	N=No option D=DeviceNet P=Profibus S=RS232/485 M=Modbus/TCP F=Modbus/TCP 2-port, M12 E=EtherCAT A=Profinet IO 1-port B=Profinet IO 2-port G=EtherNet/IP 2-port
16	16	Software type	A=Standard
17	-	Motor PTC. (Only valid for 003-074/IP54)	N=No option P=PTC
18	-	Gland kit. (Only valid for003-074/IP54)	-=Glands not included G=Gland kit included
19	17	Approval/certification	-=CE approved D=Marine DNV Product certificate (above 100 kW) + CE approved M=Marine version + CE approved U=UL/cUL approved

1.5 Standards

The AC drives described in this instruction manual comply with the standards listed in Table 2. For the declarations of conformity and manufacturer's certificate, contact your supplier for more information or visit www.emotron.com/ www.cgglobal.com.

1.5.1 Product standard for EMC

Product standard EN(IEC)61800-3, second edition of 2004 defines the:

First Environment (Extended EMC) as environment that includes domestic premises. It also includes establishments directly connected without intermediate transformers to a low voltage power supply network that supplies buildings used for domestic purposes.

Category C: Power Drive System (PDS) of rated voltage<1.000 V, which is neither a plug in device nor a movable device and, when used in the first environment, is intended to be installed and commissioned only by a professional.

Second environment (Standard EMC) includes all other establishments.

Category C3: PDS of rated voltage <1.000 V, intended for use in the second environment and not intended for use in the first environment.

Category C4: PDS or rated voltage equal or above 1.000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment.

The AC drive complies with the product standard EN(IEC) 61800-3:2004 (Any kind of metal screened cable may be used). The standard AC drive is designed to meet the requirements according to category C3.

By using the optional "Extended EMC" filter the AC drive fulfils requirements according to category C,

WARNING!
In a domestic environment this product may cause radio interference, in which case it may be necessary to take adequate additional measures.

WARNING!
The standard AC drive, complying with category C3, is not intended to be used on a low-voltage public network which supplies domestic premises; radio interference is expected if used in such a network. Contact your supplier if you need additional measures.

Table 2 Standards

Market	Standard	Description
European	EMC Directive	2004/108/EC
	Low Voltage Directive	2006/95/EC
	WEEE Directive	2002/96/EC
All	EN 60204-1	Safety of machinery - Electrical equipment of machines Part 1: General requirements.
	EN(IEC)61800-3:2004	Adjustable speed electrical power drive systems Part 3: EMC requirements and specific test methods. **EMC Directive: Declaration of Conformity and CE marking**
	EN(IEC)61800-5-1 Ed. 2.0	Adjustable speed electrical power drive systems Part 5-1. Safety requirements - Electrical, thermal and energy. **Low Voltage Directive: Declaration of Conformity and CE marking**
	IEC 60721-3-3	Classification of environmental conditions. Air quality chemical vapours, unit in operation. Chemical gases 3C2, Solid particles 3S2. Optional with coated boards Unit in operation. Chemical gases Class 3C3, Solid particles 3S2.
	UL508C	UL Safety standard for Power Conversion Equipment
North & South America	USL	USL (United States Standards - Listed) complying with the requirements of UL508C Power Conversion Equipment
	UL 840	UL Safety standard for Power Conversion Equipment. Insulation coordination including clearances and creepage distances for electrical equipment.
	CNL	CNL (Canadian National Standards - Listed) complying with the requirements of CAN/CSA C22.2 No. 14-10 Industrial Control Equipment.
Russian	GOST R	For all sizes.

1.6 Dismantling and scrapping

The enclosures of the drives are made from recyclable material as aluminium, iron and plastic. Each drive contains a number of components demanding special treatment, for example electrolytic capacitors. The circuit boards contain small amounts of tin and lead. Any local or national regulations in force for the disposal and recycling of these materials must be complied with.

1.6.1 Disposal of old electrical and electronic equipment

This symbol on the product or on its packaging indicates that this product shall be taken to the applicable collection point for the recycling of electrical and electronic equipment. By ensuring this product is disposed of correctly, you will help prevent potentially negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. The recycling of materials will help to conserve natural resources. For more detailed information about recycling this product, please contact the local distributor of the product.

1.7 Glossary

1.7.1 Abbreviations and symbols

In this manual the following abbreviations are used:

Table 3 Abbreviations

Abbreviation/ symbol	Description
DSP	Digital signals processor
AC drive	Frequency converter
IGBT	Insulated Gate Bipolar Transistor
CP	Control panel, the programming and presentation unit on the AC drive
HCP	Handheld control panel (option)
EInt	Communication format
UInt	Communication format (Unsigned integer)
Int	Communication format (Integer)
Long	Communication format
SELV	Safety Extra Low Voltage
🔒	The function cannot be changed in run mode

1.7.2 Definitions

In this manual the following definitions for current, torque and frequency are used:

Table 4 Definitions

Name	Description	Quantity
I_{IN}	Nominal input current of AC drive	A_{RMS}
I_{NOM}	Nominal output current of AC drive	A_{RMS}
I_{MOT}	Nominal motor current	A_{RMS}
P_{NOM}	Nominal power of AC drive	kW
P_{MOT}	Motor power	kW
T_{NOM}	Nominal torque of motor	Nm
T_{MOT}	Motor torque	Nm
f_{OUT}	Output frequency of AC drive	Hz
f_{MOT}	Nominal frequency of motor	Hz
n_{MOT}	Nominal speed of motor	rpm
I_{CL}	Maximum output current	A_{RMS}
Speed	Actual motor speed	rpm
Torque	Actual motor torque	Nm
Sync speed	Synchronous speed of the motor	rpm

2. Mounting

This chapter describes how to mount the AC drive.

Before mounting it is recommended that the installation is planned out first.

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

2.1 Lifting instructions

Note: To prevent personal risks and any damage to the unit during lifting, it is advised that the lifting methods described below are used.

Recommended for AC drive models -090 to -250

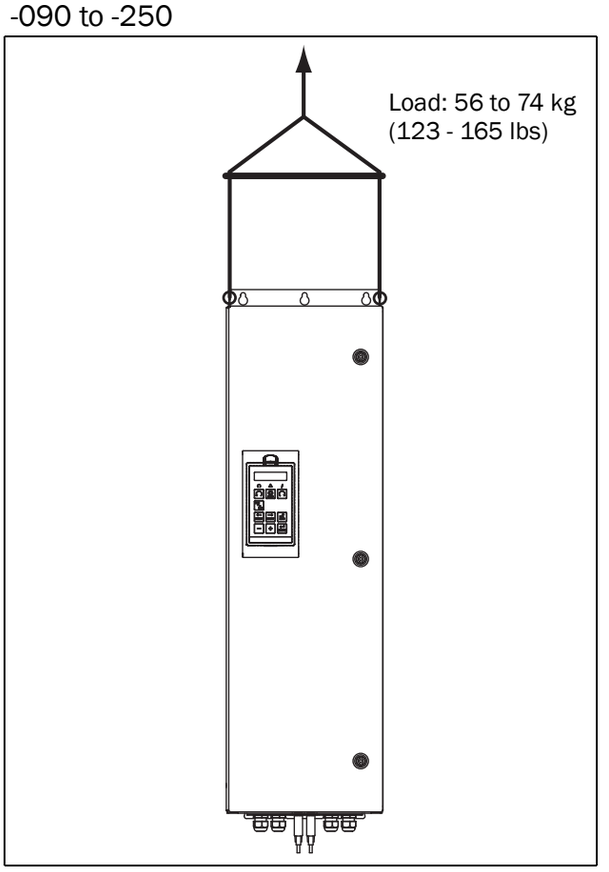

Fig. 2 Lifting AC drive model -090 to -250

2.2 Stand-alone units

The AC drive must be mounted in a vertical position against a flat surface. Use the template (in the File archive on our homepage) to mark out the position of the fixing holes.

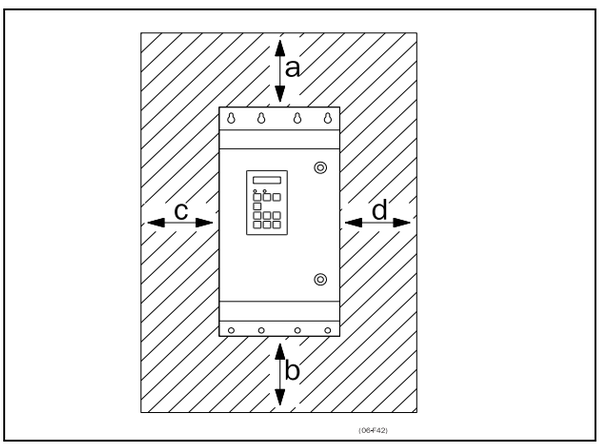

Fig. 3 AC drive mounting model 003 to 293

2.2.1 Cooling

Fig. 3 shows the minimum free space required around the AC drive for the models 003 to 293 in order to guarantee adequate cooling. Because the fans blow the air from the bottom to the top it is advisable not to position an air inlet immediately above an air outlet.

The following minimum separation between two AC drives, or a AC drive and a non-dissipating wall must be maintained. Valid if free space on opposite side.

Table 5 Mounting and cooling

		Frame size B - F2 [mm(in)]	Frame size C2, D2, E2, F2 with IP21 top cover option [mm(in)]
FLD - FLD, side-by-side mm (in)	a	200(7.9)	200(7.9)
	b	200(7.9)	200(7.9)
	c	0	50(1.97)
	d	0	50(1.97)
FLD - wall, wall-one side mm (in)	a	100(3.9)	100(3.9)
	b	100(3.9)	100(3.9)
	c	0	50(1.97)
	d	0	50(1.97)

2.2.2 Mounting schemes

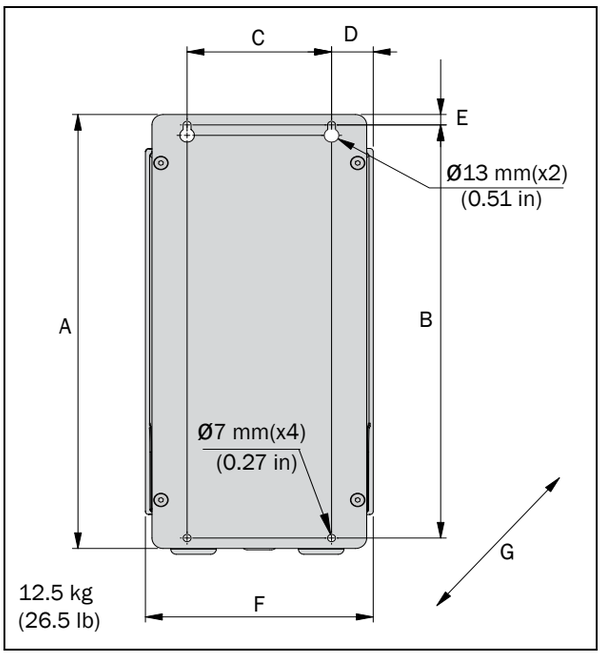

Fig. 4 Emotron FLD Model 48/52-003 to 018 (Frame size B)

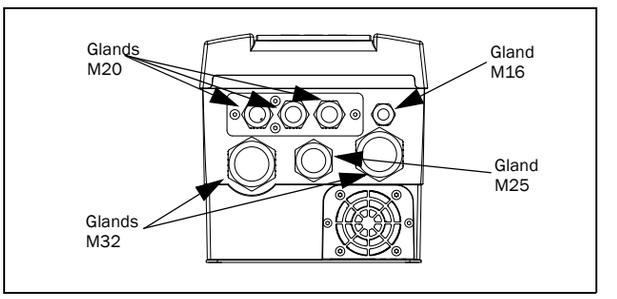

Fig. 5 Cable interface for mains, motor and communication, Emotron FLD Model 48/52-003 to 018 (Frame size B)

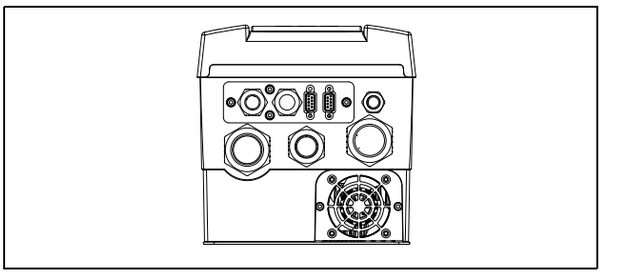

Fig. 6 Emotron FLDModel 48/52-003 to 018 (Frame size B) example with optional CRIO interface and D-sub connectors.

Table 6 Dimensions connected to Fig. 4.

Frame size	Emotron FLD model	Dimensions in mm (in)						
		A	B	C	D	E	F	G
B	003 - 018	416 (16.4)	396 (15.6)	128.5 (5.04)	37 (1.46)	10 (0.39)	202.6 (7.98)	200 (7.9)

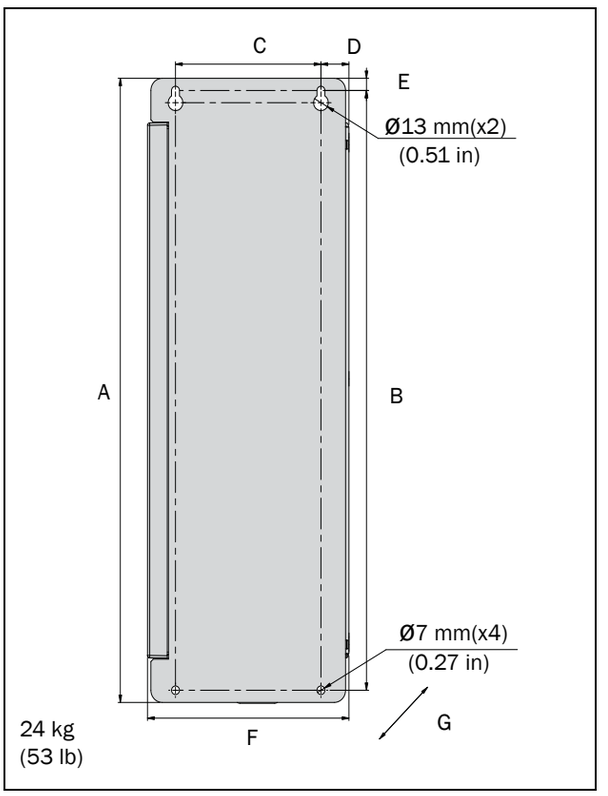

Fig. 7 Emotron FLD Model 48/52-026 to 046 (Frame size C)

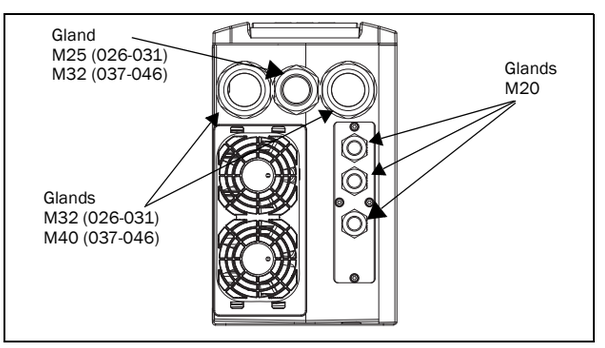

Fig. 8 Cable interface for mains, motor and communication, Emotron FLD Model 48/52-026 to 046 (Frame size C)

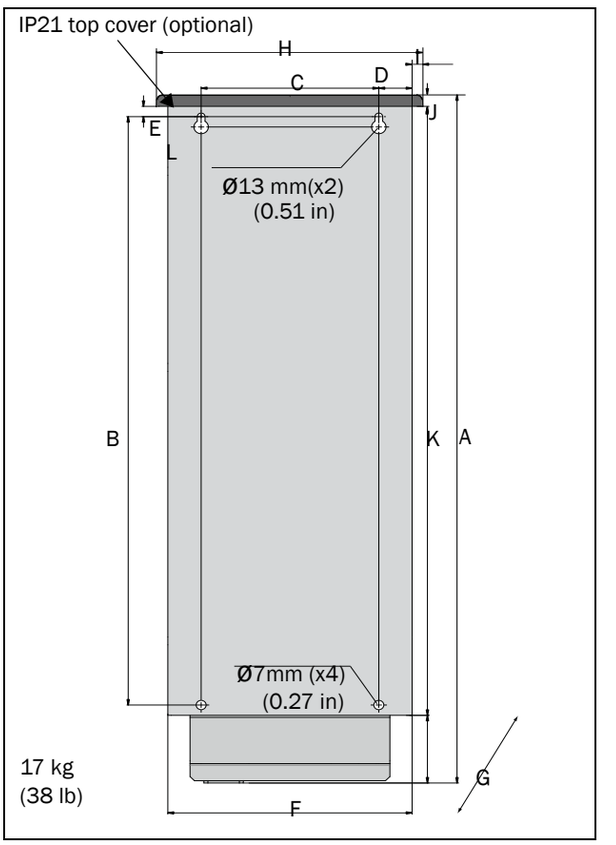

Fig. 9 Emotron FLD Model 48-025 to 48-058 (Frame size C2), backside view.

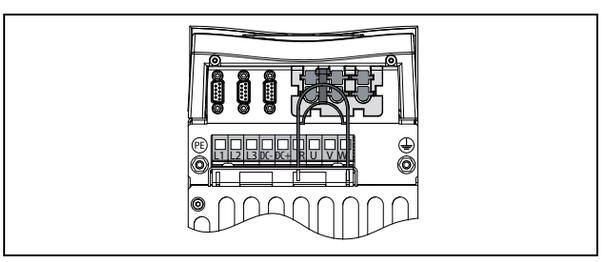

Fig. 10 Bottom view Emotron FLD Model 48-025 to 48-058 (Frame size C2), with cable interface for mains, motor, DC+/DC-, brake resistor and control

Table 7 Dimensions connected to Fig. 7 and Fig. 9.

Frame size	Emotron FLD model	Dimensions in mm (in)										
		A	B	C	D	E	F	G	H	I	J	K
C	026 - 046	512 (20.2)	492 (19.4)	128.5 (5.04)	24.8 (0.95)	10 (0.39)	178 (7)	292 (11.5)	-	-	-	-
C2	025 - 058	585.5 (23)	471 (18.5)	128.5 (5.04)	23.8 (0.91)	13 (0.51)	167 (7)	267 (10.5) IP21 282 (11.1)	196 (7.7)	10 (0.39)	23.5 (0.9)	496 (19.5)

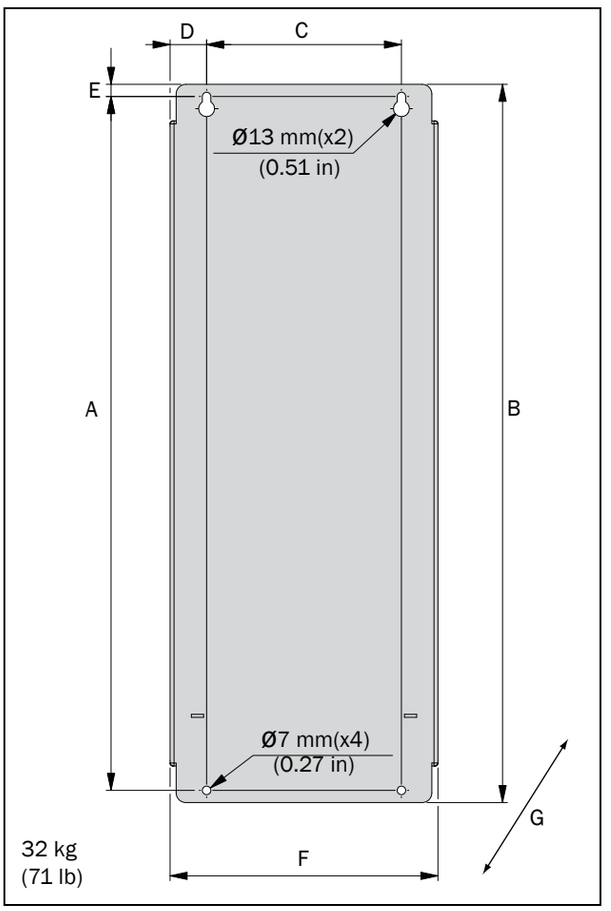

Fig. 11 Emotron FLD Model 48/52-061 and 074 (Frame size D)

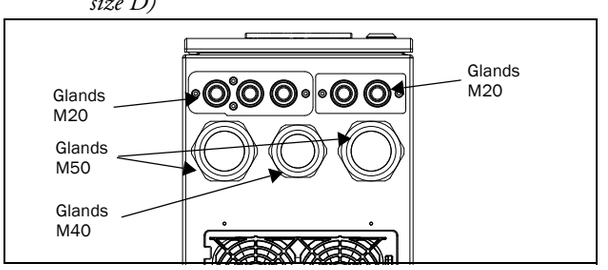

Fig. 12 Cable interface for mains, motor and communication, Emotron FLD Model 48/52-061 and 074 (Frame size D).

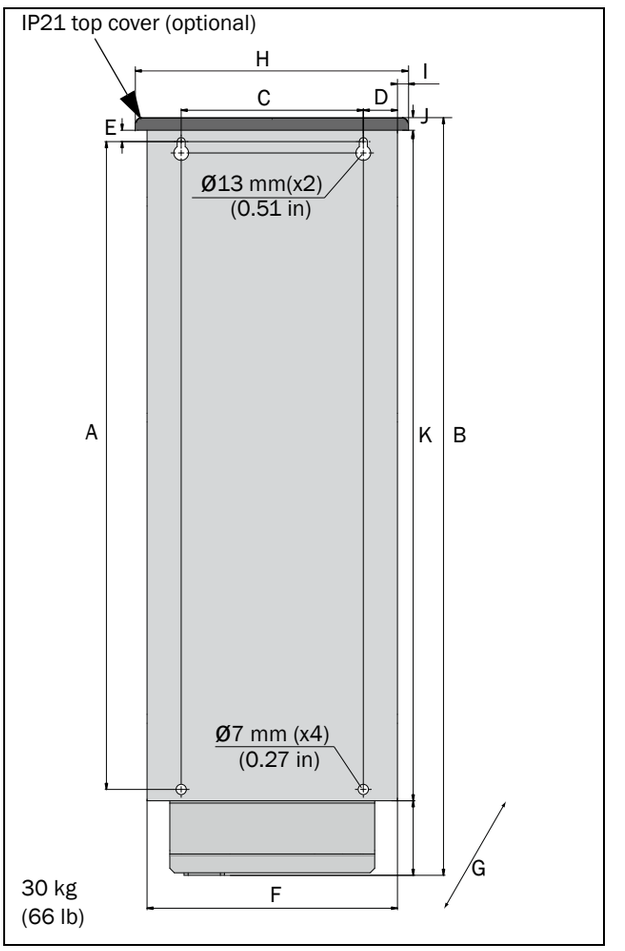

Fig. 13 Emotron FLDModel 48-072 to 48-088 (Frame size D2), backside view.

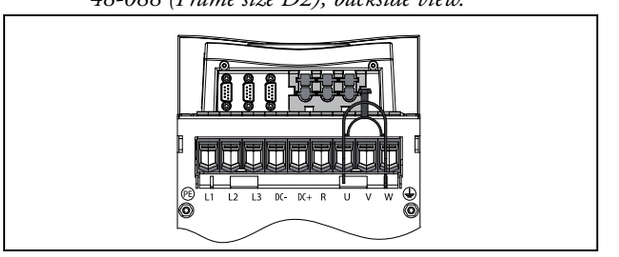

Fig. 14 Bottom view Emotron FLD Model 48-072 to 48-088 (Size D2), with cable interface for mains, motor, DC+/DC-, brake resistor and control.

NOTE: Glands for size B, C and D are available as option kit.

Table 8 Dimensions connected to Fig. 11 and Fig. 13.

Frame size	Emotron FLD model	Dimensions in mm (in)										
		A	B	C	D	E	F	G	H	I	J	K
D	061 - 074	570 (22.4)	590 (23.2)	160 (6.3)	30 (0.9)	10 (0.39)	220 (8.7)	295 (11.6)	-	-	-	-
D2	072 - 088	570 (22.4)	669.5 (26.3)	160 (6.3)	30 (0.9)	13 (0.51)	220 (8.7)	291 (11.5) IP21 - 307 (12.1)	240 (9.5)	10 (0.39)	12.5 (0.47)	590 (23.2)

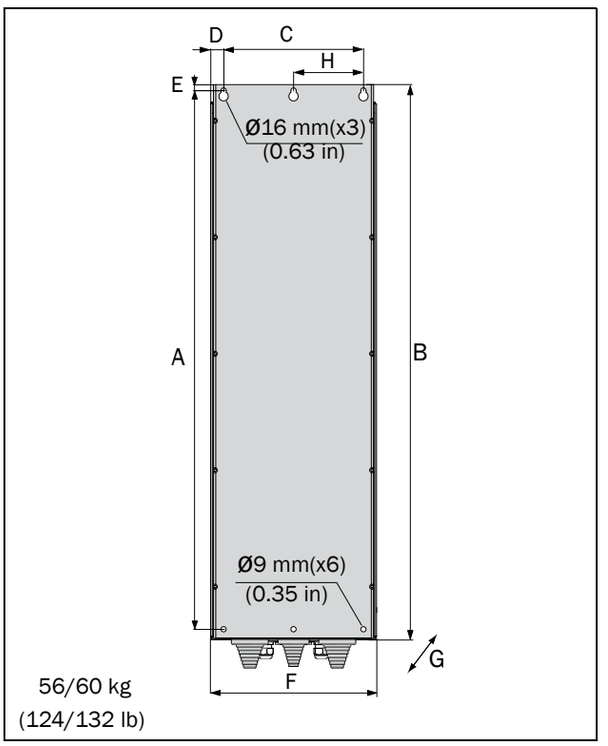

Fig. 15 Emotron FLD Model 48-090 to 175 (Frame size E).

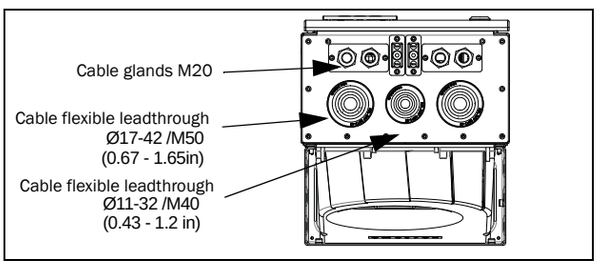

Fig. 16 Cable interface for mains, motor, DC+/DC-, brake resistor and communication, Emotron FLD Model 48-090 to 175 (Frame size E).

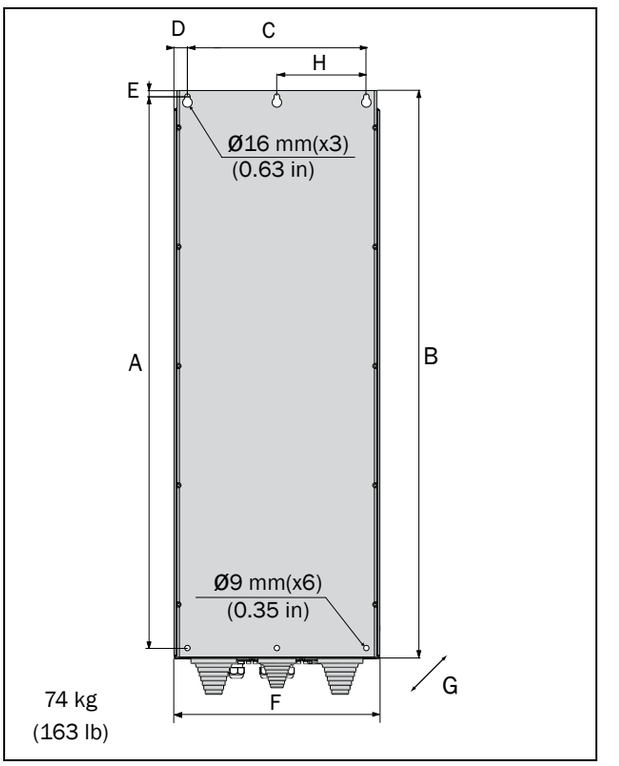

Fig. 17 Emotron FLD Model 48-210 to 250 (Frame size F) Emotron FLD Model 69-090 to 200 (Frame size F69).

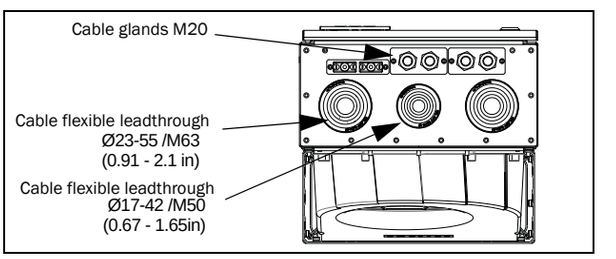

Fig. 18 Cable interface for mains, motor, DC+/DC-, brake resistor and communication, Emotron FLD Model 48-210 to 250 Emotron FLD Model 69-090 to 200.

Table 9 Dimensions connected to Fig. 15 and Fig. 17.

Frame size	Emotron FLD model	Dimension in mm (in)							
		A	B	C	D	E	F	G	H
E	090 - 175	925 (36.4)	952.5 (37.5)	240 (9.5)	22.5 (0.88)	10 (0.39)	284.5 (11.2)	314 (12.4)	120
F	210 - 250	925 (36.4)	950 (37.4)	300 (11.8)	22.5 (0.88)	10 (0.39)	344.5 (13.6)	314 (12.4)	150
F69	090 - 200	1065 (41.9)	1090 (42.9)						

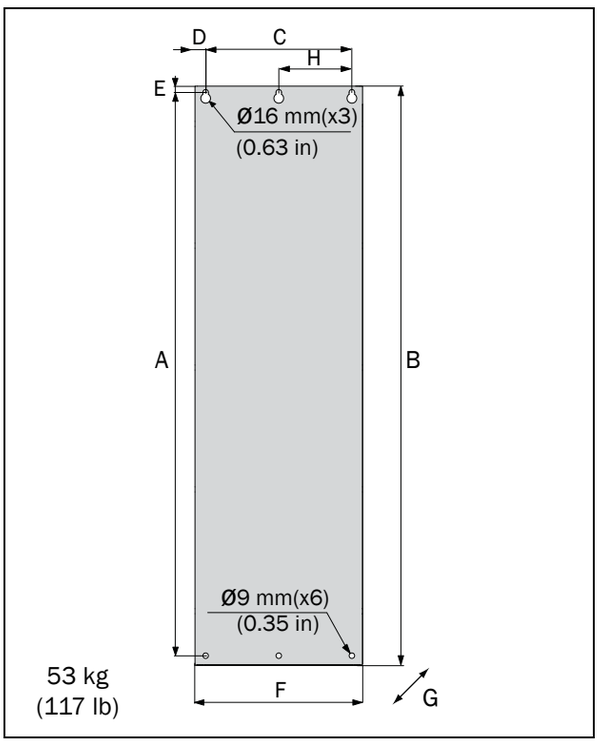

Fig. 19 Emotron FLD Model 48-106 to 48-171 (Frame size E2).

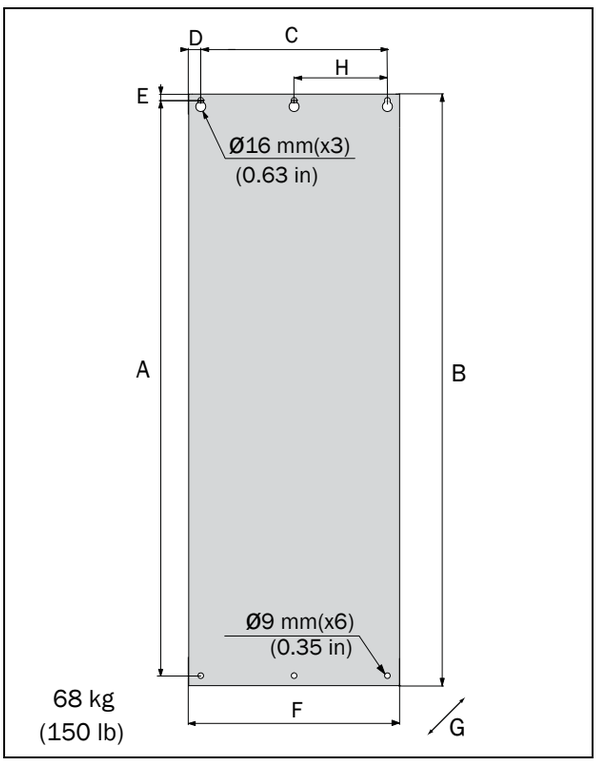

Fig. 21 Emotron FLD Model 48-205 to 48-293 (Frame size F2).

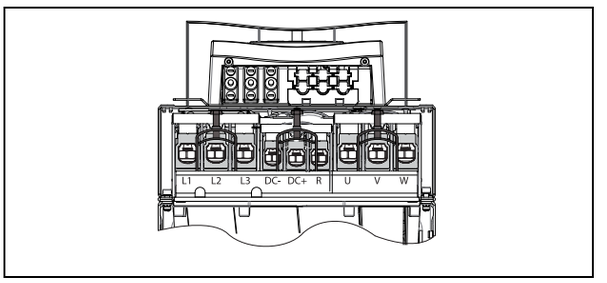

Fig. 20 Bottom view Emotron FLD Model 48-106 to 48-293 (Frame size E2 and F2), with cable interface for mains, motor, DC+/DC-, brake resistor and control. (principle drawing)

Table 10 Dimensions connected to Fig. 19 and Fig. 21.

Frame size	Emotron FLD model	Dimension in mm (in)							
		A	B	C	D	E	F	G	H
E2	106 - 171	925 (36.4)	950 (37.4)	240 (9.5)	22.5 (0.88)	10 (0.39)	275 (10.8)	294 (11.6) IP21 - 323 (12.7)	120 (4.7)
F2	205 - 293			300 (11.8)			335 (13.2)	314 (12.4) IP21 - 323 (12.7)	150 (5.9)

3. Installation

The description of installation in this chapter complies with the EMC standards and the Machine Directive.

Select cable type and screening according to the EMC requirements valid for the environment where the AC drive is installed.

3.1 Before installation

Read the following checklist and prepare for your application before installation.

- Local or remote control.
- Long motor cables (>100m (> 330 ft)), refer to section Long motor cables page 22.
- Functions used.
- Suitable AC drive size in proportion to the motor/application.

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

3.1.1 Remove/open front cover

Frame sizes B - F (IP54)

Remove/open the front cover to access the cable connections and terminals. On Frame size B and C loosen the 4 screws and remove the cover. On Frame size D and up unlock the hinged cover with the key and open it.

Frame size C2 - F2 (IP20/21)

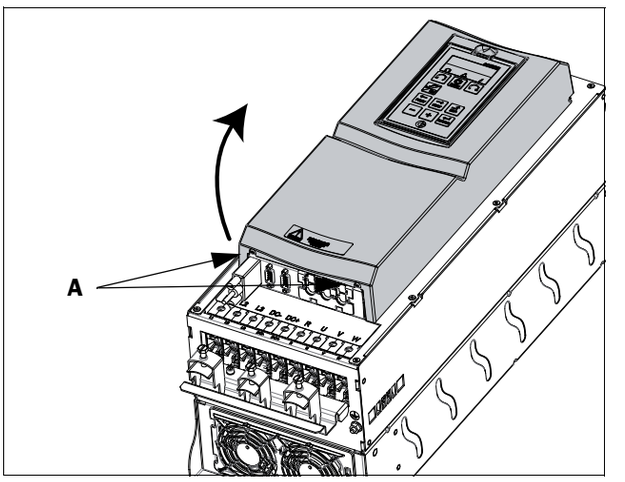

Fig. 22 Remove the front cover on frame size C2 - F2 (principle drawing).

To be able to access all cable connections and terminals, first open and remove the front cover in following order.

- Loosen the two screws A (see Fig. 22) at the bottom of the cover a couple of turns (you do not have to remove the screws).
- Swing out the lower part of the cover a bit and remove the cover downwards. Be careful, don't swing out the cover too much as this could damage the “lips” at the upper hinges.
  Now it is easy to access all terminals.

3.1.2 Remove/open the lower front cover on Frame size E2 and F2 (IP20/21)

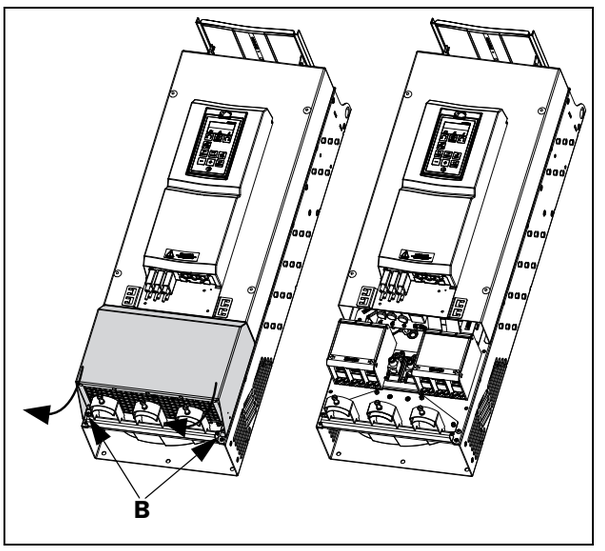

Fig. 23 Loosen the two screws and remove the lower cover (principle drawing)

In order to access the mains, motor, DC+/DC- and brake terminals, remove the lower cover in following order

- Loosen the two screws B (see Fig. 23).
- Pull down the cover a bit and lift it away.

3.2 Cable connections

IP54-FLD48/52-003 to 074 (Frame sizes B, C and D)
IP20/21 - FLD48 025 to 293 (Frame sizes C2,D2,E2 and F2).

3.2.1 Mains cables

Dimension the mains and motor cables according to local regulations. The cable must be able to carry the AC drive load current.

Recommendations for selecting mains cables

- To fulfil EMC purposes it is not necessary to use screened mains cables.
- Use heat-resistant cables, +60 °C (140 °F) or higher.
- Dimension the cables and fuses in accordance with local regulations and the nominal current of the motor. See table 37, page 61.
- PE conductor cross-sectional area shall for cable size ≤ 16mm^2 (6 AWG) be equal to the used phase conductors, for cable size above 16mm^2 (6 AWG) but smaller or equal to 35mm^2 (2 AWG) the PE conductor cross-sectional area shall be at least 16mm^2 (6 AWG). For cables >35mm^2 (>2 AWG) the PE conductor cross-sectional area should be at least 50% of the used phase conductor.
  When the PE conductor in the used cable type is not in accordance with the above mentioned cross-sectional area requirements, a separate PE conductor should be used to establish this.
- The litz ground connection see fig. 33, is only necessary if the mounting plate is painted. All the AC drives have an unpainted back side and are therefore suitable for mounting on an unpainted mounting plate.

Connect the mains cables according to fig. 24 to 30. The AC drive has as standard a built-in RFI mains filter that complies with category C3 which suits the Second Environment standard.

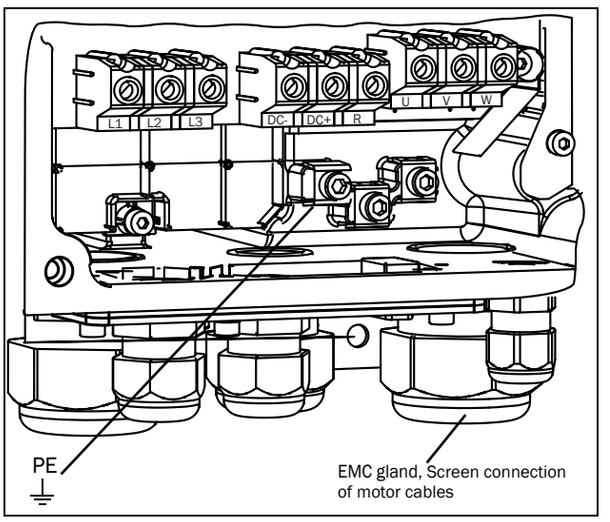

Fig. 24 Mains and motor connections, model 003-018, frame size B

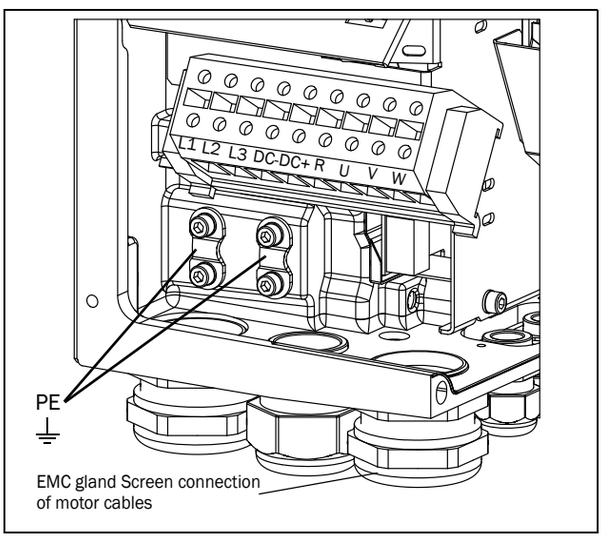

Fig. 25 Mains and motor connections, model 026-046, frame size C

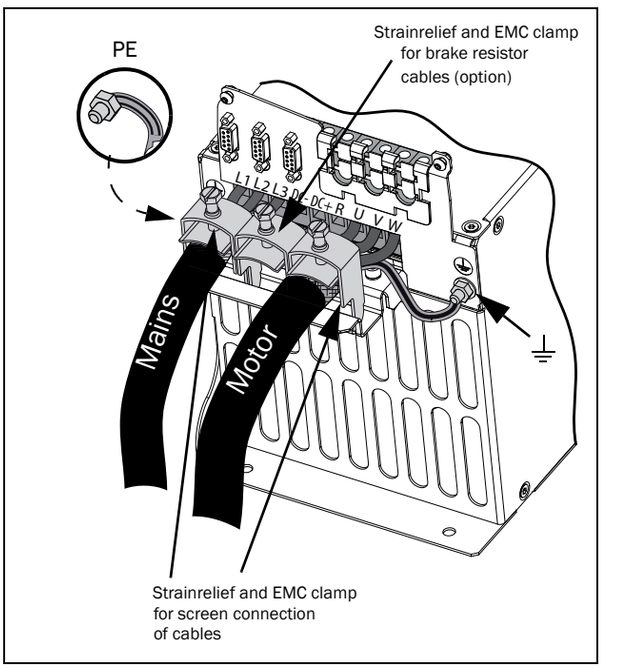

Fig. 26 Mains and motor connections model 48-025 to 48-058, frame size C2.

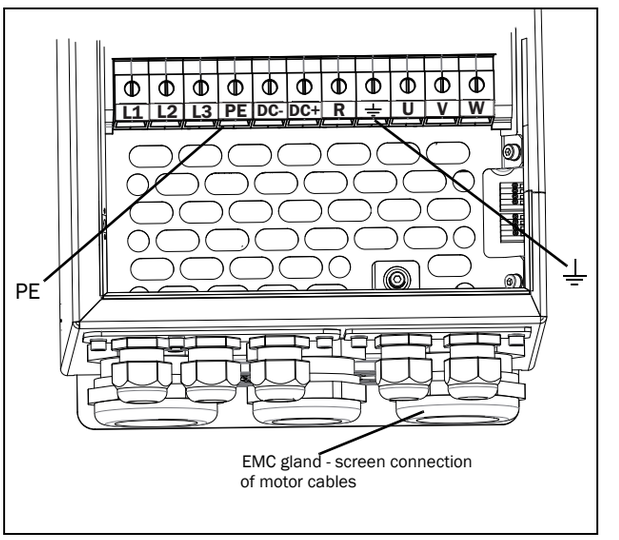

Fig. 27 Mains and motor connection, model 061 - 074, frame size D.

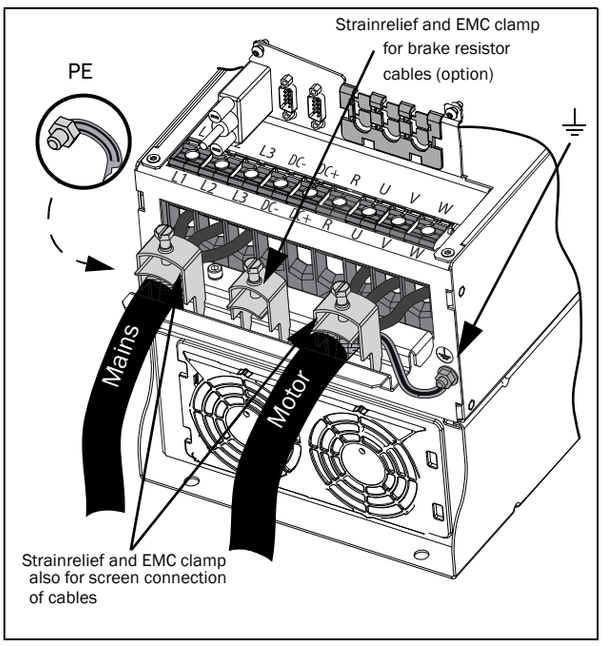

Fig. 28 Mains and motor connections model 48-072 to 48-105, frame size D2.

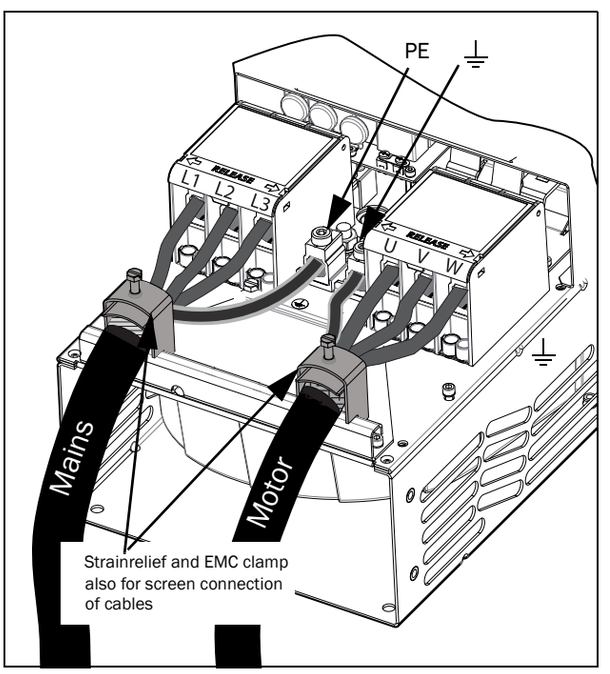

Fig. 29 Mains and motor connections model 48-142 to 48-293 (Size E2 and F2) (principle drawing).

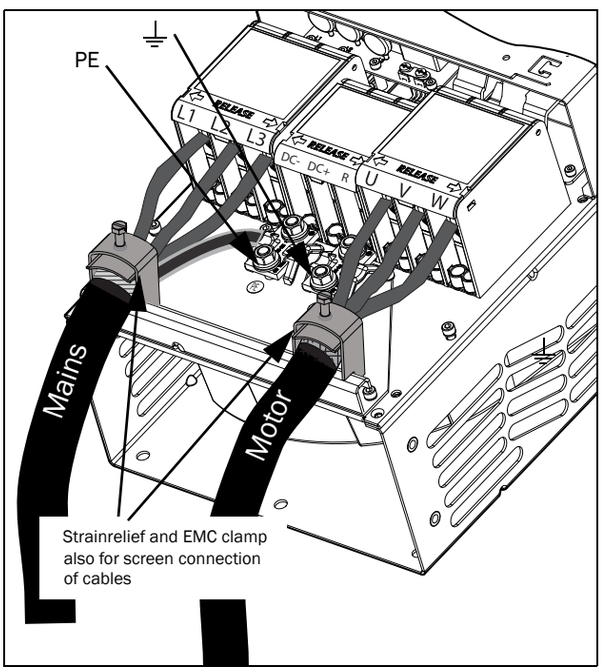

Fig. 30 Mains and motor connections model 48-142 to 48-293 (Size E2 and F2) with the optional terminals for DC-,DC+ and Brake (principle drawing)

Table 11 Mains and motor connections

L1,L2,L3 PE	Mains supply, 3 -phase Safety earth (protected earth)
⏚ U, V, W	Motor earth Motor output, 3-phase
DC-,DC+,R	Brake resistor, DC-link connections (optional)

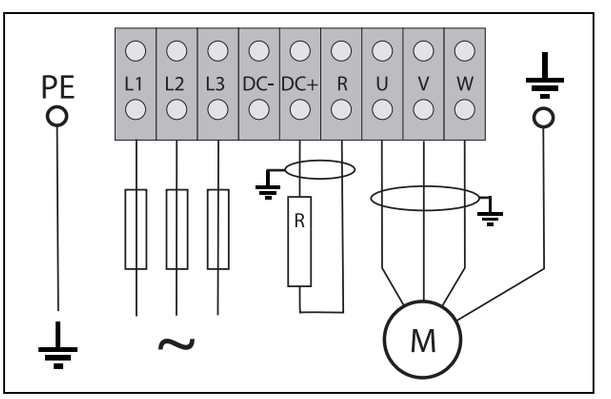

Fig. 31 Wiring example showing Protective earth, Motor earth and Brake Resistor connection

NOTE: The Brake and DC-link Terminals are only fitted if the DC+/DC- option or Brake Chopper Option is built-in.

WARNING!
The Brake Resistor must be connected between terminals DC+ and R.

WARNING!
In order to work safely, the mains earth must be connected to PE and the motor earth to ⏚.

3.2.2 Motor cables

To comply with the EMC emission standards the AC drive is provided with a RFI mains filter. The motor cables must also be screened and connected on both sides. In this way a so-called “Faraday cage” is created around the AC drive, motor cables and motor. The RFI currents are now fed back to their source (the IGBTs) so the system stays within the emission levels.

Recommendations for selecting motor cables

- Use screened cables according to specification in table 12. Use symmetrical shielded cable; three phase conductors and a concentric or otherwise symmetrically constructed PE conductor, and a shield.
- PE conductor cross-sectional area shall for cable size ≤ 16mm^2 (6 AWG) be equal to the used phase conductors, for cable size above 16mm^2 (6 AWG) but smaller or equal to 35mm^2 (2 AWG) the PE conductor cross-sectional area shall be at least 16mm^2 (6 AWG). For cables >35mm^2 (2 AWG) the PE conductor cross-sectional area should be at least 50% of the used phase conductor.
  When the PE conductor in the used cable type is not in accordance with the above mentioned cross-sectional area requirements, a separate PE conductor should be used to establish this.
- Use heat-resistant cables, +60 °C (140 °F) or higher.
- Dimension the cables and fuses in accordance with the nominal output current of the motor. See table 37, page 61.
- Keep the motor cable between AC drive and motor as short as possible.
- The screening must be connected with a large contact surface of preferable 360° and always at both ends, to the motor housing and the AC drive housing. When painted mounting plates are used, do not be afraid to scrape away the paint to obtain as large contact surface as possible at all mounting points for items such as saddles and the bare cable screening. Relying just on the connection made by the screw thread is not sufficient.

NOTE: It is important that the motor housing has the same earth potential as the other parts of the machine.

- The litz ground connection, see fig. 33, is only necessary if the mounting plate is painted. All the AC drives have an unpainted back side and are therefore suitable for mounting on an unpainted mounting plate.

Connect the motor cables according to U - U, V - V and W - W, see Fig. 24, to Fig. 30 .

NOTE: The terminals DC-, DC+ and R are options.

Switches between the motor and the AC drive

If the motor cables are to be interrupted by maintenance switches, output coils, etc., it is necessary that the screening is continued by using metal housing, metal mounting plates, etc. as shown in the Fig. 33.

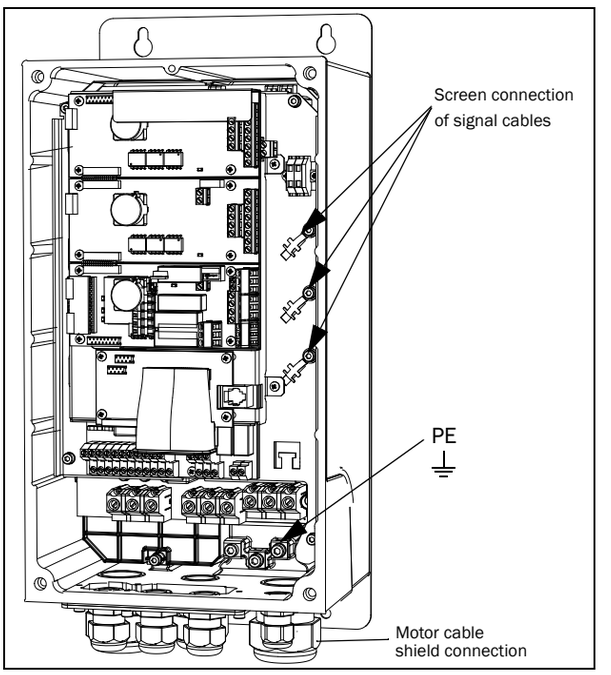

Fig. 32 Screen connection of cables.

Pay special attention to the following points:

- If paint must be removed, steps must be taken to prevent subsequent corrosion. Repaint after making connections!
- The fastening of the whole AC drive housing must be electrically connected with the mounting plate over an area which is as large as possible. For this purpose the removal of paint is necessary. An alternative method is to connect the AC drive housing to the mounting plate with as short a length of litz wire as possible.
- Try to avoid interruptions in the screening wherever possible.
- If the AC drive is mounted in a standard cabinet, the internal wiring must comply with the EMC standard. Fig. 33 shows an example of a AC drive built into a cabinet.

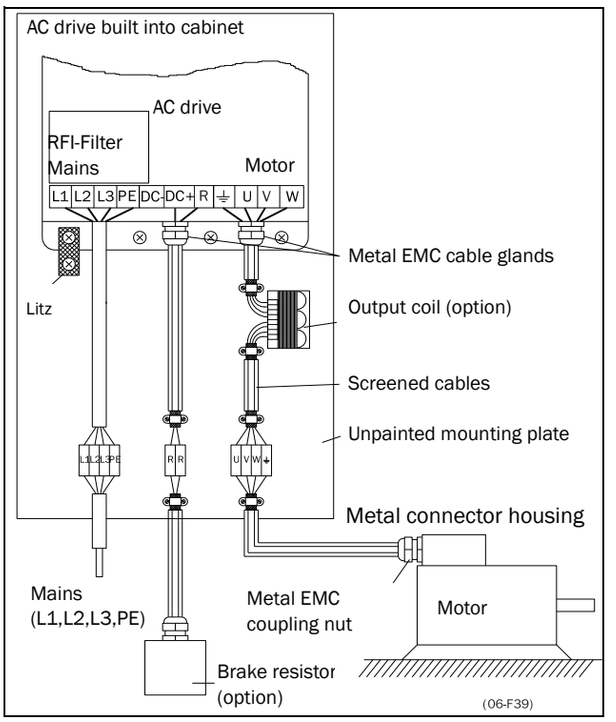

Fig. 33 AC drive in a cabinet on a mounting plate

Fig. 34 shows an example when there is no metal mounting plate used (e.g. if IP54 AC drives are used). It is important to keep the "circuit" closed, by using metal housing and cable glands.

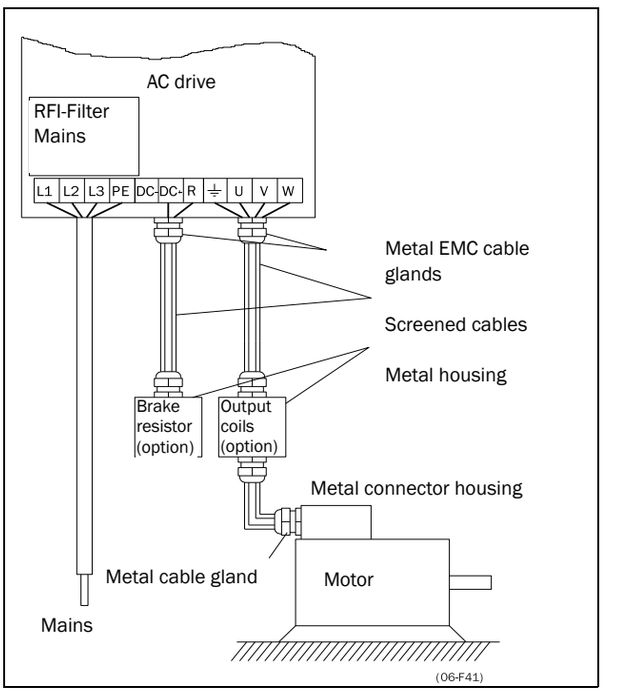

Fig. 34 AC drive as stand alone

Connect motor cables

1. Remove the cable interface plate from the AC drive housing.
2. Put the cables through the glands.
3. Strip the cable according to Table 13.
4. Connect the stripped cables to the respective motor terminal.
5. Put the cable interface plate in place and secure with the fixing screws.
6. Tighten the EMC gland with good electrical contact to the motor and brake chopper cable screens.

Placing of motor cables

Keep the motor cables as far away from other cables as possible, especially from control signals. The minimum distance between motor cables and control cables is 300 mm (12 in).

Avoid placing the motor cables in parallel with other cables.

The power cables should cross other cables at an angle of 90°.

Long motor cables

If the connection to the motor is longer than 100 m (330 ft)(for powers below 7.5 kW (10.2 hp) please contact CG Drives & Automation), it is possible that capacitive current peaks will cause tripping at overcurrent. Using output coils can prevent this. Contact the supplier for appropriate coils.

Switching in motor cables

Switching in the motor connections is not advisable. In the event that it cannot be avoided (e.g. emergency or maintenance switches) only switch if the current is zero. If this is not done, the AC drive can trip as a result of current peaks.

3.3 Connection of motor and mains cables for larger frame sizes

IP54 - FLD 48-090 to 250 (Frame sizes E - F) and
FLD 69-090 to 200 (Frame size F69)

Emotron FLD48-090 and up, Emotron FLD69-090 and up

To simplify the connection of thick motor and mains cables to the AC drive, the cable interface plate can be removed.

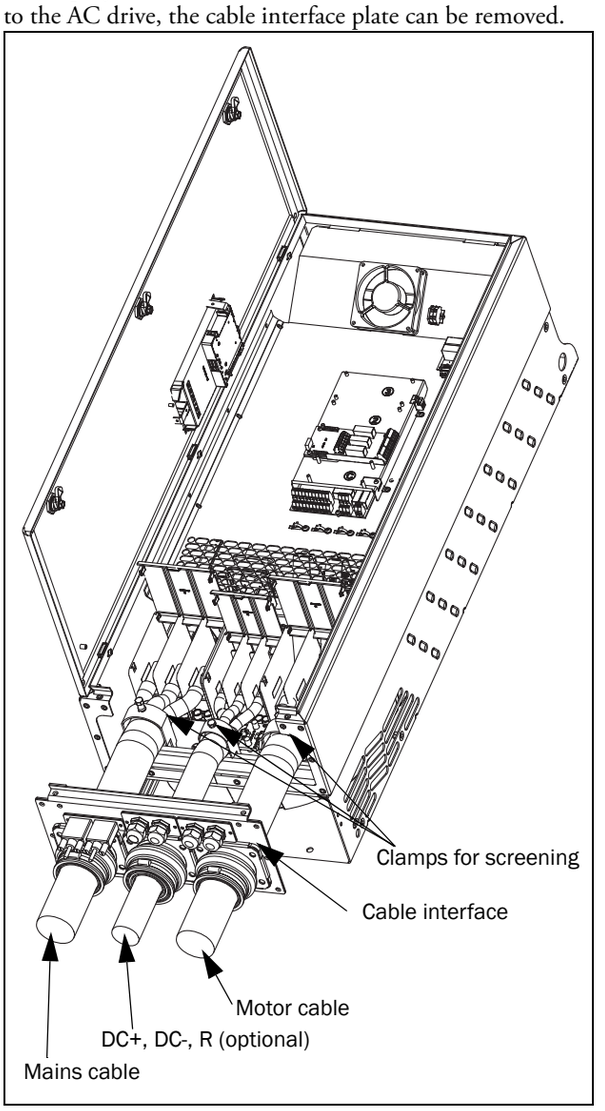

Fig. 35 Connecting motor and mains cables.

1. Remove the cable interface plate from the AC drive housing.
2. Put the cables through the glands.
3. Strip the cable according to Table 13.
4. Connect the stripped cables to the respective mains/ motor terminal.
5. Fix the clamps on appropriate place and tighten the cable in the clamp with good electrical contact to the cable screen.
6. Put the cable interface plate in place and secure with the fixing screws.

3.4 Cable specifications

Table 12 Cable specifications

Cable	Cable specification
Mains	Power cable suitable for fixed installation for the voltage used.
Motor	Symmetrical three conductor cable with concentric protection (PE) wire or a four conductor cable with compact low-impedance concentric shield for the voltage used.
Control	Control cable with low-impedance shield, screened.

3.4.1 Stripping lengths

Fig. 3.4.2 indicates the recommended stripping lengths for motor and mains cables.

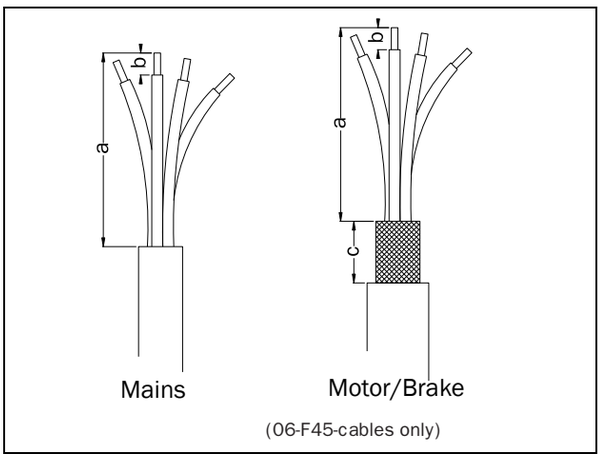

Fig. 36 Stripping lengths for cables

Table 13 Stripping lengths for mains, motor, brake and earth cables

Model	Frame size	Mains cable		Motor cable			Brake cable			Earth cable	
		a mm (in)	b mm (in)	a mm (in)	b mm (in)	c mm (in)	a mm (in)	b mm (in)	c mm (in)	a mm (in)	b mm (in)
FLD##003 - 018	B	90 (3.5)	10 (0.4)	90 (3.5)	10 (0.4)	20 (0.8)	90 (3.5)	10 (0.4)	20 (0.8)	90 (3.5)	10 (0.4)
FLD##026 – 046	C	150 (5.9)	14 (0.2)	150 (5.9)	14 (0.2)	20 (0.8)	150 (5.9)	14 (0.2)	20 (0.8)	150 (5.9)	14 (0.2)
FLD48-025 – 058	C2	65 (2.7)	18 (0.7)	65 (2.7)	18 (0.7)	36 (1.4)	65 (2.7)	18 (0.7)	36 (1.4)	65 (2.7)	M6 screw*
FLD##061 – 074	D	110 (4.3)	17 (0.7)	110 (4.3)	17 (0.7)	34 (1.4)	110 (4.3)	17 (0.7)	34 (1.4)	110 (4.3)	17 (0.7)
FLD48-072 – 105	D2	92 (3.6)	18 (0.7)	92 (3.6)	18 (0.7)	36 (1.4)	92 (3.6)	18 (0.7)	36 (1.4)	92 (3.6)	M6 screw*
FLD##090 - 175	E	173 (6.8)	25 (1)	173 (6.8)	25 (1)	41 (1.6)	173 (6.8)	25 (1)	41 (1.6)	173 (6.8)	25 (1) 40 (1.6)**
FLD48-142 – 171	E2										
FLD48-205 – 293	F2	178 (7)	32 (1.3)	178 (7)	32 (1.3)	46 (1.8)	178 (7)		46 (1.8)	178 (7)	32 (1.3) 40 (1.6)**
FLD48-210 – 250 FLD69-090 – 200	F										

* With cable shoe for M6 screw

**Valid when brake chopper electronics are built in

3.4.2 Fuse data

Please refer to the chapter Technical data, section 8.7, page 61.

3.4.3 Cable connection data for mains, motor and PE cables according to IEC ratings

NOTE: The dimensions of the power terminals used in the cabinet drive models 300 to 3K0 can differ depending on customer specification.

Table 14 Cable connector range and tightening torque for Emotron FLD48 and FLD52, according to IEC ratings.

Model	Frame size	Cable cross section connector range						Cable type
		Mains and motor		Brake		PE		
		Cable area mm^2	Tightening torque Nm	Cable area mm^2	Tightening torque Nm	Cable area mm^2	Tightening torque Nm	
FLD##-003	B	0.5 - 10	1.2-1.4	0.5 - 10	1.2-1.4	1.5 - 16	2.6	Copper (Cu) 75°C
FLD##-004								
FLD##-006								
FLD##-008								
FLD##-010								
FLD##-013								
FLD##-018								
FLD48-025	C2	4 - 25	2	4 - 25	2	4 - 25 *	4.3	
FLD48-030								
FLD48-036								
FLD48-045								
FLD48-058								
FLD##-026	C	2.5-16 stranded 2.5-25 solid	1.2-1.4	2.5-16 stranded 2.5-25 solid	1.2-1.4	6-16 stranded 6-25 solid	1.2-1.4	
FLD##-031								
FLD##-037								
FLD##-046								
FLD48-072	D2	0.75 - 50	3.3	0.75 - 50	3.3	10 - 70*	4.3	
FLD48-088	D2	16 - 50	7.9	16 - 50	7.9			
FLD48-105								
FLD##-061	D	10-35 stranded 10-50 solid	2.8-3	10-35 stranded 10-50 solid	2.8-3	16-35 stranded 16-50 solid	2.8-3	
FLD##-074								
FLD48-142	E2	16- 150	31 (for 16-34 mm^2) 42 (for 35-150 mm^2)	16 - 120	31 (for 16-34 mm^2) 42 (for 35-120 mm^2)	16- 150 16 - 185 **	31 (for 16-34 mm^2) 42 (for 35-150 mm^2) 10 **	
FLD48-171								
FLD48-090	E							
FLD48-109								
FLD48-146								
FLD48-175								

Table 14 Cable connector range and tightening torque for Emotron FLD48 and FLD52, according to IEC ratings.

Model	Frame size	Cable cross section connector range						Cable type
		Mains and motor		Brake		PE		
		Cable area mm^2	Tightening torque Nm	Cable area mm^2	Tightening torque Nm	Cable area mm^2	Tightening torque Nm	
FLD48-205	F2	25 - 240	31 (for 25-34 mm^2) 42 (for 35-152 mm^2) 56 (for 153-240 mm^2)	16 - 150	31 (for 16-34 mm^2) 42 (for 35-150 mm^2)	25 - 240 16 - 185 **	31 (for 25-34 mm^2) 42 (for 35-152 mm^2) 56 (for 153-240 mm^2) 10 **	Copper (Cu) 75°C
FLD48-244								
FLD48-210	F							
FLD48-228								
FLD48-250								

* = With cable shoe for M6 screw.

**= Valid when brake chopper electronics are built in.

Table 15 Cable connector range and tightening torque for Emotron FLD69, according to IEC ratings.

Model	Frame size	Cable cross section connector range						Cable type
		Mains and motor		Brake		PE		
		Cable area mm^2	Tightening torque Nm	Cable area mm^2	Tightening torque Nm	Cable area mm^2	Tightening torque Nm	
FLD69-090	F69	16 - 150	31 (for 16 - 34 mm^2) 42 (for 35-150 mm^2)	16 - 120	31 (for 16 - 34 mm^2) 42 (for 35-120 mm^2)	16 - 150 16 - 185 **	31 (for 16 - 34 mm^2) 42 (for 35-150 mm^2) 10 **	Copper (Cu) 75°C
FLD69-109								
FLD69-146								
FLD69-175								
FLD69-200								

3.4.4 Cable connection data for mains, motor and PE cables according to NEMA ratings

List of cable cross section connector range with minimum required AWG cable cross section which fits to the terminals according to UL-requirements.

Table 16 Cable connector range and tightening torque for Emotron FLD48 and FLD52, according to NEMA ratings

Model	Frame size	Cable cross section connector range						Cable type
		Mains and motor		Brake		PE		
		Cable range AWG	Tightening torque Lb-In	Cable range AWG	Tightening torque Lb-In	Cable range AWG	Tightening torque Lb-In	
FLD##-003	B	20 - 6	11.5	20 - 6	11.5	20 - 6	23	Copper (Cu) 75 °C
FLD##-004								
FLD##-006								
FLD##-008								
FLD##-010								
FLD##-013								
FLD##-018								
FLD48-025	C2	12 - 4	18	12 - 4	18	12 - 4*	38	
FLD48-030								
FLD48-036								
FLD48-045								
FLD48-058								
FLD##-026	C	18 - 4	10.6-12.3	18 - 4	10.6-12.3	18 - 4	10.6-12.3	
FLD##-031								
FLD##-037								
FLD##-046								
FLD48-072	D2	10 - 0	30 - 50	10 - 0	30 - 50	8 - 2/0*	38	
FLD48-088	D2	3 - 2/0	70	3 - 2/0	70			
FLD48-105								
FLD##-061	D	10 - 0	24.3-26.1	10 - 0	24.3-26.1	10 - 0	24.3-26.1	
FLD##-074								
FLD48-142	E2	6 - 300 kcmil	275 (for AWG 6 - 2) 375 (for AWG 1 - 300Kcmil)	6 - 250 kcmil	275 (for AWG 6 - 2) 375 (for AWG 1 -250Kcmil)	6 - 300 kcmil 6 - 2/0**	275 (for AWG 6-2) 375 (for AWG 1-300Kcmil) 88**	
FLD48-171								
FLD48-090	E							
FLD48-109								
FLD48-146								
FLD48-175								
FLD48-205	F2	4 - 500 kcmil	275 (for AWG 4 - 2) 375 (for AWG 1 -300 kcmil) 500 (for AWG 350 -500 kcmil)	6 - 300 kcmil	275 (for AWG 6 - 2) 375 (for AWG 1 -300Kcmil)	4 - 500 kcmil 6 - 2/0**	275 (for AWG 4 - 2) 375 (for AWG 1 - 300 kcmil) 500 (for AWG 350 - 500 kcmil) 88**	
FLD48-244								
FLD48-293								
FLD48-210	F							
FLD48-228								
FLD48-250								

* = With cable shoe for M6 screw.

**= Valid when brake chopper electronics are built in.

3.5 Thermal protection on the motor

Standard motors are normally fitted with an internal fan. The cooling capacity of this built-in fan is dependent on the frequency of the motor. At low frequency, the cooling capacity will be insufficient for nominal loads. Please contact the motor supplier for the cooling characteristics of the motor at lower frequency.

WARNING!
Depending on the cooling characteristics of the motor, the application, the speed and the load, it may be necessary to use forced cooling on the motor.

Motor thermistors offer better thermal protection for the motor. Depending on the type of motor thermistor fitted, the optional PTC input may be used. The motor thermistor gives a thermal protection independent of the speed of the motor, thus of the speed of the motor fan. See the functions, Motor I^2t type [231] and Motor I^2t current [232].

3.6 Motors in parallel

t is possible to have motors in parallel as long as the total current does not exceed the nominal value of the AC drive. The following has to be taken into account when setting the motor data:

Menu [221] Motor Voltage:	The motors in parallel must have the same motor voltage.
Menu [222] Motor Frequency:	The motors in parallel must have the same motor frequency.
Menu [223] Motor Power:	Add the motor power values for the motors in parallel.
Menu [224] Motor Current:	Add the current for the motors in parallel.
Menu [225] Motor Speed:	Set the average speed for the motors in parallel.
Menu [227] Motor Cos PHI:	Set the average Cos PHI value for the motors in parallel.

4. Control Connections

4.1 Control board

Fig. 37 shows the layout of the control board which is where the parts most important to the user are located. Although the control board is galvanically isolated from the mains, for safety reasons do not make changes while the mains supply is on!

WARNING!
Always switch off the mains voltage and wait at least 7 minutes to allow the DC capacitors to discharge before connecting the control signals or changing position of any switches. If the option External supply is used, switch of the mains to the option. This is done to prevent damage on the control board.

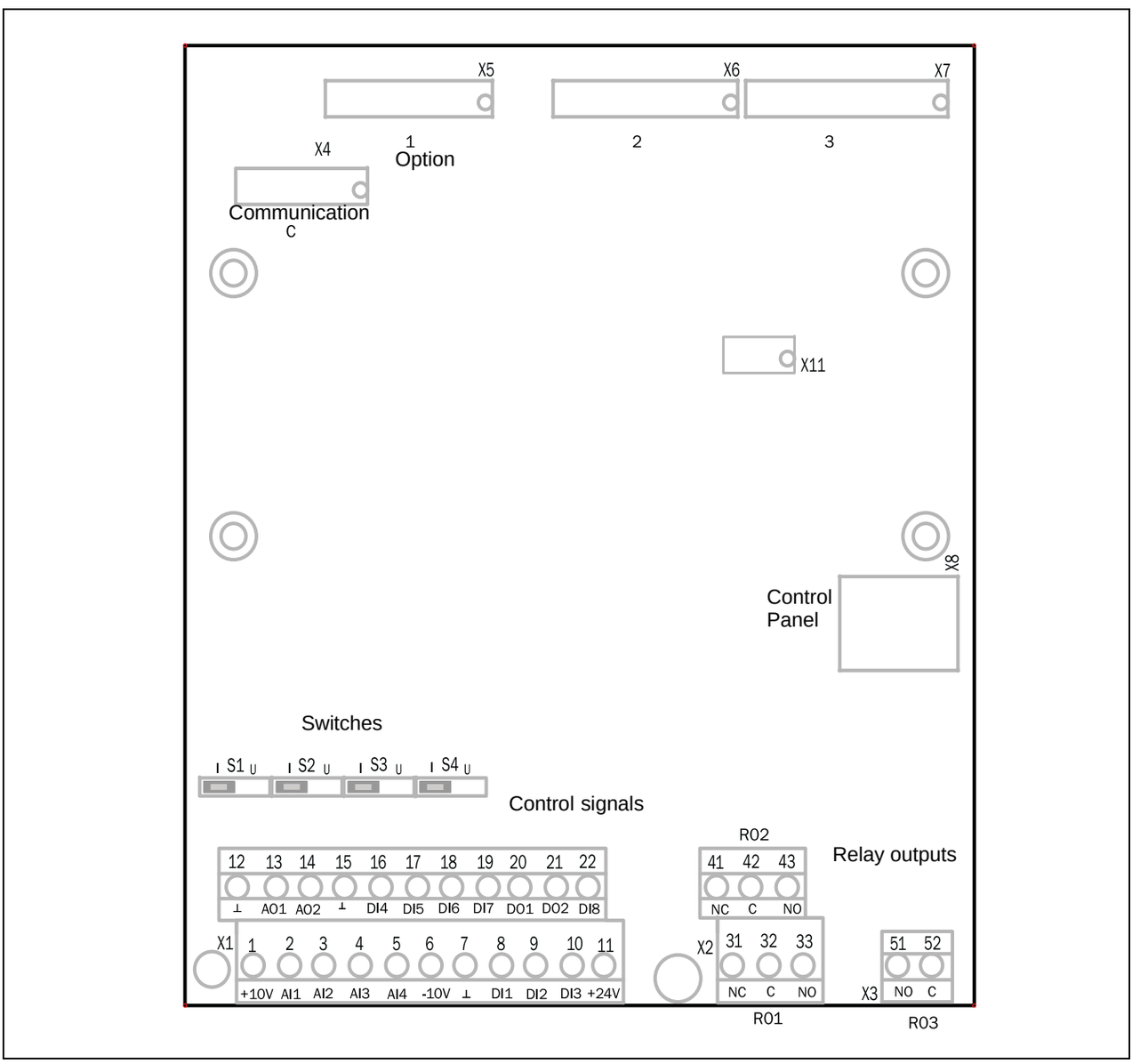

Fig. 37 Control board layout

4.2 Terminal connections

The terminal strip for connecting the control signals is accessible after opening the front panel.

The table describes the default functions for the signals. The inputs and outputs are programmable for other functions as described in chapter 10. page 65. For signal specifications refer to chapter 8. page 53.

NOTE: The maximum total combined current for outputs 11, 20 and 21 is 100mA.

NOTE: It is possible to use external 24V DC if connection to Common (15).

Table 17 Control signals

Terminal	Name	Function (Default)
Outputs		
1	+10 V	+10 VDC supply voltage
6	-10 V	
7	Common	Signal ground
11	+24 V	+24 VDC supply voltage
12	Common	
15	Common	
Digital inputs		
8	DigIn 1	Auto run
9	DigIn 2	Forced run
10	DigIn 3	FlowLinkIn
16	DigIn 4	Off
17	DigIn 5	Off
18	DigIn 6	Overflow level switch (optional)
19	DigIn 7	Off
22	DigIn 8	Reset
Digital outputs		
20	DigOut 1	
21	DigOut 2	FlowLinkOut
Analogue inputs		
2	AnIn 1	Level sensor
3	AnIn 2	Off
4	AnIn 3	Off
5	AnIn 4	Off
Analogue outputs		
13	AnOut 1	
14	AnOut 2	

Table 17 Control signals

Terminal	Name	Function (Default)
Relay outputs		
31	N/C 1	Relay 1 output Trip, active when the AC drive is in a TRIP condition.
32	COM 1	
33	N/O 1	
41	N/C 2	Relay 2 output Run, active when the AC drive is started, also active during sleep mode.
42	COM 2	
43	N/O 2	
51	COM 3	Relay 3 output Off
52	N/O 3	

NOTE: N/C is opened when the relay is active and N/O is closed when the relay is active.

NOTE! Using potentiometer for reference signal to Analogue input: Possible potentiometer value in range of 1 kΩ to 10 kΩ (¼ Watt) linear, where we advice to use a linear 1 kΩ / ¼ W type potentiometer for best control linearity.

WARNING!
The relay terminals 31-52 are single isolated. Do NOT mix SELV voltage with e.g. 230 VAC on these terminals. A solution when dealing with mixed SELV/system voltage signals is to install an additional I/O board option (see chapter 7.5 page 48) and connect all SELV voltage signals to the relay terminals of this option board while connecting all 230VAC signals to the power board relay terminals 31 - 52.

4.3 Inputs configuration with the switches

The switches S1 to S4 are used to set the input configuration for the 4 analogue inputs AnIn1, AnIn2, AnIn3 and AnIn4 as described in table 18. See Fig. 37 for the location of the switches.

Table 18 Switch settings

Input	Signal type	Switch
AnIn1	Voltage	S1 
	Current (default)	S1 
AnIn2	Voltage	S2 
	Current (default)	S2 
AnIn3	Voltage	S3 
	Current (default)	S3 
AnIn4	Voltage	S4 
	Current (default)	S4 

NOTE: Scaling and offset of AnIn1 - AnIn4 can be configured using the software. See menus [512], [515], [518] and [51B] in section 10.5, page 138.

NOTE: the 2 analogue outputs AnOut 1 and AnOut 2 can be configured using the software. See menu [530] section 10.5.3, page 148

4.4 Connect control cables

Here you will make up the minimum wiring for starting. To comply with the EMC standard, use screened control cables with plaited flexible wire up to 1.5 mm2 (AWG15) or solid wire up to 2.5 mm2(AWG13). We recommend using twisted pair cables between Master and follower for communication signals.

1. Connect a level sensor between terminals 1 (+10 VDC) and 2 (AnIn 1) as in Fig. 38 The default setting for the AnIn1 is 4-20 mA. If the level sensor has a 0-10 V interface, change the position of switch (S1) on control board (chapter 4.3 page 35).
2. Connect an external Auto run switch between terminal 11 (+24 VDC) and 8 (DigIn1, Flow Auto) as in Fig. 38. Set the switch in the open position (digital input set to low state). (Do not activate the signal at this point.)
3. Connect an external Full speed switch between terminal 11 (+24 VDC) and 9 (DigIn2, Flow Run) as in Fig. 38. Set the switch in the open position (digital input set to low state). (Do not activate the signal at this point.)
4. Connect a communication cable between Master terminal 10 (DigIn3) and Follower terminal 21 (DigOut2) as in Fig. 38. (Only if Master/Follower).
5. Connect a communication cable between Master terminal 21 (DigOut2) and Follower terminal 10 (DigIn3) as in Fig. 38. (Only if Master/Follower).
6. Connect an overflow level switch (optional) between terminal 11 (+24 VDC) and 18 (DigIn6, Lvl Overflow) as in Fig. 38 Connect the signal to the Follower drive instead in a Master-Follower configuration for redundancy.

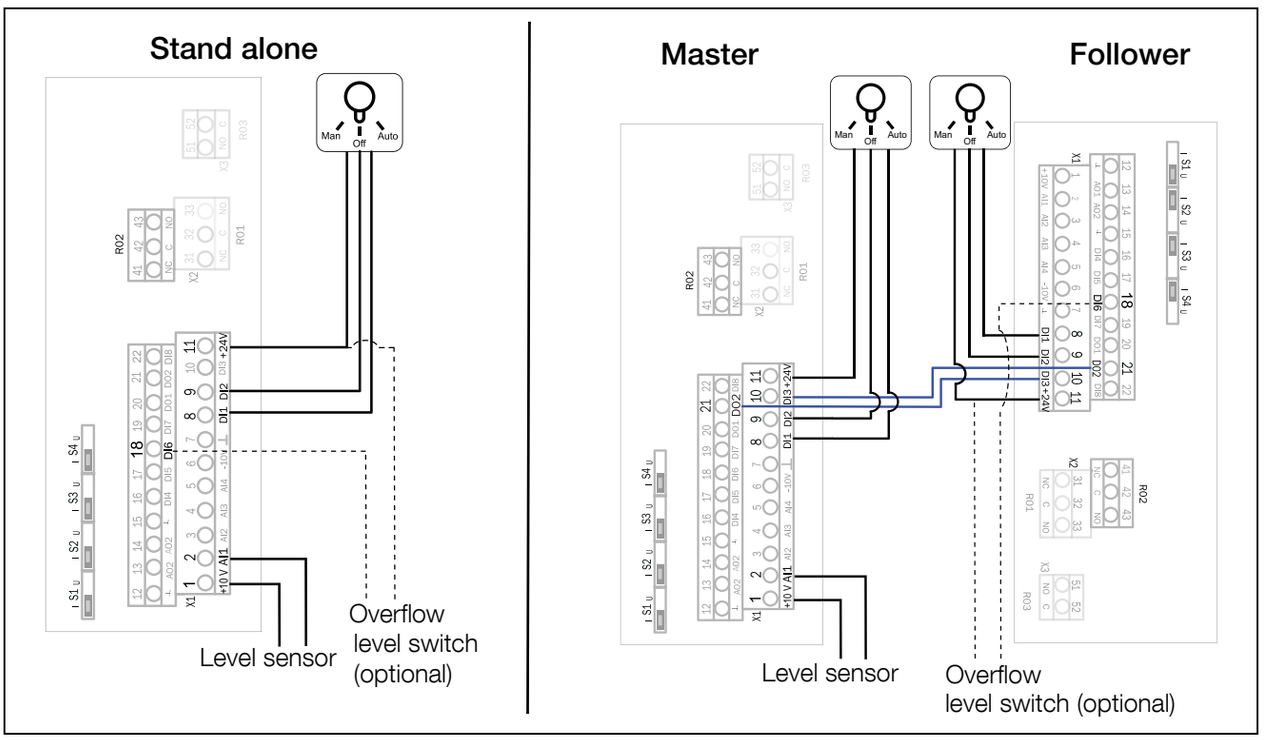

Fig. 38 General control I/O wiring.

Table 19 Terminals and description of functions.

Stand alone / Master			Follower		
Terminal	**Name**	**Function**	**Terminal**	**Name**	**Function**
Analogue inputs					
2	AnIn 1	Level sensor			
Outputs					
1	+10V	+10V DC supply voltage			
11	+24V	+24V DC supply voltage	11	+24V	+24V DC supply voltage
Digital inputs					
8	DigIn 1	Auto run	8	DigIn 1	Auto run
9	DigIn 2	Forced run	9	DigIn 2	Forced run
10	DigIn 3	FlowLinkIn (Follower feedback)	10	DigIn 3	FlowLinkIn (Follower control)
22	DigIn 6	Overflow level switch (optional)	22	DigIn 6	Overflow level switch (optional)
Digital outputs					
21	DigOut 2	FlowLinkOut (Follower control)	21	DigOut 2	FlowLinkOut (Follower feedback)

4.4.1 Connection example

Fig. 39 gives an overall view of a AC drive connection example.

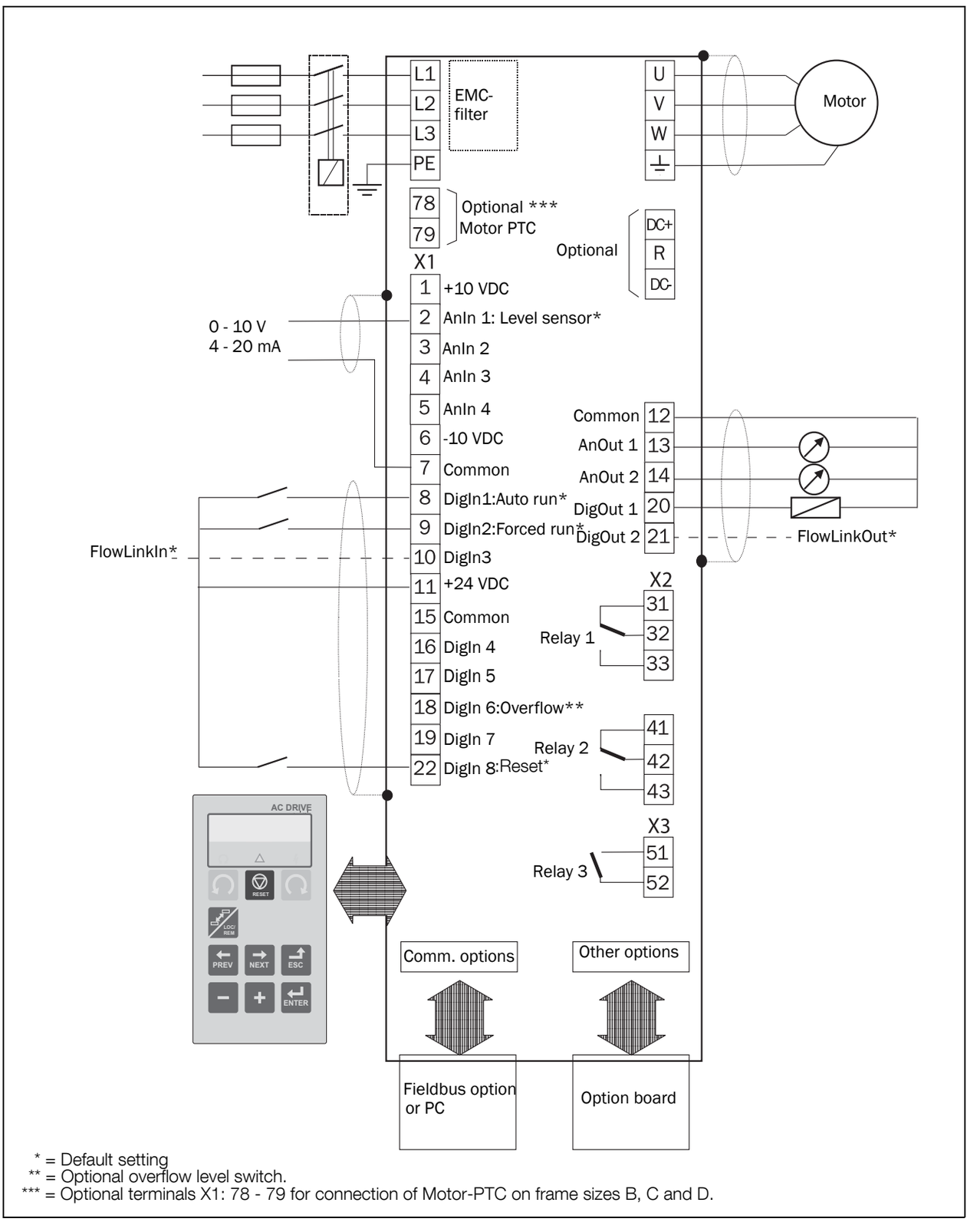

Fig. 39 Connection example

4.4.2 Connecting the Control Signal cables

The standard control signal connections are suitable for stranded flexible wire up to 1.5 mm^2 (AWG16) and for solid wire up to 2.5 mm^2(AWG14) .

NOTE: The screening of control signal cables must comply with the immunity levels given in the EMC Directive (reduction of noise level).

NOTE: The control cables must be separated from motor and mains cables.

Table 20 Description of optional terminals in fig. 40 to fig. 44.

Terminals 78, 79	For connection of Motor PTC
Terminals A-, B+	For connection of 24V Stand-by Supply (only valid for sizes D & D2)

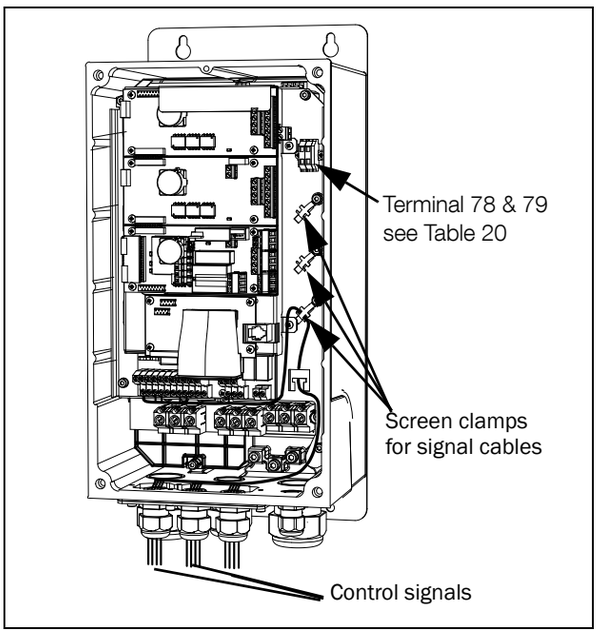

Fig. 40 Connecting the control signals, FLD model 003 to 018, frame size B.

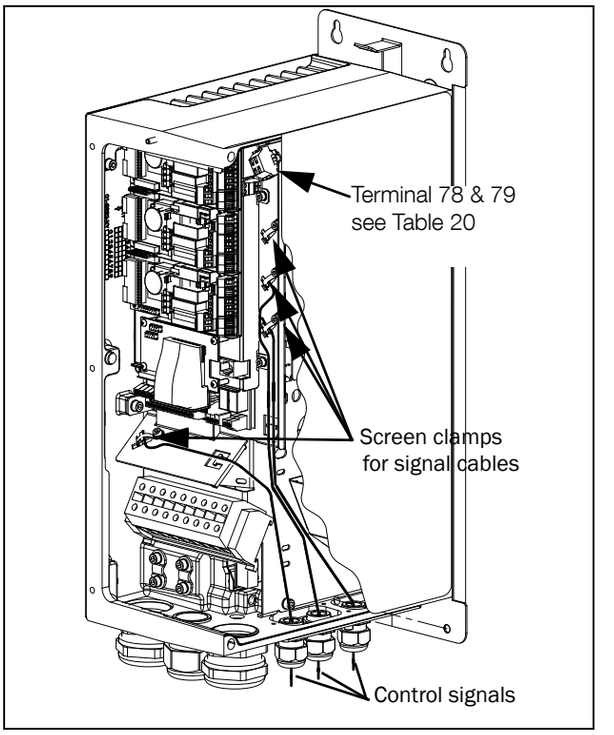

Fig. 41 Connecting the control signals, FLD model 026 to 046, frame size C.

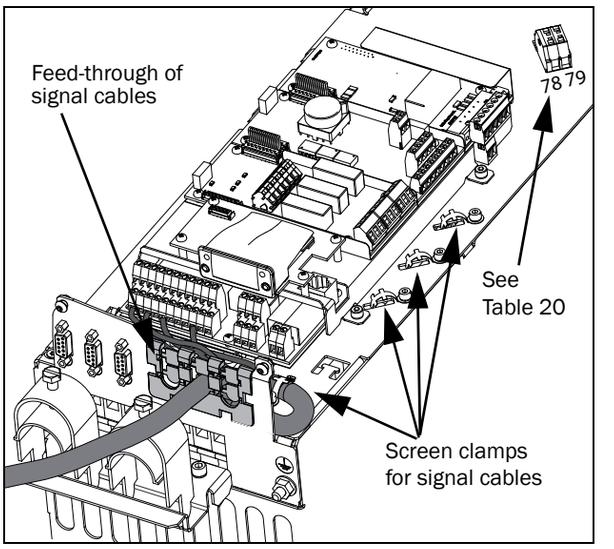

Fig. 42 Connecting the control signals, FLD model 48-025 to 48-058 frame size C2.

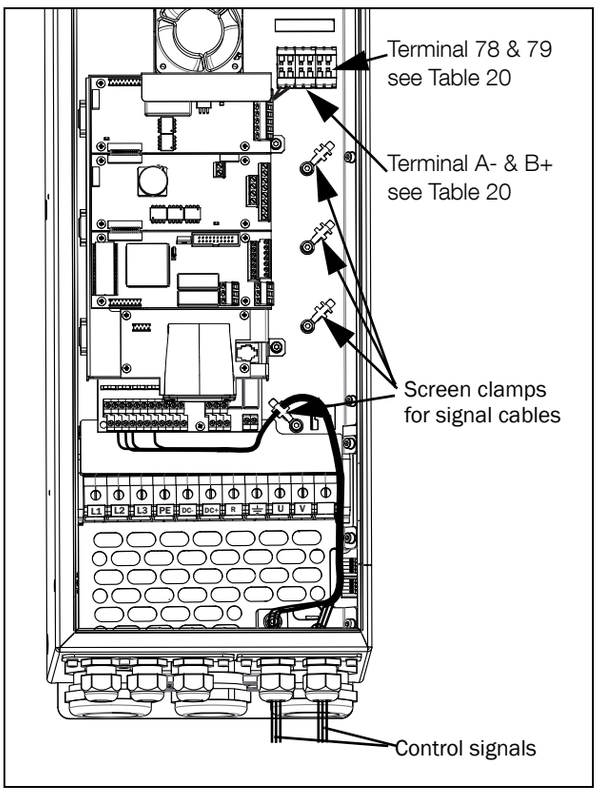

Fig. 43 Connecting the control signals, FLD model 061 to 074, frame size D.

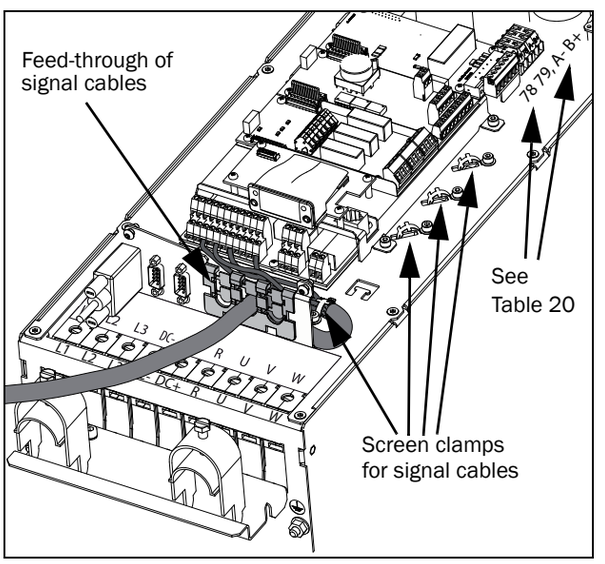

Fig. 44 Connecting the control signals, FLD model 48-072 to 48-105 frame size D2.

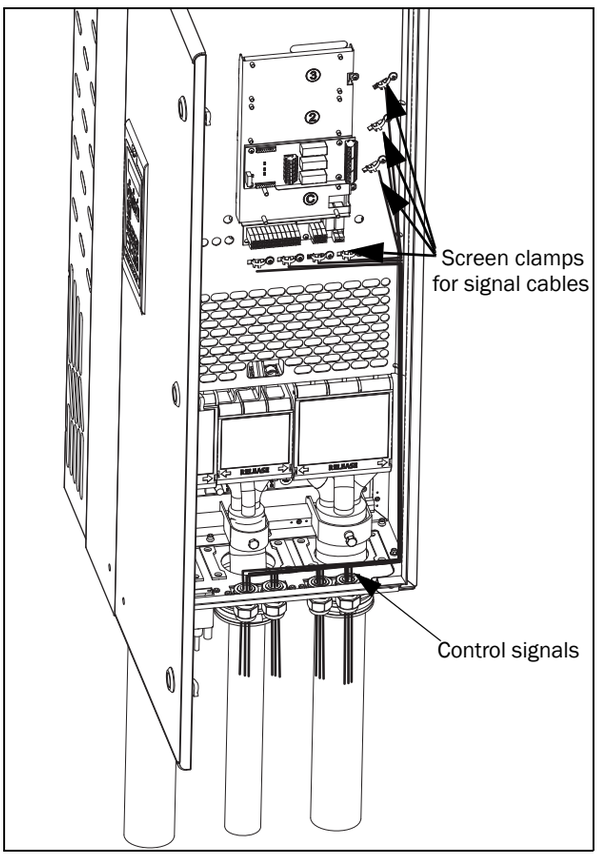

Fig. 45 Connecting the control signals, FLD model 48-090 to 250 and FLD model 69-90 to 200, frame size E, F and F69 (principle drawing).

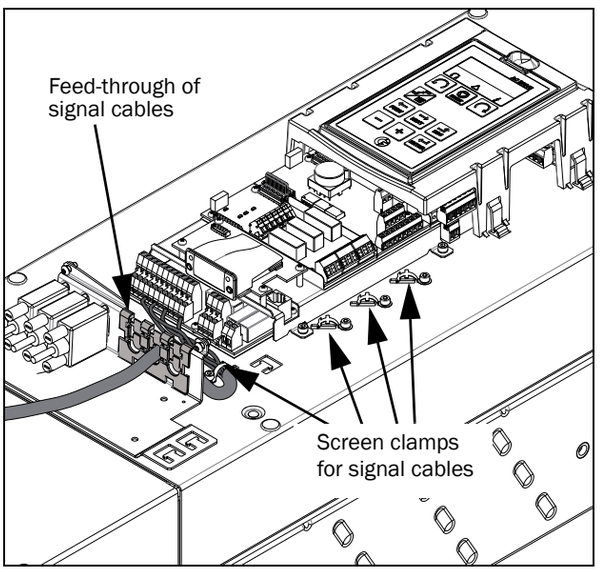

Fig. 46 Connecting the control signals, FLD model 48-142 to 48-293 frame size E2 and F2 (principle drawing)

NOTE: The screening of control signal cables is necessary to comply with the immunity levels given in the EMC Directive (it reduces the noise level).

NOTE: Control cables must be separated from motor and mains cables.

4.4.3 Types of control signals

Always make a distinction between the different types of signals. Because the different types of signals can adversely affect each other, use a separate cable for each type. This is often more practical because, for example, the cable from a pressure sensor may be connected directly to the AC drive.

We can distinguish between the following types of control signals:

Analogue inputs

Voltage or current signals, (0-10 V, 0/4-20 mA) normally used as control signals for speed, torque and PID feedback signals.

Analogue outputs

Voltage or current signals, (0-10 V, 0/4-20 mA) which change slowly or only occasionally in value. In general, these are control or measurement signals.

Digital

Voltage or current signals (0-10 V, 0-24 V, 0/4-20 mA) which can have only two values (high or low) and only occasionally change in value.

Data

Usually voltage signals (0-5 V, 0-10 V) which change rapidly and at a high frequency, generally data signals such as RS232, RS485, Profibus, etc.

Relay

Relay contacts (0-250 VAC) can switch highly inductive loads (auxiliary relay, lamp, valve, brake, etc.).

Signal type	Maximum wire size	Tightening torque	Cable type
Analogue	Rigid cable: 0.14-2.5 mm^2 (AWG 26 - 14) Flexible cable: 0.14-1.5 mm^2 (AWG 26 - 16) Cable with ferrule: 0.25-1.5 mm^2 (AWG 24 - 16)	0.5 Nm (4.4 LB-in)	Screened
Digital			Screened
Data			Screened
Relay			Not screened

Example:

The relay output from a AC drive which controls an auxiliary relay can, at the moment of switching, form a source of interference (emission) for a measurement signal from, for example, a pressure sensor. Therefore it is advised to separate wiring and screening to reduce disturbances.

4.4.4 Screening

For all signal cables the best results are obtained if the screening is connected to both ends: the AC drive side and at the source (e.g. PLC, or computer). See Fig. 47.

It is strongly recommended that the signal cables be allowed to cross mains and motor cables at a 90° angle. Do not let the signal cable go in parallel with the mains and motor cable.

4.4.5 Single-ended or double-ended connection?

In principle, the same measures applied to motor cables must be applied to all control signal cables, in accordance with the EMC-Directives.

For all signal cables as mentioned in section 4.4.3 the best results are obtained if the screening is connected to both ends. See Fig. 47.

NOTE: Each installation must be examined carefully before applying the proper EMC measurements.

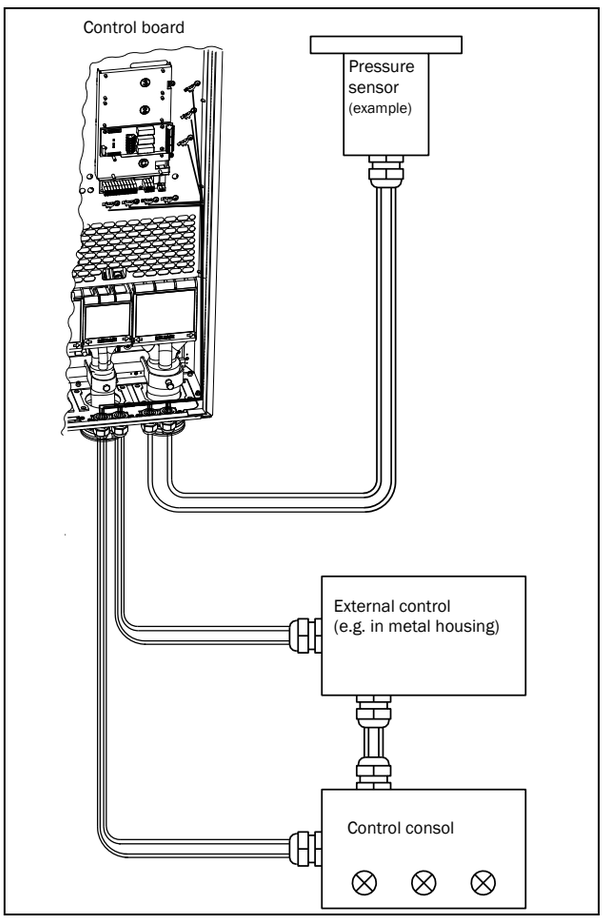

Fig. 47 Electro Magnetic (EM) screening of control signal cables.

4.4.6 Current signals ((0)4-20 mA)

A current signal like (0)4-20 mA is less sensitive to disturbances than a 0-10 V signal, because it is connected to an input which has a lower impedance (250 Ω) than a voltage signal (20 kΩ). It is therefore strongly advised to use current control signals if the cables are longer than a few metres.

4.4.7 Twisted cables

Analogue and digital signals are less sensitive to interference if the cables carrying them are “twisted”. This is certainly to be recommended if screening cannot be used. By twisting the wires the exposed areas are minimised. This means that in the current circuit for any possible High Frequency (HF) interference fields, no voltage can be induced. For a PLC it is therefore important that the return wire remains in proximity to the signal wire. It is important that the pair of wires is fully twisted over 360°.

4.5 Connecting options

The option cards are connected by the optional connectors X4 or X5 on the control board see Fig. 37, page 29 and mounted above the control board. The inputs and outputs of the option cards are connected in the same way as other control signals.

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E-mail: info@famcocorp.com
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Tel:۰۲۱-۴۸۰۰۰۰۴۹
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تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

5. Getting Started

This chapter is a step by step guide that will show you the quickest way to get the pumps running.

We assume that:

- the AC drive is mounted on a wall or in a cabinet as in the chapter 2. page 11.
- mains and motor cable are connected according to chapter 3.3 page 23.
- control cables are connected according to chapter 4.4 page 31.

FlowDrive can operate as a Standalone unit (1 drive) or in a Master-Follower configuration (2 drives).

Sections

Chapter 5.1 - Describes how to use the function keys on the control panel.

Chapter 5.2 - Covers generic configuration like language and motor parameters.

Chapter 5.3 - Describes configuration of level control parameters related to the pump sump.

Chapter 5.4 - Describes how to start up the system and make sure everything is correctly configured.

Chapter 5.5 - Run the Auto tune program.

Chapter 5.6 - Configuration of additional features.

5.1 Function keys

The function keys operate the menus and are also used for programming and read-outs of all the menu settings.

ENTER	step to lower menu level or confirm changed setting
ESC	step to higher menu level or ignore changed setting
NEXT	step to next menu on the same level
PREV	step to previous menu on the same level
+	increase value or change selection
−	decrease value or change selection
LOC/REM	- Toggle between menus in the toggle loop - Switching between local and remote control - Change the sign of a value

5.1.1 Using the function keys

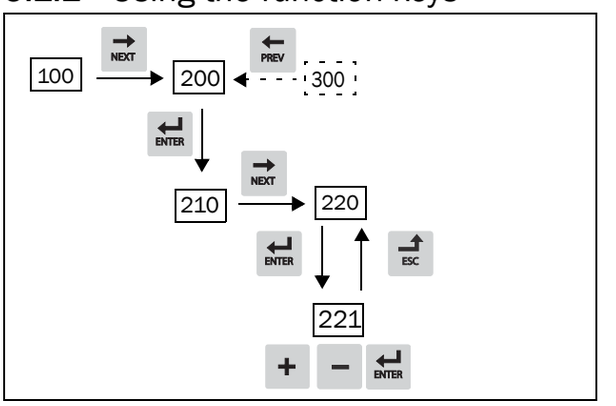

Fig. 48 Example of menu navigation when entering motor voltage

Example:

Setting Motor data.

Menu [100], “Preferred View” is displayed when started.

1. Press NEXT to display menu [200], “Main Setup”.
2. Press ENTER and then NEXT two times to display menu [220], “Motor Data”.
3. Press ENTER to display menu [221] and set motor voltage.
4. Change the value using the + and − keys. Confirm with ENTER.

5.1.2 Toggle loop

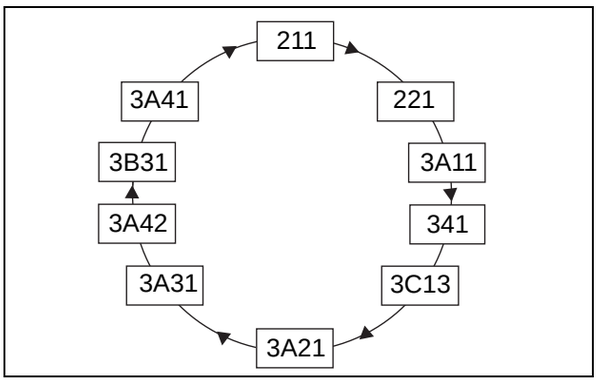

Fig. 49 Default toggle loop

To ease commissioning there is a pre-programmed default toggle loop that can be used to jump between the parameters described in this guide. Often other settings adjacent to these entry points should be configured.

- [211] Language - Select language
- [221] Motor Volts - Motor configuration
- [3A11] Drive Conf .- Generic drive configuration
- [341] Min speed - Speed configuration
- [3C13] Sensor min – Level sensor configuration
- [3A21] Overflow low– Configurations of levels (where to start, stop pumping)
- [3A31] Level 1 – Reservoir configuration
- [3A42]LoadMonTune – Option to tune load monitor during auto tune program
- [3B31]Act.PumpCln - Option to clean pumps during auto tune program
- [3A41] Start AutoT – Start the Auto tune program

5.2 Generic configuration (all drives)

This section is valid for all drive configurations, stand alone, master or follower.

5.2.1 Switch on the mains

Once the mains is switched on, the internal fan in the AC drive will run for 5 seconds (In frame size A3 the fan runs continuously). The control panel is lighted up and the drive can be configured.
To change settings use the keys on the control panel as outlined above or remote access program such as EmoSoftCom. For further information about the control panel, EmoSoftCom and menu structure, see the software instruction

5.2.2 Language

Menu [100], “Preferred View” is displayed when started. Navigate to menu [211] or press toggle button once and you will jump directly to menu [211].
“[211] Language” – Set preferred language.

5.2.3 Set the Motor Data

Navigate to menu [221] or press toggle button once and you will jump directly to menu [221].
Enter correct motor data for the connected motor. Change settings using the keys on the control panel. For further information about the control panel and menu structure, see the software instruction.

1. Set motor voltage [221].
2. Set motor frequency [222].
3. Set motor power [223].
4. Set motor current [224].
5. Set motor speed [225].
6. Set power factor (cos φ) [227].
7. Press toggle button to continue.

5.2.4 Set FlowDrive configuration

The FlowDrive can work in two drive modes;
FlowDrive mode and generic drive mode.
In FlowDrive mode the drive is configured for reservoir level control and in generic drive mode it behaves just like a normal Emotron FDU drive.

By default the drive is configured in FlowDrive mode and the remaining quick start guide describes configuring this mode. In case you are interested in running the FlowDrive as a normal drive change parameter "[21C] Drive appl." to "Generic" and consult the software instruction manual.

In FlowDrive mode the drive can operate as a Standalone unit (1 drive) or in a Master-Follower configuration (2 drives).
The following configurations should be done on all drives independent of drive mode (Standalone, Master, or Follower).

1. Press toggle button once more or navigate to menu "[3A11] FLD Config"
   Select whether the FlowDrive should be controlled as a
   - 'Standalone', Configuration for a single drive/pump in pump sump.
   - 'Master' Configuration for the main drive in a dual drive/pump setup
   - 'Follower' Configuration for the secondary drive in a dual drive/pump setup.
2. Press toggle button again or navigate to menu
   " [341] Min frequency"
   Minimum frequency is by default set to 70% of nominal motor frequency. I.e. 35Hz in case nominal motor frequency is 50Hz. In most cases this is low enough to be able to find the best efficiency point and high enough to ensure that the pump generates a sufficient flow. Adjust upwards if the default value is considered to be too low for keeping up with normal inflow.

For units configured as "Follower" in menu [3A11] this concludes the configuration. For other units continue with the next section.

5.3 Additional configuration for Standalone / Master drives

5.3.1 Level sensor configuration

The level sensor connected to the standalone or master unit needs to be configured based on its type and placement.
Navigate to menu [3C13] or press the toggle button.

1. "[3C13] Sensor min"
   This is configuration of which level, in meters, the min analogue signal from the sensor should represent. Generally this is 0 for a pressure sensor placed in the bottom of the sump. Press NEXT to continue.
2. "[3C14] Sensor max"
   This is configuration of which level, in meters, the max analogue signal from the sensor represents. This data is dependent on the sensor but often sensors with a range of 5 or 10 meters is used.

See also Fig. 50, page 42.

Regarding more advanced functions please refer to the Software instruction manual

5.3.2 Set sump levels

Set the desired levels for actions to be taken (starting and stopping of the pumps), see Fig. 50, page 42.
Navigate to menu [3A21] or press the toggle button again and set following.

1. "[3A21]Overflow " Level where the overflow alarm is triggered. Press NEXT to continue.
2. "[3A23] Start level" Level where the pump is started, Press NEXT to continue.
3. "[3A25] Stop level" Level where the pump is stopped Press NEXT to continue.

Note: Overflow level has to be higher than Start level which has to be higher than Stop level.

5.3.3 Set reservoir geometry

The reservoir geometry settings are crucial for the auto tune program and flow estimations. Please enter values as precisely as possible, failing to do so will result in inaccurate measurements.
Navigate to menu “[3A31] Level 1” or press toggle button.

Start from the bottom level (level 1) and set a corresponding area for each change of shape in the reservoir. It is possible to use 5 levels and areas. Use as many as required, unused levels/areas should be set to 0/Off.

Level 1 [3A31]	Area 1 [3A32]
Level 2 [3A33]	Area 2 [3A34]
Level 3 [3A35]	Area 3 [3A36]
Level 4 [3A37]	Area 4 [3A38]
Level 5 [3A39]	Area 5 [3A3A]

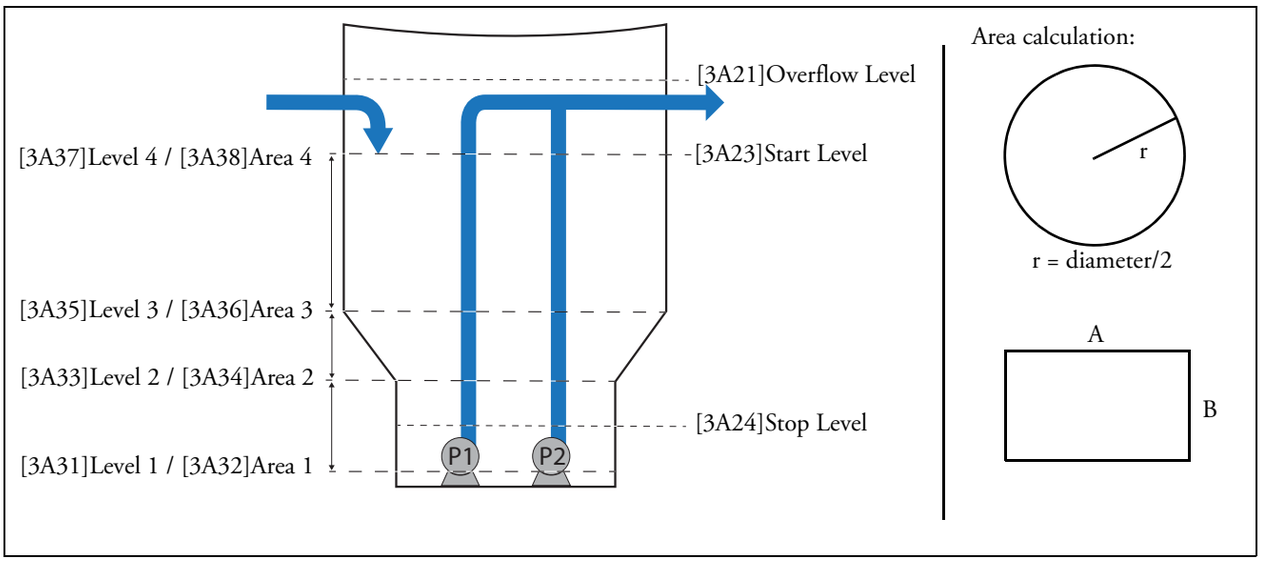

Fig. 50 Sump areas and levels, examples.

Example with round reservoir:

Level= X m,

Area = πr^2

Level 1 = 0 m
Area 1 = Radius is 0.6 m, area 1 is calculated:

$\pi\ 0.6^2 = 1.13 m^2$

Level 2 = 0.6 m,

Area 2 = Radius is 0.6 m, area 2 is calculated:
$\pi\ 0.6^2 = 1.13 m^2$

Level 3 = 0.5 m
Area 3 = Radius 0.9 m, area 3 is calculated:
$\pi\ 0.9^2 = 2.54\ m^2$

Level 4 = 1.5 m
Area 4 = Radius 0.9 m, area 4 is calculated:
$\pi\ 0.9^2 = 2.54\ m^2$

Example with rectangular reservoir:

Level= X m,

Area = A x B m^2

Level 1: 0 m
Area 1 : A= 1.2 m, B= 0.5m, area 1 is calculated:
1.2 x 0.5 = 0.6 m^2

Level 2 = 0.6 m,

Area 2 : A= 1.2 m, B= 0.5m, area 2 is calculated:
1.2 x 0.5 = 0.6 m^2

Level 3 = 0.5 m
Area 3 : A= 1.8 m, B= 0.5m, area 3 is calculated:
1.8 x 0.5 = 0.9 m^2

Level 4 = 1.5 m
Area 4 : A= 1.8 m, B= 0.5m, area 4 is calculated:
1.8 x 0.5 = 0.9 m^2

5.4 Test run

Now the configuration is finished; time to test that everything works as expected

Sump Level

By default the sump level should be shown as first row in [100] menu. Make sure current sump level displayed corresponds to actual level in the sump.

Run switches

Make sure the external Auto/Off/Manual switch is configured correctly

1. Go to menu “[746] Pump mode”. In this menu the mode for the pumps are shown.
2. Make sure “Off” is shown for both pumps. If not make sure the switch is working, in right position and correctly connected. Also inspect the configuration in menu “[52X] DigIn X” where X is the digitial input pin number.
3. Turn the full speed switch“On” for one of the pumps. The corresponding pump should start and “[746] Pump mode” should change to “Manual” for the corresponding pump (the other pump should stay in “Off” state). Test both pumps. Switch both back to “Off”.
4. Change both switches to Auto mode.
5. “[746] Pump mode” should change to “Auto”.

Verify “Auto mode” operation

In “Auto” pump mode the pump should start when “[3A23] Start level” is reached. Monitor how the level decreases and that the pump stops when “[3A25] Stop level” is reached.

5.5 Engage “auto tune” program to optimize energy consumption

When concluded that the FlowDrive appears to be running correctly as described above the “Auto tune” program can be started. It is designed to measure reference outflows and find the best efficiency point. In addition the auto tune program can configure the load monitor enabling detection of obstructed pumps.

Load monitor

Decide if load monitor should be configured during the auto tune program. The load monitor needs to be configured to detect over/under load of the pumps during normal operation; e.g. to detect that a rug has got stuck in the pump.

- Go to menu [3A42] or press the toggle button. “[3A42]LoadMonTune” – Set to “Yes” if you want the load monitor to be configured during auto tune program.

Clean pumps

It is not mandatory to run pump cleaning but it will help getting accurate measurements in the auto tune program. Decide if a pump cleaning should be done prior to the auto tune program.

NOTE: Pump cleaning will reverse the pumps. Check with the pump manufacturer that the connected pump can operate in the reverse direction.
Activating of pump cleaning is necessary for “Load monitor” to be able to clean the pump(s).

- Navigate to menu [3B31] or press the toggle button. “[3B31]Allowed” – Set to “Yes” to allow pump cleaning. If allowed the auto tune program will start with cleaning the pump(s).

Start Auto tune

The auto tune program will do a lot of measurements and will take several hours, up to days, to complete. After completion the drive will automatically jump into normal running mode.

- Navigate to menu [3A41] or press toggle button. “[3A41] Start AutoT” – Set to “Start” to initiate the Auto Tune program

The progress can be seen in menu “[7492] BEP progres” as a percentage. When finished the result can be seen in the following parameters:
“[349] BEP Speed” – The frequency where it is most efficient to pump at
“[94X] Flow log 1P” – Log of outflow and energy data for one pump at different frequencies
“[95X] Flow log 2P” – Log of flows and energy data for two pumps at different frequencies
“[41CX] Load Curve” – If load monitor was configured load data at different frequencies can be found here

5.6 Configuration of additional features

Here is a very short description of some of the additional features built into the FlowDrive. Please consult the software manual for more options and a more throughout description.

Flush start

Function to always ramp up to full speed to get sludge and sediment moving. Flushing time and frequency can be configured in [3B1X] menus. By default this feature is turned on.

Random start level

To avoid building up residues at start level on the sump wall, it is possible to randomize where the pumps are started. By default randomized start level is turned off.

Activate this function by setting start level in "[3B2]Start lvl Δ ", by default this is set to off.

"[3B2] Start lvl Δ "– Set the desired variation in meters.

Example

Start level is set to: 1.5 meters
Start lvl Δ is set to: 0.4m
Actual start level will then be randomized between 1.1m-1.5m.

Pump cleaning

Pump cleaning runs the pump in a specific pattern in both forward and reverse direction to clean the pump from rugs and dirt buildup. By default this feature is turned off.

NOTE: Pump cleaning will reverse the pumps. Check with the pump manufacturer that the connected pump can operate in the reverse direction.

"[3B31] Act.PumpCln" – Set to 'Yes' to allow pump cleaning
"[3B32] ForcePumpCl" – Set to 'Master', 'Follower', or 'Both' to request a "one-off" pump cleaning right away

Sump cleaning

Pump sump cleaning empties the pump sump by running the selected pump(s) below the normal stop level until free running. This will help to get rid of accumulated residues in the bottom of the pump sump.

NOTE 1: Running pumps below their normal stop level might cause the pump to overheat.
NOTE 2: Problems might emerge from sucking air into the pump/pipes in some installations.

"[3B41] Act.SumpCln" – Activates a "one-off" run of sump cleaning if set to 'Yes' in accordance with "Run mode"
"[3B42] ForceSumpCl" – Configures how to run sump cleaning.

Pipe cleaning

Pipe cleaning function produce as much flow as possible for as long time as possible to clean the pipes from loose residues.

"[3B51] ForcePipeC" – Activate a "one-off" run of pipe cleaning if set to 'Yes'.

6. EMC and standards

6.1 EMC standards

The AC drive complies with the following standards:

EN(IEC)61800-3:2004 Adjustable speed electronic power drive systems, part 3, EMC product standards:

Standard: category C3, for systems of rated supply voltage< 1000 VAC, intended for use in the second environment.

Optional: Category C2 and even Category C1 for frame size C drives, for systems of rated supply voltage <1.000 V, which is neither a plug in device nor a movable device and, when used in the first environment, is intended to be installed and commissioned only by experienced person with the necessary skills in installing and/or commissioning AC drives including their EMC aspects.

6.2 Stop categories and emergency stop

The following information is important if emergency stop circuits are used or needed in the installation where a AC drive is used. EN 60204-1 defines 3 stop categories:

Category 0: Uncontrolled STOP:

Stopping by switching off the supply voltage. A mechanical stop must be activated. This STOP may not be implemented with the help of a AC drive or its input/output signals.

Category 1: Controlled STOP:

Stopping until the motor has come to rest, after which the mains supply is switched off. This STOP may not be implemented with the help of a AC drive or its input/output signals.

Category 2: Controlled STOP:

Stopping while the supply voltage is still present. This STOP can be implemented with each of the AC drives STOP command.

WARNING!
EN 60204-1 specifies that every machine must be provided with a category 0 stop. If the application prevents this from being implemented, this must be explicitly stated. Furthermore, every machine must be provided with an Emergency Stop function. This emergency stop must ensure that the voltage at the machine contacts, which could be dangerous, is removed as quickly as possible, without resulting in any other danger. In such an Emergency Stop situation, a category 0 or 1 stop may be used. The choice will be decided on the basis of the possible risks to the machine.

NOTE: With option Safe Stop, a "Safe Torque Off (STO)" stop according EN-IEC 62061:2005 SIL 3 & EN-ISO 13849-1:2006, can be achieved.
See chapter, Safe Stop option

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7. Options

The standard options available are described here briefly. Some of the options have their own instruction or installation manual. For more information please contact your supplier. See also in “Technical catalogue AC drives” for more info.

7.1 Options for the control panel

Part number	Description
01-3957-00	Panel kit complete including panel
01-3957-01	Panel kit complete including blank panel

Mounting cassette, blank panel and straight RS232-cable are available as options for the control panel. These options may be useful, for example for mounting a control panel in a cabinet door.

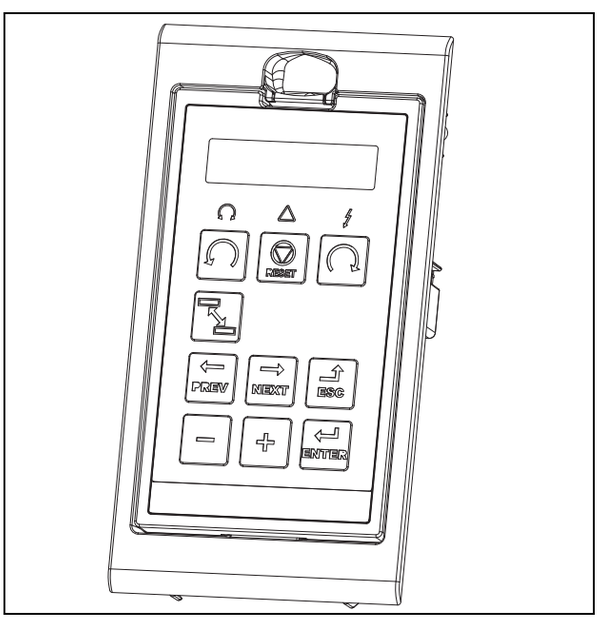

Fig. 51 Control panel in mounting cassette

7.2 Handheld Control Panel 2.0

Part number	Description
01-5039-00	Handheld Control Panel 2.0 complete for FDU/VFX2.0 or CDU/CDX 2.0

The Handheld Control Panel - HCP 2.0 is a complete control panel, easy to connect to the AC drive, for temporary use when e.g. commissioning, servicing and so on.

The HCP has full functionality including memory. It is possible to set parameters, view signals, actual values, fault logger information and so on. It is also possible to use the memory to copy all data (such as parameter set data and motor data) from one AC drive to the HCP and then load this data to other AC drives

7.3 Gland kits

Gland kits are available for frame sizes B, C and D.

Metal EMC glands are used for motor and brake resistor cables.

Part Number	Current (dimension)	Frame size
01-4601-21	3 - 6 A (M16 - M20)	B
01-4601-22	8 - 10 A (M16 - M25)	
01-4601-23	13 - 18 A (M16 - M32)	
01-4399-01	26 - 31 A (M12 - M32)	C
01-4399-00	37 - 46 A (M12 - M40)	
01-4833-00	61 - 74 A (M20 - M50)	D

7.4 EmoSoftCom

EmoSoftCom is an optional software that runs on a personal computer. It can also be used to load parameter settings from the AC drive to the PC for backup and printing. Recording can be made in oscilloscope mode. Please contact CG Drives & Automation sales for further information.

7.5 I/O Board

Part number	Description
01-3876-01	I/O option board 2.0

Each I/O option board 2.0 provides three extra relay outputs and three extra isolated digital inputs (24V). The I/O Board works in combination with the Pump/Fan Control, but can also be used as a separate option. Maximum 3 I/O boards possible. This option is described in a separate manual.

7.6 PTC/PT100

Part number	Description
01-3876-08	PTC/PT100 2.0 option board

The PTC/PT100 2.0 option board for connecting motor thermistors and max 3 PT100 elements to the AC drive is described in a separate manual.

7.7 RTC- Real time clock board

Part number	Description
01-3876-15	RTC option board

With this option board connected, it is possible to see and set actual time, date and weekday. This can be used to start or stop certain functions such as pump cleaning, pipe cleaning or sump cleaning at certain time, date or weekdays.

7.8 Serial communication and fieldbus

Part number	Description
01-3876-04	RS232/485
01-3876-05	Profibus DP
01-3876-06	DeviceNet
01-3876-09	Modbus/TCP, Industrial Ethernet
01-3876-14	Modbus/TCP, two port M12 Industrial Ethernet
01-3876-10	EtherCAT, Industrial Ethernet
01-3876-11	Profinet IO, one port Industrial Ethernet
01-3876-12	Profinet IO, two port Industrial Ethernet
01-3876-13	EtherNet/IP, two port industrial EtherNet

For communication with the AC drive there are several option boards for communication. There are different options for Fieldbus communication and one serial communication option with RS232 or RS485 interface which has galvanic isolation.

7.9 Standby supply board option

Part number	Description
01-3954-00	Standby power supply kit for after mounting. Not for frame sizes D & D2

The standby supply board option provides the possibility of keeping the communication system up and running without having the 3-phase mains connected. One advantage is that the system can be set up without mains power. The option will also give backup for communication failure if main power is lost.

The standby supply board option is supplied with external ±10% 24 V_{DC} protected by a 2 A slow acting fuse, from a double isolated transformer. The terminals X1:1, X1:2 (on size B, C and E to F) are voltage polarity independent. The terminals A- and B+ (on size D) are voltage polarity dependent.

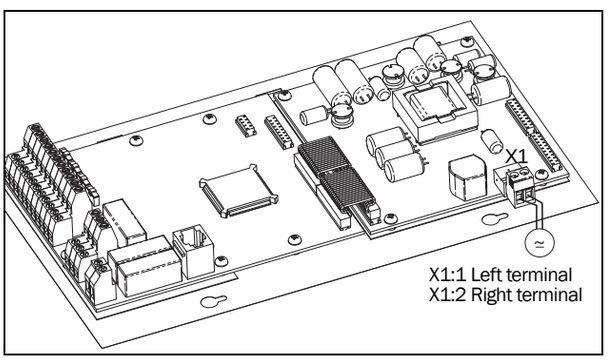

Fig. 52 Connection of standby supply option n frame sizes B, C, C2, E, E2, F and F2.

X1 terminal	Name	Function	Specification
1	Ext. supply 1	External, AC drive main power independent, supply voltage for control and communication circuits	24 V_{DC} or V_{AC} ±10% Double isolated
2	Ext. supply 2		

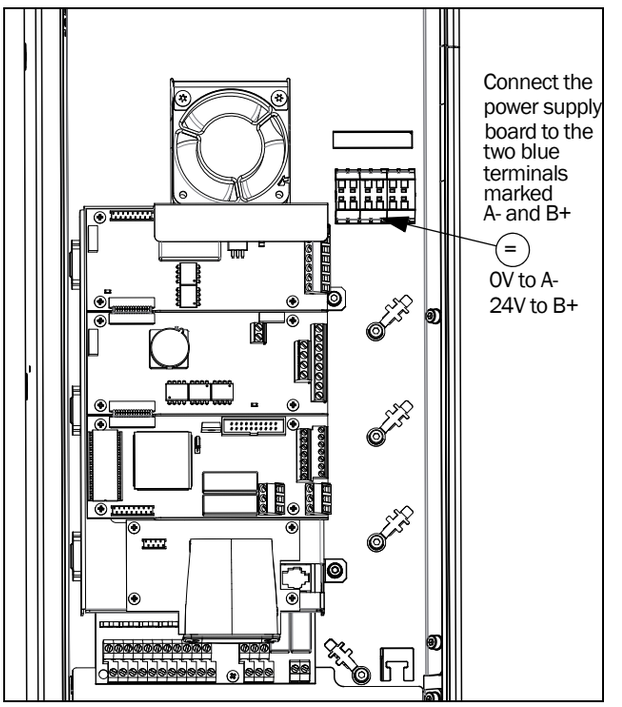

Fig. 53 *Connection of standby supply option on frame size D and D2*

Terminal	Name	Function	Specification
A -	0V	External, AC drive main power independent, supply voltage for control and communication circuits	24 V_{DC} ±10% Double isolated
B +	+24V		

7.10 Safe Stop option

To realize a Safe Stop configuration in accordance with Safe Torque Off (STO) EN-IEC 62061:2005 SIL 3 & EN-ISO 13849-1:2006, the following three parts need to be attended to:

1. Inhibit trigger signals with safety relay K1 (via Safe Stop option board).
2. Enable input and control of AC drive (via normal I/O control signals of AC drive).
3. Power conductor stage (checking status and feedback of driver circuits and IGBT's).

To enable the AC drive to operate and run the motor, the following signals should be active:

- "Inhibit" input, terminals 1 (DC+) and 2 (DC-) on the Safe Stop option board should be made active by connecting 24 V_{DC} to secure the supply voltage for the driver circuits of the power conductors via safety relay K1. See also Fig. 107.
- High signal on the digital input, e.g. terminal 10 in Fig. 107, which is set to "Enable". For setting the digital input please refer to section 10.5.2, page 132.

These two signals need to be combined and used to enable the output of the AC drive and make it possible to activate a Safe Stop condition.

NOTE: The "Safe Stop" condition according to EN-IEC 62061:2005 SIL 3 & EN-ISO 13849-1:2006, can only be realized by de-activating both the "Inhibit" and "Enable" inputs.

When the "Safe Stop" condition is achieved by using these two different methods, which are independently controlled, this safety circuit ensures that the motor will not start running because:

- The 24VDC signal is disconnected from the "Inhibit" input, terminals 1 and 2, the safety relay K1 is switched off.

  The supply voltage to the driver circuits of the power conductors is switched off. This will inhibit the trigger pulses to the power conductors.
- The trigger pulses from the control board are shut down.

  The Enable signal is monitored by the controller circuit which will forward the information to the PWM part on the Control board.

To make sure that the safety relay K1 has been switched off, this should be guarded externally to ensure that this relay did not refuse to act. The Safe Stop option board offers a feedback signal for this via a second forced switched safety relay K2 which is switched on when a detection circuit has confirmed that the supply voltage to the driver circuits is shut down. See Table 34 for the contacts connections.

To monitor the "Enable" function, the selection "RUN" on a digital output can be used. For setting a digital output, e.g. terminal 20 in the example Fig. 107, please refer to section 10.5.4, page 138 [540].

When the "Inhibit" input is de-activated, the AC drive display will show a flashing "SST" indication in section D (bottom left corner) and the red Trip LED on the Control panel will be flashing.

To resume normal operation, the following steps have to be taken:

- Release "Inhibit" input; $24V_{DC}$ (High) to terminal 1 and 2.
- Give a STOP signal to the AC drive, according to the set Run/Stop Control in menu [215].
- Give a new Run command, according to the set Run/Stop Control in menu [215].

NOTE: The method of generating a STOP command is dependent on the selections made in Start Signal Level/ Edge [21A] and the use of a separate Stop input via digital input.

WARNING!
The safe stop function can never be used for electrical maintenance. For electrical maintenance the AC drive should always be disconnected from the supply voltage.

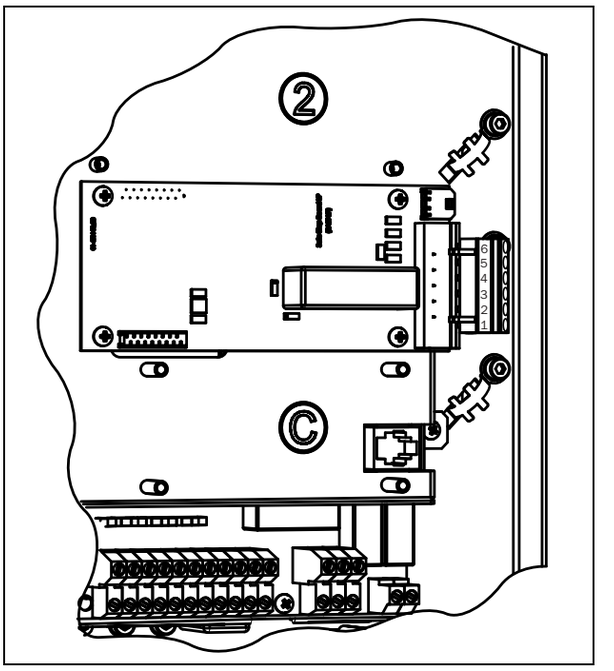

Fig. 54 Connection of safe stop option in size B .

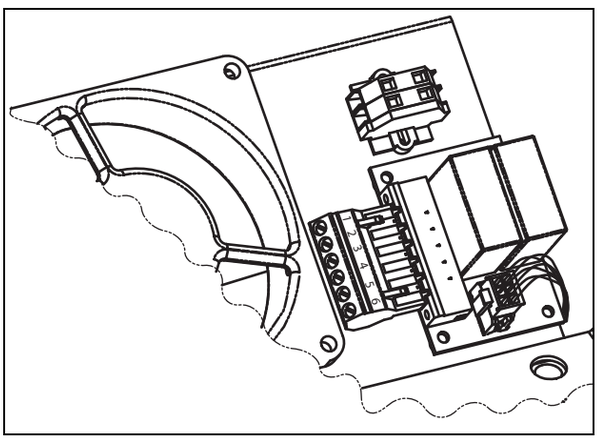

Fig. 55 Connection of safe stop option in size E and up.

Table 21 Specification of Safe Stop option board

X1 pin	Name	Function	Specification
1	Inhibit +	Inhibit driver circuits of power conductors	DC 24 V (20–30 V)
2	Inhibit -		
3	NO contact relay K2	Feedback; confirmation of activated inhibit	48 V_{DC}/ 30 V_{AC}/2 A
4	P contact relay K2		
5	GND	Supply ground	
6	+24 VDC	Supply Voltage for operating Inhibit input only.	+24 V_{DC}, 50 mA

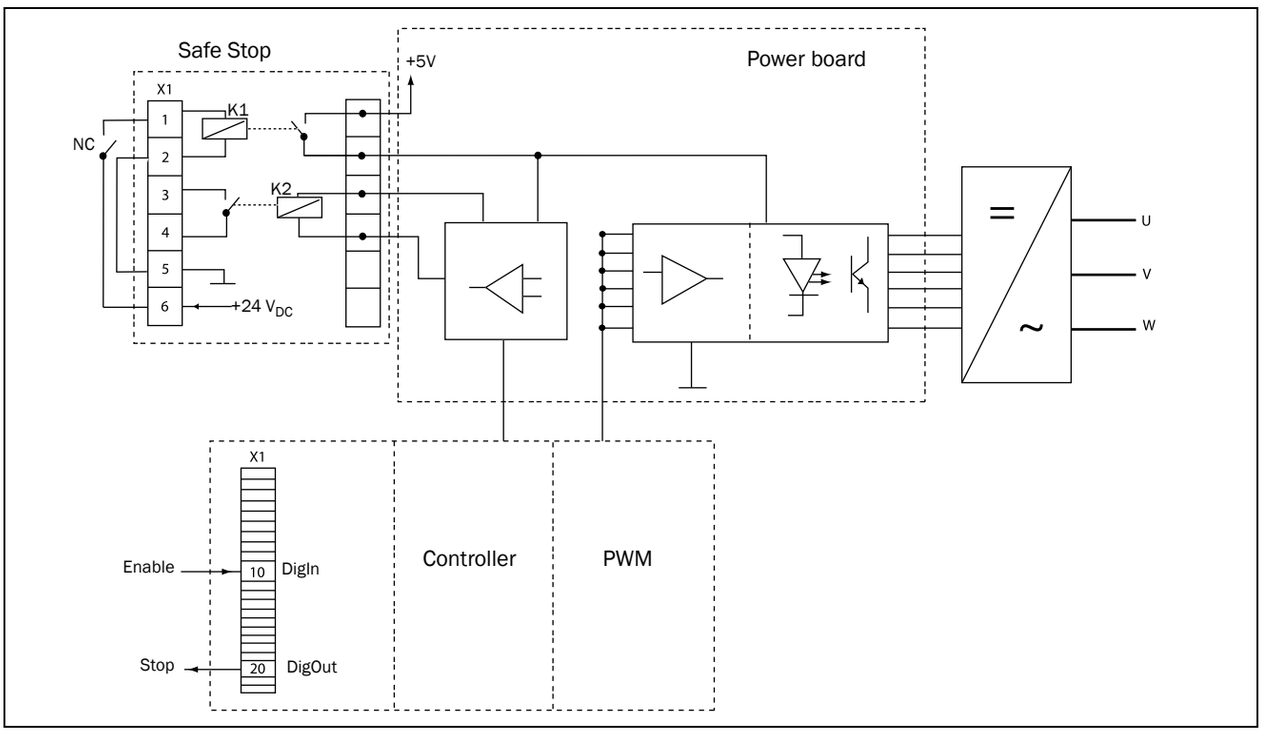

Fig. 56 Safe Stop connection

7.11 EMC filter class C1/C2

EMC filter according to EN61800-3:2004 class C1 (for frame size C types) and C2 - 1st environment restricted distribution.
For sizes BC, C2, D and D2, the filter is mounted inside the drive module.
For sizes E , external EMC filters are available.
For more information refer to “Technical catalogue for AC drives”.
Note: EMC filter according to class C3 - 2nd environment included as standard in all drive units.

7.12 Output chokes

Output chokes, which are supplied separately, are recommended for lengths of screened motor cable longer than 100 m. Because of the fast switching of the motor voltage and the capacitance of the motor cable (both line to line and line to earth screen), large switching currents can be generated with long lengths of motor cable. Output chokes prevent the AC drive from tripping and should be installed as closely as possible to the AC drive.
See also in “Technical catalogue AC drives” for filter selection guide.

7.13 Liquid cooling

AC drive modules in frame sizes E - O and F69 - T69 are available in a liquid cooled version. These units are designed for connection to a liquid cooling system, normally a heat exchanger of liquid-liquid or liquid-air type. Heat exchanger is not part of the liquid cooling option.
Drive units with parallel power modules (frame size G - T69) are delivered with a dividing unit for connection of the cooling liquid. The drive units are equipped with rubber hoses with leak-proof quick couplings.
The Liquid cooling option is described in a separate manual.

7.14 Top cover for IP20/21 version

Part number	Description
01-5356-00	Top cover for frame size C2
01-5355-00	Top cover for frame sizes D2, E2 and F2

This Top cover can be mounted on IP20 versions of frame sizes C2, D2, E2 and F2.
By mounting the top cover, the protection class will change to IP21 in accordance with EN 60529 standard.

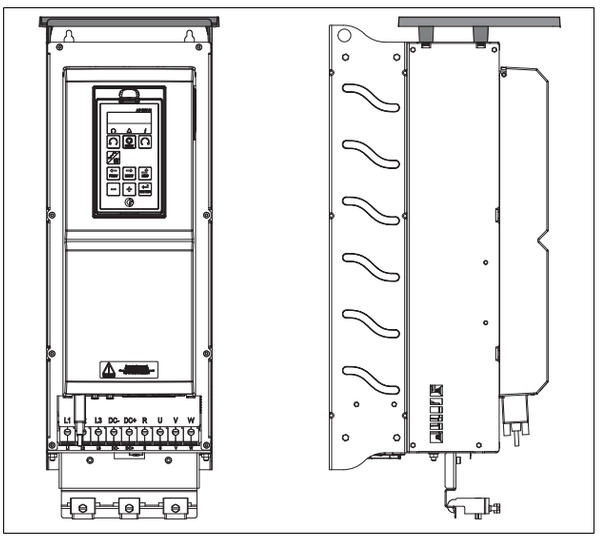

Fig. 57 Optional top cover mounted on frame size D2

7.15 Other options

Following options are also available, for more information regarding these options, see in “Technical catalogue AC drives”.

Overshoot clamp

Sine wave filter

Common mode filter

Brake resistors

8. Technical Data

8.1 Electrical specifications related to model

Emotron FLD - IP20/21 version

Table 22 Typical motor power at mains voltage 230, 400 and 460V. AC drive main voltage range 230 - 480 V.

Model	Max. output current [A]*	Normal duty (120%, 1 min every 10 min)					Frame size
		Rated current [A]	Power @230V [kW]	Power @230V [HP]	Power @400V [kW]	Power @460V [HP]	
FLD48-025-20	30	**25**	5.5	7.5	11	15	C2
FLD48-030-20	36	**30**	7.5	10	15	20	
FLD48-036-20	43	**36**	7.5	10	18.5	25	
FLD48-045-20	54	**45**	11	15	22	30	
FLD48-058-20	68	**58**	15	20	30	40	
FLD48-072-20	86	**72**	18.5	25	37	50	D2
FLD48-088-20	106	**88**	22	30	45	60	
FLD48-105-20	126	**105**	30	40	55	75	
FLD48-142-20	170	**142**	37	50	75	100	E2
FLD48-171-20	205	**171**	45	60	90	125	
FLD48-205-20	246	**205**	55	75	110	150	F2
FLD48-244-20	293	**244**	75	100	132	200	
FLD48-293-20	352	**293**	90	125	160	250	

* Available during limited time and as long as allowed by drive temperature.

Emotron FLD - IP54 version

Table 23 Typical motor power at mains voltage 230, 400 and 460 V. AC drive main voltage range 230 - 480 V.

Model	Max. output current [A]*	Normal duty (120%, 1 min every 10 min)					Frame size	IP klass
		Rated current [A]	Power @230V [kW]	Power @230V [HP]	Power @400V [kW]	Power @460V [HP]		
FLD48-003-54	3.0	**2.5**	0.37	0.5	0.75	1	B	IP 54 wall mounted
FLD48-004-54	4.8	**4.0**	0.75	1	1.5	2		
FLD48-006-54	7.2	**6.0**	1.1	1.5	2.2	3		
FLD48-008-54	9.0	**7.5**	1.5	2	3	3		
FLD48-010-54	11.4	**9.5**	2.2	3	4	5		
FLD48-013-54	15.6	**13.0**	2.2	3	5.5	7.5		
FLD48-018-54	21.6	**18.0**	4	5	7.5	10		
FLD48-026-54	31	**26**	5.5	7.5	11	15	C	
FLD48-031-54	37	**31**	7.5	10	15	20		
FLD48-037-54	44	**37**	7.5	10	18.5	25		
FLD48-046-54	55	**46**	11	15	22	30		
FLD48-061-54	73	**61**	15	20	30	40	D	
FLD48-074-54	89	**74**	18.5	25	37	50		
FLD48-090-54	108	**90**	22	30	45	60	E	
FLD48-109-54	131	**109**	30	40	55	75		
FLD48-146-54	175	**146**	37	50	75	100		
FLD48-175-54	210	**175**	45	60	90	125		
FLD48-210-54	252	**210**	55	75	110	150	F	
FLD48-228-54	300	**228**	55	75	110	200		
FLD48-250-54	300	**250**	75	100	132	200		

* Available during limited time and as long as allowed by drive temperature.

Emotron FLD 2.0 - IP54 version (Model 69-250 and up also available as IP20)

Table 24 Typical motor power at mains voltage 525, 575 and 690 V.
AC drive main voltage range, for 52: 440 - 525 V and for 69: 500 - 690 V.

Model	Max. output current [A]*	Normal duty (120%, 1 min every 10 min)				Frame size	IP class
		Rated current [A]	Power @525V [kW]	Power @575V [HP]	Power @690V [kW]		
FLD52-003-54	3.0	**2.5**	1.1	-	-	B	IP 54 wall mounted
FLD52-004-54	4.8	**4.0**	2.2	-	-		
FLD52-006-54	7.2	**6.0**	3	-	-		
FLD52-008-54	9.0	**7.5**	4	-	-		
FLD52-010-54	11.4	**9.5**	5.5	-	-		
FLD52-013-54	15.6	**13.0**	7.5	-	-		
FLD52-018-54	21.6	**18.0**	11	-	-		
FLD52-026-54	31	**26**	15	-	-	C	
FLD52-031-54	37	**31**	18.5	-	-		
FLD52-037-54	44	**37**	22	-	-		
FLD52-046-54	55	**46**	30	-	-		
FLD52-061-54	73	**61**	37	-	-	D	
FLD52-074-54	89	**74**	45	-	-		
FLD69-090-54	108	**90**	55	75	90	F69	
FLD69-109-54	131	**109**	75	100	110		
FLD69-146-54	175	**146**	90	125	132		
FLD69-175-54	210	**175**	110	150	160		
FLD69-200-54	240	**200**	132	200	200		

* Available during limited time and as long as allowed by drive temperature.

8.2 General electrical specifications

Table 25 General electrical specifications

General	
Mains voltage: 48 52 69 Mains frequency: Mains voltage imbalance: Input power factor: Output voltage: Output frequency: Output switching frequency: Efficiency at nominal load:	230-480V +10%/-15% (-10% at 230 V) 440-525 V +10 %/-15 % 500-690V +10%/-15% 45 to 65 Hz max. ±3.0% of nominal phase to phase input voltage. 0.95 0–Mains supply voltage: 0–400 Hz 3 kHz (adjustable 1,5-6 kHz) 97% for models 003 to 018 98% for models 025 to 3K0
Control signal inputs: Analogue (differential)	
Analogue Voltage/current: Max. input voltage: Input impedance: Resolution: Hardware accuracy: Non-linearity	0-±10 V/0-20 mA via switch +30 V/30 mA 20 kohm (voltage) 250 kohm (current) 11 bits + sign 1% type + 1 ½ LSB fsd 1½ LSB
Digital:	
Input voltage: Max. input voltage: Input impedance: Signal delay:	High: >9 VDC, Low: <4 VDC +30 VDC <3.3 VDC: 4.7 kohm ≥3.3 VDC: 3.6 kohm ≤8 ms
Control signal outputs Analogue	
Output voltage/current: Max. output voltage: Short-circuit current (∞): Output impedance: Resolution: Maximum load impedance for current Hardware accuracy: Offset: Non-linearity:	0-10 V/0-20 mA via software setting +15 V @5 mA cont. +15 mA (voltage), +140 mA (current) 10 ohm (voltage) 10 bit 500 ohm 1.9% type fsd (voltage), 2.4% type fsd (current) 3 LSB 2 LSB
Digital	
Output voltage: Shortcircuit current(∞):	High: >20 VDC @50 mA, >23 VDC open Low: <1 VDC @50 mA 100 mA max (together with +24 VDC)
Relays	
Contacts	0.1 – 2 A/Umax 250 VAC or 42 VDC (30 VDC acc. to UL requirement) for general Purpose or Resistive use only .
References	
+10VDC -10VDC +24VDC	+10 V_{DC} @10 mA Short-circuit current +30 mA max - 10 V_{DC} @10 mA +24 V_{DC} Short-circuit current +100 mA max (together with Digital Outputs)

8.3 Operation at higher temperatures

Most Emotron AC drives are made for operation at maximum of 40°C (104 °F) ambient temperature. However, it is possible to use the AC drive at higher temperatures with reduced output rating.

Possible derating

Derating of output current is possible with
-1% / degree Celsius to max +15 °C (= max temp 55 °C) or
-0.55%/ degree Fahrenheit to max +27 °F
(= max temp. 131 °F).

Example

In this example we have a motor with the following data that we want to run at the ambient temperature of
45 °C (113 °F):

Voltage 400 V
Current 72 A
Power 37 kW (50 hp)

Select AC drive

The ambient temperature is 5 °C (9 °F) higher than the maximum ambient temperature. The following calculation is made to select the correct AC drive model.

Derating is possible with loss in performance of
1%/°C (0.55%/ degree F).

Derating will be: 5 x 1% = 5%

Calculation for model 48-074
74 A - (5% x 74) = 70.3 A; this is not enough.

Calculation for model 48-090
90 A - (5% x 90) = 85.5 A

In this example we select the 48-090.

8.4 Operation at higher switching frequency

Table 26 shows the switching frequency for the different AC drive models. With the possibility of running at higher switching frequency you can reduce the noise level from the motor. The switching frequency is set in menu [22A], Motor sound, see software instruction. At switching frequencies >3 kHz derating might be needed.

Table 26 Switching frequency

Models	Standard Switching frequency	Range
FLD##-003 to FLD##-250	3 kHz	1.5–6 kHz

8.5 Dimensions and Weights

The table below gives an overview of the dimensions and weights. The models 003 to 250 are available in IP54 as wall mounted modules.
Protection class IP54 is according to the EN 60529 standard.

Table 27 Mechanical specifications, 48, 52

Models	Frame size	IP54 Dim. H x W x D mm (in)	IP54 Weight kg (lb)
003 to 018	B	350/416 x 203 x 200 (13.8/16.4 x 8 x 7.9)	12.5 (27.6)
026 to 046	C	440/512 x178x292 (17.3/20.2 x 7 x 11.5)	24 (52.9)
061 to 074	D	545/590 x 220 x 295 (21.5/23.2 x 8.7 x 11.5)	32 (70.6)
90 to 109	E	950 x 285 x 314 (37.4 x 11.2 x 12.4)	56 (123.5)
146 to 175	E	950 x 285 x 314 (37.4 x 11.2 x 12.4)	60 (132.3)
210 to 250	F	950 x 345 x 314 (37.4 x 13.6 x 12.4)	74 (163.1)

Table 28 Mechanical specifications, 69

Models	Frame size	IP54 Dim. H x W x D mm (in)	Weight IP54 kg (lb)
90 to 200	F69	1090 x 345 x 314 (42.9 x 13.6 x 12.4)	77 (169.8)

Dimensions and weights for models Emotron 48 - IP20/21 version

The table below gives an overview of the dimensions and weights of the Emotron IP20/21 version.

These AC drives are available as wall mounted modules; The IP20 version is optimised for cabinet mounting. With the optional top cover, protection class is in compliance with IP21, making it suitable for mounting directly on the electrical room wall.

The protection classes IP20 and IP21 are defined according to the EN 60529 standard.

Table 29 Mechanical specifications, 48 - IP20 and IP21 version

Models	Frame size	IP20 Dim. H1/H2 x W x D mm (in)	IP21* Dim. H1/H2 x W x D mm (in)	IP20/21 Weight kg (lb)
025 to 058	C2	438 / 536 x 176 x 267 (17.2/21.1 x 6.9 x 10.5)	438 / 559 x 196 x 282 (17.2/22 x 7.7 x 11.1)	17 (37.5)
072 to 105	D2	545 / 658 x 220 x 291 (21.5/25.9 x 8.7 x 11.5)	545 / 670 x 240 x 307 (21.5/26.4 x 9.5 x 12.1)	30 (66)
142 to 171	E2	956 / 956 x 275 x 294 (37.6/37.6 x 10.8 x 11.6)	956 / 956 x 275 x 323 (37.6/37.6 x 10.8 x 12.7)	53 (117)
205 to 293	F2	956 / 956 x 335 x 294 (37.6/37.6 x 13.2 x 11.6)	956 / 956 x 335 x 323 (37.6/37.6 x 13.2 x 12.7)	68 (150)

H1 = Enclosure height.
H2 = Total height including cable interface.
* with optional top cover

8.6 Environmental conditions

Table 30 Operation

Parameter	Normal operation
Nominal ambient temperature	0 °C–40 °C (32 °F - 104 °F) See table, see chapter 8.3 page 56 for different conditions
Atmospheric pressure	86–106 kPa (12.5 - 15.4 PSI)
Relative humidity according to IEC 60721-3-3	Class 3K4, 5...95% and non condensing
Contamination, according to IEC 60721-3-3	No electrically conductive dust allowed. Cooling air must be clean and free from corrosive materials. Chemical gases, class 3C2. Solid particles, class 3S2.
Vibrations	According to IEC 600068-2-6, Sinusodial vibrations: 10<f<57 Hz, 0.075 mm (0.00295 ft) 57<f<150 Hz, 1g (0,035 oz)
Altitude	0–1000 m (0 - 3280 ft) 480V AC drives, with derating 1%/100 m (328 ft) of rated current up to 4000 m (13123 ft) 690V AC drives, with derating 1%/100 m (328 ft) of rated current up to 2000 m (6562) ft Coated boards required for 2000 - 4000 m(6562 - 13123 ft)

Table 31 Storage

Parameter	Storage condition
Temperature	-20 to +60 °C (-4 to + 140 °F)
Atmospheric pressure	86–106 kPa (12.5 - 15.4 PSI)
Relative humidity according to IEC 60721-3-1	Class 1K4, max. 95% and non condensing and no formation of ice.

8.7 Fuses and glands

8.7.1 According to IEC ratings

Use mains fuses of the type gL/gG conforming to IEC 269 or breakers with similar characteristics. Check the equipment first before installing the glands.

Max. Fuse = maximum fuse value that still protects the AC drive and upholds warranty.

NOTE: The dimensions of fuse and cable cross-section are dependent on the application and must be determined in accordance with local regulations.

NOTE: The dimensions of the power terminals used in the cabinet drive models 300 to 3K0 can differ depending on customer specification.

Table 32 Fuses, cable cross-sections and glands

Model	Nominal input current [A]	Maximum value fuse [A]	Cable glands (clamping range) *	
			mains / motor	Brake
##-003	2.2	4	M32 opening M20 + reducer (6–12 mm(0.24 - 0.47 in))	M25 opening M20 + reducer (6–12 mm(0.24 - 0.47 in))
##-004	3.5	4		
##-006	5.2	6		
##-008	6.9	10	M32 (12–20)/M32 opening M25+reducer (10-14 mm(0.39 - 0.55 in))	M25 (10-14 mm(0.39 - 0.55 in))
##-010	8.7	10		
##-013	11.3	16	M32 (16–25)/M32 (13–18)	
##-018	15.6	20		
##-025	22	25	- (12 - 16 mm(0.55 - 0.63 in))	
##-026	22	25	M32 (15–21 mm(0.59 - 0.83 in))	M25
##-030	26	35	- (16 - 20 mm (0.63 - 0.79 in))	
##-031	26	35	M32 (15–21 mm(0.59 - 0.83 in))	M25
##-036	31	35	- (20 - 24 mm(0.79 - 0.94))	
##-037	31	35	M40 (19–28 mm (0.75 - 1.1 in))	M32
##-045	38	50	- (24 - 28 mm(0.94 - 1.1 in))	
##-046	38	50	M40 (19–28 mm (0.75 - 1.1 in))	M32
##-058	50	63	- (24 - 28 mm(0.94 - 1.1 in))	
##-061	52	63	M50 (27 - 35 mm(1.06 - 1.38 in))	M40 (19–28 mm (0.75 - 1.1 in))
##-072	64	80	- (28 - 32 mm(1.1 - 1.26 in))	
##-074	65	80	M50 (27 - 35 mm(1.06 - 1.38 in))	M40 (19–28 mm(0.75 - 1.1 in))
##-088	78	100	- (32 - 36 mm(1.26 - 1.42 in))	
##-090	78	100	48: (Ø17-42 mm (0.67 - 1.65 in)) cable flexible leadthrough or M50 opening. 69: (Ø23-55 mm (0.9 - 2.16 in)) Cable flexible leadthrough or M63 opening.	48: (Ø11-32 mm(0.43 - 1.26 in)) Cable flexible leadthrough or M40 opening. 69: (Ø17-42 mm (0.67 - 1.65 in)) Cable flexible leadthrough or M50 opening.
##-105	91	100	- (32 - 36 mm(1.26 - 1.42 in))	
##-109	94	100	48: (Ø17-42 mm (0.67 - 1.65 in)) cable flexible leadthrough or M50 opening. 69: (Ø23-55 mm (0.9 - 2.16 in)) Cable flexible leadthrough or M63 opening.	48: (Ø11-32 mm(0.43 - 1.26 in)) Cable flexible leadthrough or M40 opening. 69: (Ø17-42 mm (0.67 - 1.65 in)) Cable flexible leadthrough or M50 opening.
##-142	126	160	- (40 - 44 mm (1.57 - 1.73 in))	- (36 - 40 mm(1.42 - 1.57 in))

Table 32 Fuses, cable cross-sections and glands

Model	Nominal input current [A]	Maximum value fuse [A]	Cable glands (clamping range) *	
			mains / motor	Brake
##-146	126	160	48: (Ø17-42 mm (0.67 - 1.65 in)) cable flexible leadthrough or M50 opening. 69: (Ø23-55 mm (0.9 - 2.16 in)) Cable flexible leadthrough or M63 opening.	48: (Ø11-32 mm(0.43 - 1.26 in)) Cable flexible leadthrough or M40 opening. 69: (Ø17-42 mm (0.67 - 1.65 in)) Cable flexible leadthrough or M50 opening.
##-171	152	160	- (40 - 44 mm (1.57 - 1.73 in))	- (36 - 40 mm(1.42 - 1.57 in))
##-175	152	160	48: (Ø17-42 mm (0.67 - 1.65 in)) cable flexible leadthrough or M50 opening. 69: (Ø23-55 mm (0.9 - 2.16 in)) Cable flexible leadthrough or M63 opening.	48: (Ø11-32 mm(0.43 - 1.26 in)) Cable flexible leadthrough or M40 opening. 69: (Ø17-42 mm (0.67 - 1.65 in)) Cable flexible leadthrough or M50 opening.
##-205	178	200	- (48 - 52 mm(1.89 - 2.05 in)/ 52 - 56 mm (2.05 - 2.2 in))	- (44 - 48 mm (1.73 - 1.89 in))
##-210	182	200	(Ø23 - 55 mm (0.9 - 2.16 in)) cable flexible leadthrough or M63 opening.	(Ø17- 42 mm (0.67 - 1.65 in)) cable flexible leadthrough or M50 opening.
##-228	197	250		
##-244	211	250	- (48 - 52 mm(1.89 - 2.05 in)/ 52 - 56 mm (2.05 - 2.2 in))	- (44 - 48 mm (1.73 - 1.89 in))
##-250	216	250	Ø(23 - 55 mm (0.9 - 2.16 in)) cable flexible leadthrough or M63 opening.	Ø(23 - 55 mm (0.9 - 2.16 in)) cable flexible leadthrough or M63 opening.
##-293	254	300	- (48 - 52 mm(1.89 - 2.05 in)/ 52 - 56 mm (2.05 - 2.2 in))	- (44 - 48 mm (1.73 - 1.89 in))

Note: For IP54 models 003 to 074 cable glands are optional.

* IP20/21 models are equipped with cable clamps instead of glands.

For data on cable connection ranges, see section 3.4.3, page 25

8.7.2 Fuses according to NEMA ratings

Table 33 Types and fuses

Model	Input current [Arms]	Mains input fuses	
		UL Class J TD (A)	Ferraz-Shawmut type
48-003	2.2	6	AJT6
48-004	3.5	6	AJT6
48-006	5.2	6	AJT6
48-008	6.9	10	AJT10
48-010	8.7	10	AJT10
48-013	11.3	15	AJT15
48-018	15.6	20	AJT20
48-025	21.7	25	AJT25
48-026	22	25	AJT25
48-030	26	30	AJT30
48-031	26	30	AJT30
48-036	31	35	AJT35
48-037	31	35	AJT35
48-045	39	45	AJT45
48-046	40	45	AJT45
48-058	50	60	AJT60
48-061	52	60	AJT60
48-072	64	80	AJT80
48-074	65	80	AJT80
48-088	78	100	AJT100
48-090	78	100	AJT100
48-105	91	110	AJT110
48-109	94	110	AJT110
48-142	126	125	AJT150
48-146	126	150	AJT150
48-171	152	175	AJT175
48-175	152	175	AJT175
48-205	178	200	AJT200
48-210	182	200	AJT200
48-228	197	250	AJT250
48-244	211	250	AJT250
48-250	216	250	AJT250

8.8 Control signals

Table 34

Terminal X1	Name:	Function (Default):	Signal:	Type:
1	+10 V	+10 VDC Supply voltage	+10 VDC, max 10 mA	output
2	AnIn1	Level sensor	0 -10 VDC or 0/4–20 mA bipolar: -10 - +10 VDC or -20 - +20 mA	analogue input
3	AnIn2	Off	0 -10 VDC or 0/4–20 mA bipolar: -10 - +10 VDC or -20 - +20 mA	analogue input
4	AnIn3	Off	0 -10 VDC or 0/4–20 mA bipolar: -10 - +10 VDC or -20 - +20 mA	analogue input
5	AnIn4	Off	0 -10 VDC or 0/4–20 mA bipolar: -10 - +10 VDC or -20 - +20 mA	analogue input
6	-10 V	-10VDC Supply voltage	-10 VDC, max 10 mA	output
7	Common	Signal ground	0V	output
8	DigIn 1	Auto run	0-8/24 VDC	digital input
9	DigIn 2	Forced run	0-8/24 VDC	digital input
10	DigIn 3	FlowLinkIn	0-8/24 VDC	digital input
11	+24 V	+24VDC Supply voltage	+24 VDC, 100 mA	output
12	Common	Signal ground	0 V	output
13	AnOut 1	Min speed to max speed	0 ±10 VDC or 0/4– +20 mA	analogue output
14	AnOut 2	0 to max torque	0 ±10 VDC or 0/4– +20 mA	analogue output
15	Common	Signal ground	0 V	output
16	DigIn 4	Off	0-8/24 VDC	digital input
17	DigIn 5	Off	0-8/24 VDC	digital input
18	DigIn 6	Overflow level switch (optional)	0-8/24 VDC	digital input
19	DigIn 7	Off	0-8/24 VDC	digital input
20	DigOut 1	Ready	24 VDC, 100 mA	digital output
21	DigOut 2	FlowLinkOut	24 VDC, 100 mA	digital output
22	DigIn 8	Reset	0-8/24 VDC	digital input
Terminal X2				
31	N/C 1	Relay 1 output Trip, active when the AC drive is in a TRIP condition N/C is opened when the relay is active (valid for all relays) N/O is closed when the relay is active (valid for all relays)	potential free change over 0.1 – 2 A U_{max} = 250 VAC or 42 VDC	relay output
32	COM 1			
33	N/O 1			
41	N/C 2	Relay 2 Output Run, active when the AC drive is started, also active during sleep mode.	potential free change over 0.1 – 2 A U_{max} = 250 VAC or 42 VDC	relay output
42	COM 2			
43	N/O 2			
Terminal X3				
51	COM 3	Relay 3 Output Off	potential free change over 0.1 – 2 A U_{max} = 250 VAC or 42 VDC	relay output
52	N/O 3			

NOTE: Possible potentiometer value in range of 1 kΩ to 10 kΩ (¼ Watt) linear, where we advice to use a linear 1 kΩ / ¼ W type potentiometer for best control linearity.

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