Emotron VFX 2.0
AC drive



Instruction manual

English

Valid from software version 4.39

emotron
DEDICATED DRIVE
A CG Product

Emotron VFX 2.0

INSTRUCTION MANUAL - ENGLISH

Valid from Software version 4.39

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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 instruction 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 7minutes 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 to the standard IEC61800-5-1 the protective earth connection must be assured by one of following conditions:
PE conductor cross-sectional area shall for phase cable size ≤ 16 mm^2 (6 AWG) be >10 mm^2 Cu (16 mm^2 Al) or use a second PE conductor with same area as original PE conductor.
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.

VFX48: 230-480 V
VFX52: 440-525 V
VFX69: 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.

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1. Introduction

Emotron VFX is intended for controlling the speed and torque of standard three phase asynchronous electrical motors. The AC drive (Frequency converter) is equipped with direct torque control which uses built-in digital signal processor - DSP, giving the AC drive the capability of high dynamic performance even at very low speeds without using feedback signals from the motor. Therefore the inverter is designed for use in high dynamic applications where low speed high torque and high-speed accuracy are demanded. In “simpler” application such as fans or pumps, the VFX direct torque control offers other great advantages such as insensitivity to mains disturbances or load shocks. Several options are available, listed in chapter 13. page 203, 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.

Users

This instruction manual is intended for:

- installation engineers
- maintenance engineers
- service engineers

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

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

Check that the software version number on the first page of this manual matches the software version in the AC drive. See chapter 11.9.1 page 192

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.

The Quick Setup Card 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
Encoder board	Emotron Encoder board 2.0, Instruction manual / 01-5917-01
PTC/PT100 board	PTC/PT100 board 2.0, instruction manual / 01-5920-01
CRIO board (VFX)	Emotron AC Drive Crane option 2.0, Instruction manual
Crane interface (VFX)	
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

Table 1 Available options and documents

Option	Valid instruction manual/ document number
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
AFE- Active front end	Emotron VFX/FDU 2.0 AFE- Active Front End option, Instruction manual / 01-5386-01

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	VFX	48	-017	-20	C	E	–	–	–	A	–	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 090-3K0	Configuration	
1	1	AC drive type	VFX
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 - -3K0=3000 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 090-3k0)	–=No safe stop T=Safe stop incl.
9	10	Brand label	A=Standard
10	-	Painted AC drive	A=Standard paint
11	11	Coated boards, option	V=Coated boards, standard
12	12	Option position 1	N=No option C=Crane I/O (max. 1) E=Encoder (max. 1) P=PTC/PT100 (max. 1) I=Extended I/O (max. 3) S=Safe Stop (only 003-074/IP54) (max. 1)
13	13	Option position 2	
14	14	Option position 3	

Position for 003-074	Position for 090-3K0	Configuration	
15	15	Option position, communication	N=No option D=DeviceNet P=Profibus S=RS232/485 M=Modbus/TCP E=EtherCAT F=Modbus/TCP 2-port, M12 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 C2: 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 C2,



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
PEBB	Power Electronic Building Block
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 -295

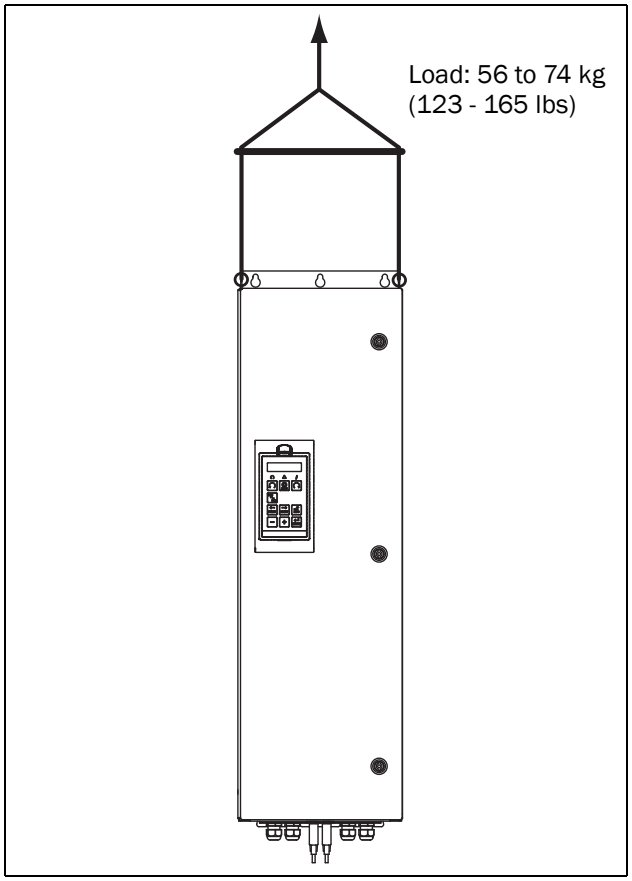


Fig. 2 Lifting AC drive model -090 to -295

Recommended for AC drive models -300 to - 3K0

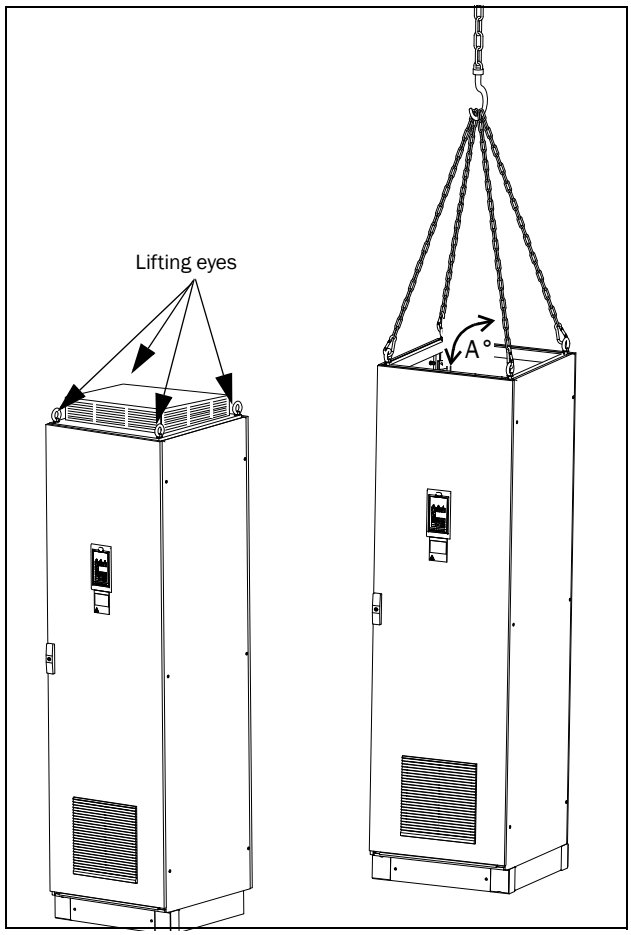


Fig. 3 Remove the roof unit and use the lifting eyes to lift single unit 600mm(23.6 in) and 900mm(35.4 in).

Single cabinet drives can be lifted/transported safely using the eyebolts supplied and lifting cables/chains as in illustration Fig. 3 above.
Depending on the cable/chain angle A (in Fig. 3), following loads are permitted:

Cable/chain angle A	Permitted load
45 °	4 800 N (1080 lbf)
60 °	6 400 N (1439 lbf)
90 °	13 600N (3057 lbf)

Regarding lifting instructions for other cabinet sizes, please contact CG Drives & Automation.

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.

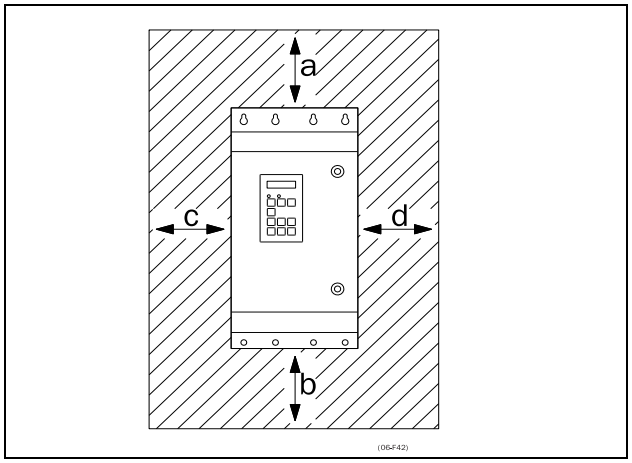


Fig. 4 AC drive mounting model 003 to 3K0

2.2.1 Cooling

Fig. 4 shows the minimum free space required around the AC drive for the models 003 to 3K0 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)]	300-3K0 cabinet [mm(in)]
VFX-VFX, side-by-side mm (in)	a	200(7.9)	200(7.9)	100(3.9)
	b	200(7.9)	200(7.9)	0
	c	0	50(1.97)	0
	d	0	50(1.97)	0
VFX-wall, wall-one side mm (in)	a	100(3.9)	100(3.9)	100(3.9)
	b	100(3.9)	100(3.9)	0
	c	0	50(1.97)	0
	d	0	50(1.97)	0

NOTE: When a 300 to 3K0 model is placed between two walls, a minimum distance at each side of 200 mm (7.9 in) must be maintained.

2.2.2 Mounting schemes

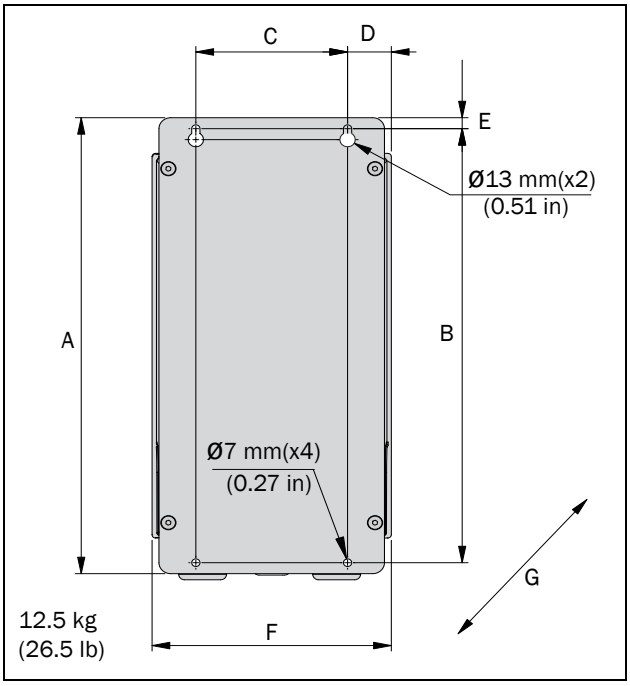


Fig. 5 Emotron VFX Model 48/52-003 to 018 (Frame size B)

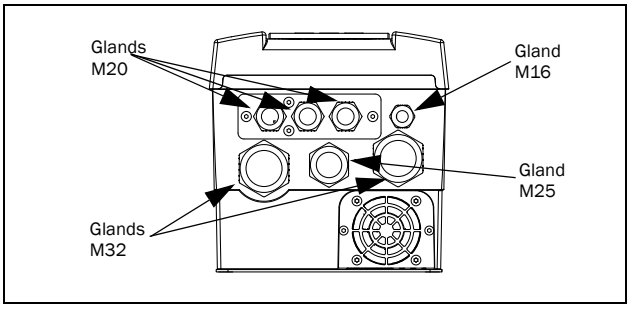


Fig. 6 Cable interface for mains, motor and communication, Emotron VFX Model 48/52-003 to 018 (Frame size B)

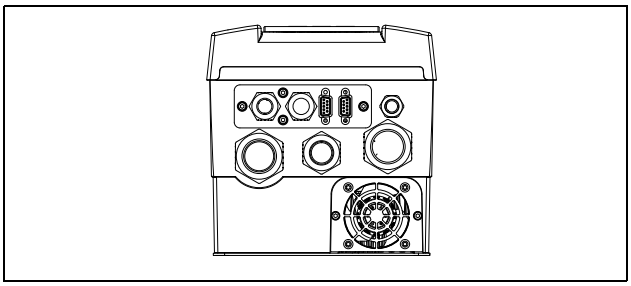


Fig. 7 Emotron VFX Model 48/52-003 to 018 (Frame size B) example with optional CRIO interface and D-sub connectors.

Table 6 Dimensions connected to Fig. 5.

Frame size	Emotron VFX 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)

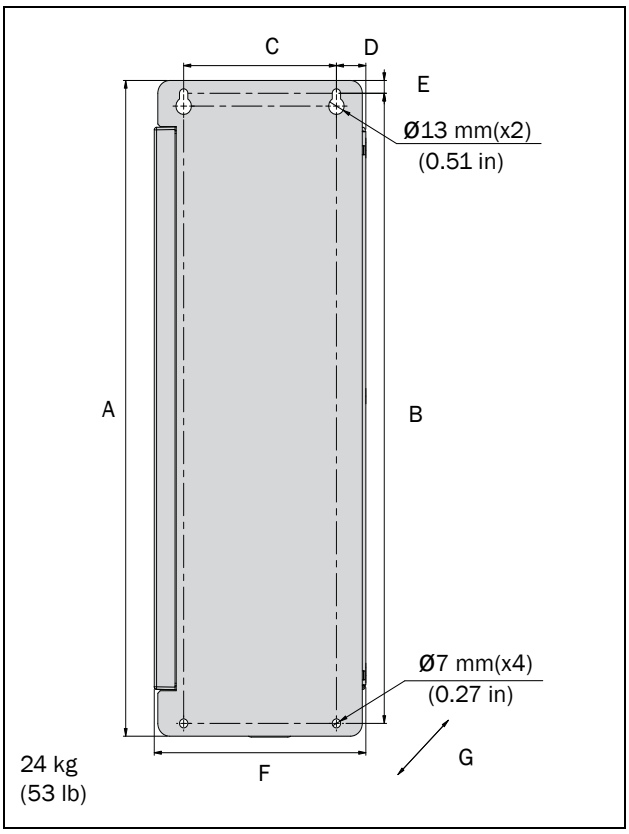


Fig. 8 Emotron VFX Model 48/52-026 to 046 (Frame size C)

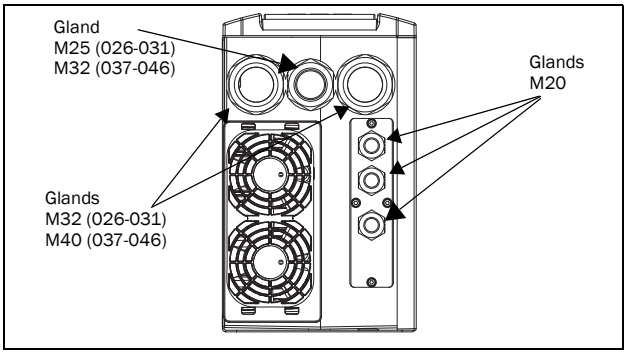


Fig. 9 Cable interface for mains, motor and communication, Emotron VFX Model 48/52-026 to 046 (Frame size C)

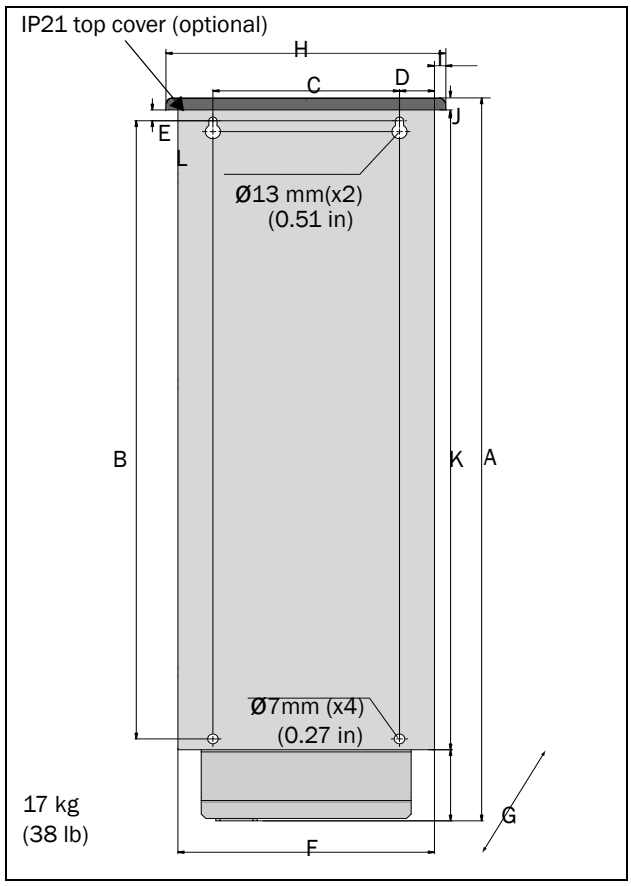


Fig. 10 Emotron VFX Model 48-025 to 48-058 (Frame size C2), backside view.

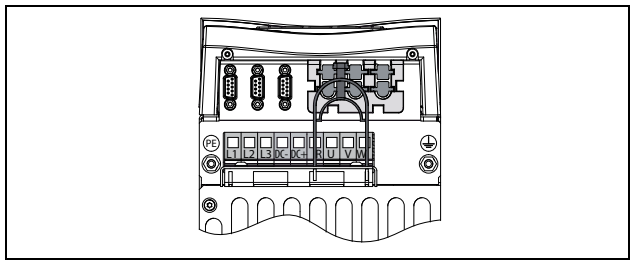


Fig. 11 Bottom view Emotron VFX Model 48-025 to 48-058 (Frame size C2), with cable interface for mains, motor, DC+/DC-, brake resistor and control

Table 7 Dimensions connected to Fig. 8 and Fig. 10.

Frame size	Emotron VFX 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)

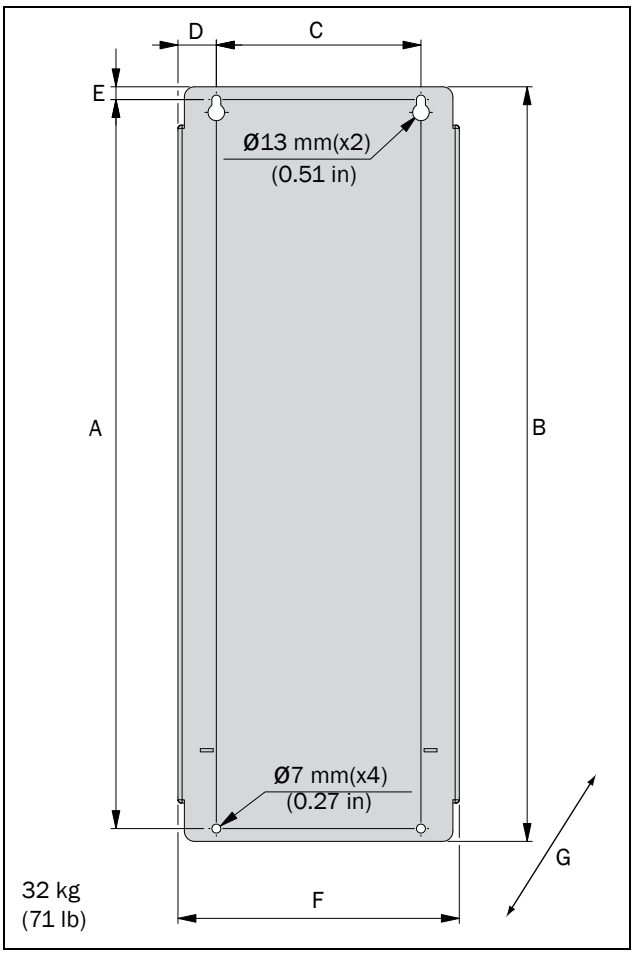


Fig. 12 Emotron VFX Model 48/52-061 and 074 (Frame size D)

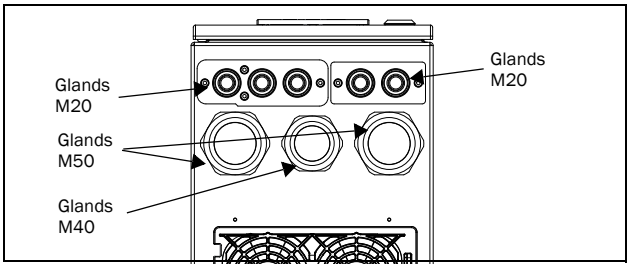


Fig. 13 Cable interface for mains, motor and communication, Emotron VFX Model 48/52-061 and 074 (Frame size D).

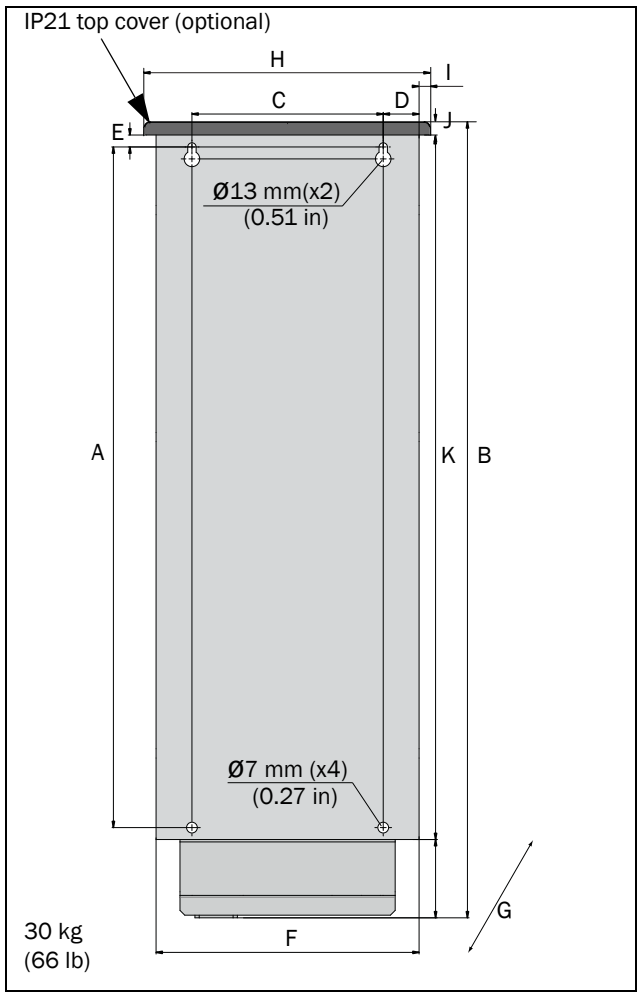


Fig. 14 Emotron VFXModel 48-060 to 48-105 (Frame size D2), backside view.

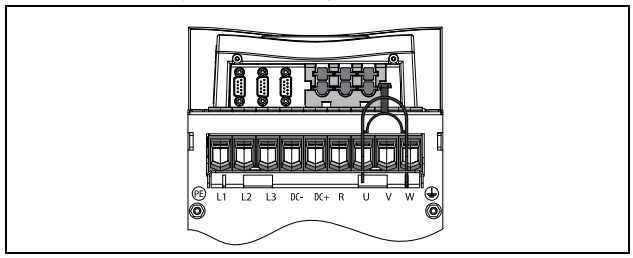


Fig. 15 Bottom view Emotron VFX Model 48-060 to 48-105 (Size D2), with cable interface for mains, motor, DC+/DC-, brake resistor and control.

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

Table 8 Dimensions connected to Fig. 12 and Fig. 14.

Frame size	Emotron VFX 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	060 - 105	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)

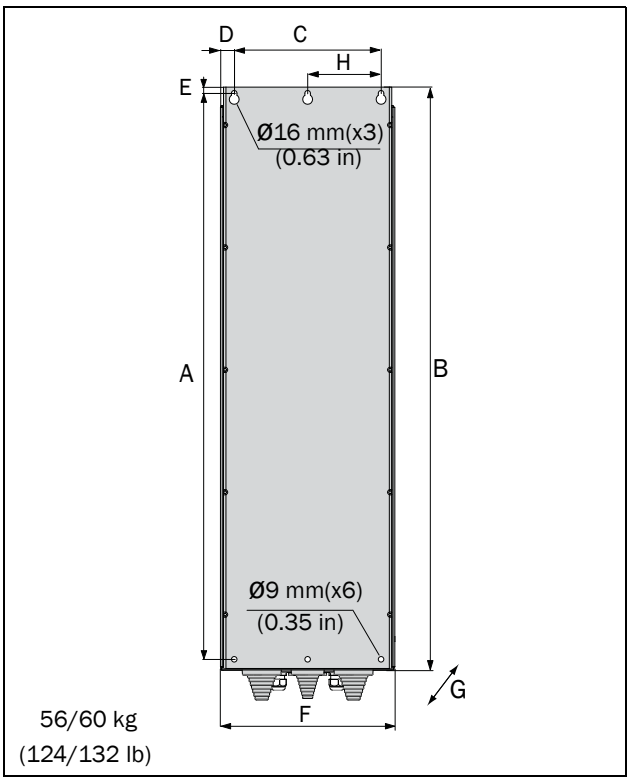


Fig. 16 Emotron VFX Model 48-090 to 175 (Frame size E).

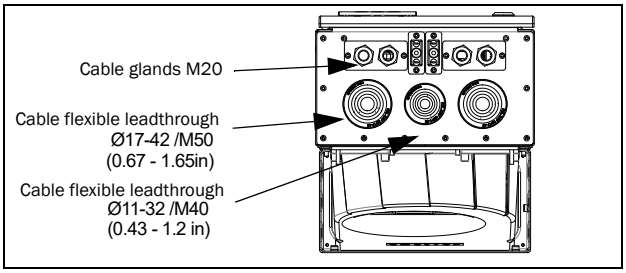


Fig. 17 Cable interface for mains, motor, DC+/DC-, brake resistor and communication, Emotron VFX Model 48-090 to 175 (Frame size E).

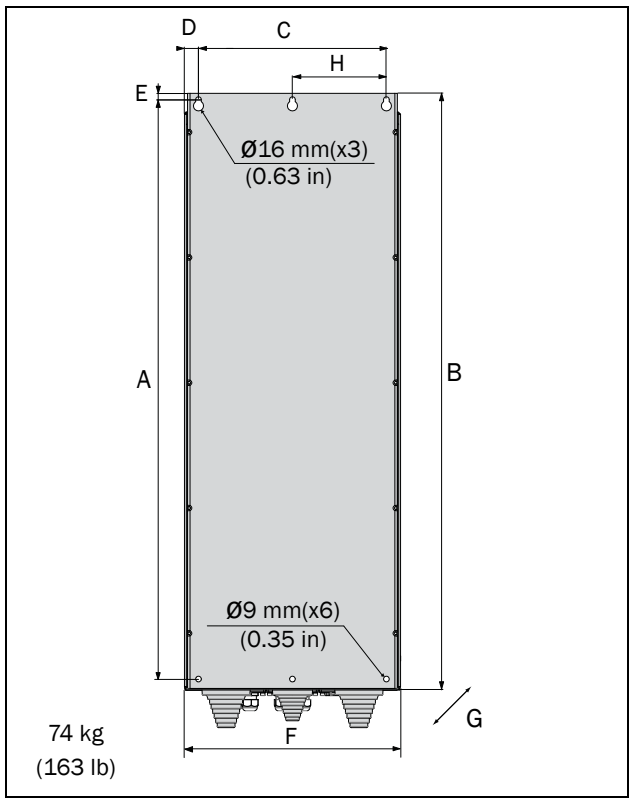


Fig. 18 Emotron VFX Model 48-210 to 295 (Frame size F) Emotron VFX Model 69-90 to 200 (Frame size F69).

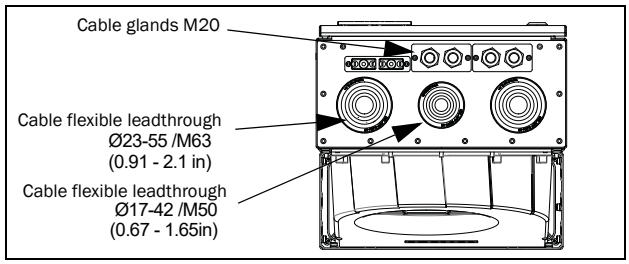


Fig. 19 Cable interface for mains, motor, DC+/DC-, brake resistor and communication, Emotron VFX Model 48-210 to 295 Emotron VFX Model 69-90 to 200.

Table 9 Dimensions connected to Fig. 16 and Fig. 18.

Frame size	Emotron VFX 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 - 295	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)						

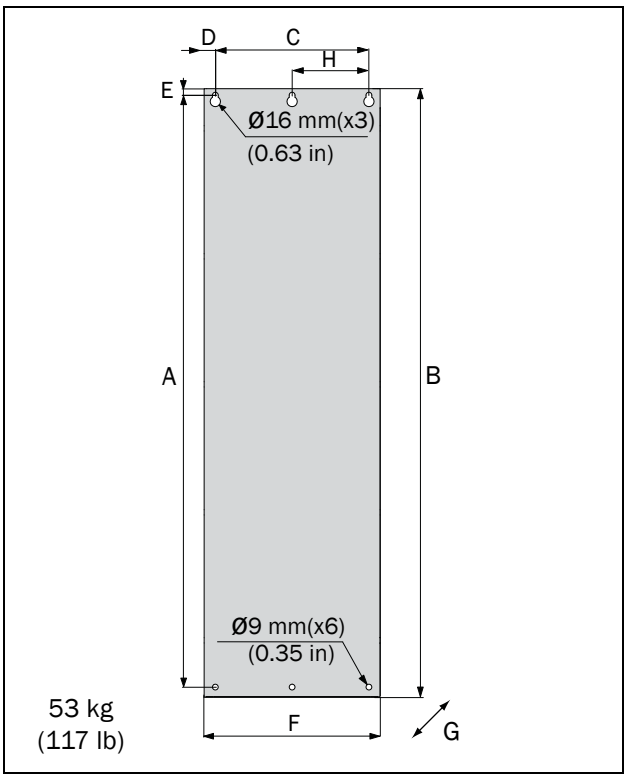


Fig. 20 Emotron VFX/ Model 48-142 to 48-171 (Frame size E2).

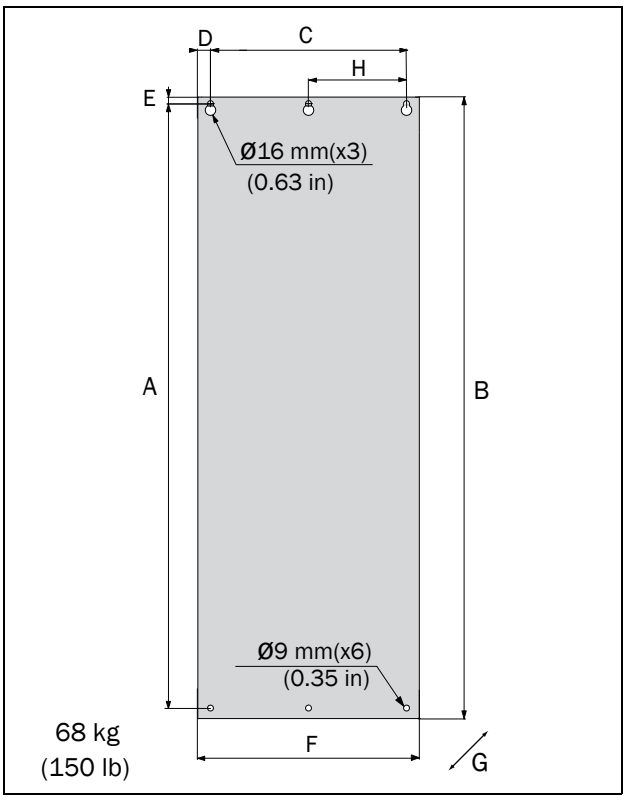


Fig. 22 Emotron VFX/ Model 48-205 to 48-293 (Frame size F2).

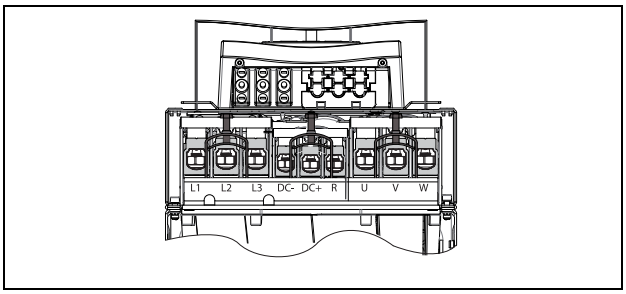


Fig. 21 Bottom view Emotron VFX/ Model 48-142 to 48-293 (Frame size E2 and F2), with cable interface for mains, motor, DC+/DC-, brake resistor and control. (principle drawing)

Table 10 Dimensions connected to Fig. 20 and Fig. 22.

Frame size	Emotron VFX model	Dimension in mm (in)							
		A	B	C	D	E	F	G	H
E2	142 - 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)

2.3 Cabinet mounting

2.3.1 Cooling

If the variable speed drive is installed in a cabinet, the rate of airflow supplied by the cooling fans must be taken into consideration.

Frame	Emotron VFX Model	Flow rate m^3/h (ft^3/min)
B	003-018	75 (144)
C - C2	025 – 031	120 (171)
C - C2	036 - 058	170 (100)
D - D2	060 - 105	170 (100)
E - E2	090 - 175	510 (300)
F - F2	205 - 295	800 (471)
F69	090 - 200	
G	300 - 375	1020 (600)
H	430 - 500	1600 (942)
H69	250 - 400	
I	600 - 750	2400 (1413)
I69	430 - 595	
J	860 - 1K0	3200 (1883)
J69	650 - 800	
KA	1K15 - 1K25	4000 (2354)
KA69	905 - 995	
K	1K35 - 1K5	4800 (2825)
K69	1K2	
L	1K75	5600 (3296)
L69	1K4	
M	2K0	6400 (3767)
M69	1K6	
N	2K25	7200 (4238)
N69	1K8	
O	2K5	8000 (4709)
O69	2K0	
P69	2K2	8800 (5179)
Q69	2K4	9600 (5650)
R69	2K6	10400 (6121)
S69	2K8	11200 (6592)
T69	3K0	12000 (7063)

NOTE: For the models 48-860/69-650 to 69-3K0 the mentioned amount of air flow should be divided equally over the cabinets.

2.3.2 Recommended free space in front of cabinet

All cabinet mounted AC drives are designed in modules, so called PEBBs. These PEBBs can be folded out to be replaced. To be able to remove a PEBB in the future, we recommend 1.30 meter (39.4 in) free space in front of the cabinet, see Fig. 23.

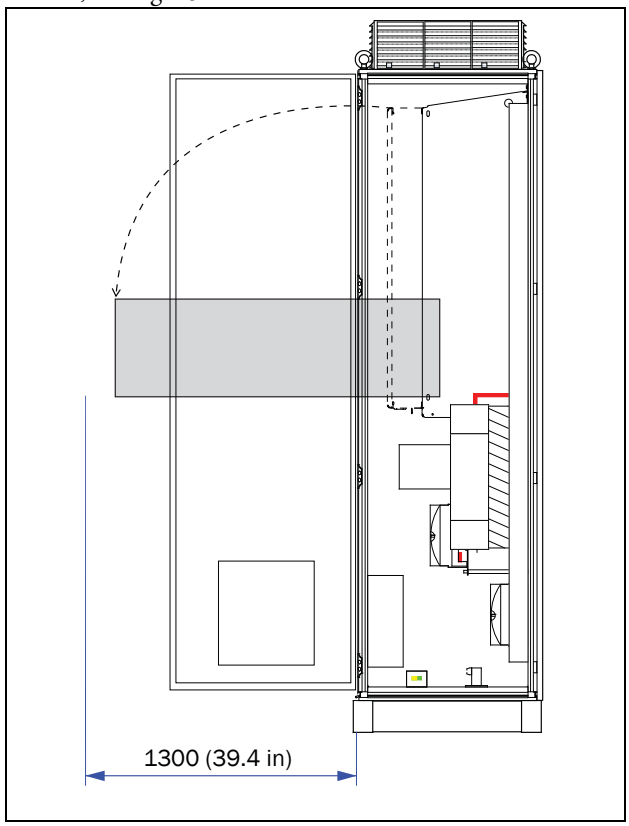
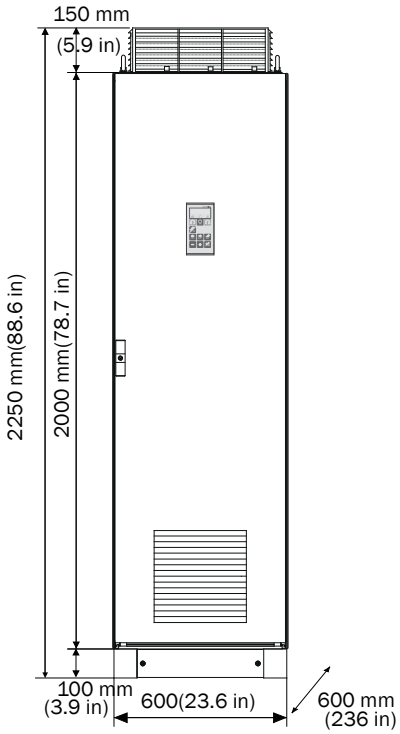
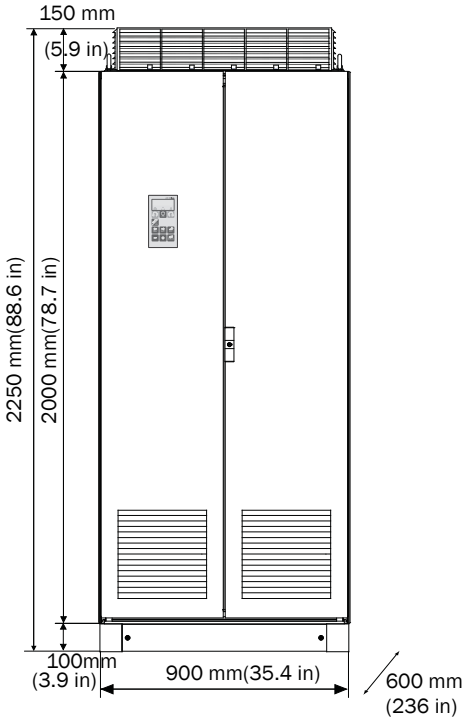


Fig. 23 Recommended free space in front of the cabinet mounted AC drive

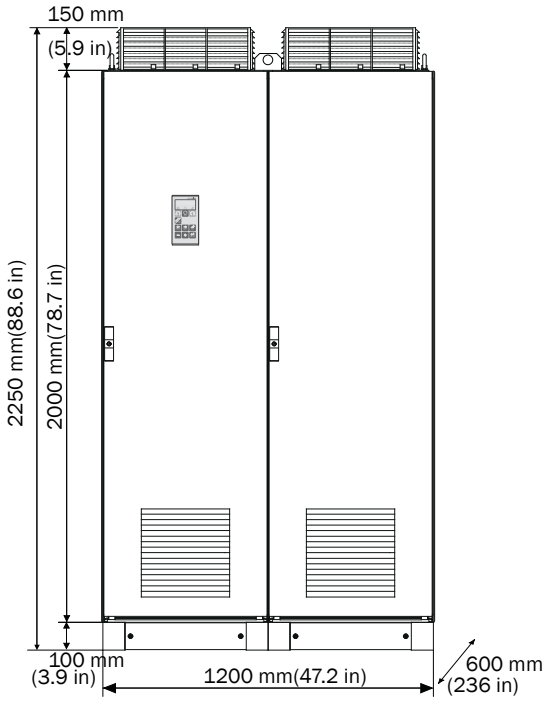
2.3.3 Mounting schemes, cabinets



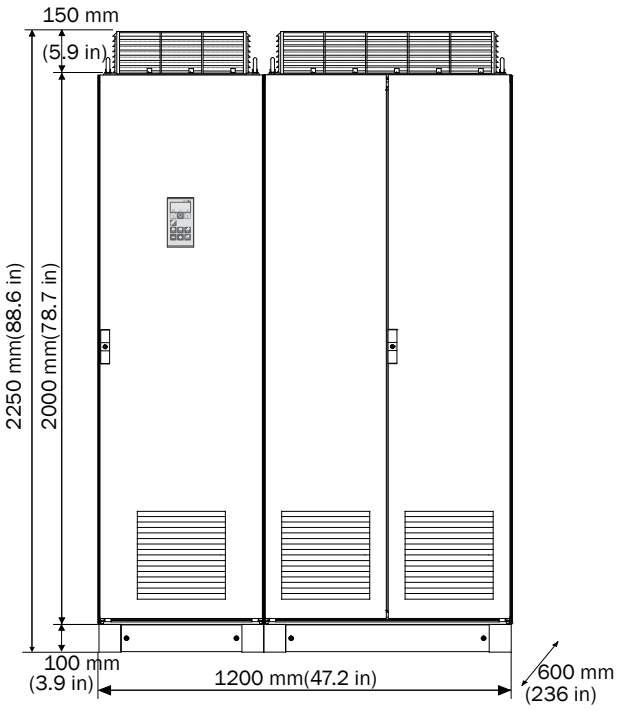
Emotron VFX48: Model 300 to 500 (Frame size G and H)
Emotron VFX69: Model 250 to 400(Frame size H69)



Emotron VFX48: Model 600 to 750 (Frame size I)
Emotron VFX69: Model 430 to595 (Frame size I69)

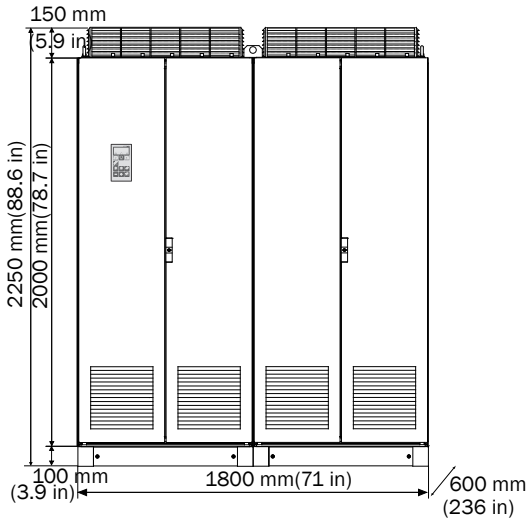


Emotron VFX48: Model 860 to 1K0 (Frame size J)
Emotron VFX69: Model 650 to800 (Frame size J69)

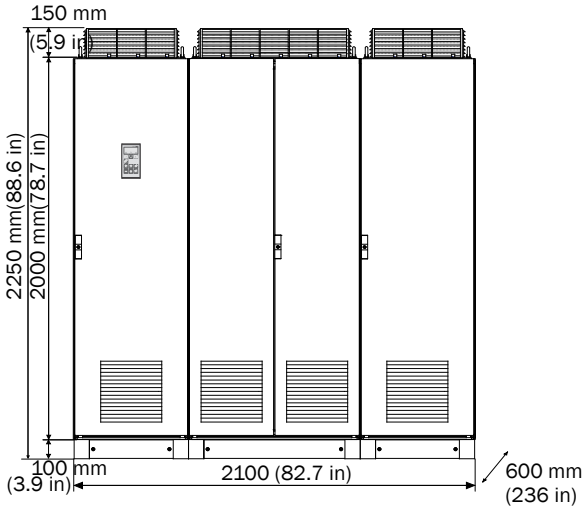


Emotron VFX48: Model 1K15 to 1K25 (Frame size KA)
Emotron VFX69: Model 905 to 995(Frame size KA69)

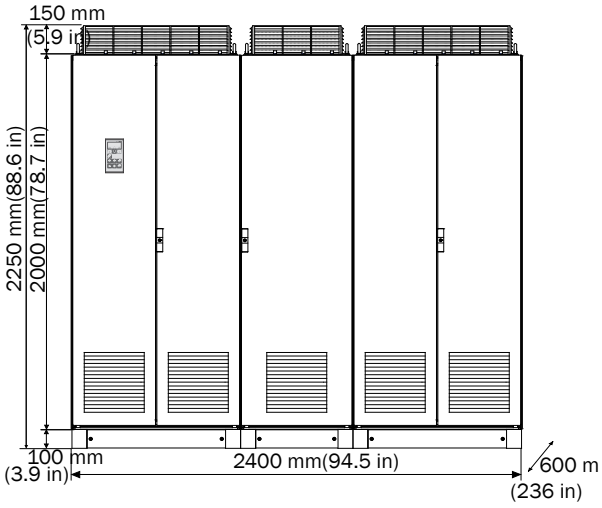
Fig. 24



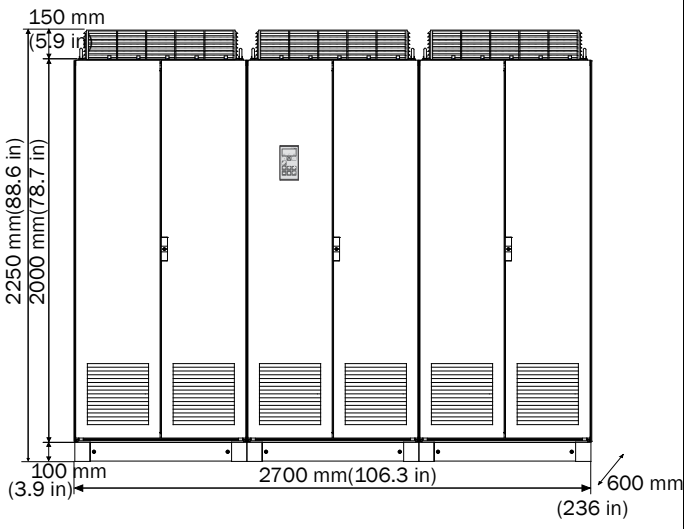
Emotron VFX48: Model 1K35 to 1K5 (Frame size K) Emotron VFX69: Model1K2 (Frame size K69)



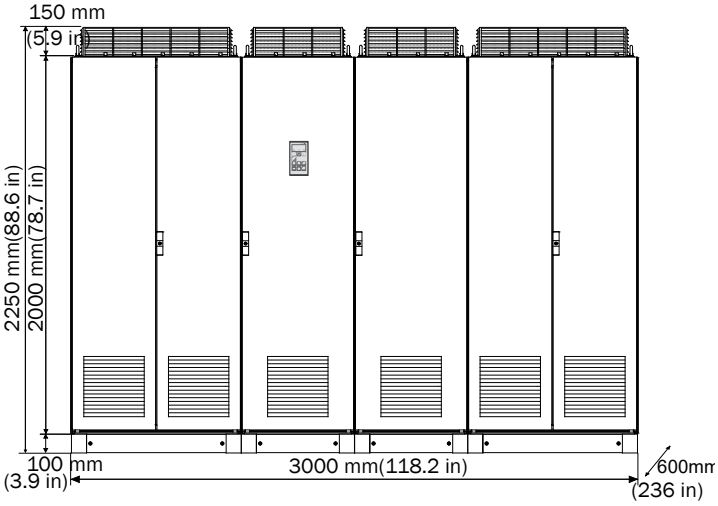
Emotron VFX48: Model 1K75 (Frame size L)



Emotron VFX48: Model 2K0(Frame size M)
Emotron VFX69: Model 1K6 (Frame sizeM69)



Emotron VFX48: Model 2K25 (Frame size N)
Emotron VFX69: Model 1K8 (Frame size N69)



Emotron VFX48: Model 2K5(Frame size O)
Emotron VFX69: Model 2K0 (Frame size O69)

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 26.
- Motors in parallel, refer to menu §Drive Mode [213], page 74.
- 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)

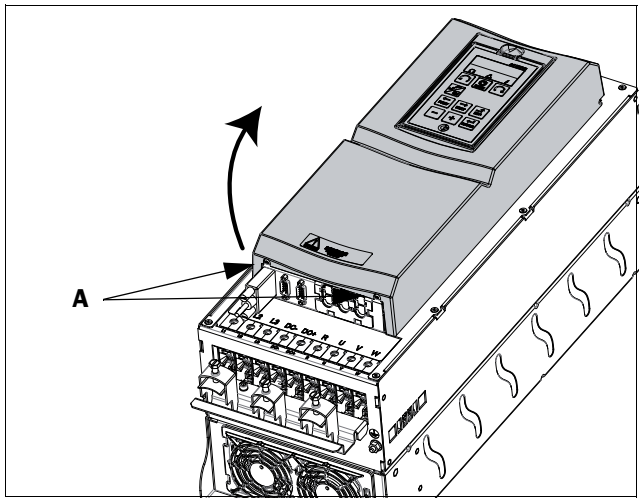


Fig. 26 Remove the front cover on frame size C2 - F2 (principle drawing).

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. 26) 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)

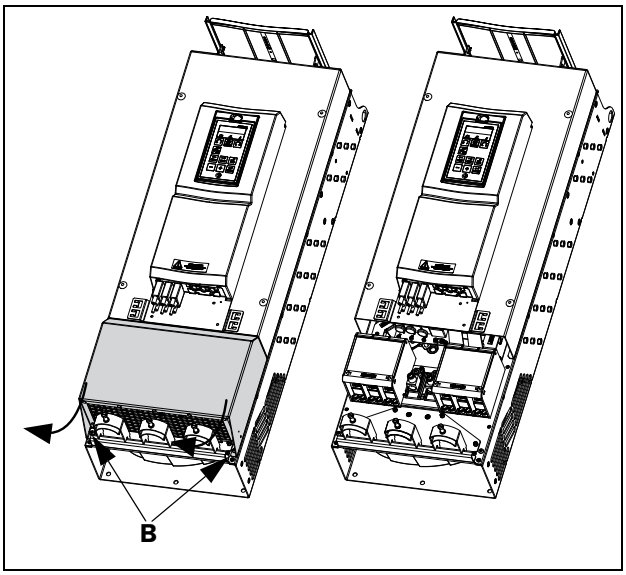


Fig. 27 Loosen the two screws and remove the lower cover (principle drawing)

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. 27).
- Pull down the cover a bit and lift it away.

3.2 Cable connections for smaller frame sizes

IP54-VFX48/52-003 to 074 (Frame sizes B, C and D)
IP20/21 - VFX48 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 phase cable size < 16 mm2 (6 AWG) be >10 mm2 Cu (16 mm2 Al) or a second PE conductor with same area as original PE conductor,
  for cable size above 16mm2 (6 AWG) but smaller or equal to 35mm2 (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. 37, 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. 28 to 34. The AC drive has as standard a built-in RFI mains filter that complies with category C3 which suits the Second Environment standard.

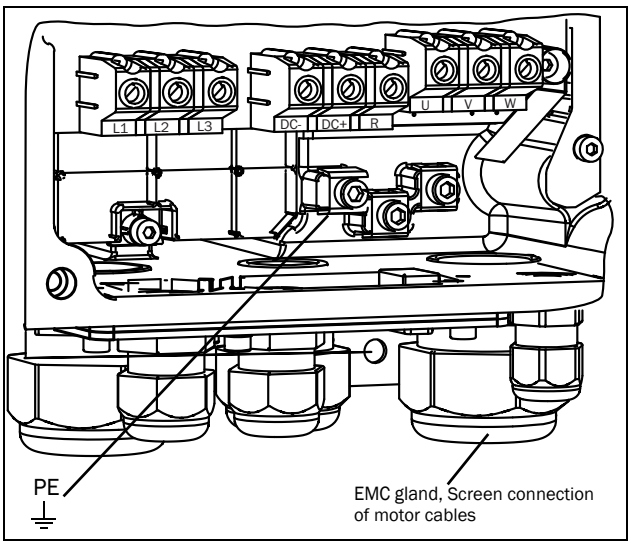


Fig. 28 Mains and motor connections, model 003-018, frame size B

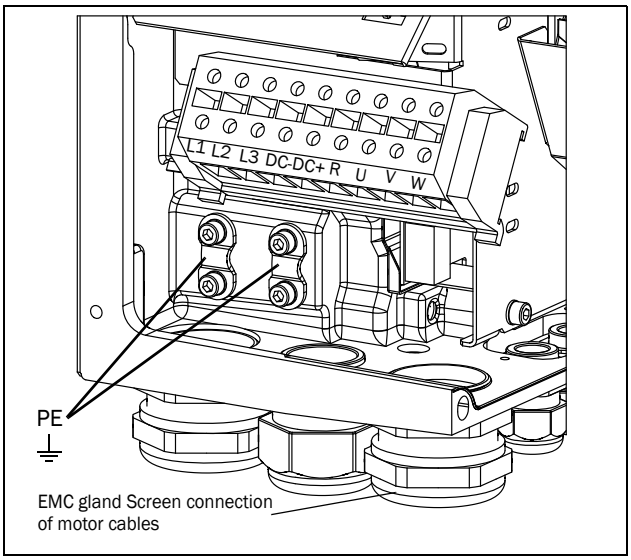


Fig. 29 Mains and motor connections, model 026-046, frame size C

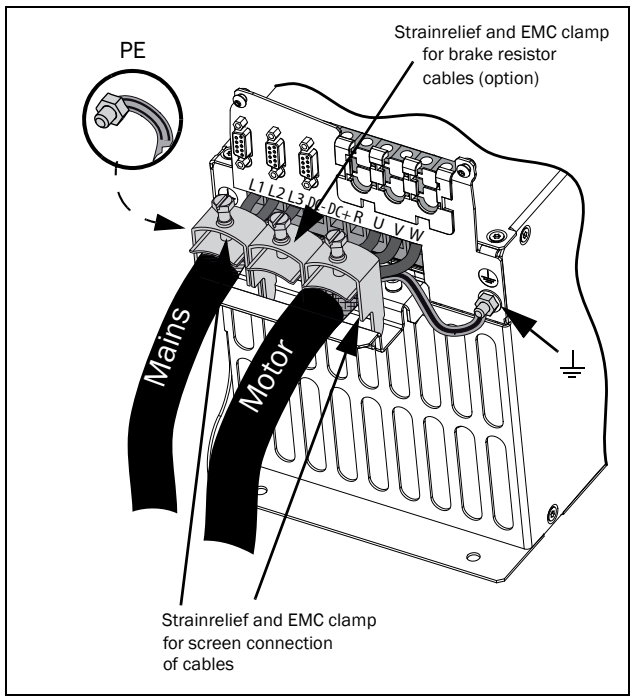


Fig. 30 Mains and motor connections model 48-025 to 48-058, frame size C2.

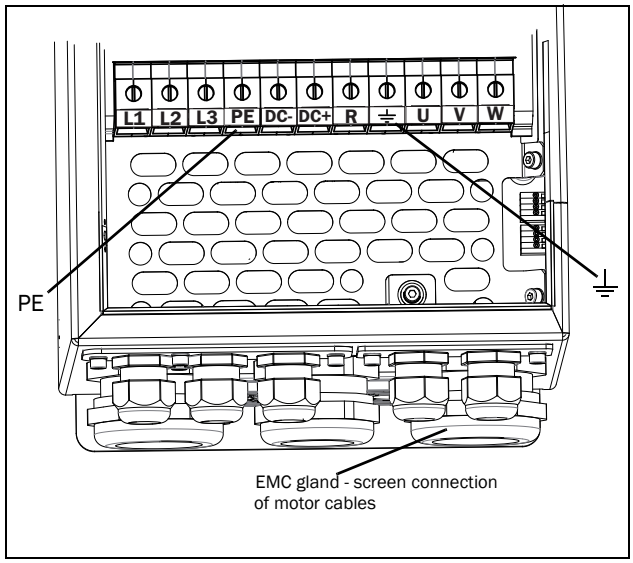


Fig. 31 Mains and motor connection, model 061 - 074, frame size D.

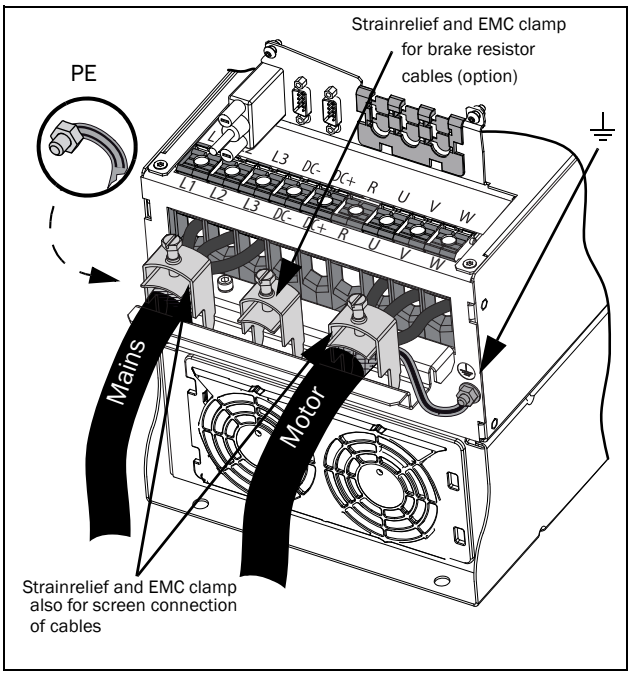


Fig. 32 Mains and motor connections model 48-060 to 48-105, frame size D2.

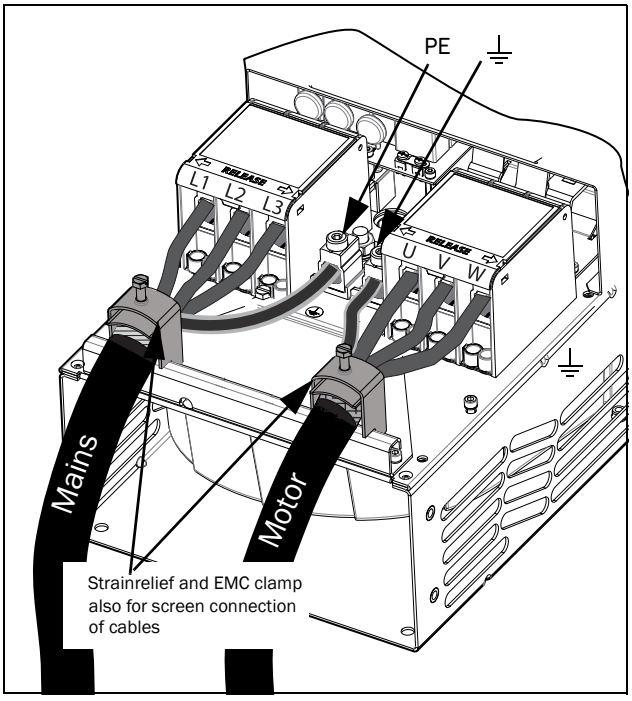


Fig. 33 Mains and motor connections model 48-142 to 48-293 (Size E2 and F2) (principle drawing).

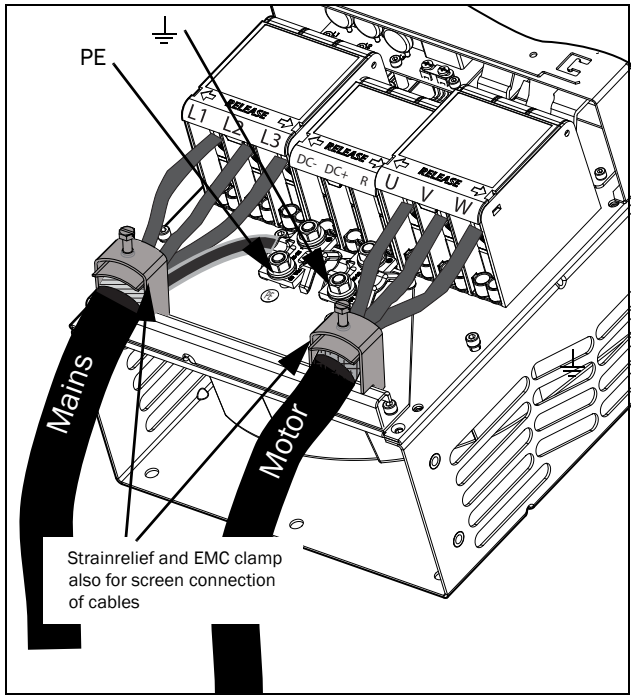


Fig. 34 Mains and motor connections model 48-142 to 48-293 (Size E2 and F2) with the optional terminals for DC-,DC+ and Brake (principle drawing)

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)

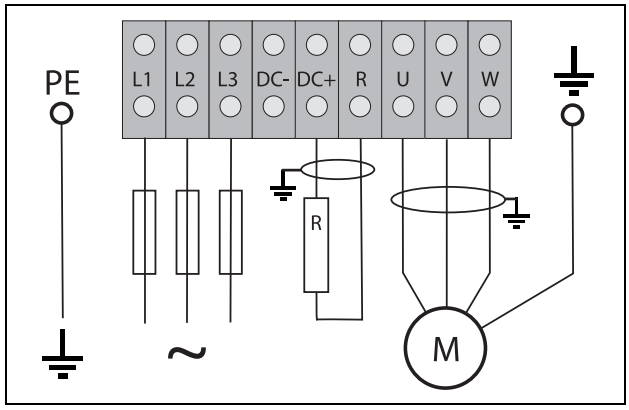


Fig. 35 Wiring example showing Protective earth, Motor earth and Brake Resistor connection

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 phase cable size < 16 mm2 (6 AWG) be >10 mm2 Cu (16 mm2 Al) or use a second PE conductor with same area as original PE conductor.
  For cable size above 16mm2 (6 AWG) but smaller or equal to 35mm2 (2 AWG) the PE conductor cross-sectional area shall be at least 16mm2 (6 AWG).
  For cables >35mm2 (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. 37, 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. 28, to Fig. 34 .

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. 37.

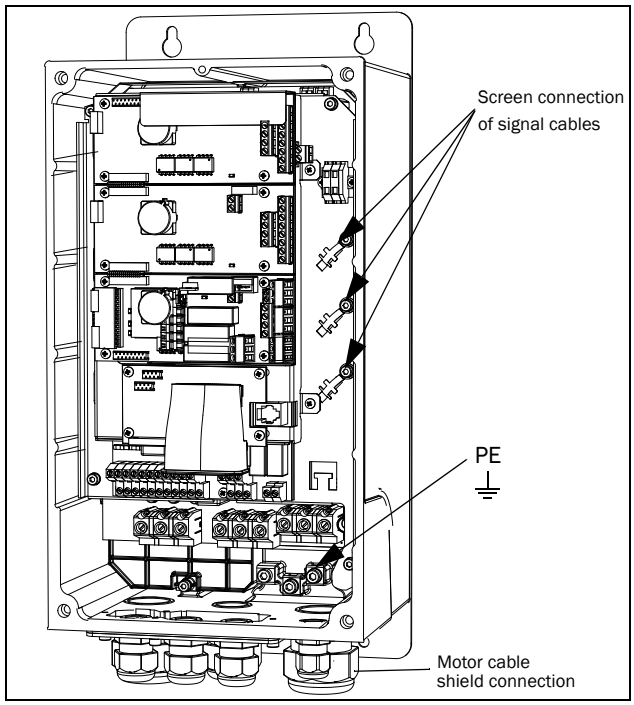


Fig. 36 Screen connection of cables.

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. 37 shows an example of a AC drive built into a cabinet.

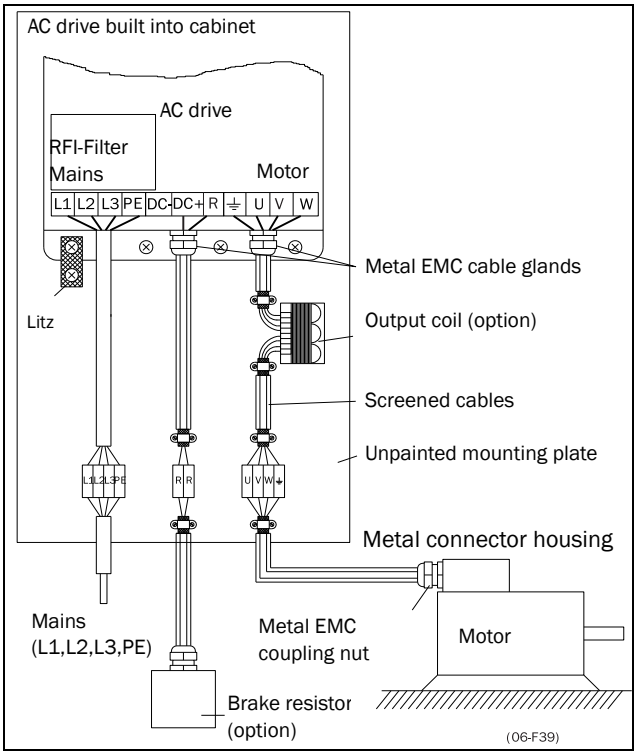


Fig. 37 AC drive in a cabinet on a mounting plate

Fig. 38 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.

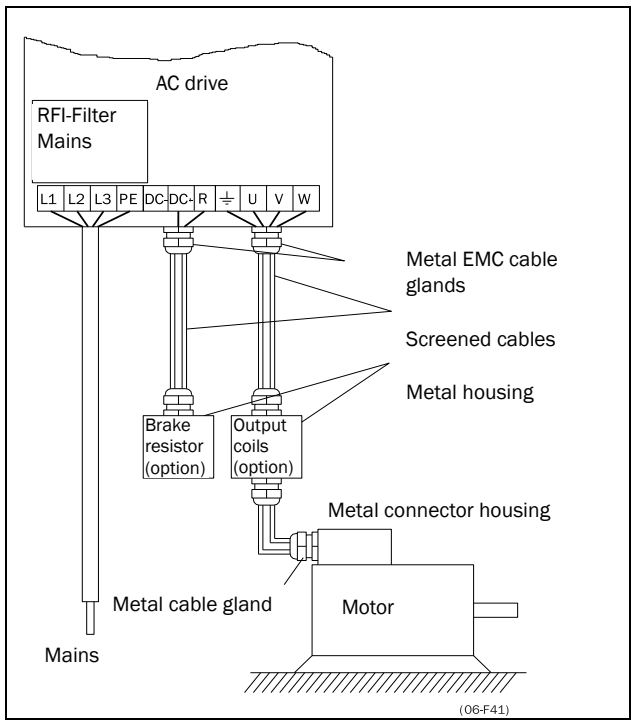


Fig. 38 AC drive as stand alone

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 - VFX 48-090 to 295 (Frame sizes E - F) and
VFX 69-090 to 200 (Frame size F69)
IP20 - VFX 48-300 and up (Frame sizes G and up) and
VFX 69-250 and up (Frame sizes H69 and up).

Emotron VFX48-090 and up, Emotron VFX69-090 and up

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

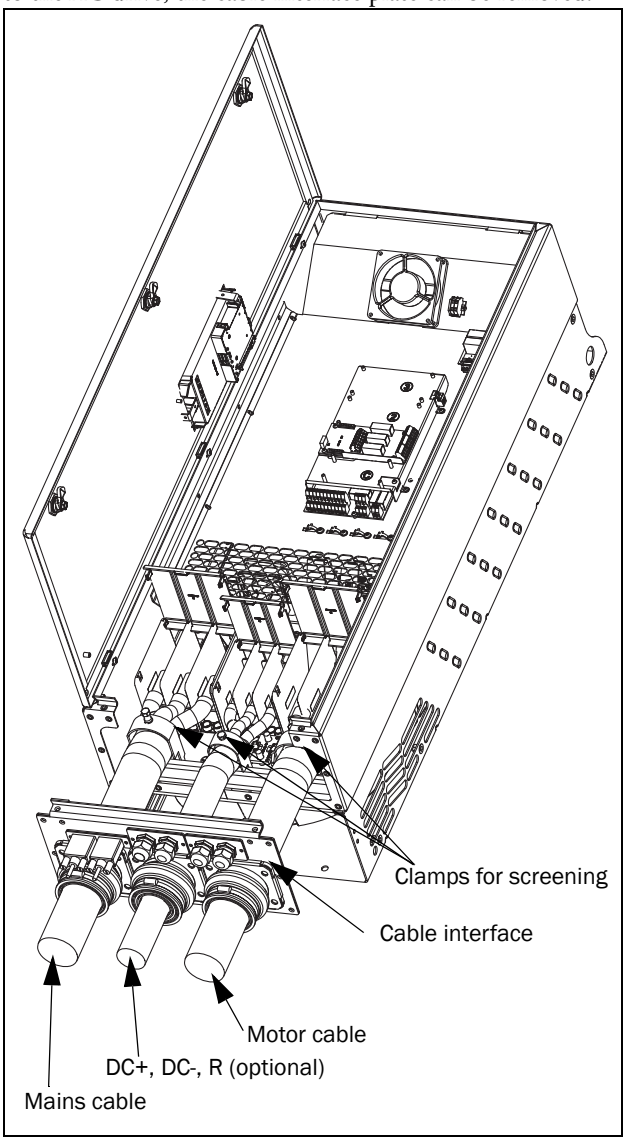


Fig. 39 Connecting motor and mains cables.

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.

AC drive model 48-300 & 69-250 and up

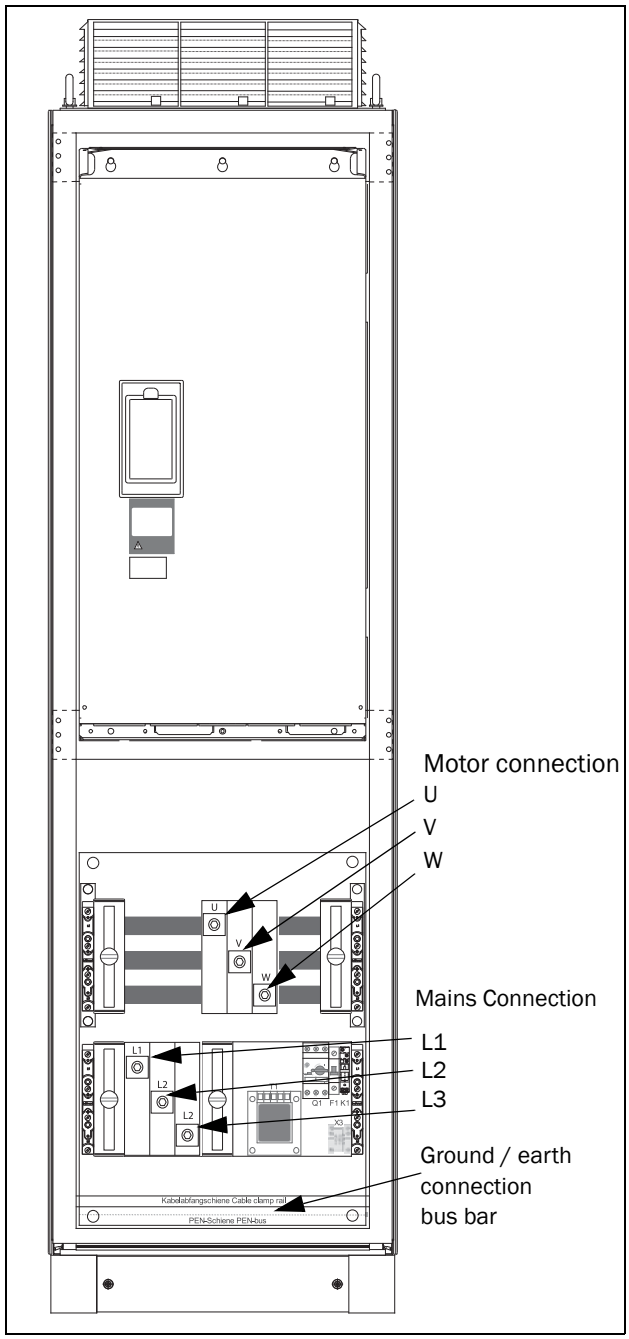


Fig. 40 Connect motor cables and mains cables to the terminals and earth/ground to the bus bar.

AC drive models 48-300 & 69-250 and up are supplied with power clamps for mains and motors. For connection of PE and earth there is a grounding bus bar.

For all type of wires to be connected the stripping length should be 32 mm (1.26 in).

3.3.1 Connection of mains and motor cables on IP20 modules

The Emotron IP 20 modules are delivered complete with factory mounted cables for mains and motor. The length of the cables are app. 1100 mm (43 in). The cables are marked L1, L2, L3 for mains connection and U, V, W for motor connection.

NOTE: The IP20 modules are connected to PE/Ground via the mounting screws. Make sure that these will have good contact to the grounded mounting plate/ cabinet wall.

For detailed information about use of the IP20 modules, please contact CG Drives & Automation.

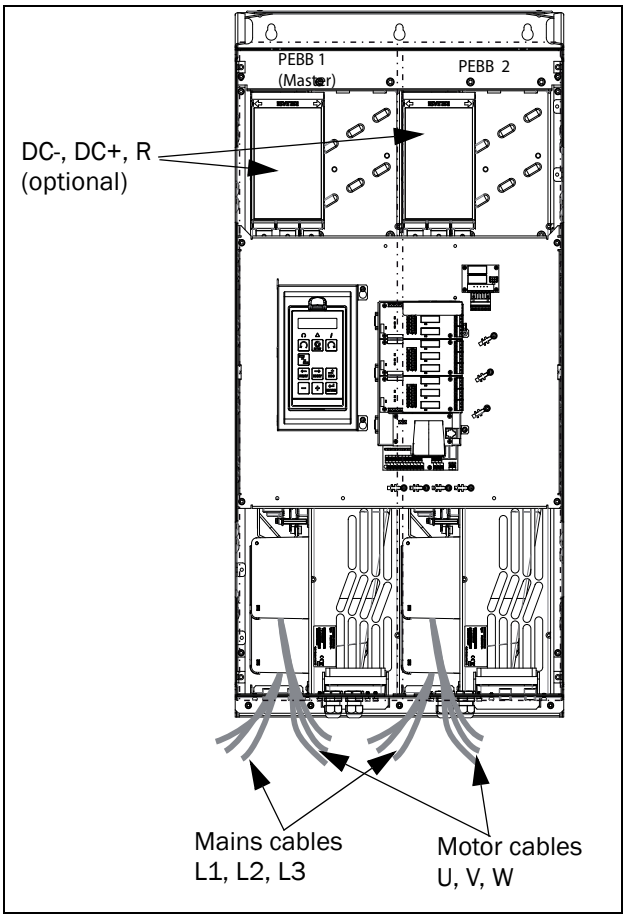


Fig. 41 IP20 module size G and H, with qty 2 x 3 mains cables and qty 2 x 3 motor cables.

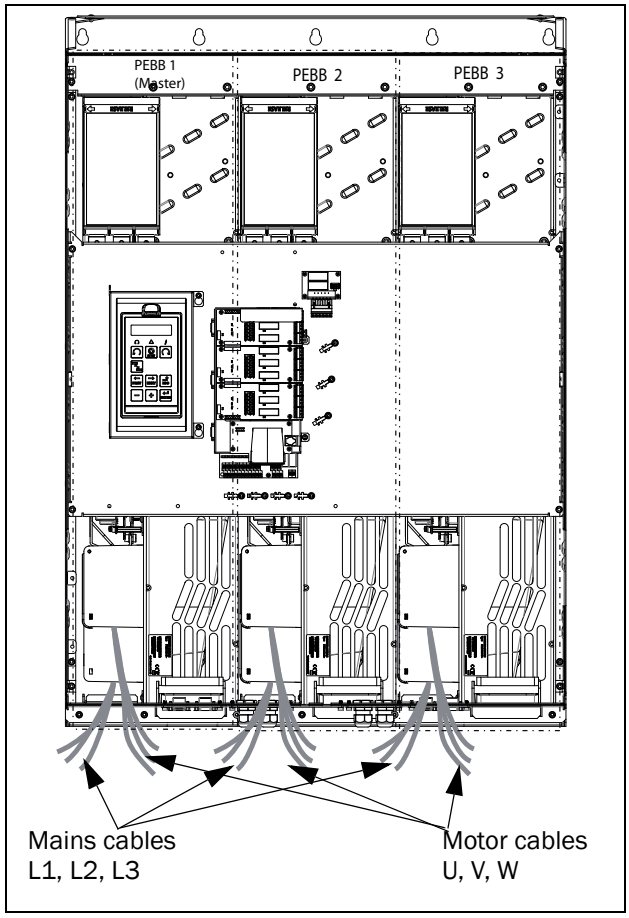


Fig. 42 IP20 module size I/I69 with qty 3 x 3 Mains cables and qty 3 x 3 motor cables.

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.

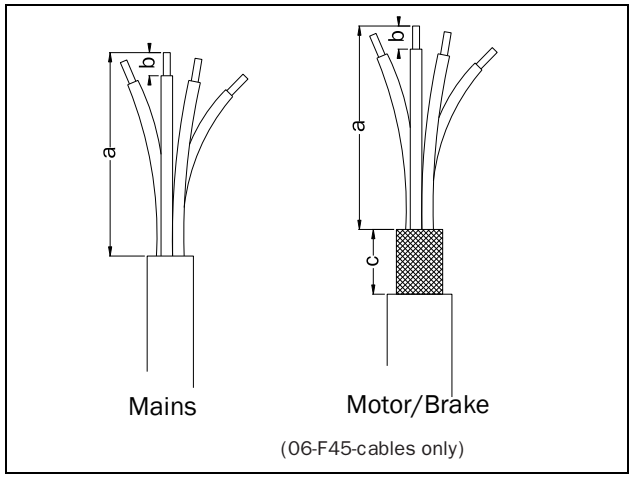


Fig. 43 Stripping lengths for cables

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)
VFX##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)
VFX##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)
VFX48-025 – 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*
VFX##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)
VFX48-060 – 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*
VFX##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)**
VFX48-142 – 171	E2										
VFX48-205 – 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)**
VFX48-210 – 295 VFX69-090 – 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 VFX48 and VFX52, 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	
VFX##-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
VFX##-004								
VFX##-006								
VFX##-008								
VFX##-010								
VFX##-013								
VFX##-018								
VFX48-025	C2	4 - 25	2	4 - 25	2	4 - 25 *	4.3	
VFX48-030								
VFX48-036								
VFX48-045								
VFX48-058								
VFX##-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	
VFX##-031								
VFX##-037								
VFX##-046								
VFX48-060	D2	0.75 -50	3.3	0.75 -50	3.3	10 - 70*	4.3	
VFX48-072								
VFX48-088	D2	16 - 50	7.9	16 - 50	7.9			
VFX48-105								
VFX##-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	
VFX##-074								
VFX48-142	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 **	
VFX48-171								
VFX48-090	E							
VFX48-109								
VFX48-146								
VFX48-175								

Table 14 Cable connector range and tightening torque for Emotron VFX48 and VFX52, according to IEC ratings.

<table>
<tr><th rowspan="3">Model</th><th rowspan="3">Frame size</th><th colspan="6">Cable cross section connector range</th><th rowspan="3">Cable type</th></tr>
<tr><th colspan="2">Mains and motor</th><th colspan="2">Brake</th><th colspan="2">PE</th></tr>
<tr><th>Cable area mm^2</th><th>Tightening torque Nm</th><th>Cable area mm^2</th><th>Tightening torque Nm</th><th>Cable area mm^2</th><th>Tightening torque Nm</th></tr>
<tr><td>VFX48-205</td><td rowspan="3">F2</td><td rowspan="8">25 - 240</td><td rowspan="8">31 (for 25-34 mm^2)

42 (for 35-152 mm^2)

56 (for 153-240 mm^2)</td><td rowspan="8">16 - 150</td><td rowspan="8">31 (for 16-34 mm^2)

42 (for 35-150 mm^2)</td><td rowspan="8">25 - 240

16 - 185 **</td><td rowspan="8">31 (for 25-34 mm^2)

42 (for 35-152 mm^2)

56 (for 153-240 mm^2)

10 **</td><td rowspan="28">Copper (Cu) 75 °C</td></tr>
<tr><td>VFX48-244</td></tr>
<tr><td>VFX48-293</td></tr>
<tr><td>VFX48-210</td><td rowspan="4">F</td></tr>
<tr><td>VFX48-228</td></tr>
<tr><td>VFX48-250</td></tr>
<tr><td>VFX48-295</td></tr>
<tr><td>VFX48-300</td><td rowspan="2">G</td><td rowspan="2">(2x) 25 - 240</td><td rowspan="19">31 (for 25-34 mm^2)

42 (for 35-152 mm^2)

56 (for 153-240 mm^2)</td><td rowspan="2">(2x) 25 - 240</td><td rowspan="19">31 (for 25-34 mm^2)

42 (for 35-152 mm^2)

56 (for 153-240 mm^2)</td><td colspan="2" rowspan="19">PE/Earth via mounting screws/ mounting frame.
In order to secure proper earthing, always use all mounting screws and tighten them thoroughly.</td></tr>
<tr><td>VFX48-375</td></tr>
<tr><td>VFX48-430</td><td rowspan="2">H</td><td rowspan="2">(2x) 25 - 240</td></tr>
<tr><td>VFX48-500</td></tr>
<tr><td>VFX48-600</td><td rowspan="3">I</td><td rowspan="3">(3x) 25 - 240</td><td rowspan="3">(3x) 25 - 240</td></tr>
<tr><td>VFX48-650</td></tr>
<tr><td>VFX48-720, 750</td></tr>
<tr><td>VFX48-860</td><td rowspan="3">J</td><td rowspan="3">(4x) 25 - 240</td><td rowspan="3">(4x) 25 - 240</td></tr>
<tr><td>VFX48-900</td></tr>
<tr><td>VFX48-1k0</td></tr>
<tr><td>VFX48-1k15</td><td rowspan="3">KA</td><td rowspan="3">(5x) 25 - 240</td><td rowspan="3">(5x) 25 - 240</td></tr>
<tr><td>VFX48-1k2</td></tr>
<tr><td>VFX48-1k25</td></tr>
<tr><td>VFX48-1k35</td><td rowspan="2">K</td><td rowspan="2">(6x) 25 - 240</td><td rowspan="2">(6x) 25 - 240</td></tr>
<tr><td>VFX48-1k5</td></tr>
<tr><td>VFX48-1k75</td><td>L</td><td>(7x) 25 - 240</td><td>(7x) 25 - 240</td></tr>
<tr><td>VFX48-2k0</td><td>M</td><td>(8x) 25 - 240</td><td>(8x) 25 - 240</td></tr>
<tr><td>VFX48-2k25</td><td>N</td><td>(9x) 25 - 240</td><td>(9x) 25 - 240</td></tr>
<tr><td>VFX48-2k5</td><td>O</td><td>(10x) 25 - 240</td><td>(10x) 25 - 240</td></tr>
</table>

* = With cable shoe for M6 screw.

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

Table 15 Cable connector range and tightening torque for Emotron VFX69, 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	
VFX69-090	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
VFX69-109								
VFX69-146								
VFX69-175								
VFX69-200								
VFX69-250	H69	(2x) 25 - 240	31 (for 25-34 mm^2) 42 (for 35-152 mm^2) 56 (for 153-240 mm^2)	(2x) 25 - 240	31 (for 25-34 mm^2) 42 (for 35-152 mm^2) 56 (for 153-240 mm^2)	PE/Earth via mounting screws/mounting frame. In order to secure proper earthing, always use all mounting screws and tighten them thoroughly.		
VFX69-300								
VFX69-375								
VFX69-400								
VFX69-430	I69	(3x) 25 - 240		(3x) 25 - 240				
VFX69-500								
VFX69-595								
VFX69-650	J69	(4x) 25 - 240		(4x) 25 - 240				
VFX69-720								
VFX69-800								
VFX69-905	KA69	(5x) 25 - 240		(5x) 25 - 240				
VFX69-995								
VFX69-1k2	K69	(6x) 25 - 240		(6x) 25 - 240				
VFX69-1k4	L69	(7x) 25 - 240		(7x) 25 - 240				
VFX69-1k6	M69	(8x) 25 - 240		(8x) 25 - 240				
VFX69-1k8	N69	(9x) 25 - 240		(9x) 25 - 240				
VFX69-2k0	O69	(10x) 25 - 240		(10x) 25 - 240				
VFX69-2k2	P69	(11x) 25 - 240		(11x) 25 - 240				
VFX69-2k4	Q69	(12x) 25 - 240		(12x) 25 - 240				
VFX69-2k6	R69	(13x) 25 - 240		(13x) 25 - 240				
VFX69-2k8	S69	(14x) 25 - 240		(14x) 25 - 240				
VFX69-3k0	T69	(15x) 25 - 240		(15x) 25 - 240				

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

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 VFX48 and VFX52, 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	
VFX##-003	B	20 - 8	11.5	20 - 8	11.5	16 - 6	23	Copper (Cu) 75 °C
VFX##-004								
VFX##-006								
VFX##-008								
VFX##-010								
VFX##-013								
VFX##-018								
VFX48-025	C2	12 - 4	18	12 - 4	18	12 - 4*	38	
VFX48-030								
VFX48-036								
VFX48-045								
VFX48-058								
VFX##-026	C	18 - 4	10.6-12.3	18 - 4	10.6-12.3	18 - 4	10.6-12.3	
VFX##-031								
VFX##-037								
VFX##-046								
VFX48-060	D2	10 - 0	30 - 50	10 - 0	30 - 50	8 - 2/0*	38	
VFX48-072								
VFX48-088	D2	3 - 2/0	70	3 - 2/0	70			
VFX48-105								
VFX##-061	D	10 - 0	24.3-26.1	10 - 0	24.3-26.1	10 - 0	24.3-26.1	
VFX##-074								
VFX48-142	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**	
VFX48-171								
VFX48-090	E							
VFX48-109								
VFX48-146								
VFX48-175								
VFX48-205	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**	
VFX48-244								
VFX48-293								
VFX48-210	F							
VFX48-228								
VFX48-250								
VFX48-295								

Table 16 Cable connector range and tightening torque for Emotron VFX48 and VFX52, 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	
VFX48-300	G	(2x) 4 - 500 kcmil	275 (for AWG 4 - 2) 375 (for AWG 1 - 300 kcmil) 500 (for AWG 350 -500 kcmil)	(2x) 4 - 500 kcmil	275 (for AWG 4 - 2) 375 (for AWG 1 -300 kcmil) 500 (for AWG 350 -500 kcmil)	PE/Earth via mounting screws/mounting frame. In order to secure proper earthing, always use all mounting screws and tighten them thoroughly.		Copper (Cu) 75°C
VFX48-375								
VFX48-430	H							
VFX48-500								
VFX48-600	I	(3x) 4 - 500 kcmil		(3x) 4 - 500 kcmil				
VFX48-650								
VFX48-720, 750								
VFX48-860	J	(4x) 4 - 500 kcmil		(4x) 4 - 500 kcmil				
VFX48-900								
VFX48-1k0								
VFX48-1k15	KA	(5x) 4 - 500 kcmil		(5x) 4 - 500 kcmil				
VFX48-1K2								
VFX48-1k25								
VFX48-1k35	K	(6x) 4 - 500 kcmil		(6x) 4 - 500 kcmil				
VFX48-1k5								
VFX48-1k75	L	(7x) 4 - 500 kcmil		(7x) 4 - 500 kcmil				
VFX48-2k0	M	(8x) 4 - 500 kcmil		(8x) 4 - 500 kcmil				
VFX48-2k25	N	(9x) 4 - 500 kcmil		(9x) 4 - 500 kcmil				
VFX48-2k5	O	(10x) 4 - 500 kcmil		(10x) 4 - 500 kcmil				

* = 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

The Drive Mode "Speed" or "Torque", see menu [213], performs very well in most applications based on the direct torque control as motor control method. However in applications with multiple motors connected in parallel to the AC drive output one should select Drive Mode = "V/Hz" and then it 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. 44 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.

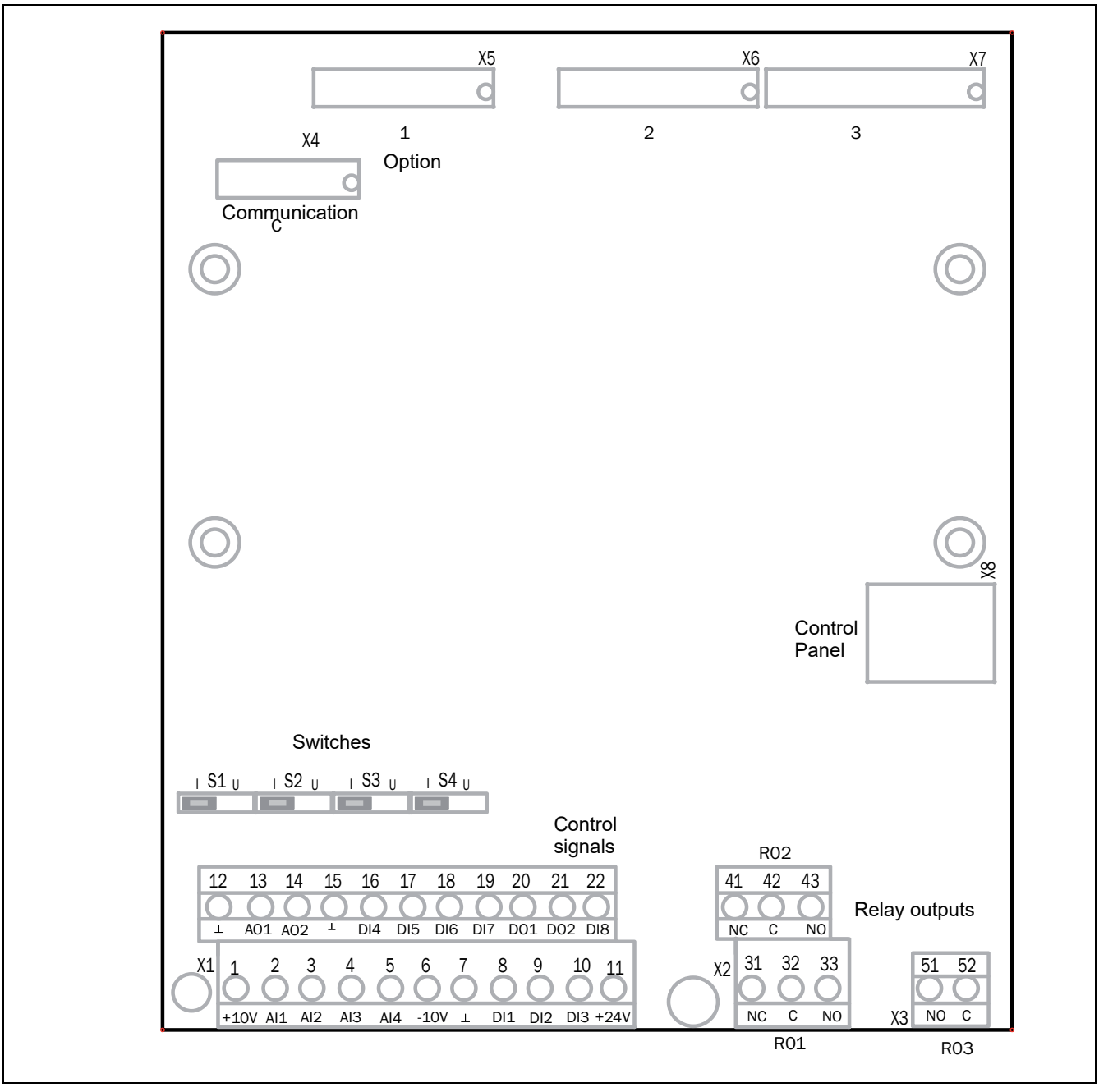


Fig. 44 Control board layout

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 11. page 71. For signal specifications refer to chapter 14. page 211.

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	-10 VDC supply voltage
7	Common	Signal ground
11	+24 V	+24 VDC supply voltage
12	Common	Signal ground
15	Common	Signal ground
Digital inputs		
8	DigIn 1	RunL (reverse)
9	DigIn 2	RunR (forward)
10	DigIn 3	Off
16	DigIn 4	Off
17	DigIn 5	Off
18	DigIn 6	Off
19	DigIn 7	Off
22	DigIn 8	RESET
Digital outputs		
20	DigOut 1	Ready
21	DigOut 2	Brake
Analogue inputs		
2	AnIn 1	Process Ref
3	AnIn 2	Off
4	AnIn 3	Off
5	AnIn 4	Off
Analogue outputs		
13	AnOut 1	Min speed to max speed
14	AnOut 2	0 to max torque

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.
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 13.6 page 206) 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. 44 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 11.5, page 144.

NOTE: the 2 analogue outputs AnOut 1 and AnOut 2 can be configured using the software. See menu [530] section 11.5.3, page 153

4.4 Connection example

Fig. 45 gives an overall view of a AC drive connection example.

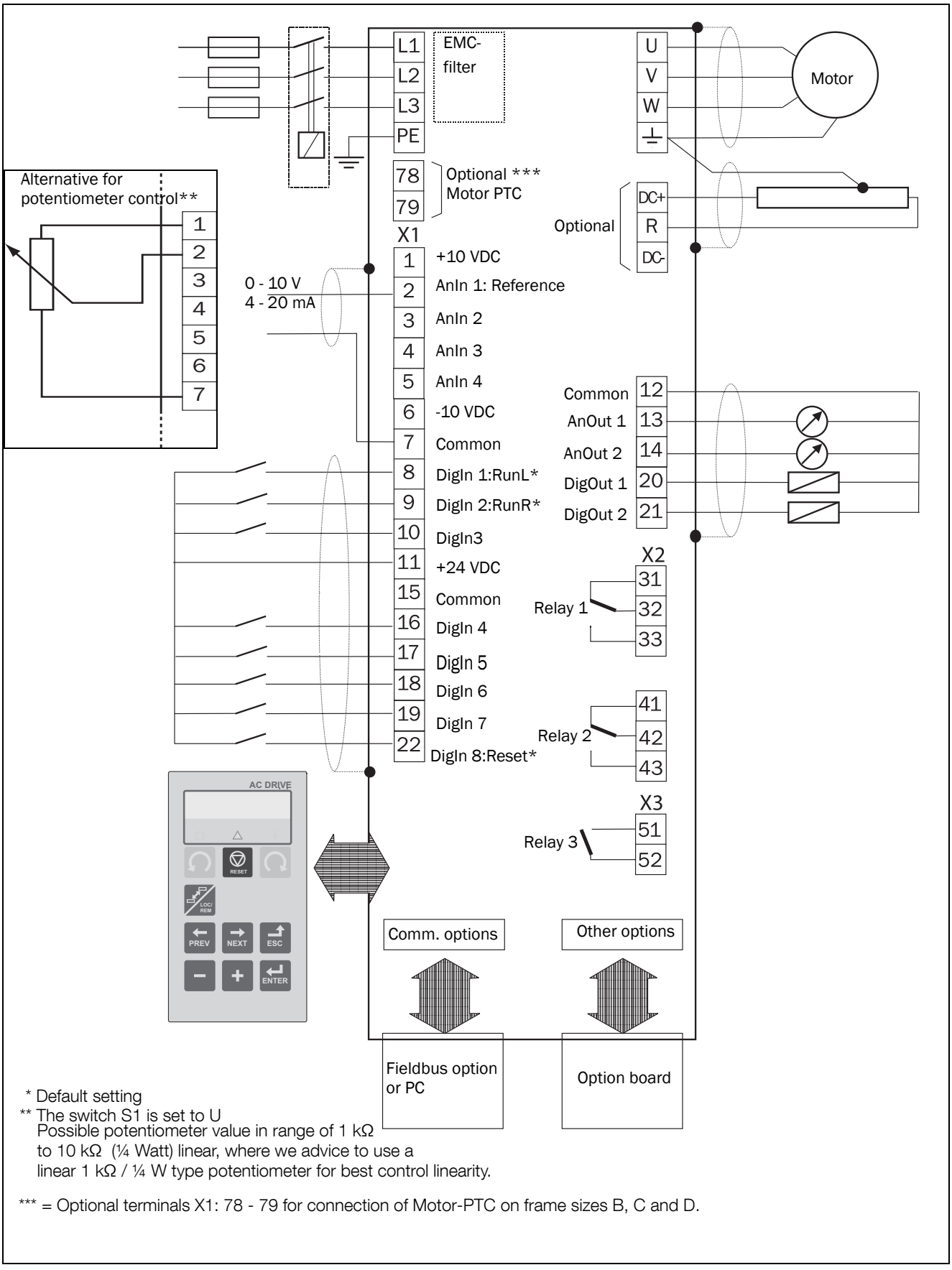


Fig. 45 Connection example

4.5 Connecting the Control Signals

4.5.1 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 19 Description of optional terminals in fig. 46 to fig. 50.

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

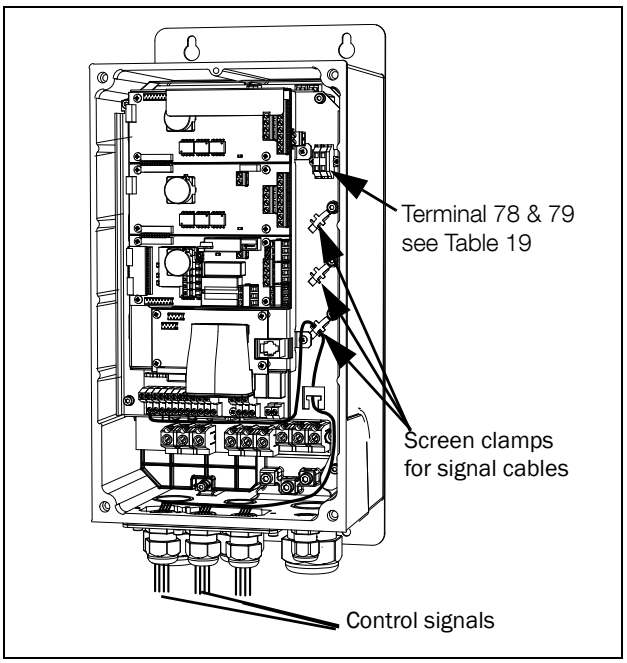


Fig. 46 Connecting the control signals, VFX model 003 to 018, frame size B.

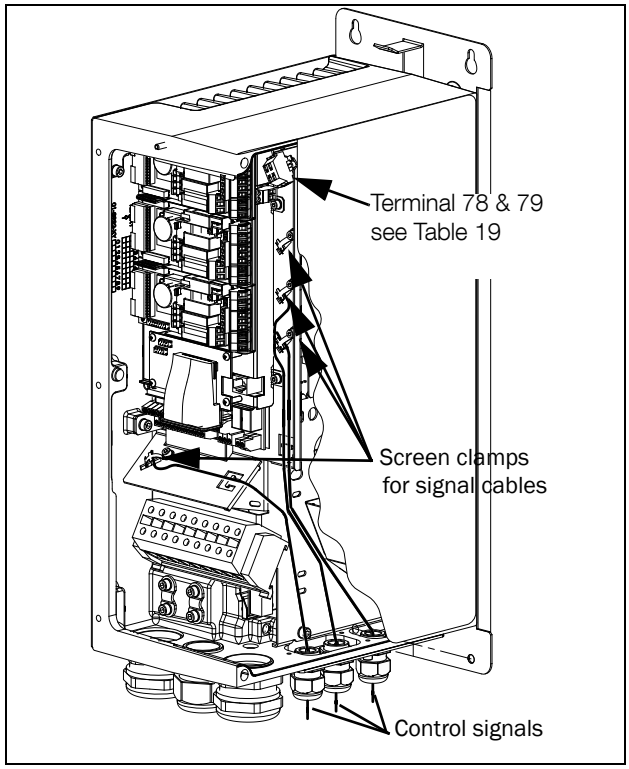


Fig. 47 Connecting the control signals, VFX model 026 to 046, frame size C.

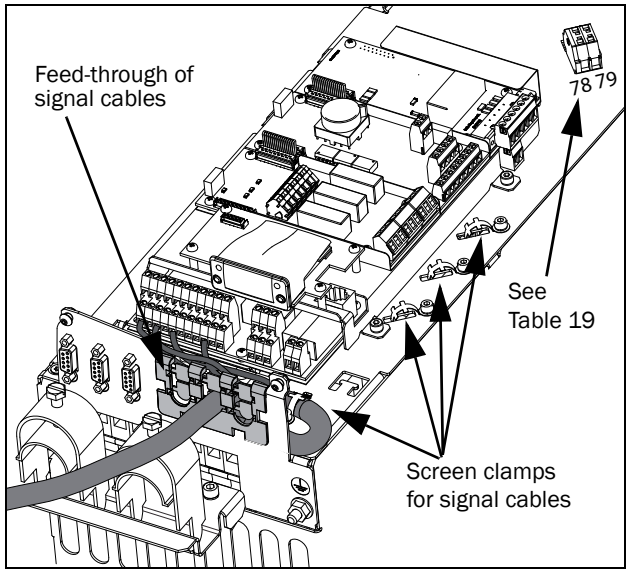


Fig. 48 Connecting the control signals, VFX model 48-025 to 48-058 frame size C2.

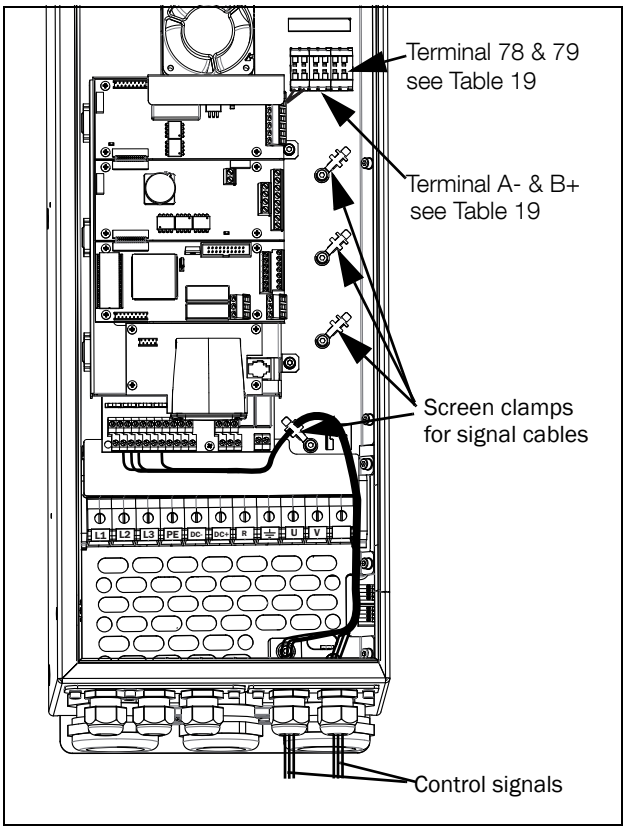


Fig. 49 Connecting the control signals, VFX model 061 to 074, frame size D.

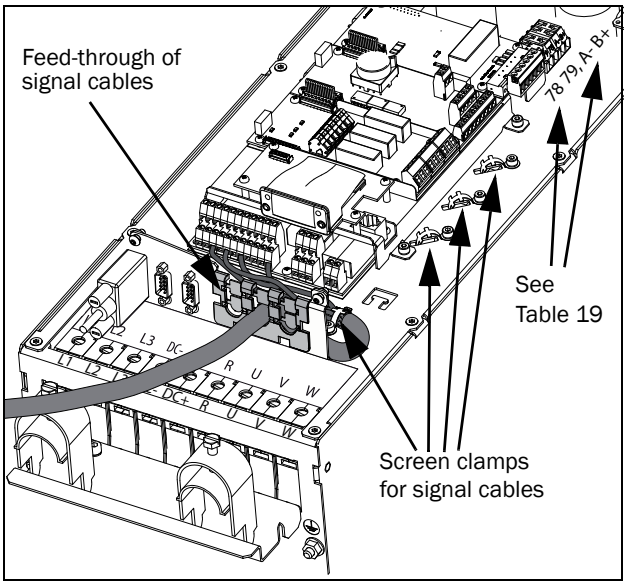


Fig. 50 Connecting the control signals, VFX model 48-060 to 48-105 frame size D2.

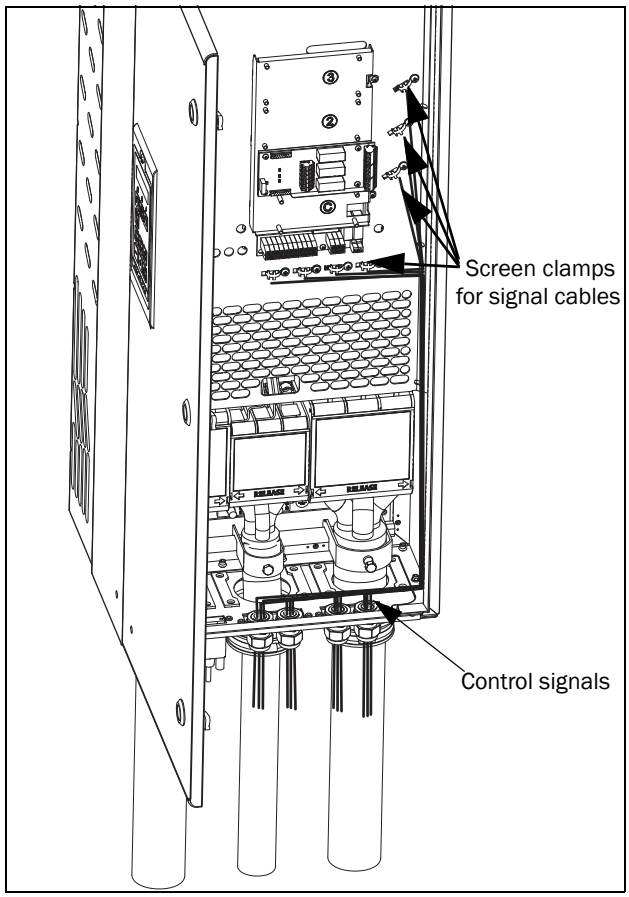


Fig. 51 Connecting the control signals, VFX model 48-090 to 295 and VFX model 69-90 to 200, frame size E, F and F69 (principle drawing).

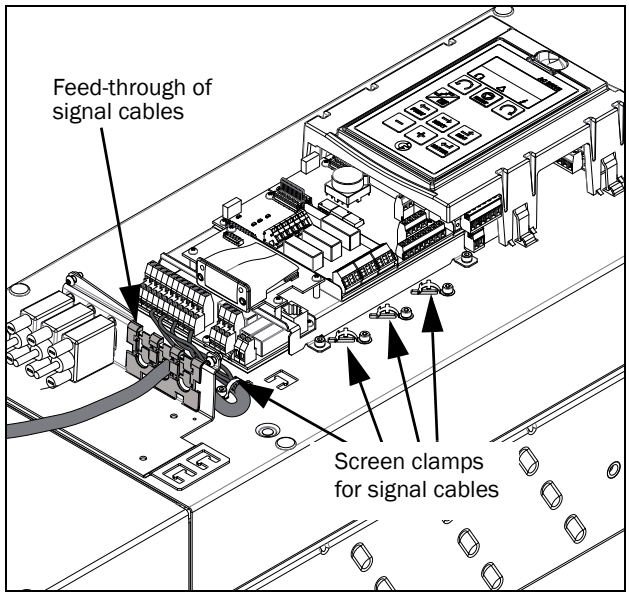


Fig. 52 Connecting the control signals, VFX model 48-142 to 48-293 frame size E2 and F2 (principle drawing)

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.

4.5.2 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.

4.5.3 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. 53.

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.

4.5.4 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 4.5.2 the best results are obtained if the screening is connected to both ends. See Fig. 53.

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

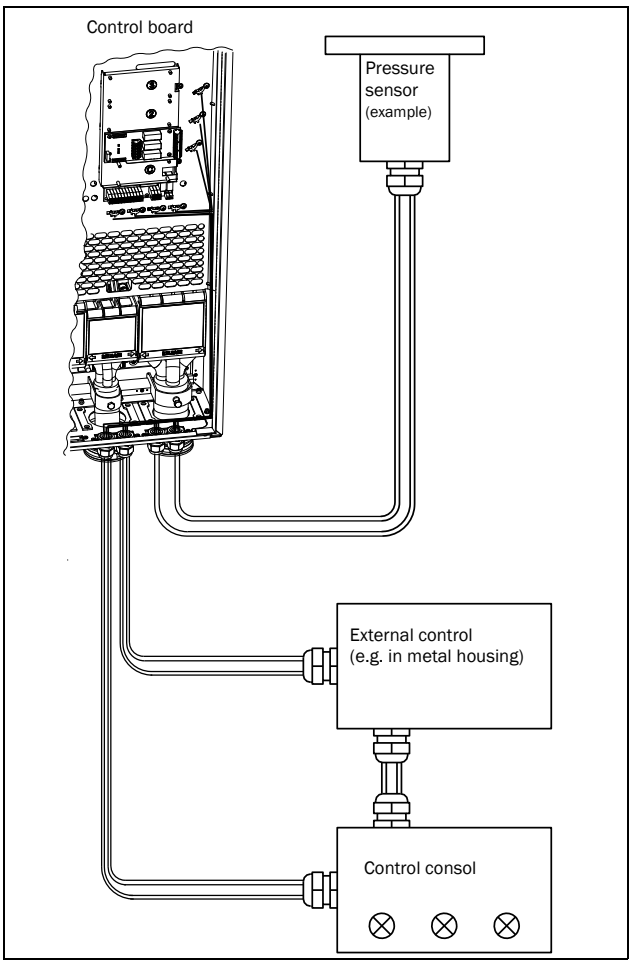


Fig. 53 Electro Magnetic (EM) screening of control signal cables.

4.5.5 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.

4.5.6 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°.

4.6 Connecting options

The option cards are connected by the optional connectors X4 or X5 on the control board see Fig. 44, page 37 and mounted above the control board. The inputs and outputs of the option cards are connected in the same way as other control signals.

5. Getting Started

This chapter is a step by step guide that will show you the quickest way to get the motor shaft turning. We will show you two examples, remote control and local control.

We assume that the AC drive is mounted on a wall or in a cabinet as in the chapter 2. page 11.

First there is general information of how to connect mains, motor and control cables. The next section describes how to use the function keys on the control panel. The subsequent examples covering remote control and local control describe how to program/set the motor data and run the AC drive and motor.

5.1 Connect the mains and motor cables

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

5.1.1 Mains cables

1. Connect the mains cables as in Fig. 54. The AC drive has, as standard, a built-in RFI mains filter that complies with category C3 which suits the Second Environment standard.

5.1.2 Motor cables

Connect the motor cables as in Fig. 54. To comply with the EMC directive you have to use screened cables and the motor cable screen has to be connected on both sides: to the housing of the motor and the housing of the AC drive.

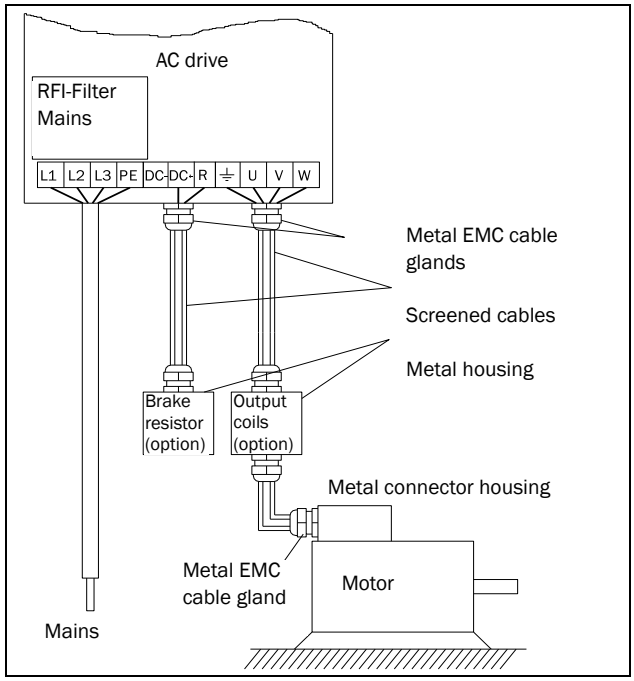


Fig. 54 Connection of mains and motor cables.

Table 20 Mains and motor connection

L1,L2,L3 PE	Mains supply, 3 -phase Safety earth
⏚ U, V, W	Motor earth Motor output, 3-phase

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

5.2 Using the function keys

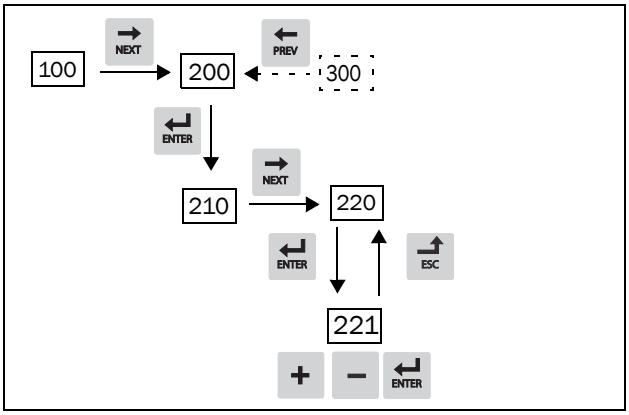


Fig. 55 Example of menu navigation when entering motor voltage

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

5.3 Remote control

In this example external signals are used to control the AC drive/motor.

A standard 4-pole motor for 400 V, an external start button and a reference value will also be used.

5.3.1 Connect control cables

Here you will make up the minimum wiring for starting. In this example the motor/AC drive will run with right rotation.

To comply with the EMC standard, use screened control cables with plaited flexible wire up to 1.5 mm^2 (AWG15) or solid wire up to 2.5 mm^2(AWG13).

2. Connect a reference value between terminals 7 (Common) and 2 (AnIn 1) as in Fig. 56.
3. Connect an external start button between terminal 11 (+24 VDC) and 9 (DigIn2, RUNR) as in Fig. 56.

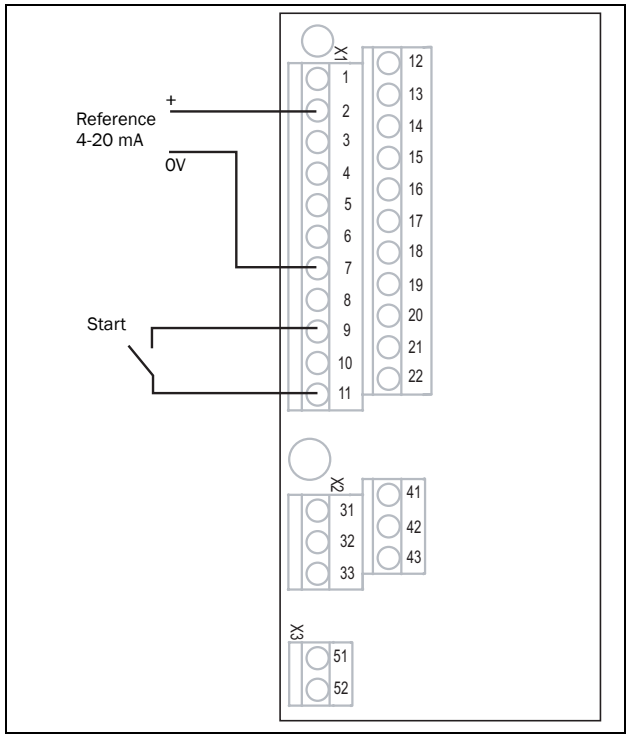


Fig. 56 Wiring

5.3.2 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).

5.3.3 Set the Motor Data

Enter correct motor data for the connected motor. The motor data is used in the calculation of complete operational data in the AC drive.

Change settings using the keys on the control panel. For further information about the control panel and menu structure, see the chapter 9. page 61.

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

1. Press NEXT to display menu [200], “Main Setup”.
2. Press ENTER and then NEXT 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. Set motor frequency [222].
6. Set motor power [223].
7. Set motor current [224].
8. Set motor speed [225].
9. Set power factor (cos φ) [227].
10. Select supply voltage level used [21B].
11. Set Motor type[22I].
12. [229] Motor ID run: Choose Short, confirm with ENTER and give start command ↻.

    The AC drive will now measure some motor parameters. The motor makes some beeping sounds but the shaft does not rotate. When the ID run is finished after about one minute ("Test Run OK!" is displayed), press STOP/RESET to continue.
13. Use AnIn1 as input for the reference value. The default range is 4-20 mA. If you need a 0-10 V reference value, change switch (S1) on control board.
14. Switch off power supply.
15. Connect digital and analogue inputs/outputs as in Fig. 56.
16. Ready!
17. Switch on power supply.

5.3.4 Run the AC drive

Now the installation is finished, and you can press the external start button to start the motor.

When the motor is running the main connections are OK.

5.4 Local control

Manual control via the control panel can be used to carry out a test run.

Use a 400 V motor and the control panel.

5.4.1 Switch on the mains

Once the mains is switched on, the AC drive is started and the internal fan will run for 5 seconds (In frame size A3 the fan runs continuously).

5.4.2 Select manual control

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

1. Press NEXT to display menu [200], “Main Setup”.
2. Press ENTER to display menu [210], “Operation”.
3. Press ENTER to display menu [211], “Language”.
4. Press NEXT to display menu [214], “Reference Control”.
5. Select **Keyboard** using the key + and press ENTER to confirm.
6. Press NEXT to get to menu [215], “Run/Stop Control”.
7. Select **Keyboard** using the key + and press ENTER to confirm.
8. Press ESC to get to previous menu level and then NEXT to display menu [220], “Motor Data”.

5.4.3 Set the Motor Data

Enter correct motor data for the connected motor.

9. Press ENTER to display menu [221].
10. Change the value using the + and − keys. Confirm with ENTER.
11. Press NEXT to display menu [222].
12. Repeat step 9 and 10 until all motor data is entered.
13. Press ESC twice and then PREV to display menu [100], Preferred View.

5.4.4 Enter a Reference Value

Enter a reference value.

14. Press NEXT until menu [300], “Process” is displayed.
15. Press ENTER to display menu [310], “Set/View reference” value.
16. Use the + and − keys to enter, for example, 300 rpm. We select a low value to check the rotation direction without damaging the application.

5.4.5 Run the AC drive

Press the ↻ key on the control panel to run the motor forward.

If the motor is running the main connections are OK.

6. Applications

This chapter contains tables giving an overview of many different applications/duties in which it is suitable to use AC drives from CG Drives & Automation. Further on you will find application examples of the most common applications and solutions.

6.1 Application overview

6.1.1 Cranes

Challenge	Emotron VFX solution	Menu
Starting with heavy load is difficult and risky. Can lead to jerks causing swinging load.	Direct torque control, fast motor pre-magnetization and precise brake control gives instant yet soft start with heavy load.	331–338, 339, 351
Jerky movements can cause load to be dropped, jeopardizing safety of people and goods.	Deviation control immediately detects load change. Signals to parallel safety system to activate mechanical brakes.	3AB, 3AC
Crane is driven slowly when returning empty or with light load. Valuable time is lost.	Speed can be increased by field weakening.	343, 3AA, 3AD, 713
Braking with heavy load is difficult and risky. Can lead to jerks causing swinging load.	Direct torque control and vector brake gradually reduce speed to zero before mechanical brake is activated.	213, 33E,33F, 33G
Operator starts braking long before end position to avoid jerks. Valuable time is lost.	System automatically stops crane at end position. Operator can safely drive at full speed.	3A2–3AA

6.1.2 Crushers

Challenge	Emotron VFX solution	Menu
High start currents require larger fuses and cables, or for mobile crushers larger diesel generators.	Direct torque control reduces start current. Same fuses as those for the motor, or smaller generator.	331-338, 351
Difficult to start with heavy load.	Possible to boost torque at start to overcome initial torque peak.	351–353
Material that could cause damage gets into the crusher.	Load Curve Protection quickly detects deviation. Warning is sent or safety stop activated.	411–41C9
Process inefficiency due to e.g. broken feeder or worn jaw. Wasted energy, mechanical stress, and risk of process failure.	Load Curve Protection quickly detects deviation from normal load. Warning is sent or safety stop activated.	411–41B, 41C1–41C9

6.1.3 Mills

Challenge	Emotron VFX solution	Menu
High start currents require larger fuses and cables. Cause stress on equipment and higher energy cost.	Direct torque control reduces start current. Same fuses can be used as those required for the motor.	331-338, 350
Difficult to start with heavy load.	Possible to boost torque at start to overcome initial torque peak.	351–353
Material that could cause damage gets into the mill.	Load Curve Protection quickly detects deviation. Warning is sent or safety stop activated.	411–41C9
Process inefficiency due to broken or worn equipment. Energy wasted and risk of process failure.	Load Curve Protection quickly detects deviation. Warning is sent or safety stop activated.	411–41B, 41C1–41C9

6.1.4 Mixers

Challenge	Emotron VFX solution	Menu
High start currents require larger fuses and cables. Cause stress on equipment and higher energy cost.	Direct torque control reduces start current. Same fuses can be used as those required for the motor.	331-338, 350
Difficult to determine when mixing process is ready.	Built-in shaft power monitor determines when viscosity is right.	411–41B
Process inefficiency due to e.g. a damaged or broken blade. Energy wasted and risk of process failure.	Load Curve Protection quickly detects deviation. Warning is sent or safety stop activated.	411–41B, 41C1 –41C9

7. Main Features

This chapter contains descriptions of the main features of the AC drive.

7.1 Parameter sets

Only valid if the option HCP - Handheld Control Panel is used.

Parameter sets are used if an application requires different settings for different modes. For example, a machine can be used for producing different products and thus requires two or more maximum speeds and acceleration/deceleration times. With the four parameter sets different control options can be configured with respect to quickly changing the behaviour of the AC drive. It is possible to adapt the AC drive online to altered machine behaviour. This is based on the fact that at any desired moment any one of the four parameter sets can be activated during Run or Stop, via the digital inputs or the control panel and menu [241].

Each parameter set can be selected externally via a digital input. Parameter sets can be changed during operation and stored in the control panel.

NOTE: The only data not included in the parameter set is Motor data 1-4, (entered separately), language, communication settings, selected set, local remote, and keyboard locked.

Define parameter sets

When using parameter sets you first decide how to select different parameter sets. The parameter sets can be selected via the control panel, via digital inputs or via serial communication. All digital inputs and virtual inputs can be configured to select parameter set. The function of the digital inputs is defined in the menu [520].

Fig. 57 shows the way the parameter sets are activated via any digital input configured to Set Ctrl 1 or Set Ctrl 2.

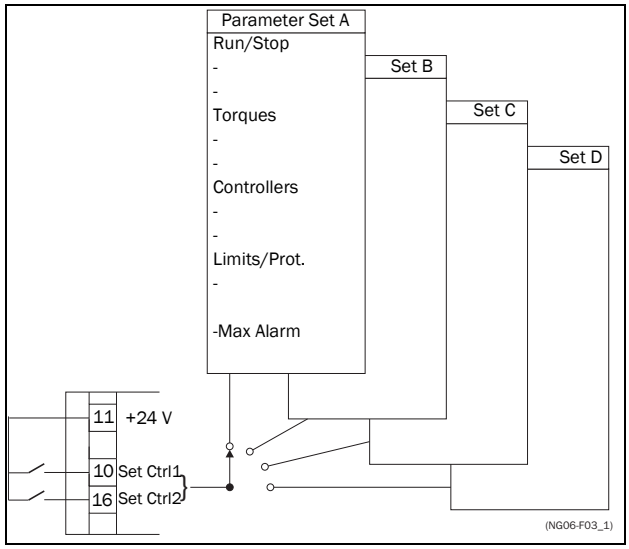


Fig. 57 Selecting the parameter sets

Select and copy parameter set

The parameter set selection is done in menu [241], “Select Set”. First select the main set in menu [241], normally A. Adjust all settings for the application. Usually most parameters are common and therefore it saves a lot of work by copying set A>B in menu [242]. When parameter set A is copied to set B you only change the parameters in the set that need to be changed. Repeat for C and D if used.

With menu [242], Copy Set, it is easy to copy the complete contents of a single parameter set to another parameter set. If, for example, the parameter sets are selected via digital inputs, DigIn 3 is set to Set Ctrl 1 in menu [523] and DigIn 4 is set to Set Ctrl 2 in menu [524], they are activated as in Table 21.

Activate the parameter changes via digital input by setting menu [241], “Select Set” to DigIn.

Table 21 Parameter set

Parameter set	Set Ctrl 1	Set Ctrl 2
A	0	0
B	1	0
C	0	1
D	1	1

NOTE: The selection via the digital inputs is immediately activated. The new parameter settings will be activated on-line, also during Run.

NOTE: The default parameter set is parameter set A.

Examples

Different parameter sets can be used to easily change the setup of a AC drive to adapt quickly to different application requirements. For example when

- a process needs optimized settings in different stages of the process, to
  - increase the process quality
  - increase control accuracy
  - lower maintenance costs
  - increase operator safety

With these settings a large number of options are available. Some ideas are given here:

Multi frequency selection

Within a single parameter set the 7 preset references can be selected via the digital inputs. In combination with the parameter sets, 28 preset references can be selected using all 5 digital inputs: DigIn1, 2 and 3 for selecting preset reference within one parameter set and DigIn 4 and DigIn 5 for selecting the parameter sets.

Bottling machine with 3 different products

Use 3 parameter sets for 3 different Jog reference speeds when the machine needs to be set up. The 4th parameter set can be used for “normal” remote control when the machine is running at full production.

Product changing on winding machines

If a machine has to change between 2 or 3 different products e.g. winding machine with different gauges of thread, it is important that acceleration, deceleration times, Max Speed and Max Torque are adapted. For each thread size a different parameter set can be used.

Manual - automatic control

If in an application something is filled up manually and then the level is automatically controlled using PID regulation, this is solved using one parameter set for the manual control and one for the automatic control.

7.1.1 One motor and one parameter set

This is the most common application for pumps and fans.

Once default motor M1 and parameter set A have been selected:

1. Enter the settings for motor data.
2. Enter the settings for other parameters e.g. inputs and outputs

7.1.2 One motor and two parameter sets

This application is useful if you for example have a machine running at two different speeds for different products.

Once default motor M1 is selected:

1. Select parameter set A in menu [241].
2. Enter motor data in menu [220].
3. Enter the settings for other parameters e.g. inputs and outputs.
4. If there are only minor differences between the settings in the parameter sets, you can copy parameter set A to parameter set B, menu [242].
5. Enter the settings for parameters e.g. inputs and outputs.

Note: Do not change motor data in parameter set B.

7.1.3 Two motors and two parameter sets

This is useful if you have a machine with two motors that can not run at the same time, such as a cable winding machine that lifts up the reel with one motor and then turns the wheel with the other motor.

One motor must stop before changing to an other motor.

1. Select parameter set A in menu [241].
2. Select motor M1 in menu [212].
3. Enter motor data and settings for other parameters e.g. inputs and outputs.
4. Select parameter set B in menu [241].
5. Select M2 in menu [212].
6. Enter motor data and settings for other parameters e.g. inputs and outputs.

7.1.4 Autoreset at trip

For several non-critical application-related failure conditions, it is possible to automatically generate a reset command to overcome the fault condition. The selection can be made in menu [250]. In this menu the maximum number of automatically generated restarts allowed can be set, see menu [251], after this the AC drive will stay in fault condition because external assistance is required.

Example

The motor is protected by an internal protection for thermal overload. When this protection is activated, the AC drive should wait until the motor is cooled down enough before resuming normal operation. When this problem occurs three times in a short period of time, external assistance is required.

The following settings should be applied:

- Insert maximum number of restarts; set menu [251] to 3.
- Activate Motor I^2t to be automatically reset; set menu [25A] to 300 s.
- Set relay 1, menu [551] to "AutoRst Trip"; a signal will be available when the maximum number of restarts is reached and the AC drive stays in fault condition.
- The reset input must be constantly activated.

7.1.5 Reference priority

The active speed reference signal can be programmed from several sources and functions. The table below shows the priority of the different functions with regards to the speed reference.

Table 22 Reference priority

Main Priority	Ref. selection	Priority
1. Jog, (menu [520], [348])	-	
2. Reference selection, (menu [214])	Remote	1. Preset
		2. MotPot
		3. AnIn
	Keypad	-
	Com	-
	Option	-

7.1.6 Preset references

The AC drive is able to select fixed speeds via the control of digital inputs. This can be used for situations where the required motor speed needs to be adapted to fixed values, according to certain process conditions. Up to 7 preset references can be set for each parameter set, which can be selected via all digital inputs that are set to Preset Ctrl1, Preset Ctrl2 or Preset Ctrl3. The amount digital inputs used that are set to Preset Ctrl determines the number of Preset References available; using 1 input gives 1 speed, using 2 inputs gives 3 speeds and using 3 inputs gives 7 speeds.

Example

The use of four fixed speeds, at 50 / 100 / 300 / 800 rpm, requires the following settings:

- Set DigIn 5 as first selection input; set [525] to Preset Ctrl1.
- Set DigIn 6 as second selection input; set [526] to Preset Ctrl2.
- Set menu [341] "Min Speed" to 50 rpm.
- Set menu [362] "Preset Ref 1" to 100 rpm.
- Set menu [363] "Preset Ref 2" to 300 rpm.
- Set menu [364] "Preset Ref 3" to 800 rpm.

With these settings, the AC drive switched on and a RUN command given, the speed will be:

- 50 rpm, when both DigIn 5 and DigIn 6 are low.
- 100 rpm, when DigIn 5 is high and DigIn 6 is low.
- 300 rpm, when DigIn 5 is low and DigIn 6 is high.
- 800 rpm, when both DigIn 5 and DigIn 6 are high.

7.2 Remote control functions

Operation of the Run/Stop/Enable/Reset functions

As default, all the run/stop/reset related commands are programmed for remote operation via the inputs on the terminal strip (terminals 1-22) on the control board. With the function “Run/Stp Ctrl” [215] and “Reset Control” [216], this can be selected for keyboard or serial communication control.

NOTE: The examples in this paragraph do not cover all possibilities. Only the most relevant combinations are given. The starting point is always the default setting (factory) of the AC drive.

Default settings of the Run/Stop/ Enable/Reset functions

The default settings are shown in Fig. 58. In this example the AC drive is started and stopped with DigIn 2 and a reset after trip can be given with DigIn 8.

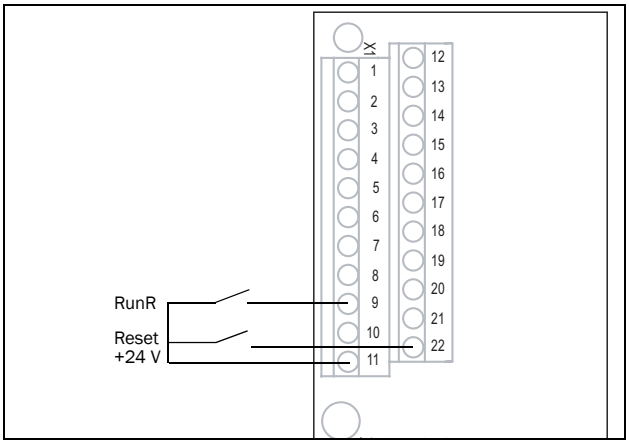


Fig. 58 Default setting Run/Reset commands

The inputs are default set for level-control. The rotation is determined by the setting of the digital inputs.

Enable and Stop functions

Both functions can be used separately or simultaneously. The choice of which function is to be used depends on the application and the control mode of the inputs (Level/Edge [21A]).

NOTE: In Edge mode, at least one digital input must be programmed to “stop”, because the Run commands are only able to start the AC drive.

Enable

Input must be active (HI) to allow any Run signal. If the input is made LOW, the output of the AC drive is immediately disabled and the motor will coast.

CAUTION!
If the Enable function is not programmed to a digital input, it is considered to be active internally.

Stop

If the input is low then the AC drive will stop according to the selected stop mode set in menu [33B] “Stop Mode”. Fig. 59 shows the function of the Enable and the Stop input and the Stop Mode=Decel [33B].

To run the input must be high.

NOTE: Stop Mode=Coast [33B] will give the same behaviour as the Enable input.

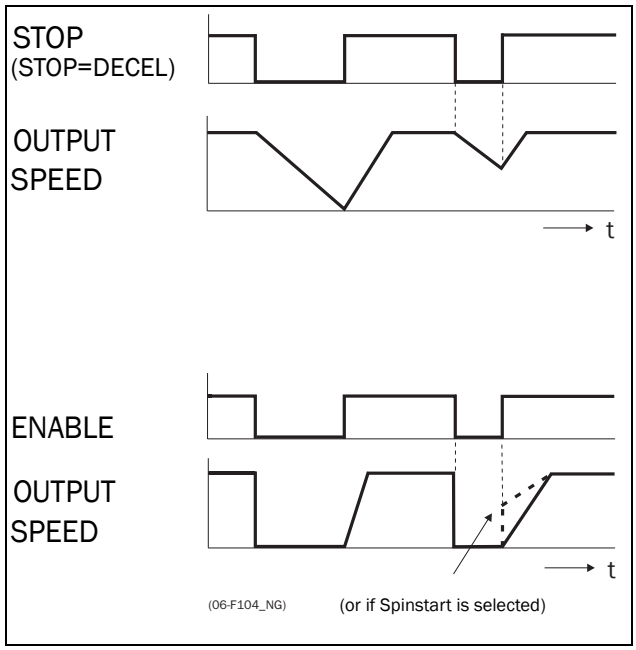


Fig. 59 Functionality of the Stop and Enable input

Reset and Autoreset operation

If the AC drive is in Stop Mode due to a trip condition, the AC drive can be remotely reset by a pulse (“low” to “high” transition) on the Reset input, default on DigIn 8. Depending on the selected control method, a restart takes place as follows:

Level-control

If the Run inputs remain in their position the AC drive will start immediately after the Reset command is given.

Edge-control

After the Reset command is given a new Run command must be applied to start the AC drive again.

Autoreset is enabled if the Reset input is continuously active. The Autoreset functions are programmed in menu “Autoreset [250]”.

NOTE: If the control commands are programmed for Keyboard control or Com, Autoreset is not possible.

Run Inputs Level-controlled.

The inputs are set as default for level-control. This means that an input is activated by making the input continuously “High”. This method is commonly used if, for example, PLCs are used to operate the AC drive.

CAUTION!
Level-controlled inputs DO NOT comply with the Machine Directive, if the inputs are directly used to start and stop the machine.

The examples given in this and the following paragraphs follow the input selection shown in Fig. 60.

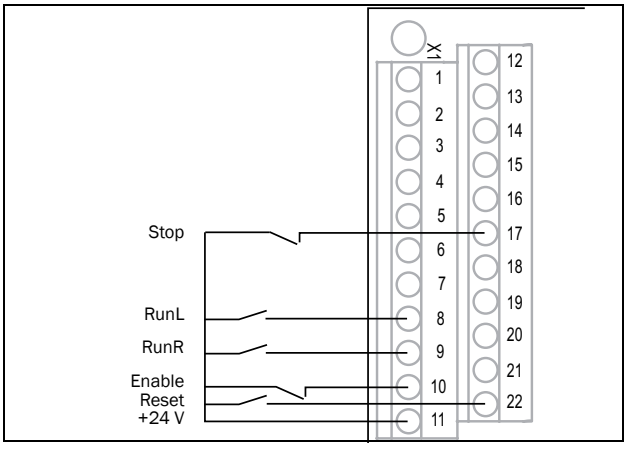


Fig. 60 Example of wiring for Run/Stop/Enable/Reset inputs

The Enable input must be continuously active in order to accept any run-right or run-left command. If both RunR and RunL inputs are active, then the AC drive stops according to the selected Stop Mode. Fig. 61 gives an example of a possible sequence.

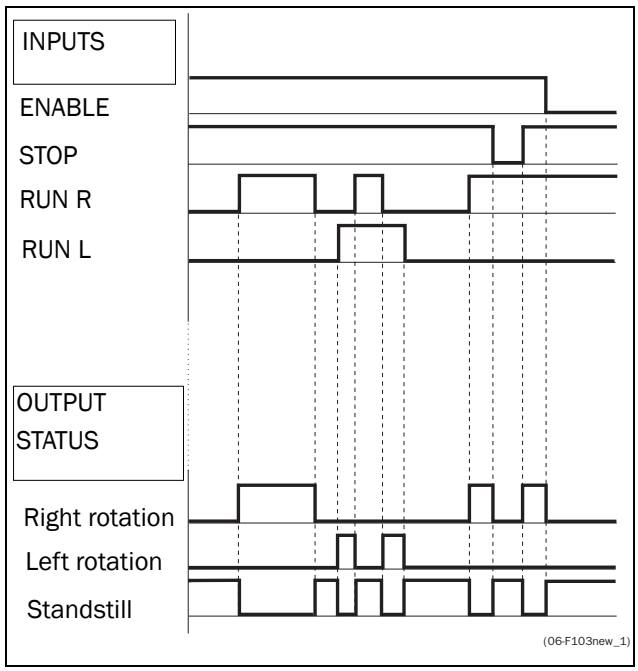


Fig. 61 Input and output status for level-control

Run Inputs Edge-controlled

Menu “[21A] Start signal” Level/Edge must be set to Edge to activate edge control. This means that an input is activated by a “low” to “high” transition or vice versa.

NOTE: Edge-controlled inputs comply with the Machine Directive (see Chapter 8. page 59), if the inputs are directly used for starting and stopping the machine.

See Fig. 60. The Enable and Stop input must be active continuously in order to accept any run-right or run-left command. The last edge (RunR or RunL) is valid. Fig. 62 gives an example of a possible sequence.

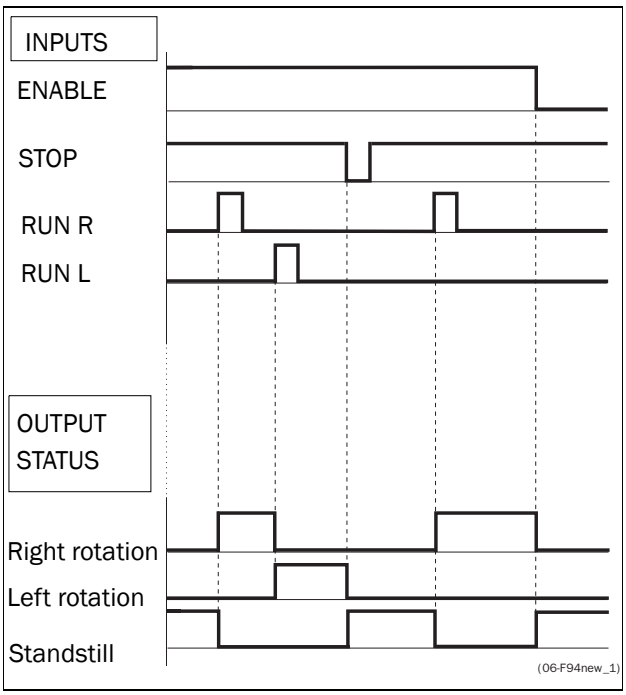


Fig. 62 Input and output status for edge-control

7.3 Performing an Identification Run

To get the optimum performance out of your AC drive/ motor combination, the AC drive must measure the electrical parameters (resistance of stator winding, etc.) of the connected motor. See menu [229] “Motor ID-Run”.

It is recommended that the extended ID run is used before the motor is installed in the application.

If this is not possible, the short ID run should be used.

WARNING!
During the extended ID RUN, the motor shaft will rotate. Take safety measures to avoid unforeseen dangerous situations.

7.4 Using the Control Panel Memory

Data can be copied from the AC drive to the memory in the control panel and vice versa. To copy all data (including parameter set A-D and motor data) from the AC drive to the control panel, select Copy to CP[234], Copy to CP.

To copy data from the control panel to the AC drive, enter the menu [235], Load from CP and select what you want to copy.

The memory in the control panel is useful in applications with AC drives without a control panel and in applications where several AC drives have the same setup. It can also be used for temporary storage of settings. Use a control panel to upload the settings from one AC drive and then move the control panel to another AC drive and download the settings.

NOTE: Load from and copy to the AC drive is only possible when the AC drive is in stop mode.

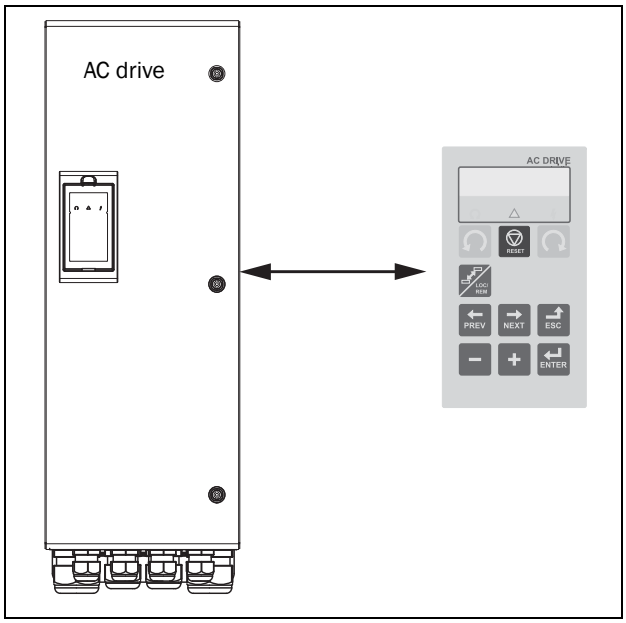


Fig. 63 Copy and load parameters between AC drive and control panel

7.5 Load Monitor and Process Protection [400]

7.5.1 Load Monitor [410]

The monitor functions enable the AC drive to be used as a load monitor. Load monitors are used to protect machines and processes against mechanical overload and underload, such as a conveyer belt or screw conveyer jamming, belt failure on a fan or a pump dry running. The load is measured in the AC drive by the calculated motor shaft torque. There is an overload alarm (Max Alarm and Max Pre-Alarm) and an underload alarm (Min Alarm and Min Pre-Alarm).

The Basic Monitor type uses fixed levels for overload and underload (pre-)alarms over the whole speed range. This function can be used in constant load applications where the torque is not dependent on the speed, e.g. conveyor belt, displacement pump, screw pump, etc.

For applications with a torque that is dependent on the speed, the Load Curve monitor type is preferred. By measuring the actual load curve of the process, characteristically over the range of minimum speed to maximum speed, an accurate protection at any speed can be established.

The max and min alarm can be set for a trip condition. The pre-alarms act as a warning condition. All the alarms can be monitored on the digital or relay outputs.

The autoset function automatically sets the 4 alarm levels whilst running: maximum alarm, maximum pre-alarm, minimum alarm and minimum pre-alarm.

Fig. 64 gives an example of the monitor functions for constant torque applications.

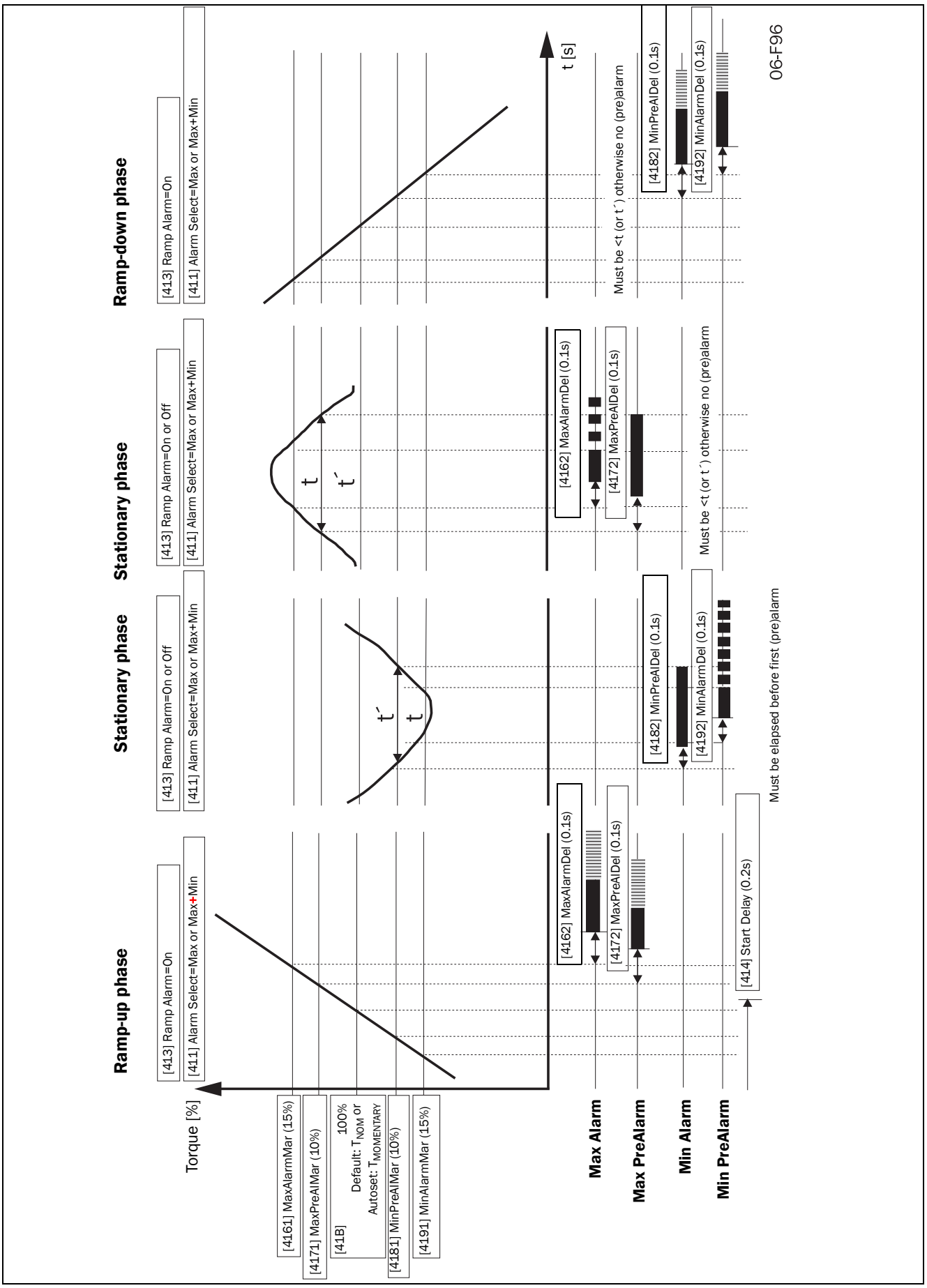

Ramp-up phase
Stationary phase
Stationary phase
Ramp-down phase
[413] Ramp Alarm=On
[411] Alarm Select=Max or Max+Min
[413] Ramp Alarm=On or Off
[411] Alarm Select=Max or Max+Min
[413] Ramp Alarm=On or Off
[411] Alarm Select=Max or Max+Min
[413] Ramp Alarm=On
[411] Alarm Select=Max or Max+Min
Torque [%]
t [s]
t
t´
t´
t
[4161] MaxAlarmMar (15%)
[4171] MaxPreAlMar (10%)
[41B] 100%
Default: T_NOM or
Autoset: T_MOMENTARY
[4181] MinPreAlMar (10%)
[4191] MinAlarmMar (15%)
[4162] MaxAlarmDel (0.1s)
[4172] MaxPreAlDel (0.1s)
[4182] MinPreAlDel (0.1s)
[4192] MinAlarmDel (0.1s)
[414] Start Delay (0.2s)
Must be elapsed before first (pre)alarm
Must be <t (or t´) otherwise no (pre)alarm
Must be <t (or t´) otherwise no (pre)alarm
Max Alarm
Max PreAlarm
Min Alarm
Min PreAlarm
06-F96

Fig. 64

8. EMC and standards

8.1 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 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.

8.2 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

9. Operation via the Control Panel

This chapter describes how to use the control panel. The AC drive can be delivered with a control panel or a blank panel.

9.1 General

The control panel displays the status of the AC drive and is used to set all the parameters. It is also possible to control the motor directly from the control panel. The control panel can be built-in or located externally via serial communication.The AC drive can be ordered without the control panel. Instead of the control panel there will be a blank panel.

NOTE: The AC drive can run without the control panel being connected. However the settings must be such that all control signals are set for external use.

9.2 The control panel

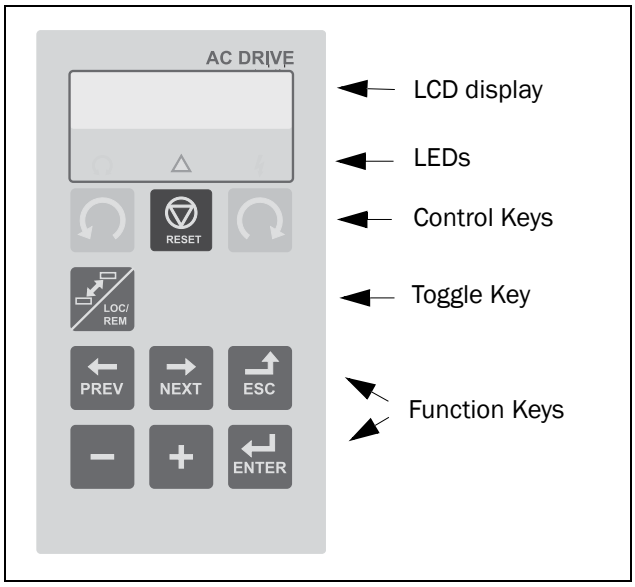


Fig. 65 Control panel display, LEDs and Keys.

9.2.1 The display

The display is back lit and consists of 2 rows, each with space for 16 characters. The display is divided into six areas.

The different areas in the display are described below:

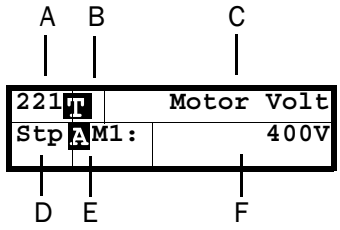


Fig. 66 The display

Area A: Shows the actual menu number (3 or 4 digits).

Area B Shows if the menu is in the toggle loop or the AC drive is set for Local operation.

Area C: Shows the heading of the active menu.

Area D *: Shows the status of the AC drive (3 digits). The following status indications are possible:

Digits	Description	Bit*
Stp	Motor is stopped	0
Run	Motor runs	1
Acc	Acceleration	2
Dec	Deceleration	3
Trp	Tripped	4
SST	Operating Safe Stop, is flashing when activated	5
VL	Operating at voltage limit	6
SL	Operating at speed limit	7
CL	Operating at current limit	8
TL	Operating at torque limit	9
OT	Operating at temperature limit	10
I^2t	Active I^2t protection	11
LV	Operating at low voltage	12
Sby	Operating from Standby power supply	13
LCL	Operating with low cooling liquid level	14
Slp	Sleep mode	15
SPS	Spin start active	16

*) The status shown in Area D on the control panel can be read via a fieldbus or serial communication, e.g. using Modbus address nr 30053.
It is also possible to read all status indications, not just the highest prioritized one, via a fieldbus or serial communication, e.g. using Modbus address nr 30180 and 30182. This information is also shown in EmoSoftCom PC-tool (optional) see menu “Area D stat [72B]”.

Area E: Shows active parameter set and if it is a motor parameter.

Area F: Shows the setting or selection in the active menu. This area is empty at the 1st level and 2nd level menu. This area also shows warnings and alarm messages. In some situations this area could indicate "+++" or " - - -" please see further information in Chapter 9.2.2 page 62



Fig. 67 Example 1st level menu

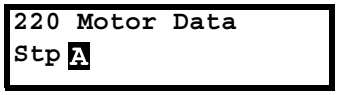


Fig. 68 Example 2nd level menu

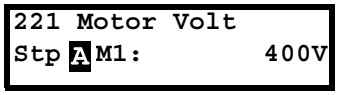


Fig. 69 Example 3d level menu

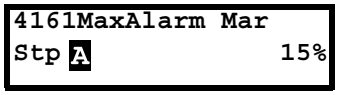


Fig. 70 Example 4th level menu

9.2.2 Indications on the display

The display can indicate "+++" or "- - -" if a parameter is out of range. In the AC drive there are parameters which are dependent on other parameters. For example, if the speed reference is 500 and the maximum speed value is set to a value below 500, this will be indicated with "+++" on the display. If the minimum speed value is set over 500, "- - -" is displayed.

9.2.3 LED indicators

The symbols on the control panel have the following functions:

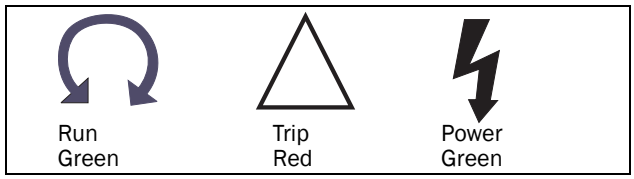


Fig. 71 LED indications

Table 23 LED indication

Symbol	Function		
	ON	FLASHING	OFF
POWER (green)	Power on	----------	Power off
TRIP (red)	AC drive tripped	Warning/Limit	No warning or trip
RUN (green)	Motor shaft rotates	Motor speed increase/ decrease	Motor stopped

9.2.4 Control keys

The control keys are used to give the Run, Stop or Reset commands directly. As default these keys are disabled, set for remote control. Activate the control keys by selecting Keyboard in the menus "Ref Control [214]", "Run/Stop Control [215]" and "Reset Ctrl [216]".

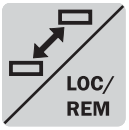
If the Enable function is programmed on one of the digital inputs, this input must be active to allow Run/Stop commands from the control panel.

Table 24 Control keys

	RUN L:	gives a start with left rotation
RESET	STOP/RESET:	stops the motor or resets the AC drive after a trip
	RUN R:	gives a start with right rotation

NOTE: It is not possible to simultaneously activate the Run/Stop commands from the keyboard and remotely from the terminal strip (terminals 1-22). Exception is the JOG-function which can give start command, see " Jog Speed [348]" on page 117

9.2.5 The Toggle and Loc/Rem Key



This key has two functions: Toggle and switching between Loc/Rem function.

Press one second to use the toggle function

Press and hold the toggle key for more than five seconds to switch between Local and Remote function, depending on the settings in [2171] and [2172].

When editing values, the toggle key can be used to change the sign of the value, see section 9.5, page 65.

Toggle function

Using the toggle function makes it possible to easily step through selected menus in a loop. The toggle loop can contain a maximum of ten menus. As default the toggle loop contains the menus needed for Quick Setup. You can use the toggle loop to create a quick-menu for the parameters that are most importance to your specific application.

NOTE: Do not keep the Toggle key pressed for more than five seconds without pressing either the +, - or Esc key, as this may activate the Loc/Rem function of this key instead. See menu [217].

Add a menu to the toggle loop

1. Go to the menu you want to add to the loop.
2. Press the Toggle key and keep it pressed while pressing the + key.

Delete a menu from the toggle loop

1. Go to the menu you want to delete using the toggle key.
2. Press the Toggle key and keep it pressed while pressing the - key.

Delete all menus from the toggle loop

1. Press the Toggle key and keep it pressed while pressing the Esc key.
2. Confirm with Enter.

Default toggle loop

Fig. 72 shows the default toggle loop. This loop contains the necessary menus that need to be set before starting. Press Toggle to enter menu [211] then use the Next key to enter the sub menus [212] to [21A] and enter the parameters. When you press the Toggle key again, menu [221] is displayed.

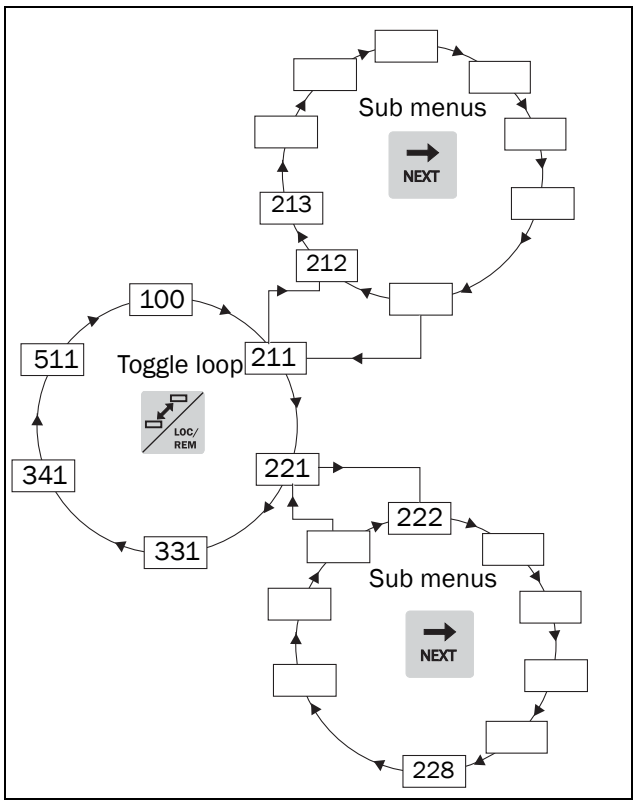


Fig. 72 Toggle loop example.

Indication of menus in toggle loop

Menus included in the toggle loop are indicated with a T in area B in the display.

Loc/Rem function

The Loc/Rem function of this key is disabled as default. Enable the function in menu [2171] and/or [2172].

With the function Loc/Rem you can change between local and remote control of the AC drive from the control panel. The function Loc/Rem can also be changed via the DigIn, see menu “Digital inputs [520]”.

Change control mode

1. Press the Loc/Rem key for five seconds, until Local? or Remote? is displayed.
2. Confirm with Enter.
3. Cancel with Esc.

Local mode

Local mode is used for temporary operation. When switched to LOCAL operation, the AC drive is controlled via the defined Local operation mode, i.e. [2171] and [2172]. The actual status of the AC drive will not change, e.g. Run/Stop conditions and the actual speed will remain exactly the same. When the AC drive is set to Local operation, the display will show L in area B in the display.

Remote mode

When the AC drive is switched to REMOTE operation, the AC drive will be controlled according to selected control methods in the menu's "Reference Control [214]", "Run/ Stop Control [215]" and "Reset Control [216]".
To monitor the actual Local or Remote status of the AC drive control, a "Loc/Rem" signal is available on the Digital Outputs or Relays. When the AC drive is set to Local, the signal on the DigOut or Relay will be active/high, in Remote the signal will be inactive/low. See menu "Digital Outputs [540]" and "Relays [550]".

9.2.6 Function keys

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

Table 25 Function keys

ENTER	ENTER key:	- step to a lower menu level - confirm a changed setting
ESC	ESCAPE key:	- step to a higher menu level - ignore a changed setting, without confirming
PREV	PREVIOUS key:	- step to a previous menu within the same level - go to more significant digit in edit mode
NEXT	NEXT key:	- step to a next menu within the same level - go to less significant digit in edit mode
−	- key:	- decrease a value - change a selection
+	+ key:	- increase a value - change a selection
LOC/ REM	TOGGLE and LOC/REM key:	- Toggle between menus in the toggle loop - Switching between local and remote control - Change the sign of a value

9.3 The menu structure

The menu structure consists of 4 levels:

Main Menu 1st level	The first character in the menu number.
2nd level	The second character in the menu number.
3rd level	The third character in the menu number.
4th level	The fourth character in the menu number.

This structure is consequently independent of the number of menus per level.

For instance, a menu can have one selectable menu (Set/ View Reference Value [310]), or it can have 17 selectable menus (menu Speeds [340]).

NOTE: If there are more than 10 menus within one level, the numbering continues in alphabetic order.

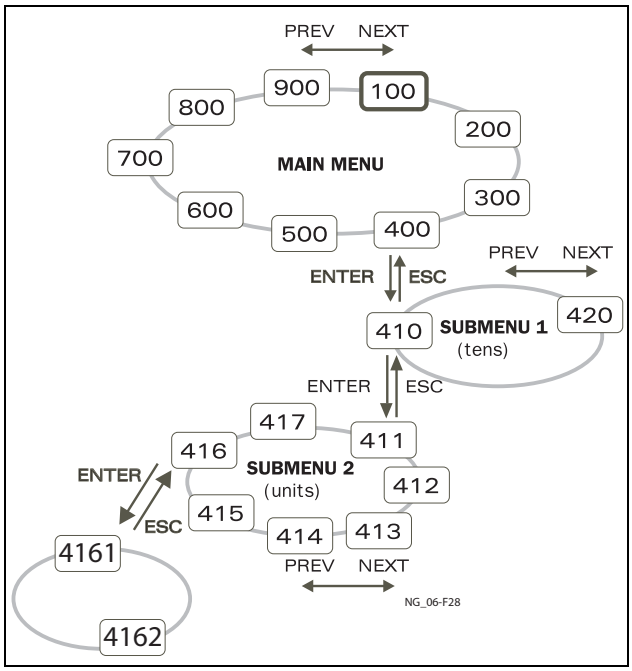


Fig. 73 Menu structure

9.3.1 The main menu

This section gives you a short description of the functions in the Main Menu.

100 Preferred View

Displayed at power-up. It displays the actual process value as default. Programmable for many other read-outs.

200 Main Setup

Main settings to get the AC drive operable. The motor data settings are the most important. Also option utility and settings.

300 Process and Application Parameters

Settings more relevant to the application such as Reference Speed, torque limitations, PID control settings, etc.

400 Shaft Power Monitor and Process Protection

The monitor function enables the AC drive to be used as a load monitor to protect machines and processes against mechanical overload and underload.

500 Inputs/Outputs and Virtual Connections

All settings for inputs and outputs are entered here.

600 Logical Functions and Timers

All settings for conditional signals are entered here.

700 View Operation and Status

Viewing all the operational data like frequency, load, power, current, etc.

800 View Trip Log

Viewing the last 10 trips in the trip memory.

900 Service Information and AC drive Data

Electronic type label for viewing the software version and AC drive type.

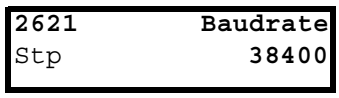
9.4 Programming during operation

Most of the parameters can be changed during operation without stopping the AC drive. Parameters that can not be changed are marked with a lock symbol in the display.

NOTE: If you try to change a function during operation that only can be changed when the motor is stopped, the message "Stop First" is displayed.

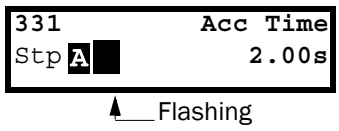
9.5 Editing values in a menu

Most values in the second row in a menu can be changed in two different ways. Enumerated values like the baud rate can only be changed with alternative 1.



Alternative 1

When you press the + or - keys to change a value, the cursor is flashing to the left in the display and the value is increased or decreased when you press the appropriate key. If you keep the + or - keys pressed, the value will increase or decrease continuously. When you keep the key pressed the change speed will increase. The Toggle key is used to change the sign of the entered value. The sign of the value will also change when zero is passed. Press Enter to confirm the value.

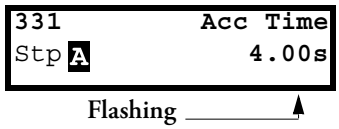


Alternative 2

Press the + or - key to enter edit mode. Then press the Prev or Next key to move the cursor to the right most position of the value that should be changed. The cursor will make the selected character flashes. Move the cursor using the Prev or Next keys. When you press the + or - keys, the character at the cursor position will increase or decrease. This alternative is suitable when you want to make large changes, i.e. from 2 s to 400 s.

To change the sign of the value, press the toggle key. This makes it possible to enter negative values (Only valid for certain parameters).

Example: When you press Next the 4 will flash.



Press Enter to save the setting and Esc to leave the edit mode.

9.6 Copy current parameter to all sets

When a parameter is displayed, press the Enter key for 5 seconds. Now the text To all sets? is displayed. Press Enter to copy the setting for current parameter to all sets.

9.7 Programming example

This example shows how to program a change of the Acc. Time set from 2.0 s to 4.0 s.

The flashing cursor indicates that a change has taken place but is not saved yet. If at this moment, the power fails, the change will not be saved.

Use the ESC, Prev, Next or the Toggle keys to proceed and to go to other menus.

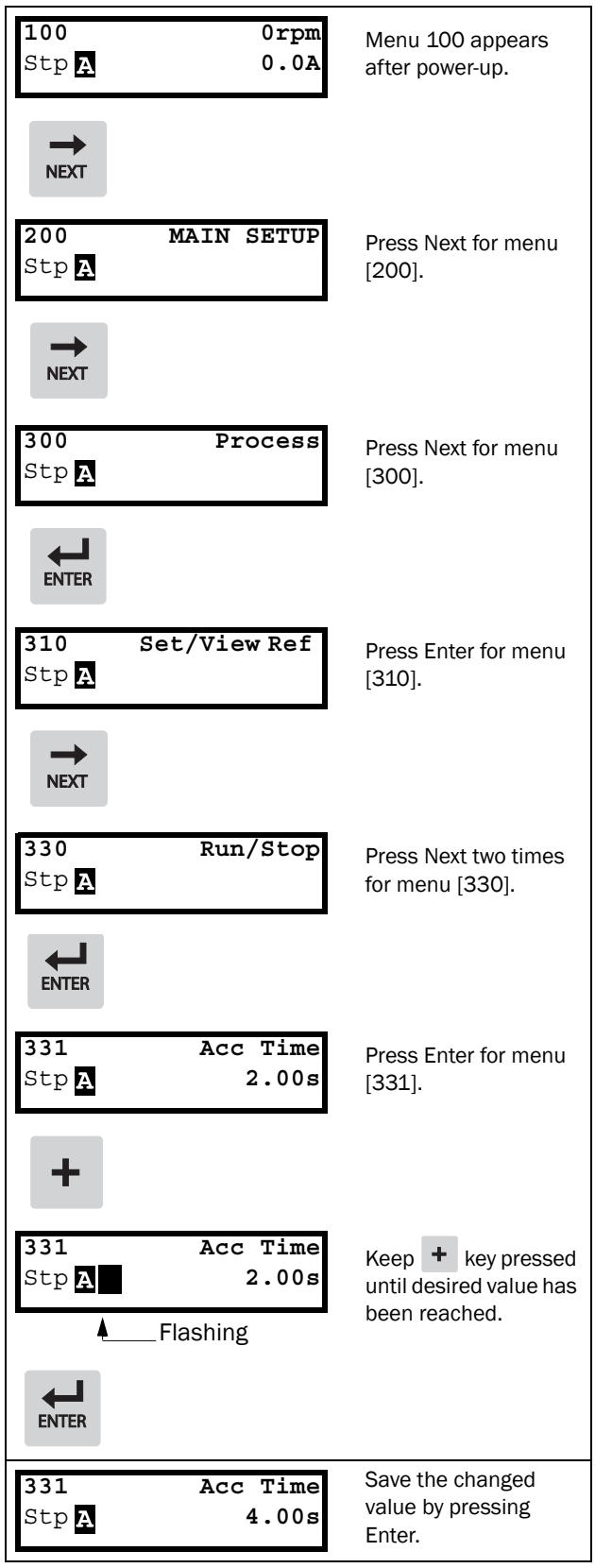


Fig. 74 Programming example

10. Serial communication

The AC drive provides possibility for different types of serial communication.

- Modbus RTU via RS232/485
- Fieldbuses as Profibus DP and DeviceNet
- Industrial Ethernet as Modbus/TCP, Profinet IO, EtherCAT and EtherNet/IP

10.1 Modbus RTU

Use the isolated RS232/485 option board for serial communication. This port is galvanically isolated.
The protocol used for data exchange is based on the Modbus RTU protocol, originally developed by Modicon. The physical connection is RS232/485. The AC drive acts as a slave with selectable address in a master-slave configuration. The communication is half-duplex. It has a standard non return zero (NRZ) format.

The baud rate is adjustable between 2400 to 38400.

The character frame format (always 11 bits) has:

- one start bit
- eight data bits
- two stop bits
- no parity

The AC drive has also an asynchronous serial communication interface behind the control panel. Please note that this port is not galvanically isolated.

It is possible to temporarily connect a personal computer with for example the software EmoSoftCom (programming and monitoring software) to the RS232 connector on the control panel. This can be useful when copying parameters between AC drives etc. For permanent connection of a personal computer you have to use one of the communication option boards.

NOTE: This RS232 port is not isolated.

WARNING!
Correct and safe use of a RS232 connection depends on the ground pins of both ports being the same potential. Problems can occur when connecting two ports of e.g. machinery and computers where both ground pins are not the same potential. This may cause hazardous ground loops that can destroy the RS232 ports.

The RS232 connection behind the control panel is not galvanically isolated.

The RS232/485 option board from CG Drives & Automation is galvanically isolated.

Note that the control panel RS232 connection can safely be used in combination with commercial available isolated USB to RS232 converters.

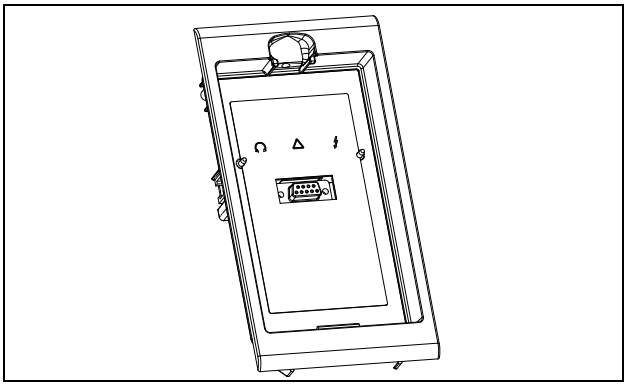


Fig. 75 RS232 connector behind the control panel

10.2 Parameter sets

Communication information for the different parameter sets.

The different parameter sets in the AC drive have the following DeviceNet instance numbers, Profibus slot/index numbers, Profinet IO index and EtherCAT index numbers:

Param. set	Modbus/ DeviceNet Instance number	Profibus Slot/Index	Profinet IO index	EtherCAT index (hex)
A	43001–43899	168/160 to 172/38	19385 - 20283	4bb9 - 4f3b
B	44001–44899	172/140 to 176/18	20385 - 21283	4fa1 - 5323
C	45001–45899	176/120 to 179/253	21385 - 22283	5389 - 5706
D	46001–46899	180/100 to 183/233	22385 - 23283	5771 - 5af3

Parameter set A contains parameters 43001 to 43899. The parameter sets B, C and D contains the same type of information. For example parameter 43123 in parameter set A contain the same type of information as 44123 in parameter set B.

10.3 Motor data

Communication information for the different motors.

Motor	Modbus/ DeviceNet Instance number	Profibus Slot/ Index	Profinet IO index	EtherCAT index (hex)
M1	43041–43048	168/200 to 168/207	19425 - 19432	4be1 - 4be8
M2	44041–44048	172/180 to 174/187	20425 - 20432	4fc9 - 4fd0
M3	45041–45048	176/160 to 176/167	21425 - 21432	53b1 - 53b8
M4	46041–46048	180/140 to 180/147	22425 - 22432	5799 - 57a0

M1 contains parameters 43041 to 43048. The M2, M3, and M4 contains the same type of information. For example parameter 43043 in motor M1 contain the same type of information as 44043 in M2.

10.4 Start and stop commands

Set start and stop commands via serial communication.

Modbus/DeviceNet Instance number	Function
42901	Reset
42902	Run, active together with either RunR or RunL to perform start.
42903	RunR
42904	RunL

Note! Bipolar reference mode is activated if both RunR and RunL is active.

10.5 Reference signal

When menu “Reference Control [214]” is set to “Com” the following parameter data should be used:

Default	0
Range	-16384 to 16384
Corresponding to	-100% to 100% ref

Communication information

Modbus /DeviceNet Instance number	42905
Profibus slot /Index	168/64
EtherCAT index (hex)	4b59
Profinet IO index	19289
Fieldbus format	Int
Modbus format	Int

10.5.1 Process value

It is also possible to send the Process value feedback signal over a bus (e.g. from a process or temperature sensor) for use with PID Process controller [380].

Set menu “Process Source [321]” to F(Bus). Use following parameter data for the process value:

Default	0
Range	-16384 to 16384
Corresponding to	-100% to 100% process value

Communication information

Modbus /DeviceNet Instance number	42906
Profibus slot /Index	168/65
EtherCAT index (hex)	4b5a
Profinet IO index	19290
Fieldbus format	Int
Modbus format	Int

Example:

(See Emotron Fielbus manual for detailed information)

We would like to control the AC drive over a bus system using the first two bytes of the Basic Control Message by setting menu “[2661] FB Signal 1” to 49972. Further, we also want to transmit a 16 bit signed reference and a 16 bit process value. This is done by setting menu “[2662] FB Signal 2” to 42905 and menu “[2663] FB Signal 3” to 42906.

NOTE! It is possible to view the transmitted process value in control panel menu Operation [710]. The presented value is depending on settings in menus “Process Min [324]” and “Process Max [325]”.

10.6 Description of the EInt formats

A parameter with Eint format can be represented in two different formats (F). Either as a 15 bit unsigned integer format (F= 0) or a Emotron floating point format (F=1). The most significant bit (B15) indicates the format used. See detailed description below.
All parameters written to a register may be rounded to the number of significant digits used in the internal system.

The matrix below describes the contents of the 16-bit word for the two different EInt formats:

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
F=1	e3	e2	e1	e0	m10	m9	m8	m7	m6	m5	m4	m3	m2	m1	m0
F=0	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0

If the format bit (B15) is 0, then all bits may be treated as a standard unsigned integer (UInt)

If the format bit is 1, then is the number interpreted as this:

Value = M * 10^E, where M=m10..m0 represents a two- complement signed mantissa and E= e3..e0 represents a two- complement signed exponent.

NOTE: Parameters with EInt format may return values both as 15 bit unsigned int (F=0) or in Emotron floating point (F=1).

Example, resolution

If you write the value 1004 to a register and this register has 3 significant digits, it will be stored as 1000.

In the Emotron floating point format (F=1), one 16-bit word is used to represent large (or very small numbers) with 3 significant digits.

If data is read or written as a fixed point (i.e. no decimals) number between 0-32767, the 15 bit Unsigned integer format (F=0) may be used.

Detailed description of Emotron floating point format

```
e3-e0 4-bit signed exponent. Gives a value
range:
-8..+7 (binary 1000 .. 0111)
m10-m0 11-bit signed mantissa.Gives a value
range:
-1024..+1023 (binary
10000000000..01111111111)
```

A signed number should be represented as a two complement binary number, like below:

Value Binary

```
-8 1000
-7 1001
..
-2 1110
-1 1111
0 0000
1 0001
2 0010
..
6 0110
7 0111
```

The value represented by the Emotron floating point format is m·10e.

To convert a value from the Emotron floating point format to a floating point value, use the formula above.

To convert a floating point value to the Emotron floating point format, see the C-code example below.

Example, floating point format

The number 1.23 would be represented by this in Emotron floating point format,

```
F EEEE MMMMMMMMMMM
1 1110 00001111011
F=1 -> floating point format used
E=-2
M=123
```

The value is then $123x10^{-2} = 1.23$

Example 15bit unsigned int format

The value 72.0 can be represented as the fixed point number 72. It is within the range 0-32767, which means that the 15-bit fixed point format may be used.

The value will then be represented as:

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0

Where bit 15 indicates that we are using the fixed point format (F=0).

Programming example:

```
typedef struct
{
  int m:11; // mantissa, -1024..1023
  int e: 4; // exponent -8..7
  unsigned int f: 1; // format, 1->special emoint format
}    eint16;
//---------------------------------------------------------------------------
unsigned short int float_to_eint16(float value)
{
  eint16 etmp;
  int dec=0;

  while (floor(value) != value && dec<16)
  {
     dec++; value*=10;
  }
  if (value>=0 && value<=32767 && dec==0)
     *(short int *)&etmp=(short int)value;
  else if (value>=-1000 && value<0 && dec==0)
  {
     etmp.e=0;
     etmp.f=1;
     etmp.m=(short int)value;
  }
  else
  {
     etmp.m=0;
     etmp.f=1;
     etmp.e=-dec;
     if (value>=0)
        etmp.m=1; // Set sign
     else
        etmp.m=-1; // Set sign
     value=fabs(value);
     while (value>1000)
     {
        etmp.e++; // increase exponent
        value=value/10;
     }
     value+=0.5; // round
     etmp.m=etmp.m*value; // make signed
  }
 return (*(unsigned short int *)&etmp);
}
//---------------------------------------------------------------------------
float eint16_to_float(unsigned short int value)
{
  float f;
  eint16 evalue;

  evalue=*(eint16 *)&value;
  if (evalue.f)
  {
     if (evalue.e>=0)
        f=(int)evalue.m*pow10(evalue.e);
     else
        f=(int)evalue.m/pow10(abs(evalue.e));
  }
  else
     f=value;

  return f;
}
//---------------------------------------------------------------------------
```

11. Functional Description

This chapter describes the menus and parameters in the software. You will find a short description of each function and information about default values, ranges, etc. There are also tables containing communication information. You will find the parameter number for all available fieldbus options as well as the enumeration for the data.
On our home page in the download area, you could find a "Communication information" list and a list to note “Parameter set” information.

NOTE: Functions marked with the sign 🔒 cannot be changed during Run Mode.

Description of menu table layout

Following two kinds of tables are used in this chapter.

🔒 ① Read-only ②		③ 332 Init Torque StpA 10%
Default:		④
⑤	o	⑦

🔒 ① Read-only ②	③ 222 Motor Frequ StpA M1 50Hz%
Default:	④
Resolution	⑦

1. Parameter cannot be changed during operation.
2. Parameter only for viewing.
3. Menu information as displayed on control panel. For explanation of display text and symbols, see Chapter 9.2 page 61.
4. Factory setting of parameter (also showed on display).
5. Available settings for the menu, listed selections.
6. Communication integer value for the selection. For use with communication bus interface (only if selection type parameters).
7. Description of selection alternative, setting or range (min - max value).

Resolution of settings

The resolution for all range settings described in this chapter is 3 significant digits. Exceptions are speed values which are presented with 4 significant digits. Table 26 shows the resolutions for 3 significant digits.

Table 26

3 Digit	Resolution
0.01-9.99	0.01
10.0-99.9	0.1
100-999	1
1000-9990	10
10000-99900	100

11.1 Preferred View [100]

This menu is displayed at every power-up. During operation, the menu [100] will automatically be displayed when the keyboard is not operated for 5 minutes. The automatic return function will be switched off when the Toggle and Stop key is pressed simultaneously. As default it displays the reference and torque values.

```
100                0rpm
Stp A              0.0Nm
```

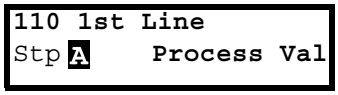
Menu “[100] Preferred View” displays the settings made in menu “[110], 1st line”, and “[120], 2nd line”. See Fig. 76.

```
100          (1st Line)
Stp A        (2nd Line)
```

Fig. 76 Display functions

11.1.1 1st Line [110]

Sets the content of the upper row in the menu "[100] Preferred View."



Default:		Process Val
Dependent on menu		
Process Val	0	Process value
Speed	1	Speed
Torque	2	Torque
Process Ref	3	Process reference
Shaft Power	4	Shaft power
El Power	5	Electrical power
Current	6	Current
Output volt	7	Output voltage
Frequency	8	Frequency
DC Voltage	9	DC voltage
Heatsink Tmp	10	Heatsink temperature
Motor Temp *	11	Motor temperature
AC drive Status	12	AC drive status
Run Time	13	Run Time
Energy	14	Energy
Mains Time	15	Mains time

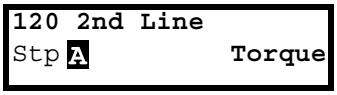
* The "Motor temp" is only visible if you have the option PTC/PT100 card installed and a PT100 input is selected in menu[236].

Communication information

Modbus Instance no/DeviceNet no:	43001
Profibus slot/index	168/160
EtherCAT index (hex)	4bb9
Profinet IO index	19385
Fieldbus format	UInt
Modbus format	UInt

11.1.2 2nd Line [120]

Sets the content of the lower row in the menu "[100] Preferred View". Same selection as in menu [110].



Default:	Torque

Communication information

Modbus Instance no/DeviceNet no:	43002
Profibus slot/index	168/161
EtherCAT index (hex)	4bba
Profinet IO index	19386
Fieldbus format	UInt
Modbus format	UInt

11.2 Main Setup [200]

The Main Setup menu contains the most important settings to get the AC drive operational and set up for the application. It includes different sub menus concerning the control of the unit, motor data and protection, utilities and automatic resetting of faults. This menu will instantaneously be adapted to build in options and show the required settings.

11.2.1 Operation [210]

Selections concerning the used motor, AC drive mode, control signals and serial communication are described in this submenu and is used to set the AC drive up for the application.

Language [211]

Select the language used on the LC Display. Once the language is set, this selection will not be affected by the Load Default command.

	211 Language Stp A English	
Default:		English
English	0	English selected
Svenska	1	Swedish selected
Nederlands	2	Dutch selected
Deutsch	3	German selected
Français	4	French selected
Español	5	Spanish selected
Русский	6	Russian selected
Italiano	7	Italian selected
Cesky	8	Czech selected
Turkish	9	Turkish selected

Communication information

Modbus Instance no/DeviceNet no:	43011
Profibus slot/index	168/170
EtherCAT index (hex)	4bc3
Profinet IO index	19395
Fieldbus format	UInt
Modbus format	UInt

Select Motor [212]

This menu is used if you have more than one motor in your application. Select the motor to define. It is possible to define up to four different motors, M1 to M4, in the AC drive. For parameter set handling including Motor sets M1 - M4 see Chapter 11.2.6 page 87.

	212 Select Motor Stp A M1	
Default:		M1
M1	0	Motor Data is connected to selected motor.

	212 Select Motor Stp A M1	
Default:		M1
M1	0	Motor Data is connected to selected motor.
M2	1	
M3	2	
M4	3	

Communication information

Modbus Instance no/DeviceNet no:	43012
Profibus slot/index	168/171
EtherCAT index (hex)	4bc4
Profinet IO index	19396
Fieldbus format	UInt
Modbus format	UInt

Drive Mode [213]

This menu is used to set the control mode for the motor. Settings for the reference signals and read-outs is made in menu “Process source, [321]”.

- Speed Mode offers an accurate control of the motor speed independently of the load. The Speed mode also increases the accuracy of the different analogue output signals that are related to the motor speed. Speed mode can also be used if several motors of same type and size are connected in parallel. Requires all motors to be mechanically connected to the load.
- Torque Mode can be selected for applications where the motor shaft torque needs to be controlled independently of the speed.
- V/Hz Mode (output speed [712] in rpm) is used when several motors in parallel of different type or size are connected or if parallel motors are not mechanically connected to the load
  Note: V/Hz mode is not available with PMSM motors.

	213 Drive Mode Stp A Speed	
Default:		Speed
Speed	0	The AC drive is speed controlled. Reference given=speed reference with ramp. Speed and torque limits can be set. Using “direct torque control” as motor control method.
Torque	1	The AC drive is torque controlled. Reference given=torque reference without ramp. Speed and torque limit can be set. Using “direct torque control” as motor control method. **NOTE: No ramps active in the AC drive. Care must be taken.**
V/Hz	2	All control loops are related to frequency control. **NOTE: All the functions and menu read-outs with regard to speed and rpm (e.g. Max Speed = 1500 rpm, Min Speed=0 rpm, etc.) remain speed and rpm, although they represent the output frequency.** **Note: V/Hz mode is not available with PMSM motors.**

Communication information

Modbus Instance no/DeviceNet no:	43013
Profibus slot/index	168/172
EtherCAT index (hex)	4bc5
Profinet IO index	19397
Fieldbus format	UInt
Modbus format	UInt

Reference control [214]

To control the speed of the motor, the AC drive needs a reference signal. This reference signal can be controlled by a remote source from the installation, the keyboard of the AC drive, or by serial or fieldbus communication. Select the required reference control for the application in this menu.

	214 Ref Control Stp A Remote	
Default:		Remote
Remote	0	The reference signal comes from the analogue inputs of the terminal strip (terminals 1-22).
Keyboard	1	Reference is set with the + and - keys on the Control Panel. Can only be done in menu “Set/View reference [310]”.
Com	2	The reference is set via the serial communication (RS 485, Fieldbus.) See section 10.5, page 68 for further information.
Option	3	The reference is set via an option. Only available if the option can control the reference value.

NOTE: If the reference is switched from Remote to Keyboard, the last remote reference value will be the default value for the control panel.

Communication information

Modbus Instance no/DeviceNet no:	43014
Profibus slot/index	168/173
EtherCAT index (hex)	4bc6
Profinet IO index	19398
Fieldbus format	UInt
Modbus format	UInt

Run/Stop Control [215]

This function is used to select the source for run and stop commands. This is described on page 115.

Start/stop via analogue signals can be achieved by using function “Stp<MinSpd [342]”.

		215 Run/Stp Ctrl Stp A Remote
Default:		Remote
Remote	0	The start/stop signal comes from the digital inputs of the terminal strip (terminals 1-22). For settings, see menu group [330] and [520].
Keyboard	1	Start and stop is set on the Control Panel.
Com	2	The start/stop is set via the serial communication (RS 485, Fieldbus.) See Fieldbus or RS232/485 option manual for details.
Option	3	The start/stop is set via an option.

Communication information

Modbus Instance no/DeviceNet no:	43015
Profibus slot/index	168/174
EtherCAT index (hex)	4bc7
Profinet IO index	19399
Fieldbus format	UInt
Modbus format	UInt

Reset Control [216]

When the AC drive is stopped due to a failure, a reset command is required to make it possible to restart the AC drive. Use this function to select the source of the reset signal.

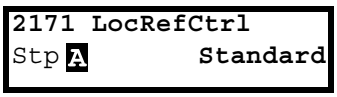
		216 Reset Ctrl Stp A Remote
Default:		Remote
Remote	0	The command comes from the inputs of the terminal strip (terminals 1-22).
Keyboard	1	The command comes from the command keys of the Control Panel.
Com	2	The command comes from the serial communication (RS 485, Fieldbus).
Remote + Keyb	3	The command comes from the inputs of the terminal strip (terminals 1-22) or the keyboard.
Com + Keyb	4	The command comes from the serial communication (RS485, Fieldbus) or the keyboard.
Rem+Keyb +Com	5	The command comes from the inputs of the terminal strip (terminals 1-22), the keyboard or the serial communication (RS485, Fieldbus).
Option	6	The command comes from an option. Only available if the option can control the reset command.

Communication information

Modbus Instance no/DeviceNet no:	43016
Profibus slot/index	168/175
EtherCAT index (hex)	4bc8
Profinet IO index	19400
Fieldbus format	UInt
Modbus format	UInt

Local/Remote key function [217]

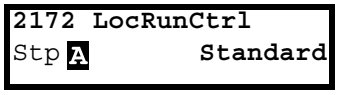
The Toggle key on the keyboard, see section 9.2.5, page 63, has two functions and is activated in this menu. As default the key is just set to operate as a Toggle key that moves you easily through the menus in the toggle loop. The second function of the key allows you to easily swap between Local and normal operation (set up via [214] and [215]) of the AC drive. Local mode can also be activated via a digital input. If both [2171] and [2172] is set to Standard, the function is disabled.



Default:		Standard
Standard	0	Local reference control set via [214]
Remote	1	Local reference control via remote
Keyboard	2	Local reference control via keyboard
Com	3	Local reference control via communication

Communication information

Modbus Instance no/DeviceNet no:	43009
Profibus slot/index	168/168
EtherCAT index (hex)	4bc1
Profinet IO index	19393
Fieldbus format	UInt
Modbus format	UInt



Default:		Standard
Standard	0	Local Run/Stop control set via [215]
Remote	1	Local Run/Stop control via remote
Keyboard	2	Local Run/Stop control via keyboard
Com	3	Local Run/Stop control via communication

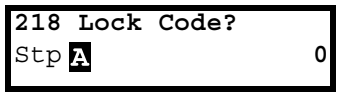
Communication information

Modbus Instance no/DeviceNet no:	43010
Profibus slot/index	168/169
EtherCAT index (hex)	4bc2
Profinet IO index	19394
Fieldbus format	UInt
Modbus format	UInt

Lock Code? [218]

To prevent the keyboard being used or to change the setup of the AC drive and/or process control, the keyboard can be locked with a password. This menu, “Lock Code [218]”, is used to lock and unlock the keyboard. Enter the password “291” to lock/unlock the keyboard operation. If the keyboard is not locked (default) the selection “Lock Code?” will appear. If the keyboard is already locked, the selection “Unlock Code?” will appear.

When the keyboard is locked, parameters can be viewed but not changed. The reference value can be changed and the AC drive can be started, stopped and reversed if these functions are set to be controlled from the keyboard.



Default:	0
Range:	0–9999

Communication information

Modbus Instance no/DeviceNet no:	43018
Profibus slot/index	168/177
EtherCAT index (hex)	4bca
Profinet IO index	19402
Fieldbus format	UInt, 1=1
Modbus format	UInt

Rotation [219]

Overall limitation of motor rotation direction

This function limits the overall rotation, either to left or right or both directions. This limit is prior to all other selections, e.g.: if the rotation is limited to right, a Run-Left command will be ignored. To define left and right rotation we assume that the motor is connected U-U, V-V and W-W.

Speed Direction and Rotation

The speed direction can be controlled by:

- RunR/RunL commands on the control panel.
- RunR/RunL commands on the terminal strip (terminals 1-22).
- Via the serial interface options.
- The parameter sets.

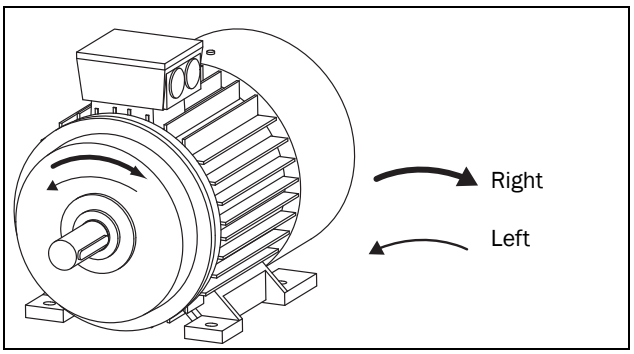


Fig. 77 Rotation

In this menu you set the general rotation for the motor.

	219 Rotation Stp A R+L	
Default:		R + L
R	1	Speed direction is limited to right rotation. The input and key RunL are disabled.
L	2	Speed direction is limited to left rotation. The input and key RunR are disabled.
R+L	3	Both speed directions allowed.

Communication information

Modbus Instance no/DeviceNet no:	43019
Profibus slot/index	168/178
EtherCAT index (hex)	4bcb
Profinet IO index	19403
Fieldbus format	UInt
Modbus format	UInt

11.2.2 Remote Signal Level/Edge [21A]

In this menu you select the way to control the inputs for RunR, RunL and Reset that are operated via the digital inputs on the terminal strip. The inputs are default set for level-control, and will be active as long as the input is made and kept high. When edge-control is selected, the input will be activated by the low to high transition of the input. See Chapter 7.2 page 54 for more information.

	21A Level/Edge Stp A Level	
Default:		Level
Level	0	The inputs are activated or deactivated by a continuous high or low signal. Is commonly used if, for example, a PLC is used to operate the AC drive.
Edge	1	The inputs are activated by a transition; for Run and Reset from “low” to “high” and for Stop from "high" to "low".

Communication information

Modbus Instance no/DeviceNet no:	43020
Profibus slot/index	168/179
EtherCAT index (hex)	4bcc
Profinet IO index	19404
Fieldbus format	UInt
Modbus format	UInt

CAUTION!
Level controlled inputs DO NOT comply with the Machine Directive if the inputs are directly used to start and stop the machine.

NOTE: Edge controlled inputs can comply with the Machine Directive (see the Chapter 8. page 59) if the inputs are directly used to start and stop the machine.

11.2.3 Mains supply voltage [21B]



WARNING!
This menu must be set according to the AC drive product label and the supply voltage used. Wrong setting might damage the AC drive or brake resistor.

In this menu the nominal mains supply voltage connected to the AC drive can be selected. The setting will be valid for all parameter sets. The default setting, Not defined, is never selectable and is only visible until a new value is selected.

This menu specifies the AC supply voltage. The corresponding DC voltage is 1.34 times higher.

Once the supply voltage is set, this selection will not be affected by the Load Default command [243].

Brake chopper activation level is adjusted using the setting of [21B].

NOTE: The setting is affected by the "Load from CP" command [245] and if loading parameter file via EmoSoftCom.

		21B Supply Volts Stp A Not defined
Default:		Not defined
Not Defined	0	Inverter default value used. Only valid if this parameter is never set.
220-240 VAC	1	Only valid for VFX48/52
380-415 VAC	3	Only valid for VFX48/52/69
440-480 VAC	4	Only valid for VFX48/52/69
500-525 VAC	5	Only valid for VFX52/69
550-600 VAC	6	Only valid for VFX69
660-690 VAC	7	Only valid for VFX69

Communication information

Modbus Instance no/DeviceNet no:	43381
Profibus slot/index	170/30
EtherCAT index (hex)	4d35
Profinet IO index	19765
Fieldbus format	UInt
Modbus format	UInt

Supply Type [21C]

Set supply voltage type.

		21C Supply Type Stp A AC Supply
Default:		AC Supply
DC Supply	0	DC supply voltage
AC Supply	1	Normal AC supply
AFE Supply	2	DC supply voltage by AFE

Communication information

Modbus Instance no/DeviceNet no:	43382
Profibus slot/index	170/31
EtherCAT index (hex)	4d36
Profinet IO index	19766
Fieldbus format	UInt
Modbus format	UInt

When changing to / from the AFE selection, the following parameters are set to following values:

Menu	to AFE	from AFE
[523] DigIn 3	Sleep	Off
[542] DigOut 3	Run	Brake
[527] DigIn 7	Off	Off
[561] VIO 1 Dest	External Trip	Off
[562] VIO 1 Source	!D1	Off
[6151] CD 1	DigIn 7	Run

11.2.4 Motor Data [220]

In this menu you enter the motor data to adapt the AC drive to the connected motor. This is crucial for the control accuracy as well as different read-outs and analogue output signals.
Emotron VFX AC drive can control both Asynchronous motors and Permanent magnet synchronous motor (PMSM) select type of motor in menu [22I].



WARNING!
Do not work on a drive when a rotating Permanent Magnet synchronous motor is connected to it. A rotating PMSM motor energizes the drive including its power terminals.

Motor M1 is selected as default and motor data entered will be valid for motor M1. If you have more than one motor you need to select the correct motor in menu [212] before entering motor data.

NOTE 1: The parameters for motor data cannot be changed during run mode.

NOTE 2: The default settings are for a standard 4-pole motor according to the nominal power of the AC drive.

NOTE 3: Parameter set cannot be changed during run if the parameter set is set for different motors.

NOTE 4: Motor Data in the different sets M1 to M4 can be revert to default setting in menu "[243] Default>Set".



WARNING!
Enter the correct motor data to prevent dangerous situations and assure correct control.

Motor Voltage [221]

Set the nominal motor voltage.

	221 Motor Volts Stp AM1: 400V
Default:	400 V for VFX48 500 V for VFX52 690 V forVFX 69
Range:	100-700 V
Resolution	1 V

NOTE: The Motor Volts value will always be stored as a 3 digit value with a resolution of 1 V.

Communication information

Modbus Instance no/DeviceNet no:	43041
Profibus slot/index	168/200
EtherCAT index (hex)	4be1
Profinet IO index	19425
Fieldbus format	Long, 1=0.1 V
Modbus format	EInt

If the voltage mentioned on the permanent magnet motor type plate is given as a voltage per speed (no-load voltage/"xx rpm"), e.g. 205V/1000 rpm, the "Motor Voltage" for a nominal synchronous speed of 1500 rpm then can be calculated according to following example:

Motor synchronous speed =1500 rpm

No-load voltage =205V/1000rpm

Calculation of Motor Voltage setting:

$$MotorVoltage[221] = \left(\frac{Nmotorsynchronous}{Nmotornoload}\right) \times NoLoadVoltage$$

$$MotorVoltag[221] = \left(\frac{1500rpm}{1000rpm}\right) \times 205V = 3\dot{0}15V$$

Note: The "Motor Voltage" is not equal to the Equivalent DC Motor (EDCM) voltage as specified by some motor manufacturers. The "Motor Voltage" setting then can be calculated by:

$$MotorVoltage[221] = \frac{EDCM}{\sqrt{3}}MM$$

Motor Frequency [222]

Set the nominal motor frequency.

	222 Motor Freq Stp AM1: 50.0Hz
Default:	50 Hz
Range:	20.0 - 300.0 Hz
Resolution	0.1 Hz

Communication information

Modbus Instance no/DeviceNet no:	43060 = 0.1	43042 = 1
Profibus slot/index	168/219	168/201
EtherCAT index (hex)	4bf4	4be2
Profinet IO index	19444	19426
Fieldbus format	Long, 1=0.1 Hz	Long, 1=1 Hz
Modbus format	EInt	EInt

Motor Power [223]

Set the nominal motor power. If parallel motors, set the value as sum of motors power. The nominal motorpower must be within the range of 1 - 150% of the AC drives nominal power.

223 Motor Power Stp AM1: (P_{NOM}) kW	
Default:	P_{NOM}AC drive
Range:	1-150 % x P_{NOM}
Resolution	3 significant digits

NOTE: The Motor Power value will always be stored as a 3 digit value in W up to 999 W and in kW for all higher powers.

Communication information

Modbus Instance no/DeviceNet no:	43043
Profibus slot/index	168/202
EtherCAT index (hex)	4be3
Profinet IO index	19427
Fieldbus format	Long, 1=1 W
Modbus format	EInt

P_{NOM} is the nominal AC drive power.

Motor Current [224]

Set the nominal motor current. If parallel motors, set the value as sum of motors current.

224 Motor Curr Stp AM1: (IMOT)A	
Default:	I_{MOT} (see Note 2 page 79)
Range:	25 - 150% x I_{NOM}

Communication information

Modbus Instance no/DeviceNet no:	43044
Profibus slot/index	168/203
EtherCAT index (hex)	4be4
Profinet IO index	19428
Fieldbus format	Long, 1=0.1 A
Modbus format	EInt

NOTE: The default settings are for a standard 4-pole motor according to the nominal power of the AC drive.



WARNING!
Do not connect motors with less than 25% of the nominal power of the AC drive. This may disrupt the control of the motor.

Motor Speed [225]

Set the nominal asynchronous motor speed.

 225 Motor Speed Stp AM1: (n_{MOT}) rpm	
Default:	n_{MOT} (see Note 2 page 79)
Range:	30 - 18000 rpm
Resolution	1 rpm, 4 sign digits



WARNING!
Do NOT enter a synchronous (no-load) motor speed.

NOTE: Maximum speed [343] is not automatically changed when the motor speed is changed.

NOTE: Entering a wrong, too low value can cause a dangerous situation for the driven application due to high speeds.

Communication information

Modbus Instance no/DeviceNet no:	43045
Profibus slot/index	168/204
EtherCAT index (hex)	4be5
Profinet IO index	19429
Fieldbus format	UInt. 1=1 rpm
Modbus format	UInt

Motor Poles [226]

When the nominal speed of the motor is ≤500 rpm, the additional menu for entering the number of poles, [226], appears automatically. In this menu the actual pole number can be set which will increase the control accuracy of the AC drive.

 226 Motor Poles Stp AM1: 4	
Default:	4
Range:	2-144

Communication information

Modbus Instance no/DeviceNet no:	43046
Profibus slot/index	168/205
EtherCAT index (hex)	4be6
Profinet IO index	19430
Fieldbus format	Long, 1=1 pole
Modbus format	EInt

Motor Cos φ [227]

Set the nominal Motor cosphi (power factor).

227 Motor Cosφ Stp AM1:CosφNOM	
Default:	$Cos\varphi_{NOM}$ (see Note 2 page 79)
Range:	0.45 - 1.00

Communication information

Modbus Instance no/DeviceNet no:	43047
Profibus slot/index	168/206
EtherCAT index (hex)	4be7
Profinet IO index	19431
Fieldbus format	Long, 1=0.01
Modbus format	EInt

Motor ventilation [228]

Parameter for setting the type of motor ventilation. Affects the characteristics of the I^2t motor protection by lowering the actual overload current at lower speeds.

228 Motor Vent Stp AM1: Self		
Default:		Self
None	0	Limited I^2t overload curve.
Self	1	Normal I^2t overload curve. Means that the motor stands lower current at low speed.
Forced	2	Expanded I^2t overload curve. Means that the motor stands almost the whole current also at lower speed.

Communication information

Modbus Instance no/DeviceNet no:	43048
Profibus slot/index	168/207
EtherCAT index (hex)	4be8
Profinet IO index	19432
Fieldbus format	UInt
Modbus format	UInt

When the motor has no cooling fan, None is selected and the current level is limited to 55% of rated motor current.

With a motor with a shaft mounted fan, Self is selected and the current for overload is limited to 87% from 20% of synchronous speed. At lower speed, the overload current allowed will be smaller.

When the motor has an external cooling fan, Forced is selected and the overload current allowed starts at 90% from rated motor current at zero speed, up to nominal motor current at 70% of synchronous speed.

Fig. 78 shows the characteristics with respect for Nominal Current and Speed in relation to the motor ventilation type selected.

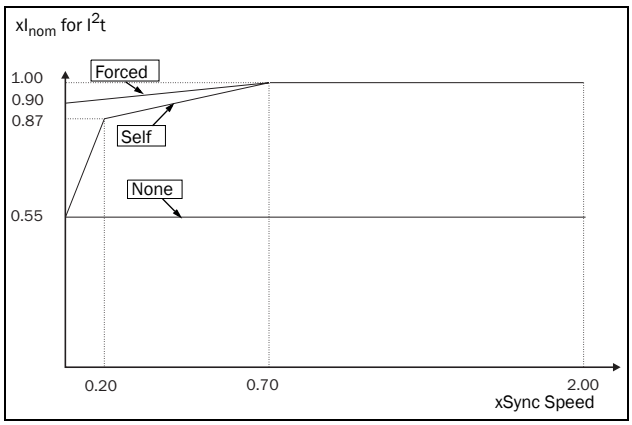


Fig. 78 I^2t curves

Motor Identification Run [229]

This function is used when the AC drive is put into operation for the first time. To achieve an optimal control performance, fine tuning of the motor parameters using a motor ID run is needed. During the test run the display shows “Test Run” flashing.

To activate the Motor ID run, select either “Short” or “Extended” and press Enter. Then press RunL or RunR on the control panel to start the ID run. If menu “[219] Rotation” is set to L the RunR key is inactive and vice versa. The ID run can be aborted by giving a Stop command via the control panel or Enable input. The parameter will automatically return to OFF when the test is completed. The message “Test Run OK!” is displayed. Before the AC drive can be operated normally again, press the STOP/RESET key on the control panel.

During the Short ID run the motor shaft does not rotate. The AC drive measures the rotor and stator resistance.

During the Extended ID run the motor is powered on and rotates. The AC drive measures the rotor and stator resistance as well as the induction and the inertia for the motor.

229 Motor ID-Run Stp AM1: Off		
Default:		Off, see Note
Off	0	Not active
Short	1	Parameters are measured with injected DC current. No rotation of the shaft will occur.
Extended	2	Additional measurements, not possible to perform with DC current, are done directly after a short ID run. The shaft will rotate and must be disconnected from the load.

Communication information

Modbus Instance no/DeviceNet no:	43049
Profibus slot/index	168/208
EtherCAT index (hex)	4be9
Profinet IO index	19433
Fieldbus format	UInt
Modbus format	UInt



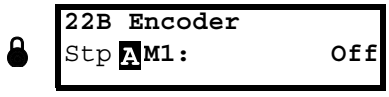
WARNING!
During the extended ID RUN, the motor will rotate. Take safety measures to avoid unforeseen dangerous situations.

NOTE: To run the AC drive it is not mandatory for the ID RUN to be executed, but without it the performance will not be optimal.

NOTE: If the ID Run is aborted or not completed the message "Interrupted!" will be displayed. The previous data do not need to be changed in this case. Check that the motor data are correct.

Encoder Feedback [22B]

Only visible if the Encoder option board is installed. This parameter enables or disables the encoder feedback from the motor to the AC drive.



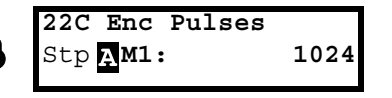
Default:		Off
Off	0	Encoder feedback disabled
On	1	Encoder feedback enabled

Communication information

Modbus Instance no/DeviceNet no:	43051
Profibus slot/index	168/210
EtherCAT index (hex)	4beb
Profinet IO index	19435
Fieldbus format	UInt
Modbus format	UInt

Encoder Pulses [22C]

Only visible if the Encoder option board is installed. This parameter describes the number of pulses per rotation for your encoder, i.e. it is encoder specific. For more information please see the encoder manual.



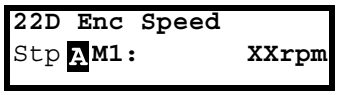
Default:	1024
Range:	5–16384

Communication information

Modbus Instance no/DeviceNet no:	43052
Profibus slot/index	168/211
EtherCAT index (hex)	4bec
Profinet IO index	19436
Fieldbus format	Long, 1=1 pulse
Modbus format	EInt

Encoder Speed [22D]

Only visible if the Encoder option board is installed. This parameter shows the measured motor speed. To check if the encoder is correctly installed, set Encoder Feedback [22B] to Off, run the AC drive at any speed and compare with the value in this menu. The value in this menu [22D] should be about the same as the motor speed [230]. If you get the wrong sign for the value, swap encoder input A and B.



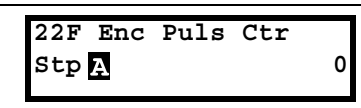
Unit:	rpm
Resolution:	speed measured via the encoder

Communication information

Modbus Instance no/DeviceNet no:	42911
Profibus slot/index	168/70
EtherCAT index (hex)	4b5f
Profinet IO index	19295
Fieldbus format	Int, 1=1 rpm
Modbus format	Int

Encoder Pulse counter [22F]

Only visible if the Encoder option is installed. Added menu/parameter for accumulated QEP (Quadrature Encoder Pulse) encoder pulses. Can be preset to any value within bus format used (Int = 2 byte, Long = 4 byte).



Default:	0
Resolution	1

Communication information

Modbus Instance no/DeviceNet no:	42912
Profibus slot/index	168/71
EtherCAT index (hex)	4b60
Profinet IO index	19296
Fieldbus format	Long, 1=1 quad encoder pulse
Modbus format	Int

Note: For a 1024 pulse encoder [22F] will count 1024 * 4= 4096 pulses per turn.

Encoder fault and speed monitoring [22G]

Parameters for encoder fault monitoring and speed supervision by use of the encoder feedback for detecting speed deviation compared to internal speed reference signal. Similar speed deviation functionality is also available in the Crane option, with parameters for speed bandwidth and delay time.

Encoder fault trip conditions:

1. No encoder board detected after power up and AC drive is setup to use encoder.
2. Lost communication to encoder board for more than 2 seconds.
3. If no pulses detected for set delay time [22G1] and drive in Torque Limit (TL) or Current Limit (CL).

Note: If encoder signals are missing or encoder cable disconnected, the measured speed will then be 0 rpm and the AC drive will run with Torque Limit (TL) at very low speed.

Note: Other likely scenarios when encoder signals are lost during operation are tripped drive due to "Overcurrent Fast" or "Desat".

Encoder speed deviation trip condition:
Encoder speed outside set speed deviation band [22G2] for set delay time [22G1].

Note: Encoder speed deviation trip re-uses "Deviation 2" trip message with ID = 2.

Encoder fault delay time [22G1]

Define the encoder fault and speed deviation delay time.

	22G1 Enc F Delay Stp A M1:Off
Default:	Off
Range	Off, 0.01 - 10.00 s where Off = 0

Communication information

Modbus Instance no/DeviceNet no:	43056
Profibus slot/index	168/215
EtherCAT index (hex)	4bf0
Profinet IO index	19440
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

Encoder fault speed deviation band [22G2]

Defines the max allowed speed deviation band = difference between measured encoder speed and speed ramp output.

	22G2 Enc F Band Stp A M1:10%
Default:	10%
Range	0 - 400 %

Communication information

Modbus Instance no/DeviceNet no:	43057
Profibus slot/index	168/216
EtherCAT index (hex)	4bf1
Profinet IO index	19441
Fieldbus format	Long, 1=1 %
Modbus format	EInt

Encoder max fault counter [22G3]

This is a measured signal showing the maximum time that the speed deviation has exceeded the allowed speed deviation band level, set in [22G2]. The parameter is intended to be used during commissioning for setting up [22G1] and [22G2] to avoid nuisance trips and can be cleared by setting it to 0.

	22G3 Max EncFCtr Stp 0.000s
Default:	0.000s
Range	0.00 - 10.00 s

Communication information

Modbus Instance no/DeviceNet no:	42913
Profibus slot/index	168/78
EtherCAT index (hex)	4b61
Profinet IO index	19297
Fieldbus format	Long, 1=0.001s
Modbus format	EInt

NOTE: The value is volatile and lost at power down. It is possible to reset the value by clearing the parameter.

Phase order[22H]

Phase sequence for motor output. In this menu you can correct rotation direction on the motor by selecting "reverse" instead of switching the motor cables..

		22H Phase order Stp A
Default:		Normal
Normal	0	Normal phase order (U,V,W)
Reverse	1	Reverse phase order (U, W, V)

Communication information

Modbus Instance no/DeviceNet no:	43058
Profibus slot/index	168/217
EtherCAT index (hex)	4bf2
Profinet IO index	19442
Fieldbus format	UInt
Modbus format	UInt

Motor type[22I]

In this menu select type of motor. Emotron AC drives can control both Asynchronous motors and Permanent Magnet Synchrononous Motor.

		22I Motor Type Stp A Async
Default:		Async
Async	0	Asynchronous motor
PMSM	1	Permanent magnet synchronous motor

Communication information

Modbus Instance no/DeviceNet no:	43059
Profibus slot/index	168/218
EtherCAT index (hex)	4bf3
Profinet IO index	19443
Fieldbus format	UInt
Modbus format	UInt

NOTE: If PMSM is selected in menu [22I], following will be set automatically:

- **"Drive mode [213]" is set to "speed" mode and can not be changed.**
- **Menu "Spin start [33A] " will be hidden. Means that spinstart is not possible.**

11.2.5 Motor Protection [230]

This function protects the motor against overload based on the standard IEC 60947-4-2.

Motor I^2t Type [231]

The motor protection function makes it possible to protect the motor from overload as published in the standard IEC 60947-4-2. It does this using "Motor I2t Current [232]" as a reference. The "Motor I2t Time [233]" is used to define the time behaviour of the function. The current set in [232] can be delivered infinite in time. If for instance in [233] a time of 1000 s is chosen the upper curve of Fig. 79 is valid. The value on the x-axis is the multiple of the current chosen in [232]. The time [233] is the time that an overloaded motor is switched off or is reduced in power at 1.2 times the current set in [232].

		231 Mot I^2t Type Stp A Trip
Default:		Trip
Off	0	I^2t motor protection is not active.
Trip	1	When the I^2t time is exceeded, the AC drive will trip on "Motor I^2t".
Limit	2	This mode helps to keep the inverter running when the Motor I2t function is just before tripping the AC drive. The trip is replaced by current limiting with a maximum current level set by the value out of the menu [232]. In this way, if the reduced current can drive the load, the AC drive continues running. If there is no reduction in thermal load, the drive will trip.

Communication information

Modbus Instance no/DeviceNet no:	43061
Profibus slot/index	168/220
EtherCAT index (hex)	4bf5
Profinet IO index	19445
Fieldbus format	UInt
Modbus format	UInt

NOTE: When Mot I2t Type=Limit, the AC drive can control the speed < MinSpeed to reduce the motor current.

Motor I^2t Current [232]

Sets the current limit for the motor I^2t protection.

	232 Mot I²t Curr Stp A 100%
Default:	100% of I_{MOT}
Range:	0–150% of I_MOT (set in menu [224])

Communication information

Modbus Instance no/DeviceNet no:	43062
Profibus slot/index	168/221
EtherCAT index (hex)	4bf6
Profinet IO index	19446
Fieldbus format	Long, 1=1%
Modbus format	EInt

NOTE: When the selection Limit is set in menu [231], the value must be above the no-load current of the motor.

Motor I^2t Time [233]

Sets the time of the I^2t function. After this time the limit for the I^2t is reached if operating with 120% of the I^2t current value. Valid when start from 0 rpm.

NOTE: Not the time constant of the motor.

	233 Mot I²t Time Stp A 60s
Default:	60 s
Range:	60–1200 s

Communication information

Modbus Instance no/DeviceNet no:	43063
Profibus slot/index	168/222
EtherCAT index (hex)	4bf7
Profinet IO index	19447
Fieldbus format	Long, 1=1 s
Modbus format	EInt

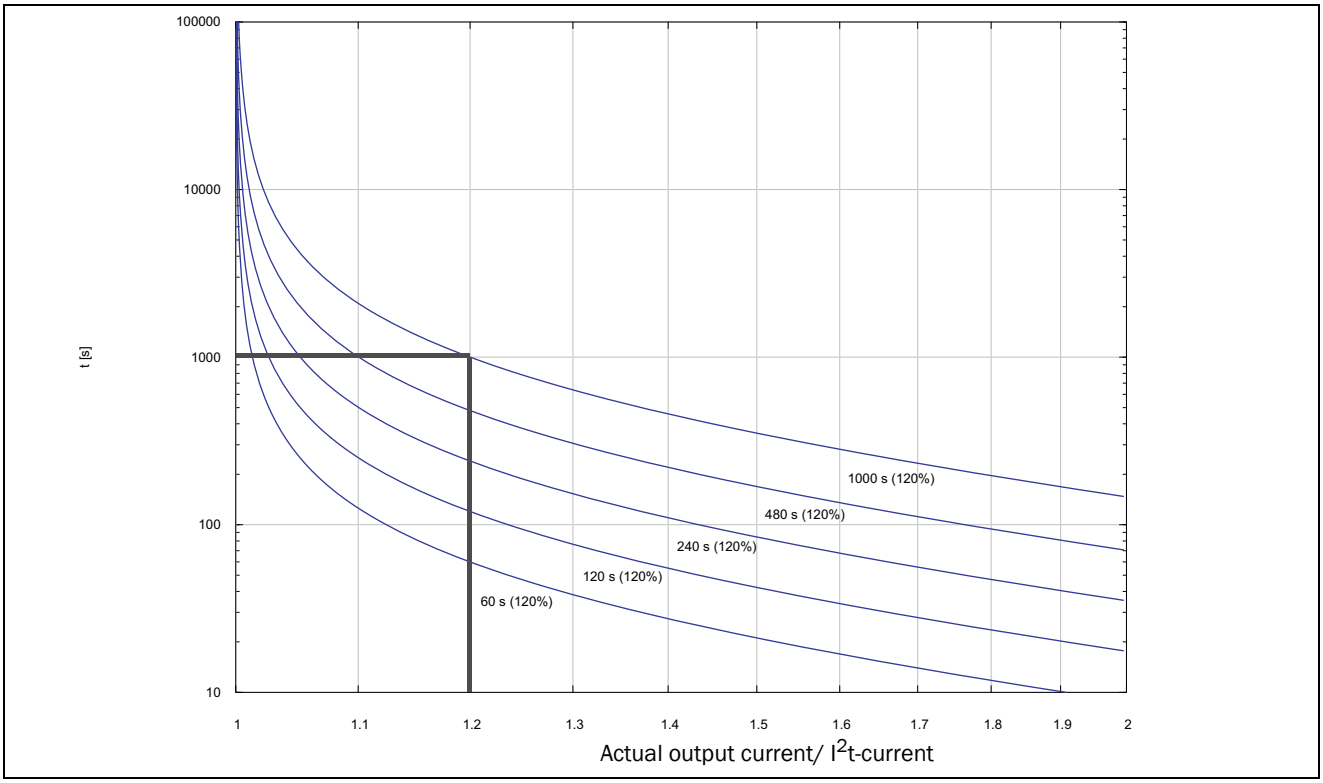


Fig. 79 I^2t function

Fig. 79 shows how the function integrates the square of the motor current according to the "Mot I^2t Curr [232]" and the "Mot I^2t Time [233]".

When the selection Trip is set in menu [231] the AC drive trips if this limit is exceeded.

When the selection Limit is set in menu [231] the AC drive reduces the torque if the integrated value is 95% or closer to the limit, so that the limit cannot be exceeded.

NOTE: If it is not possible to reduce the current, the AC drive will trip after exceeding 110% of the limit.

Example

In Fig. 79 the thick grey line shows the following example.

- Menu "[232] Mot I^2t Curr" is set to 100%. 1.2 x 100% = 120%
- Menu "[233] Mot I^2t Time" is set to 1000 s.

This means that the AC drive will trip or reduce after 1000 s if the current is 1.2 times of 100% nominal motor current.

Thermal Protection [234]

Only visible if the PTC/PT100 option board is installed. Set the PTC input for thermal protection of the motor. The motor thermistors (PTC) must comply with DIN 44081/ 44082. Please refer to the manual for the PTC/PT100 option board.

Menu [234] Thermal Prot" contains functions to enable or disable the PTC input. Here you can select and activate PTC and/or PT100.

		234 Thermal Prot Stp A Off
Default:		Off
Off	0	PTC and PT100 motor protection are disabled.
PTC	1	Enables the PTC protection of the motor via the insulated option board.
PT100	2	Enables the PT100 protection for the motor via the insulated option board.
PTC+PT100	3	Enables the PTC protection as well as the PT100 protection for the motor via the insulated option board.

Communication information

Modbus Instance no/DeviceNet no:	43064
Profibus slot/index	168/223
EtherCAT index (hex)	4bf8
Profinet IO index	19448
Fieldbus format	UInt
Modbus format	UInt

NOTE: PTC option and PT100 selections can only be selected in menu [234] if the option board is mounted.

NOTE: If you select the PTC option, the PT100 inputs as motor protection are ignored.

Motor Class [235]

Only visible if the PTC/PT100 option board is installed. Set the class of motor used. The trip levels for the PT100 sensor will automatically be set according to the setting in this menu.

		235 Mot Class Stp A F 140°C
Default:		F 140°C
A 100°C	0	
E 115°C	1	
B 120°C	2	
F 140°C	3	
F Nema 145°C	4	
H 165°C	5	

Communication information

Modbus Instance no/DeviceNet no:	43065
Profibus slot/index	168/224
EtherCAT index (hex)	4bf9
Profinet IO index	19449
Fieldbus format	UInt
Modbus format	UInt

NOTE: This menu is only valid for PT 100.

PT100 Inputs [236]

Sets which of PT100 inputs that should be used for thermal protection. Deselecting not used PT100 inputs on the PTC/ PT100 option board in order to ignore those inputs, i.e. extra external wiring is not needed if port is not used.

		236 PT100 Inputs Stp A PT100 1+2+3
Default:		PT100 1+2+3
Selection:		PT100 1, PT100 2, PT100 1+2, PT100 3, PT100 1+3, PT100 2+3, PT100 1+2+3
PT100 1	1	Channel 1 used for PT100 protection
PT100 2	2	Channel 2 used for PT100 protection
PT100 1+2	3	Channel 1+2 used for PT100 protection
PT100 3	4	Channel 3 used for PT100 protection
PT100 1+3	5	Channel 1+3 used for PT100 protection
PT100 2+3	6	Channel 2+3 used for PT100 protection
PT100 1+2+3	7	Channel 1+2+3 used for PT100 protection

Communication information

Modbus Instance no/DeviceNet no:	43066
Profibus slot/index	168/225
EtherCAT index (hex)	4bfa
Profinet IO index	19450
Fieldbus format	UInt
Modbus format	UInt

NOTE: This menu is only valid for PT 100 thermal protection if PT100 is enabled in menu [234].

Motor PTC [237]

For AC drive sizes B toD(VFX48/52-003-074) there is optional possibility to directly connect motor PTC (not to be mixed up with PTC/PT100 option board, see Chapter 13.8 page 206).

In this menu the internal motor PTC hardware option is enabled. This PTC input complies with DIN 44081/44082. For electrical specification please refer to the separate manual for the PTC/PT100 option board, same data applies (could be found on www.emotron.com/www.cgglobal.com).

This menu is only visible if a PTC (or resistor <2 kOhm) is connected to terminals X1: 78–79. See Chapter 4.5 page 41 and Chapter 4.5.1 page 41.

NOTE: This function is not related to PTC/PT100 option board.

To enable the function:

1. Connect the thermistor wires to X1: 78–79 or for testing the input, connect a resistor to the terminals .Use resistor value between 50 and 2000 ohm.
   Menu [237] will now appear.
2. Enable input by setting menu "[237] Motor PTC"=On.

If enabled and <50 ohm a sensor error trip will occur. The fault message "Motor PTC" is shown.

If the function is disabled and the PTC or resistor is removed, the menu will disappear after the next power on

	237 Motor PTC Stp A Off	
Default:		Off
Off	0	Motor PTC protection is disabled
On	1	Motor PTC protection is enabled

Communication information

Modbus Instance no/DeviceNet no:	43067
Profibus slot/index	168/226
EtherCAT index (hex)	4bfb
Profinet IO index	19451
Fieldbus format	UInt
Modbus format	UInt

11.2.6 Parameter Set Handling [240]

There are four different parameter sets available in the AC drive. These parameter sets can be used to set the AC drive up for different processes or applications such as different motors used and connected, activated PID controller, different ramp time settings, etc.

A parameter set consists of all parameters with the exception of the Global parameters. The Global parameters are only able to have one value for all parameter sets.
Following parameters are Global: [211] Language, [217] Local Remote, [218] Lock Code, [220] Motor Data, [241] Select Set, [260] Serial Communication and [21B]Mains Supply Voltage .

NOTE: Actual timers are common for all sets. When a set is changed the timer functionality will change according to the new set, but the timer value will stay unchanged.

Select Set [241]

Here you select the parameter set. Every menu included in the parameter sets is designated A, B, C or D depending on the active parameter set. Parameter sets can be selected from the keyboard, via the programmable digital inputs or via serial communication. Parameter sets can be changed during the run. If the sets are using different motors (M1 to M4) the set will be changed only when the motor is stopped.

	241 Select Set Stp A A	
Default:		A
Selection:		A, B, C, D, DigIn, Com, Option
A	0	Fixed selection of one of the 4 parameter sets A, B, C or D.
B	1	
C	2	
D	3	
DigIn	4	Parameter set is selected via a digital input. Define which digital input in menu "[520] Digital inputs".
Com	5	Parameter set is selected via serial communication.
Option	6	The parameter set is set via an option. Only available if the option can control the selection.

Communication information

Modbus Instance no/DeviceNet no:	43022
Profibus slot/index	168/181
EtherCAT index (hex)	4bce
Profinet IO index	19406
Fieldbus format	UInt
Modbus format	UInt

The active set can be viewed with function [721] VSD status.

NOTE: Parameter set cannot be changed during run if the parameter set includes change of the motor set (M2-M4). In this case always stop the motor before changing parameter set.

Prepare parameter Set when different Motor data M1 - M4:

1. Select desired parameter Set to be set in [241] A - D.
2. Select "Motor Set [212]" if other than the default Set M1.
3. Set relevant motor data in the Menu group [220].
4. Set other desired parameter settings to belong to this parameter Set.

To prepare a Set for another motor, repeat these steps.

Copy Set [242]

This function copies the content of a parameter set into another parameter set.

	242 Copy Set Stp A A>B	
Default:		A>B
A>B	0	Copy set A to set B
A>C	1	Copy set A to set C
A>D	2	Copy set A to set D
B>A	3	Copy set B to set A
B>C	4	Copy set B to set C
B>D	5	Copy set B to set D
C>A	6	Copy set C to set A
C>B	7	Copy set C to set B
C>D	8	Copy set C to set D
D>A	9	Copy set D to set A
D>B	10	Copy set D to set B
D>C	11	Copy set D to set C

Communication information

Modbus Instance no/DeviceNet no:	43021
Profibus slot/index	168/180
EtherCAT index (hex)	4bcd
Profinet IO index	19405
Fieldbus format	UInt
Modbus format	UInt

NOTE: The actual value of menu [310] will not be copied into the other set.

A>B means that the content of parameter set A is copied into parameter set B.

Load Default Values Into Set [243]

With this function three different levels (factory settings) can be selected for the four parameter sets. When loading the default settings, all changes made in the software are set to factory settings. This function also includes selections for loading default settings to the four different Motor Data Sets.

	243 Default>Set Stp A A	
Default:		A
A	0	Only the selected parameter set will revert to its default settings.
B	1	
C	2	
D	3	
ABCD	4	All four parameter sets will revert to the default settings.
Factory	5	All settings, except [211], [221]-[228], [261], [3A1] and [923], will revert to the default settings.
M1	6	Only the selected motor set will revert to its default settings.
M2	7	
M3	8	
M4	9	
M1234	10	All four motor sets will revert to default settings.

Communication information

Modbus Instance no/DeviceNet no:	43023
Profibus slot/index	168/182
EtherCAT index (hex)	4bcf
Profinet IO index	19407
Fieldbus format	UInt
Modbus format	UInt

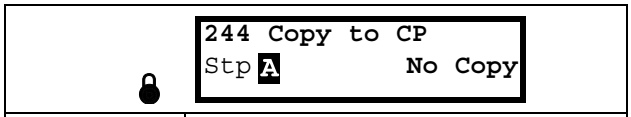
NOTE: Trip log hour counter and other VIEW ONLY menus are not regarded as settings and will be unaffected.

NOTE: If "Factory" is selected, the message "Sure?" is displayed. Press the + key to display "Yes" and then Enter to confirm.

NOTE: The parameters in menu "[220] Motor data", are not affected by loading defaults when restoring parameter sets A–D.

Copy All Settings to Control Panel [244]

All the settings can be copied into the control panel including the motor data. Start commands will be ignored during copying.



Default:		No Copy
No Copy	0	Nothing will be copied
Copy	1	Copy all settings

Communication information

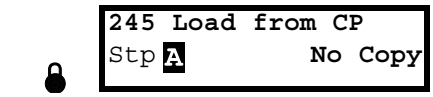
Modbus Instance no/DeviceNet no:	43024
Profibus slot/index	168/183
EtherCAT index (hex)	4bd0
Profinet IO index	19408
Fieldbus format	UInt
Modbus format	UInt

NOTE: The actual value of menu [310] will not be copied into control panel memory set.

Load Settings from Control Panel [245]

This function can load all four parameter sets from the control panel to the AC drive. Parameter sets from the source AC drive are copied to all parameter sets in the target AC drive, i.e. A to A, B to B, C to C and D to D.

Start commands will be ignored during loading.



Default:		No Copy
No Copy	0	Nothing will be loaded.
A	1	Data from parameter set A is loaded.
B	2	Data from parameter set B is loaded.
C	3	Data from parameter set C is loaded.
D	4	Data from parameter set D is loaded.
ABCD	5	Data from parameter sets A, B, C and D are loaded.
A+Mot	6	Parameter set A and Motor data are loaded.
B+Mot	7	Parameter set B and Motor data are loaded.
C+Mot	8	Parameter set C and Motor data are loaded.
D+Mot	9	Parameter set D and Motor data are loaded.
ABCD+Mot	10	Parameter sets A, B, C, D and Motor data are loaded.
M1	11	Data from motor 1 is loaded.
M2	12	Data from motor 2 is loaded.
M3	13	Data from motor 3 is loaded.
M4	14	Data from motor 4 is loaded.
M1M2M3 M4	15	Data from motor 1, 2, 3 and 4 are loaded.
All	16	All data is loaded from the control panel.

Communication information

Modbus Instance no/DeviceNet no:	43025
Profibus slot/index	168/184
EtherCAT index (hex)	4bd1
Profinet IO index	19409
Fieldbus format	UInt
Modbus format	UInt

NOTE: Loading from the control panel will not affect the value in menu [310].

11.2.7 Trip Autoreset/Trip Conditions [250]

The benefit of this feature is that occasional trips that do not affect the process will be automatically reset. Only when the failure keeps on coming back, recurring at defined times and therefore cannot be solved by the AC drive, will the unit give an alarm to inform the operator that attention is required.

For all trip functions that can be activated by the user you can select to control the motor down to zero speed according to set deceleration ramp to avoid water hammer.

Also see section 12.2, page 196.

Autoreset example:

In an application it is known that the main supply voltage sometimes disappears for a very short time, a so-called “dip”. That will cause the AC drive to trip an “Undervoltage alarm”. Using the Autoreset function, this trip will be acknowledged automatically.

- Enable the Autoreset function by making the reset input continuously high.
- Activate the Autoreset function in the menu [251], Number of trips.
- Select in menus [252] to [25N] the Trip condition that are allowed to be automatically reset by the Autoreset function after the set delay time has expired.

Number of Trips [251]

Any number set above 0 activates the Autoreset. This means that after a trip, the AC drive will restart automatically according to the number of attempts selected. No restart attempts will take place unless all conditions are normal.

If the Autoreset counter (not visible) contains more trips than the selected number of attempts, the Autoreset cycle will be interrupted. No Autoreset will then take place.

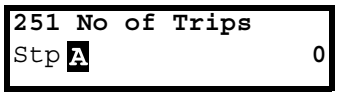
If there are no trips for more than 10 minutes, the Autoreset counter decreases by one.

If the maximum number of trips has been reached, the trip message hour counter is marked with an “A”.

If the Autoreset is full then the AC drive must be reset by a normal Reset.

Example:

- Number of allowed autoreset attempts [251]= 5.
- Within 10 minutes 6 trips occur.
- At the 6th trip there is no autoreset, because the autoreset counter is set to allow only 5 attempts to autoreset a trip.
- To reset the autoreset counter, give a new reset command (from one of the sources for reset control selected in menu [216]).
- The autoreset counter is now zeroed.

	
Default:	0 (no Autoreset)
Range:	0–10 attempts

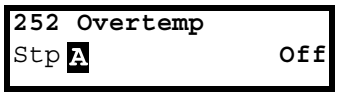
Communication information

Modbus Instance no/DeviceNet no:	43071
Profibus slot/index	168/230
EtherCAT index (hex)	4bff
Profinet IO index	19455
Fieldbus format	UInt, 1=1
Modbus format	UInt

NOTE: An auto reset is delayed by the remaining ramp time.

Over temperature [252]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

		
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43072
Profibus slot/index	168/231
EtherCAT index (hex)	4c00
Profinet IO index	19456
Fieldbus format	Long, 1=1 s
Modbus format	EInt

NOTE: An auto reset is delayed by the remaining ramp time.

Overvolt D [253]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active**.**

		253 Overvolt D Stp A Off
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43075
Profibus slot/index	168/234
EtherCAT index (hex)	4c03
Profinet IO index	19459
Fieldbus format	Long, 1=1 s
Modbus format	EInt

NOTE: An auto reset is delayed by the remaining ramp time.

Overvolt G [254]

Delay time starts counting when the fault is gone When the time delay has elapsed, the alarm will be reset if the function is active.

		254 Overvolt G Stp A Off
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43076
Profibus slot/index	168/235
EtherCAT index (hex)	4c04
Profinet IO index	19460
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Overvolt [255]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

		255 Overvolt Stp A Off
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43077
Profibus slot/index	168/236
EtherCAT index (hex)	4c05
Profinet IO index	19461
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Motor Lost [256]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

		256 Motor Lost Stp A Off
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

NOTE: Only visible when Motor Lost is selected in menu [423].

Communication information

Modbus Instance no/DeviceNet no:	43083
Profibus slot/index	168/242
EtherCAT index (hex)	4c0b
Profinet IO index	19467
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Locked Rotor [257]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active**.**



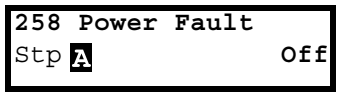
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43086
Profibus slot/index	168/245
EtherCAT index (hex)	4c0e
Profinet IO index	19470
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Power Fault [258]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active**.**



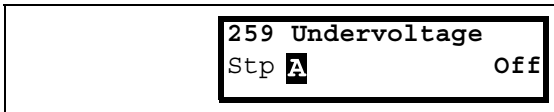
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43087
Profibus slot/index	168/246
EtherCAT index (hex)	4c0f
Profinet IO index	19471
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Undervoltage [259]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active**.**



Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43088
Profibus slot/index	168/247
EtherCAT index (hex)	4c10
Profinet IO index	19472
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Motor I^2t [25A]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active**.**



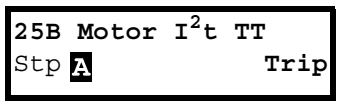
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43073
Profibus slot/index	168/232
EtherCAT index (hex)	4c01
Profinet IO index	19457
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Motor I^2t Trip Type [25B]

Select the preferred way to react to a Motor I^2t trip.



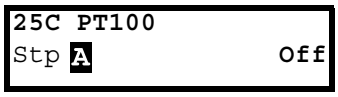
Default:		Trip
Trip	0	The motor will trip
Deceleration	1	The motor will decelerate

Communication information

Modbus Instance no/DeviceNet no:	43074
Profibus slot/index	168/233
EtherCAT index (hex)	4c02
Profinet IO index	19458
Fieldbus format	UInt
Modbus format	UInt

PT100 [25C]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.



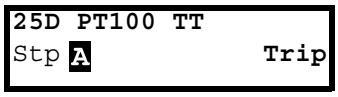
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43078
Profibus slot/index	168/237
EtherCAT index (hex)	4c06
Profinet IO index	19462
Fieldbus format	Long, 1=1 s
Modbus format	EInt

PT100 Trip Type [25D]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.



Default:	Trip
Selection:	Same as menu [25B]

Communication information

Modbus Instance no/DeviceNet no:	43079
Profibus slot/index	168/238
EtherCAT index (hex)	4c07
Profinet IO index	19463
Fieldbus format	Uint
Modbus format	UInt

PTC [25E]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.



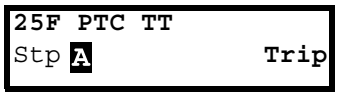
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43084
Profibus slot/index	168/243
EtherCAT index (hex)	4c0c
Profinet IO index	19468
Fieldbus format	Long, 1=1 s
Modbus format	EInt

PTC Trip Type [25F]

Select the preferred way to react to a PTC trip.



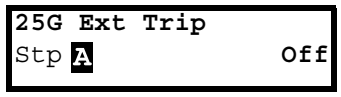
Default:	Trip
Selection:	Same as menu [25B]

Communication information

Modbus Instance no/DeviceNet no:	43085
Profibus slot/index	168/244
EtherCAT index (hex)	4c0d
Profinet IO index	19469
Fieldbus format	UInt
Modbus format	UInt

External Trip [25G]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.



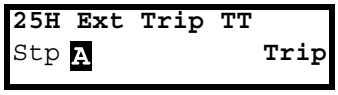
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43080
Profibus slot/index	168/239
EtherCAT index (hex)	4c08
Profinet IO index	19464
Fieldbus format	Long, 1=1 s
Modbus format	EInt

External Trip Type [25H]

Select the preferred way to react to an alarm trip.



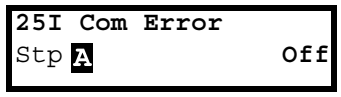
Default:	Trip
Selection:	Same as menu [25B]

Communication information

Modbus Instance no/DeviceNet no:	43081
Profibus slot/index	168/240
EtherCAT index (hex)	4c09
Profinet IO index	19465
Fieldbus format	UInt
Modbus format	UInt

Communication Error [25I]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.



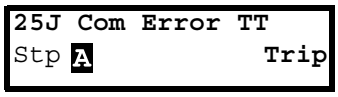
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43089
Profibus slot/index	168/248
EtherCAT index (hex)	4c11
Profinet IO index	19473
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Communication Error Trip Type [25J]

Select the preferred way to react to a communication trip.



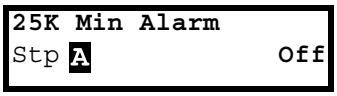
Default:	Trip
Selection:	Same as menu [25B]

Communication information

Modbus Instance no/DeviceNet no:	43090
Profibus slot/index	168/249
EtherCAT index (hex)	4c12
Profinet IO index	19474
Fieldbus format	UInt
Modbus format	UInt

Min Alarm [25K]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.



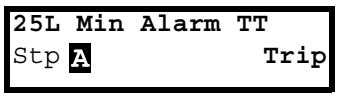
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43091
Profibus slot/index	168/250
EtherCAT index (hex)	4c13
Profinet IO index	19475
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Min Alarm Trip Type [25L]

Select the preferred way to react to a min alarm trip.



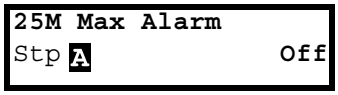
Default:	Trip
Selection:	Same as menu [25B]

Communication information

Modbus Instance no/DeviceNet no:	43092
Profibus slot/index	168/251
EtherCAT index (hex)	4c14
Profinet IO index	19476
Fieldbus format	UInt
Modbus format	UInt

Max Alarm [25M]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.



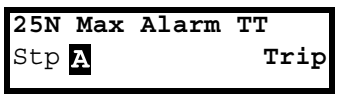
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43093
Profibus slot/index	168/252
EtherCAT index (hex)	4c15
Profinet IO index	19477
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Max Alarm Trip Type [25N]

Select the preferred way to react to a max alarm trip.



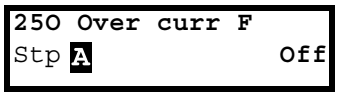
Default:	Trip
Selection:	Same as menu [25B]

Communication information

Modbus Instance no/DeviceNet no:	43094
Profibus slot/index	168/253
EtherCAT index (hex)	4c16
Profinet IO index	19478
Fieldbus format	UInt
Modbus format	UInt

Over current F [25O]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.



Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43082
Profibus slot/index	168/241
EtherCAT index (hex)	4c0a
Profinet IO index	19466
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Pump [25P]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.



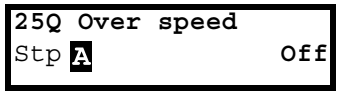
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43095
Profibus slot/index	168/254
EtherCAT index (hex)	4c17
Profinet IO index	19479
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Over Speed [25Q]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.



Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43096
Profibus slot/index	169/0
EtherCAT index (hex)	4c18
Profinet IO index	19480
Fieldbus format	Long, 1=1 s
Modbus format	EInt

External Motor Temperature [25R]

Delay time starts counting when the fault disappears. When the time delay has elapsed, the alarm will be reset if the function is active.

	25R Ext Mot Temp Stp A Off	
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43097
Profibus slot/index	168/239
EtherCAT index (hex)	4c19
Profinet IO index	19481
Fieldbus format	Long, 1=1 s
Modbus format	EInt

External Motor Trip Type [25S]

Select the preferred way to react to an alarm trip.

25S Ext Mot TT Stp A Trip	
Default:	Trip
Selection:	Same as menu [25B]

Communication information

Modbus Instance no/DeviceNet no:	43098
Profibus slot/index	168/240
EtherCAT index (hex)	4c1a
Profinet IO index	19482
Fieldbus format	UInt
Modbus format	UInt

Liquid cooling low level [25T]

Delay time starts counting when the fault disappears. When the time delay has elapsed, the alarm will be reset if the function is active.

	25T LC Level Stp A Off	
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43099
Profibus slot/index	169/3
EtherCAT index (hex)	4c1b
Profinet IO index	19483
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Liquid Cooling Low level Trip Type [25U]

Select the preferred way to react to an alarm trip.

25U LC Level TT Stp A Trip	
Default:	Trip
Selection:	Same as menu [25B]

Communication information

Modbus Instance no/DeviceNet no:	43100
Profibus slot/index	169/4
EtherCAT index (hex)	4c1c
Profinet IO index	19484
Fieldbus format	UInt
Modbus format	UInt

Brake Fault [25V]

Delay time starts counting when the fault disappears. When the time delay has elapsed, the alarm will be reset if the function is active.

	25V Brk Fault Stp A Off	
Default		Off
Off	0	Autoreset not activated.
1 - 3600s	1 - 3600	Brake fault auto reset delay time.

Communication information

Modbus Instance no/DeviceNet no:	43070
Profibus slot/index	168/229
EtherCAT index (hex)	4bfe
Profinet IO index	19454
Fieldbus format	Long, 1=1s
Modbus format	EInt

Encoder [25W]

Encoder delay time, starts counting when the fault disappears. When the time delay has elapsed, the alarm will be reset if the function is active.

	25W Encoder Stp A Off	
Default:		Off
Off	0	Off
1- 3600	1- 3600	1- 3600 s

Communication information

Modbus Instance no/DeviceNet no:	43561
Profibus slot/index	170/210
EtherCAT index (hex)	4de9
Profinet IO index	19945
Fieldbus format	Long, 1=1s
Modbus format	EInt

Crane deviation [25X]

Deviation delay time, starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

	25X Crane Deviat Stp A Off	
Default:		Off
Off	0	Off
1- 3600	1- 3600	1- 3600 s

Communication information

Modbus Instance no/DeviceNet no:	43562
Profibus slot/index	170/211
EtherCAT index (hex)	4dea
Profinet IO index	19946
Fieldbus format	Long, 1=1s
Modbus format	EInt

Crane Communication [25Y]

Crane Communication delay time, starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

	25Y Crane Comm Stp A Off	
Default:		Off
Off	0	Off
1- 3600	1- 3600	1- 3600 s

Communication information

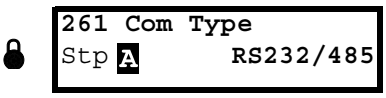
Modbus Instance no/DeviceNet no:	43563
Profibus slot/index	170/212
EtherCAT index (hex)	4deb
Profinet IO index	19947
Fieldbus format	Long, 1=1s
Modbus format	EInt

11.2.8 Serial Communication [260]

This function is to define the communication parameters for serial communication. There are two types of options available for serial communication, RS232/485 (Modbus/RTU) and fieldbus modules (Profibus, DeviceNet, Modbus/TCP, Profinet IO, EtherCAT and EtherNet/IP). For more information see Chapter 10. page 67 and respective option manual.

Comm Type [261]

Select RS232/485 [262] or Fieldbus [263].



Default:		RS232/485
RS232/485	0	RS232/485 selected
Fieldbus	1	Fieldbus selected (Profibus, DeviceNet, Modbus/TCP, Profinet IO, EtherCAT or EtherNet/IP)

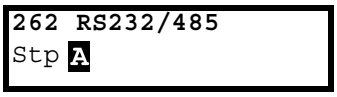
Communication information

Modbus Instance no/DeviceNet no:	43031
Profibus slot/index	168/190
EtherCAT index (hex)	4bd7
Profinet IO index	19415
Fieldbus format	UInt
Modbus format	UInt

NOTE: Toggling the setting in this menu will perform a soft reset (re-boot) of the Fieldbus module.

RS232/485 [262]

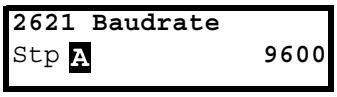
Press Enter to set up the parameters for RS232/485 (Modbus/RTU) communication.



Baud rate [2621]

Set the baud rate for the communication.

NOTE: This baud rate is only used for the isolated RS232/485 option.



Default:		9600
2400	0	Selected baud rate
4800	1	
9600	2	
19200	3	
38400	4	

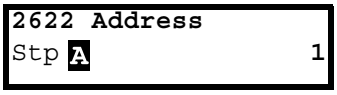
Communication information

Modbus Instance no/DeviceNet no:	43032
Profibus slot/index	168/191
EtherCAT index (hex)	4bd8
Profinet IO index	19416
Fieldbus format	UInt
Modbus format	UInt

Address [2622]

Enter the unit address for the AC drive.

NOTE: This address is only used for the isolated RS232/485 option.



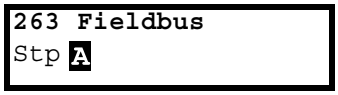
Default:	1
Selection:	1–247

Communication information

Modbus Instance no/DeviceNet no:	43033
Profibus slot/index	168/192
EtherCAT index (hex)	4bd9
Profinet IO index	19417
Fieldbus format	UInt, 1=1
Modbus format	UInt

Fieldbus [263]

Press Enter to set up the parameters for fieldbus communication.



Address [2631]

Enter/view the unit/node address of the AC drive. Read & write access for Profibus, DeviceNet. Read - only for EtherCAT.



Default:	62
Range:	Profibus 0–126, DeviceNet 0–63
Node address valid for Profibus(RW), DeviceNet (RW) and EtherCAT (RO).	

Communication information

Modbus Instance no/DeviceNet no:	43034
Profibus slot/index	168/199
EtherCAT index (hex)	4bda
Profinet IO index	19418
Fieldbus format	UInt, 1=1
Modbus format	UInt

Process Data Mode [2632]

Enter the mode of process data (cyclic data). For further information, see the Fieldbus option manual.



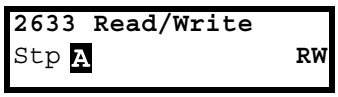
Default:		Basic
None	0	Control/status information is not used.
Basic	4	4 byte process data control/status information is used.
Extended	8	4 byte process data (same as Basic setting) + additional proprietary protocol for advanced users is used.

Communication information

Modbus Instance no/DeviceNet no:	43035
Profibus slot/index	168/194
EtherCAT index (hex)	4bdb
Profinet IO index	19419
Fieldbus format	UInt
Modbus format	UInt

Read/Write [2633]

Select read/write to control the inverter over a fieldbus network. For further information, see the Fieldbus option manual.



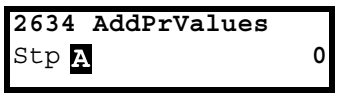
Default:		RW
RW	0	
Read	1	
Valid for process data. Select R (read only) for logging process without writing process data. Select RW in normal cases to control inverter.		

Communication information

Modbus Instance no/DeviceNet no:	43036
Profibus slot/index	168/195
EtherCAT index (hex)	4bdc
Profinet IO index	19420
Fieldbus format	UInt
Modbus format	UInt

Additional Process Values [2634]

Define the number of additional process values sent in cyclic messages.



Default:	0
Range:	0-8

Communication information

Modbus Instance no/DeviceNet no:	43039
Profibus slot/index	168/198
EtherCAT index (hex)	4bdf
Profinet IO index	19423
Fieldbus format	UInt, 1=1
Modbus format	UInt

Communication Fault [264]

Main menu for communication fault/warning settings. For further details please see the Fieldbus option manual.

Communication Fault Mode [2641]]

Selects action if a communication fault is detected.

	2641 ComFlt Mode Stp A Off	
Default:		Off
Off	0	No communication supervision.
Trip	1	RS232/485 selected: The AC drive will trip if there is no communication for time set in parameter [2642]. Fieldbus selected: The AC drive will trip if: 1. The internal communication between the control board and fieldbus option is lost for time set in parameter [2642]. 2. If a serious network error has occurred.
Warning	2	RS232/485 selected: The AC drive will give a warning if there is no communication for time set in parameter [2642]. Fieldbus selected: The AC drive will give a warning if: 1. The internal communication between the control board and fieldbus option is lost for time set in parameter [2642]. 2. If a serious network error has occurred.

NOTE: Menu [214] and/or [215] must be set to COM to activate the communication fault function.

Communication information

Modbus Instance no/DeviceNet no:	43037
Profibus slot/index	168/196
EtherCAT index (hex)	4bdd
Profinet IO index	19421
Fieldbus format	UInt
Modbus format	UInt

Communication Fault Time [2642]]

Defines the delay time for the trip/warning.

2642 ComFlt Time Stp A 0.5s	
Default:	0.5 s
Range:	0.1-15 s

Communication information

Modbus Instance no/DeviceNet no:	43038
Profibus slot/index	168/197
EtherCAT index (hex)	4bde
Profinet IO index	19422
Fieldbus format	Long, 1=0.1 s
Modbus format	EInt

Ethernet [265]

Settings for Ethernet module (Modbus/TCP, Profinet IO). For further information, see the Fieldbus option manual.

NOTE: The Ethernet module must be re-booted to activate the below settings. For example by toggling parameter [261]. Non-initialized settings indicated by flashing display text.

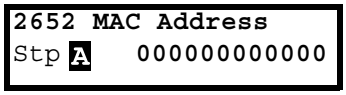
IP Address [2651]

2651 IP Address 0. 0. 0. 0	
Default:	0.0.0.0

Communication information

Modbus Instance no/DeviceNet no:	42701, 42702, 42703, 42704
Profibus slot/index	167/115, 167/116, 167/117, 167/118
EtherCAT index (hex)	4a8d, 4a8e, 4a8f, 4a90
Profinet IO index	19085, 19086, 19087, 19088
Fieldbus format	UInt, 1=1
Modbus format	UInt

MAC Address [2652]

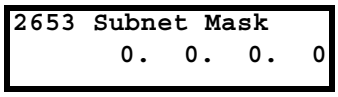


Default:	An unique number for the Ethernet module.

Communication information

Modbus Instance no/DeviceNet no:	42705, 42706, 42707, 42708, 42709, 42710
Profibus slot/index	167/119, 167/120, 167/121, 167/122, 167/123, 167/124
EtherCAT index (hex)	4a91, 4a92, 4a93, 4a94, 4a95, 4a96,
Profinet IO index	19089, 19090, 19091, 19092, 19093, 19094
Fieldbus format	UInt, 1=1
Modbus format	UInt

Subnet Mask [2653]

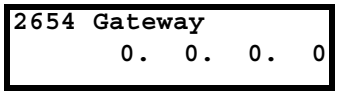


Default:	0.0.0.0

Communication information

Modbus Instance no/DeviceNet no:	42711, 42712, 42713, 42714
Profibus slot/index	167/125, 167/126, 167/127, 167/128
EtherCAT index (hex)	4a97, 4a98, 4a99, 4a9a
Profinet IO index	19095, 19096, 19097, 19098
Fieldbus format	UInt, 1=1
Modbus format	UInt

Gateway [2654]



Default:	0.0.0.0

Communication information

Modbus Instance no/DeviceNet no:	42715, 42716, 42717, 42718
Profibus slot/index	167/129, 167/130, 167/131, 167/132
EtherCAT index (hex)	4a9b, 4a9c, 4a9e, 4a9f
Profinet IO index	19099, 19100, 19101, 19102
Fieldbus format	UInt, 1=1
Modbus formatPicknik	UInt

DHCP [2655]



Default:	Off
Selection:	On/Off

Communication information

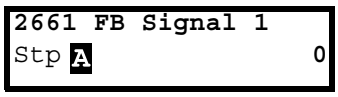
Modbus Instance no/DeviceNet no:	42719
Profibus slot/index	167/133
EtherCAT index (hex)	4a9f
Profinet IO index	19103
Fieldbus format	UInt
Modbus format	UInt

Fieldbus Signals [266]

Defines modbus mapping for additional process values. For further information, see the Fieldbus option manual.

FB Signal 1 - 16 [2661]-[266G]

Used to create a block of parameters which are read/written via communication. 1 to 8 read + 1 to 8 write parameters possible.



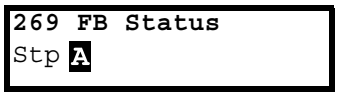
Default:	0
Range:	0-65535

Communication information

Modbus Instance no/DeviceNet no:	42801-42816
Profibus slot/index	167/215-167/230
EtherCAT index (hex)	4af1 - 4b00
Profinet IO index	19185 - 19200
Fieldbus format	UInt, 1=1
Modbus format	UInt

FB Status [269]

Sub menus showing status of fieldbus parameters. Please see the Fieldbus manual for detailed information.



11.3 Process and Application Parameters [300]

These parameters are mainly adjusted to obtain optimum process or machine performance.

The read-out, references and actual values depends on selected process source, [321}:

Table 27

Selected process source	Unit for reference and actual value	Resolution
Speed	rpm	4 digits
Torque	%	3 digits
PT100	°C	3 digits
Frequency	Hz	3 digits

11.3.1 Set/View Reference Value [310]

View reference value

As default the menu [310] is in view operation. The value of the active reference signal is displayed. The value is displayed according to selected process source, [321] or the process unit selected in menu [322].

Set reference value

If the function "Reference Control [214]" is set to "Keyboard", the reference value can be set in menu "Set/View Ref [310]" or as a motor potentiometer with the + and - keys (default) on the control panel. Selection is made with parameter Keyboard Reference Mode in menu [369]. The ramp times used when setting the reference value with MotPot function selected in [369] are according to menus "Acc MotPot [333]" and "Dec MotPot [334]".
The ramp times used for the reference value when Normal function is selected in menu [369], are according to "Acc Time [331]" and "Dec Time [332]".
Menu [310] displays on-line the actual reference value according to the Mode Settings in Table 27.

310 Set/View ref Stp A 0rpm	
Default:	0 rpm
Dependent on:	Process Source [321] and Process Unit [322]
Speed mode	0 - max speed [343]
Torque mode	0 - max torque [351]
Other modes	Min according to menu [324] - max according to menu [325]

Communication information

Modbus Instance no/DeviceNet no:	42991
Profibus slot/index	168/150
EtherCAT index (hex)	4baf
Profinet IO index	19375
Fieldbus format	Long, 1=1 rpm, 1 %,1 °C or 0.001 if Process Value/Process Ref using a [322] unit
Modbus format	EInt

NOTE: The actual value in menu [310] is not copied, or loaded from the control panel memory when Copy Set [242], Copy to CP [244] or Load from CP [245] is performed.

NOTE: If the MotPot function is used, the reference value ramp times are according to the "Acc MotPot [333]" and "Dec MotPot [334]" settings. Actual speed ramp will be limited according to "Acc Time [331]" and "Dec Time [332]".

NOTE: Write access to this parameter is only allowed when menu "Ref Control [214]" is set to Keyboard. When Reference control is used, see section "10. Serial communication" on page 67

11.3.2 Process Settings [320]

With these functions, the AC drive can be set up to fit the application. The menus [110], [120], [310], [362]-[368] and [711] use the process unit selected in [321] and [322] for the application, e.g. rpm, bar or m3/h. This makes it possible to easily set up the AC drive for the required process requirements, as well as for copying the range of a feedback sensor to set up the Process Value Minimum and Maximum in order to establish accurate actual process information.

Process Source [321]

Select the signal source for the process value that controls the motor. The Process Source can be set to act as a function of the process signal on AnIn F(AnIn), a function of the motor speed F(Speed), a function of the shaft torque F(Torque) or as a function of a process value from serial communication F(Bus). The right function to select depends on the characteristics and behaviour of the process. If the selection Speed, Torque or Frequency is set, the AC drive will use speed, torque or frequency as reference value.

Example

An axial fan is speed-controlled and there is no feedback signal available. The process needs to be controlled within fixed process values in "m^3/hr" and a process read-out of the air flow is needed. The characteristic of this fan is that the air flow is linearly related to the actual speed. So by selecting F(Speed) as the Process Source, the process can easily be controlled.

The selection F(xx) indicates that a process unit and scaling is needed, set in menus [322]-[328]. This makes it possible to e.g. use pressure sensors to measure flow etc. If F(AnIn) is selected, the source is automatically connected to the AnIn which has Process Value as selected.

		321 Proc Source Stp A Speed
Default:		Speed
F(AnIn)	0	Function of analogue input. E.g. via PID control, [380].
Speed	1	Speed as process reference[1].
Torque	2	Torque as process reference[2].
PT100	3	Temperature as process reference.
F(Speed)	4	Function of speed
F(Torque)	5	Function of torque[2]
F(Bus)	6	Function of communication reference
Frequency	7	Frequency as process reference[1].

[1]. Only when Drive mode [213] is set to Speed or V/Hz.
[2]. Only when Drive mode [213] is set to Torque.

NOTE: When PT100 is selected, use PT100 channel 1 on the PTC/PT100 option board.

NOTE: If Speed, Torque or Frequency is chosen in menu "[321] Proc Source", menus [322] - [328] are hidden.

NOTE: The motor control method depends on the selection of drive mode [213], regardless of selected process source, [321].

NOTE: If F (Bus) is chosen in menu [321] see "11.5.1 Analogue Inputs [510]" on page 144.

Communication information

Modbus Instance no/DeviceNet no:	43302
Profibus slot/index	169/206
EtherCAT index (hex)	4ce6
Profinet IO index	19686
Fieldbus format	UInt
Modbus format	UInt

Process Unit [322]

		322 Proc Unit Stp A rpm
Default:		rpm
Off	0	No unit selection
%	1	Percent
°C	2	Degrees Centigrade
°F	3	Degrees Fahrenheit
bar	4	bar
Pa	5	Pascal
Nm	6	Torque
Hz	7	Frequency
rpm	8	Revolutions per minute
m^3/h	9	Cubic meters per hour
gal/h	10	Gallons per hour
ft^3/h	11	Cubic feet per hour
User	12	User defined unit

Communication information

Modbus Instance no/DeviceNet no:	43303
Profibus slot/index	169/207
EtherCAT index (hex)	4ce7
Profinet IO index	19687
Fieldbus format	UInt
Modbus format	UInt

NOTE: In case of conflicting setup between this Process Source, [321], selection and drive mode [213] the software will automatically overrule the selection in menu [321] according to the following:

[213]=Torque and [321]=Speed; internally [321]=Torque will be used.
[213]=Speed or V/Hz and [321]=Torque; internally [321]=Speed will be used.

User-defined Unit [323]

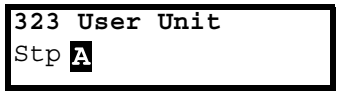
This menu is only displayed if User is selected in menu [322]. The function enables the user to define a unit with six symbols. Use the Prev and Next key to move the cursor to required position. Then use the + and - keys to scroll down the character list. Confirm the character by moving the cursor to the next position by pressing the Next key.

Character	No. for serial comm.	Character	No. for serial comm.
Space	0	m	58
0–9	1–10	n	59
A	11	ñ	60
B	12	o	61
C	13	ó	62
D	14	ô	63
E	15	p	64
F	16	q	65
G	17	r	66
H	18	s	67
I	19	t	68
J	20	u	69
K	21	ü	70
L	22	v	71
M	23	w	72
N	24	x	73
O	25	y	74
P	26	z	75
Q	27	å	76
R	28	ä	77
S	29	ö	78
T	30	!	79
U	31	¨	80
Ü	32	#	81
V	33	$	82
W	34	%	83
X	35	&	84
Y	36	·	85
Z	37	(	86
Å	38	)	87
Ä	39	*	88
Ö	40	+	89
a	41	,	90
á	42	-	91
b	43	.	92
c	44	/	93
d	45	:	94
e	46	;	95
é	47	<	96
ê	48	=	97
ë	49	>	98
f	50	?	99
g	51	@	100
h	52	^	101
i	53	_	102
í	54	°	103
j	55	2	104
k	56	3	105
l	57		

Example:

Create a user unit named kPa.

1. When in the menu [323] press + to show the cursor.
2. Press NEXT to move the cursor to the right most position.
3. Press + until the character a is displayed.
4. Press PREV.
5. Then press the + until P is displayed and press PREV.
6. Repeat until you have entered kPa, confirm with ENTER.



Default:	No characters shown

Communication information

Modbus Instance no/DeviceNet no:	43304 - 43309
Profibus slot/index	169/208 - 169/213
EtherCAT index (hex)	4ce8 - 4ced
Profinet IO index	19688 - 19693
Fieldbus format	UInt
Modbus format	UInt

Process Min [324]

This function sets the minimum process value allowed.

	324 Process Min Stp A 0
Default:	0
Range:	0.000-10000 (Speed, Torque, F(Speed), F(Torque)) -10000– +10000 (F(AnIn, PT100, F(Bus))

Communication information

Modbus Instance no/DeviceNet no:	43310
Profibus slot/index	169/214
EtherCAT index (hex)	4cee
Profinet IO index	19694
Fieldbus format	Long, 1=1 rpm, 1 %,1 °C or 0.001 if Process Value/Process Ref using a [322] unit
Modbus format	EInt

Process Max [325]

This menu is not visible when speed, torque or frequency is selected. The function sets the value of the maximum process value allowed.

	325 Process Max Stp A 0
Default:	0
Range:	0.000-10000

Communication information

Modbus Instance no/DeviceNet no:	43311
Profibus slot/index	169/215
EtherCAT index (hex)	4cef
Profinet IO index	19695
Fieldbus format	Long, 1=1 rpm, 1 %,1 °C or 0.001 if Process Value/Process Ref using a [322] unit
Modbus format	EInt

Ratio [326]

This menu is not visible when speed, frequency or torque is selected. The function sets the ratio between the actual process value and the motor speed so that it has an accurate process value when no feedback signal is used. See Fig. 80.

		326 Ratio Stp A Linear
Default:		Linear
Linear	0	Process is linear related to speed/torque
Quadratic	1	Process is quadratic related to speed/ torque

Communication information

Modbus Instance no/DeviceNet no:	43312
Profibus slot/index	169/216
EtherCAT index (hex)	4cf0
Profinet IO index	19696
Fieldbus format	UInt
Modbus format	UInt

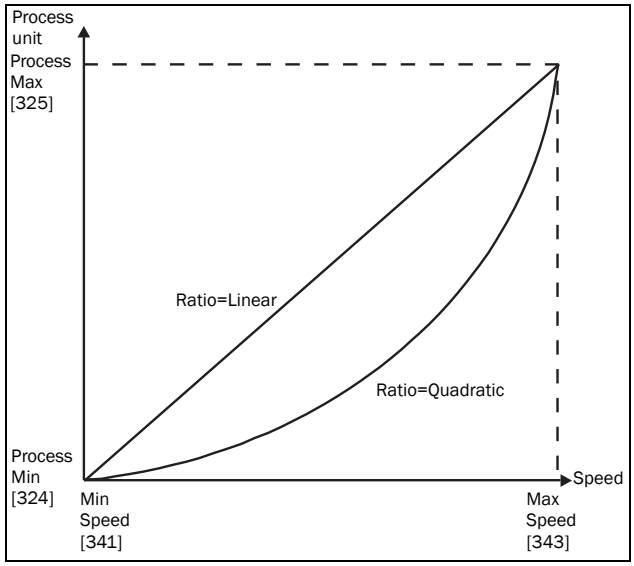


Fig. 80 Ratio

F(Value), Process Min [327]

This function is used for scaling if no sensor is used. It offers you the possibility of increasing the process accuracy by scaling the process values. The process values are scaled by linking them to known data in the AC drive. With "F(Value) Proc Min [327]" the precise value at which the entered "Process Min [324]" is valid can be entered.

NOTE: If Speed, Torque or Frequency is chosen in menu "[321] Proc Source", menus [322]- [328] are hidden.

		327 F(Val) PrMin Stp A Min
Default:		Min
Min	-1	According to Min Speed setting in [341].
Max	-2	According to Max Speed setting in [343].
0.000-10000	0-10000	0.000-10000

Communication information

Modbus Instance no/DeviceNet no:	43313
Profibus slot/index	169/217
EtherCAT index (hex)	4cf1
Profinet IO index	19697
Fieldbus format	Long, 1=1 rpm, 1 %
Modbus format	EInt

F(Value), Process Max [328]

This function is used for scaling if no sensor is used. It offers you the possibility of increasing the process accuracy by scaling the process values. The process values are scaled by linking them to known data in the AC drive. With F(Value), Proc Max the precise value at which the entered "Process Max [525]" is valid can be entered.

NOTE: If Speed, Torque or Frequency is chosen in menu "[321] Proc Source", menus [322]- [328] are hidden.

		328 F(Val) PrMax Stp A Max
Default:		Max
Min	-1	Min
Max	-2	Max
0.000-10000	0-10000	0.000-10000

Communication information

Modbus Instance no/DeviceNet no:	43314
Profibus slot/index	169/218
EtherCAT index (hex)	4cf2
Profinet IO index	19698
Fieldbus format	Long, 1=1 rpm, 1 %
Modbus format	EInt

Example

A conveyor belt is used to transport bottles. The required bottle speed needs to be within 10 to 100 bottles/s. Process characteristics:

10 bottles/s = 150 rpm
100 bottles/s = 1500 rpm
The amount of bottles is linearly related to the speed of the conveyor belt.

Set-up:

"Process Min [324]" = 10
"Process Max [325]" = 100
"Ratio [326]" = linear
"F(Value), ProcMin [327]" = 150
"F(Value), ProcMax [328]" = 1500

With this set-up, the process data is scaled and linked to known values which results in an accurate control.

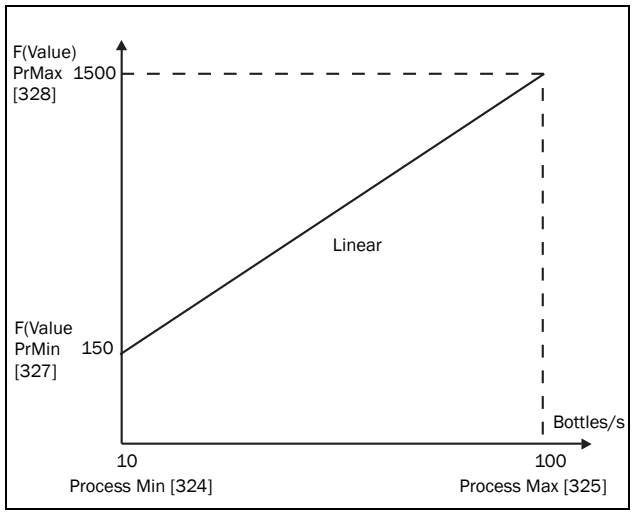


Fig. 81

11.3.3 Start/Stop settings [330]

Submenu with all the functions for acceleration, deceleration, starting, stopping, etc.

Acceleration Time [331]

The acceleration time is defined as the time it takes for the motor to accelerate from 0 rpm to nominal motor speed.

NOTE: If the Acc Time is too short, the motor is accelerated according to the Torque Limit. The actual Acceleration Time may then be longer than the value set.

331 Acc Time Stp A 10.0s	
Default:	10.0 s
Range:	0–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43101
Profibus slot/index	169/5
EtherCAT index (hex)	4c1d
Profinet IO index	19485
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

Fig. 82 shows the relationship between nominal motor speed/max speed and the acceleration time. The same is valid for the deceleration time.

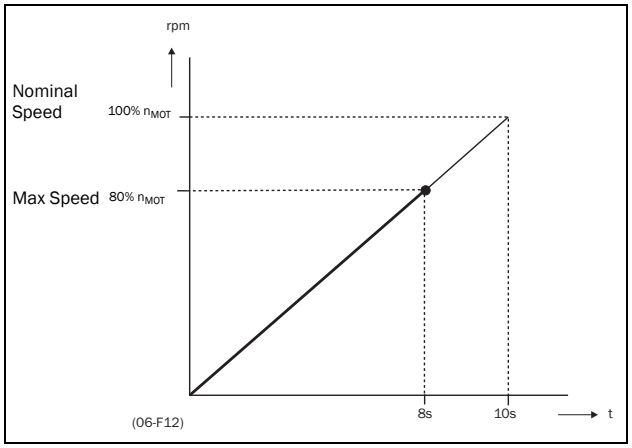


Fig. 82 Acceleration time and maximum speed

Fig. 83 shows the settings of the acceleration and deceleration times with respect to the nominal motor speed.

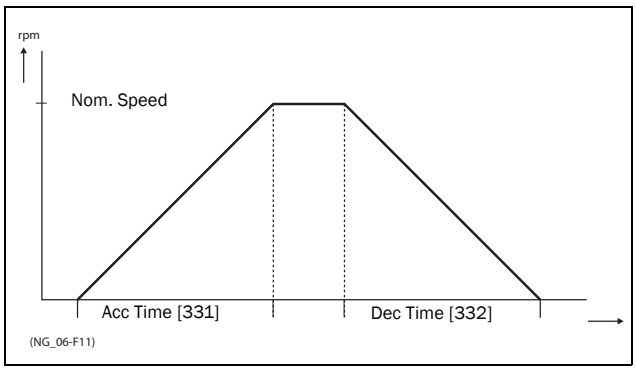


Fig. 83 Acceleration and deceleration times

Deceleration Time [332]

The deceleration time is defined as the time it takes for the motor to decelerate from nominal motor speed to 0 rpm.

332 Dec Time Stp A 10.0s	
Default:	10.0 s
Range:	0–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43102
Profibus slot/index	169/6
EtherCAT index (hex)	4c1e
Profinet IO index	19486
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

NOTE: If the Dec Time is too short and the generator energy cannot be dissipated in a brake resistor, the motor is decelerated according to the overvoltage limit. The actual deceleration time may be longer than the value set.

Acceleration Time Motor Potentiometer [333]

It is possible to control the speed of the AC drive using the motor potentiometer function. This function controls the speed with separate up and down commands, over remote signals. The MotPot function has separate ramps settings which can be set in "Acc MotPot [333]" and "Dec MotPot [334]".

If the MotPot function is selected, this is the acceleration time for the MotPot up command. The acceleration time is defined as the time it takes for the motor potentiometer value to increase from 0 rpm to nominal speed.

	333 Acc MotPot Stp A 16.0s
Default:	16.0 s
Range:	0.50–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43103
Profibus slot/index	169/7
EtherCAT index (hex)	4c1f
Profinet IO index	19487
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

Deceleration Time Motor Potentiometer [334]

If the MotPot function is selected, this is the deceleration time for the "MotPot" down command. The deceleration time is defined as the time it takes for the motor potentiometer value to decrease from nominal speed to 0 rpm.

	334 Dec MotPot Stp A 16.0s
Default:	16.0 s
Range:	0.50–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43104
Profibus slot/index	169/8
EtherCAT index (hex)	4c20
Profinet IO index	19488
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

Acceleration Time to Minimum Speed [335]

If minimum speed, [341]>0 rpm, is used in an application, the AC drive uses separate ramp times below this level. With "Acc>MinSpeed [335]" and "Dec<MinSpeed [336]" you can set the required ramp times. Short times can be used to prevent damage and excessive pump wear due too little lubrication at lower speeds. Longer times can be used to fill up a system smoothly and prevent water hammer due to rapidly exhausting air from the pipe system.

If a Minimum speed is programmed, this parameter will be used to select the acceleration time parameter [335] for speeds up to minimum speed at a run command. The ramp time is defined as the time it takes for the motor to accelerate from 0 rpm to nominal motor speed.

	335 Acc>Min Spd Stp A 10.0s
Default:	10.0 s
Range:	0-3600 s

Communication information

Modbus Instance no/DeviceNet no:	43105
Profibus slot/index	169/9
EtherCAT index (hex)	4c21
Profinet IO index	19489
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

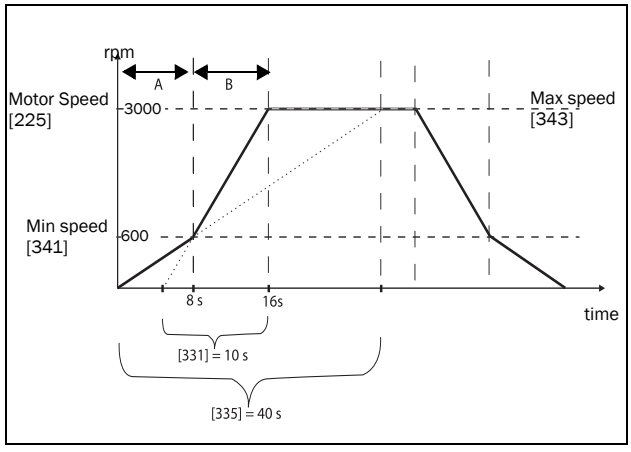


Fig. 84 Calculation example of accelerating times (graphics not proportional).

Example:

"Motor speed [225]"	3000 rpm
Minimum speed [341]	600 rpm
Maximum speed [343]	3000 rpm
Acceleration time [331]	10 seconds
Deceleration time [332]	10 seconds
Acc>Min speed[335]	40 seconds
Dec<Min speed[336]	40 seconds

A. The drive will start from 0 rpm and accelerate to Minimum speed [341] = 600 rpm in 8 seconds according to ramp time parameter Acc>Min speed [335].
Calculated as following:
600 rpm is 20% of 3000 rpm => 20% of 40 s = 8 s.

B. The acceleration continues from minimum speed level 600 rpm to maximum speed level 3000 rpm with acceleration rate according to ramp time Acceleration time [331].
Calculate by following:
3000 - 600= 2400 rpm which is 80 % of 3000 rpm => acceleration tim is 80 % x 10 s = 8 s.
This means that the total acceleration time from 0 - 3000 rpm will take 8 + 8 = 16 seconds.

Deceleration Time from Minimum Speed [336]

If a minimum speed is programmed, this parameter will be used to set the deceleration time from the minimum speed to 0 rpm at a stop command. The ramp time is defined as the time it takes for the motor to decelerate from the nominal motor speed to 0 rpm.

	336 Dec<Min Spd Stp A 10.0s
Default:	10.0 s
Range:	0-3600 s

Communication information

Modbus Instance no/DeviceNet no:	43106
Profibus slot/index	169/10
EtherCAT index (hex)	4c22
Profinet IO index	19490
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

Acceleration Ramp Type [337]

Sets the type of all the acceleration ramps in a parameter set. See Fig. 85. Depending on the acceleration and deceleration requirements for the application, the shape of both the ramps can be selected. For applications where speed changes need to be started and stopped smoothly, such as a conveyor belt with materials that can drop following a quick speed change, the ramp shape can be adapted to a S-shape and prevent speed change shocks. For applications that are not critical in this, the speed change can be fully linear over the complete range.

		337 Acc Rmp Stp A Linear
Default:		Linear
Linear	0	Linear acceleration ramp.
S-Curve	1	S-shape acceleration ramp.

NOTE: For S-curve ramps the ramp times, [331] and [332], defines the maximum acceleration and deceleration rated, i.e. linear part of S-curve, just as for the linear ramps. The S-curves are implemented so that for a speed step below sync speed the ramps are fully S-shaped while for larger steps the middle part will be linear. Therefore will a S-curve ramp from 0 –sync speed take 2 x Time while a step from 0–2 x sync speed will take 3 x Time (middle part 0.5sync speed – 1.5sync speed linear). Also valid for menu [338], Deceleration ramp type.

Communication information

Modbus Instance no/DeviceNet no:	43107
Profibus slot/index	169/11
EtherCAT index (hex)	4c23
Profinet IO index	19491
Fieldbus format	UInt
Modbus format	UInt

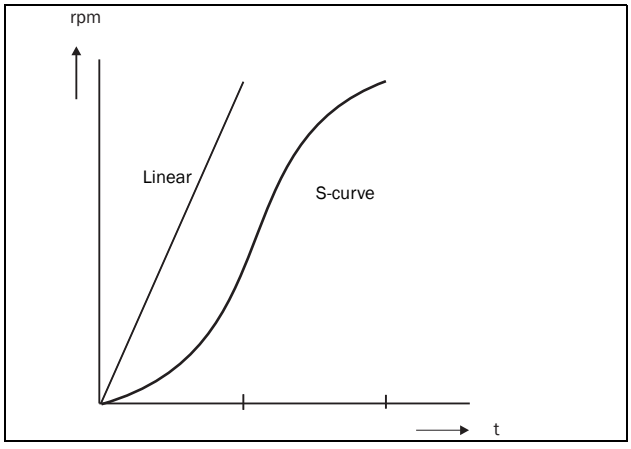


Fig. 85 Shape of acceleration ramp

Deceleration Ramp Type [338]

Sets the ramp type of all deceleration parameters in a parameter set Fig. 86.

338 Dec Rmp Stp A Linear	
Default:	Linear
Selection:	Same as menu [337]

Communication information

Modbus Instance no/DeviceNet no:	43108
Profibus slot/index	169/12
EtherCAT index (hex)	4c24
Profinet IO index	19492
Fieldbus format	UInt
Modbus format	UInt

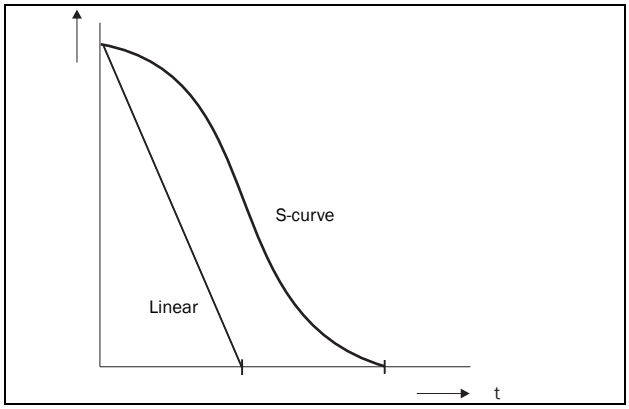


Fig. 86 Shape of deceleration ramp

Start Mode [339]

Sets the way of starting the motor when a run command is given.

339 Start Mode Stp ANormal DC		
Default:		Normal DC
Fast	0	The motor flux increases gradually. The motor shaft starts rotating immediately once the Run command is given.
Normal DC	1	After a Run command the motor will be magnetised first and the stator resistance is measured. Depending on the motor time constant and the size of the motor it can take up to 1.3 s before the motor shaft starts to rotate. This will provide better control of the motor when starting.

Communication information

Modbus Instance no/DeviceNet no:	43109
Profibus slot/index	169/13
EtherCAT index (hex)	4c25
Profinet IO index	19493
Fieldbus format	UInt
Modbus format	UInt

Spinstart [33A]

The spinstart will smoothly start a motor which is already rotating by catching the motor at the actual speed and control it to the desired speed. If in an application, such as an exhausting fan, the motor shaft is already rotating due to external conditions, a smooth start of the application is required to prevent excessive wear. With the spinstart=On, the actual control of the motor is delayed due to detecting the actual speed and rotation direction, which depend on motor size, running conditions of the motor before the Spinstart, inertia of the application, etc. Depending on the motor electrical time constant and the size of the motor, it can take maximum a couple of minutes before the motor is caught.

33A Spinstart Stp A Off		
Default:		Off
Off	0	No spinstart. If the motor is already running the AC drive can trip or will start with high current.
On	1	Spinstart will allow the start of a running motor without tripping or high inrush currents. If encoder feedback is used, both encoder speed and current signals are used to perform spinstart function.
Encoder	2	Only encoder speed used for detecting rotating machine, i.e. no rotating machine detection via initial motor current. Note: Only active if encoder is present. If no Encoder, functionality is equal to selection Off.

Communication information

Modbus Instance no/DeviceNet no:	43110
Profibus slot/index	169/14
EtherCAT index (hex)	4c26
Profinet IO index	19494
Fieldbus format	UInt
Modbus format	UInt

Stop Mode [33B]

When the AC drive is stopped, different methods to come to a standstill can be selected in order to optimize the stop and prevent unnecessary wear. Stop Mode sets the way of stopping the motor when a Stop command is given.

	33B Stop Mode Stp A Decel	
Default:		Decel
Decel	0	The motor decelerates to 0 rpm according to the set deceleration time.
Coast	1	The motor freewheels naturally to 0 rpm.

Communication information

Modbus Instance no/DeviceNet no:	43111
Profibus slot/index	169/15
EtherCAT index (hex)	4c27
Profinet IO index	19495
Fieldbus format	UInt
Modbus format	UInt

11.3.4 Mechanical brake control

The four brake-related menus [33C] to [33F] can be used to control mechanical brakes e.g. to handle basic hoisting functions. When hoisting a load generally a mechanical brake holds the load when the AC drive is not running. To prevent the load from falling down a holding torque must be initiated before the mechanical brake is released. On the other hand when stopping hoisting the brake must be activated before the holding torque is removed.

Support is included for a Brake Acknowledge signal via a digital input. It is monitored using a brake fault time parameter. Additional output and trip/warning signals are also included. The acknowledge signal is either connected from the brake contactor or from a proximity switch on the brake.

The brake acknowledge signal can also be used to improve safety by preventing hoist falling load in case the brake is not engaged when stopping.

Brake not released - Brake Fault trip

During start and running the brake acknowledge signal is compared to the actual brake output signal and if no acknowledge, i.e. brake not released, while brake output is high for the Brake Fault time [33H], then a Brake trip is generated.

Brake not engaged - Brake Warning and continued operation (keep torque)

The brake acknowledge signal is compared to the actual brake output signal at stop. If acknowledge is still active, i.e. brake not engaged, while brake output is low for the Brake Engage time [33E] then a Brake warning is generated and the torque is kept, i.e. prolonging normal brake engage mode, until brake closes or an emergency action is needed by the operator, such as setting down the load.

Brake Release Time [33C]

The Brake Release Time sets the time the AC drive delays before ramping up to whatever final reference value is selected. During this time a predefined speed can be generated to hold the load where after the mechanical brake finally releases. This speed can be selected at Release Speed, [33D]. Immediate after the brake release time expiration the brake lift signal is set. The user can set a digital output or relay to the function Brake. This output or relay can control the mechanical brake.

33C Brk Release Stp A 0.00s	
Default:	0.00 s
Range:	0.00–3.00 s

Communication information

Modbus Instance no/DeviceNet no:	43112
Profibus slot/index	169/16
EtherCAT index (hex)	4c28
Profinet IO index	19496
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

Fig. 87 shows the relation between the four Brake functions.

- Brake Release Time [33C]
- Start Speed [33D]
- Brake Engage Time [33E]
- Brake Wait Time [33F]

The correct time setting depends on the maximum load and the properties of the mechanical brake. During the brake release time it is possible to apply extra holding torque by setting a start speed reference with the function start speed [33D].

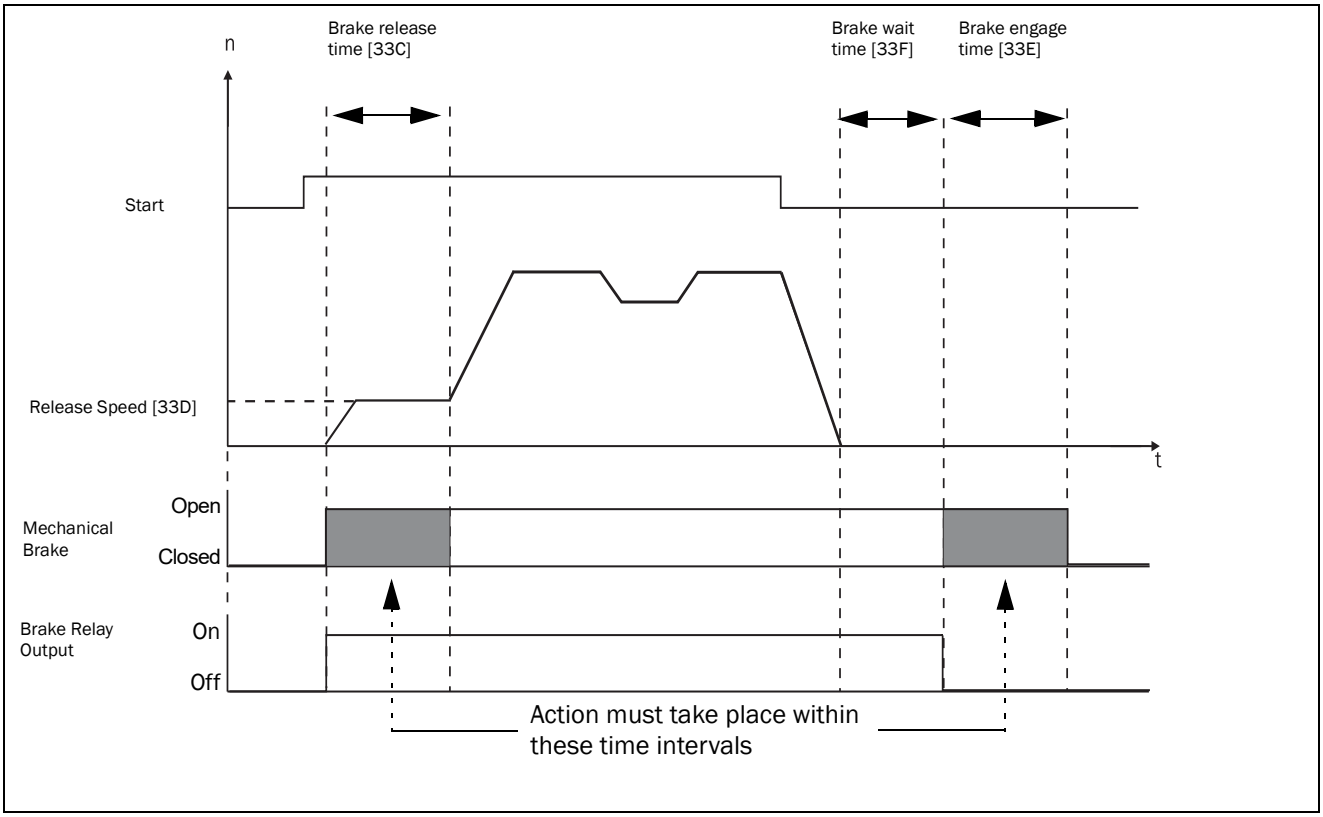


Fig. 87 Brake Output functions

NOTE: Although this function is designed to operate a mechanical brake via the digital outputs or relays (set to brake function) controlling a mechanical brake, it can also be used without a mechanical brake and hold the load in a fixed position.

Release Speed [33D]

The release speed only operates with the brake function: brake release [33C]. The release speed is the initial speed reference during the brake release time. The torque reference is initialized to 90% of T_{NOM} to ensure that the load is held in place.

	33D Release Spd Stp A 0rpm
Default:	0 rpm
Range:	- 4x Sync. Speed to 4x Sync.
Depend on:	4xmotor sync speed, 1500 rpm for 1470 rpm motor.

Communication information

Modbus Instance no/DeviceNet no:	43113
Profibus slot/index	169/17
EtherCAT index (hex)	4c29
Profinet IO index	19497
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Brake Engage Time [33E]

The brake engage time is the time the load is held while the mechanical brake engages. It is also used to get a firm stop when transmissions, etc. cause "whiplash" effects. In other words, it compensates for the time it takes to engage a mechanical brake.

	33E Brk Engage Stp A 0.00s
Default:	0.00 s
Range:	0.00–3.00 s

Communication information

Modbus Instance no/DeviceNet no:	43114
Profibus slot/index	169/18
EtherCAT index (hex)	4c2a
Profinet IO index	19498
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

Wait Before Brake Time [33F]

The brake wait time is the time to keep brake open and to hold the load, either in order to be able to speed up immediately, or to stop and engage the brake.

	33F Brk Wait Stp A 0.00s
Default:	0.00 s
Range:	0.00–30.0 s

Communication information

Modbus Instance no/DeviceNet no:	43115
Profibus slot/index	169/19
EtherCAT index (hex)	4c2b
Profinet IO index	19499
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

Vector Brake [33G]

Braking by increasing the internal electrical losses in the motor.

		33G Vector Brake Stp A Off
Default:		Off
Off	0	Vector brake switched off. AC drive brakes normal with voltage limit on the DC link.
On	1	Maximum AC drive current (I_{CL}) is available for braking.

Communication information

Modbus Instance no/DeviceNet no:	43116
Profibus slot/index	169/20
EtherCAT index (hex)	4c2c
Profinet IO index	19500
Fieldbus format	UInt
Modbus format	UInt

Brake Fault trip time [33H]

The "Brake Fault trip time" for "Brake not released" function is specified in this menu.

	33H Brk Fault Stp A 1.00s
Default:	1.00s
Range	0.00 - 5.00s

Communication information

Modbus Instance no/DeviceNet no:	43117
Profibus slot/index	169/21
EtherCAT index (hex)	4c2d
Profinet IO index	19501
Fieldbus format	Long, 1=0.01s
Modbus format	EInt

Note: The Brake Fault trip time should be set to longer time than the Brake release time[33C].

The "Brake not engaged" warning is using the setting of parameter "Brake Engaged time [33E]".
Fig. 88 shows principle of brake operation for fault during run (left) and during stop (right).

Release torque [33I]

The Brake Release Time [33C] sets the time the AC drive delays before ramping up to whatever final speed reference value is selected, to allow the brake to be fully opened. During this time a holding torque to prevent roll-back of the load can be activated. The parameter Release Torque [33I] is used for this purpose.

The release torque initiates the torque reference from the speed controller during the Brake Release Time [33C]. The release torque defines a minimum level of release (holding) torque. The set release torque is internally overruled if the actual required holding torque measured at the previous closing of brake is higher.
The release torque is set with sign in order to define the holding torque direction.

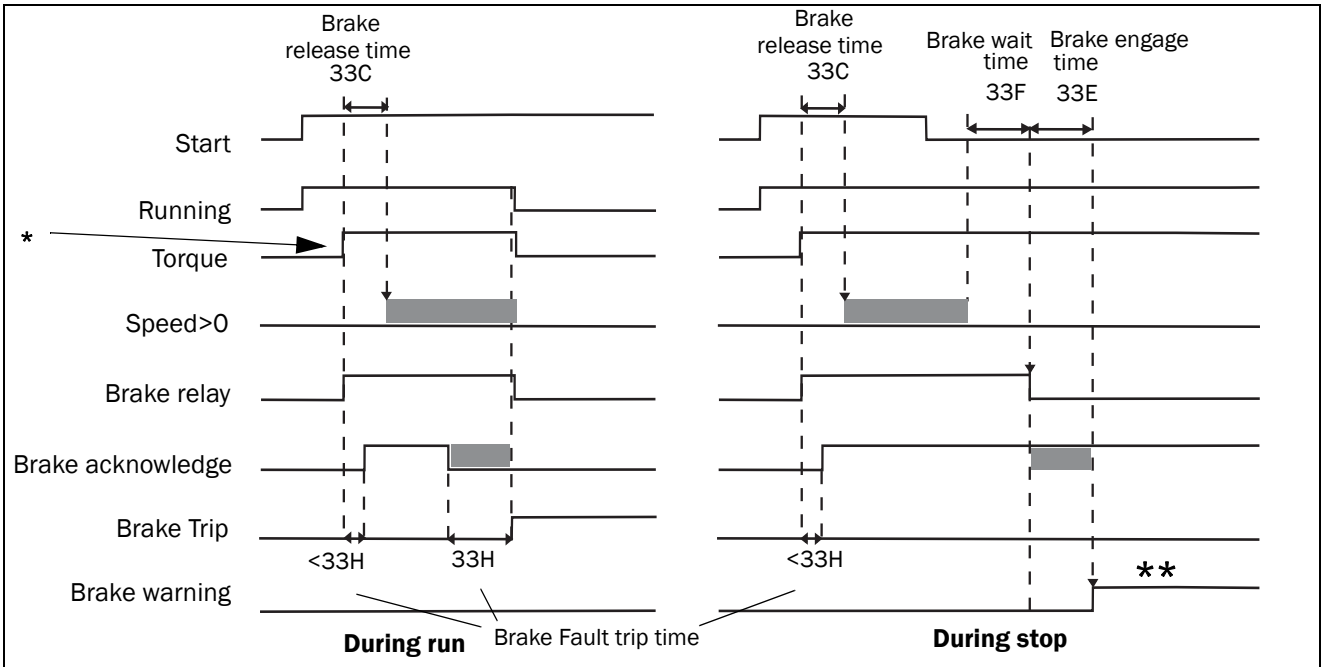
Note! Function is deactivated if set to 0%.

Note! Release Torque [33I] has priority over torque reference initialization by Release Speed [33D].

33I Release Trq Stp A 0%	
Default:	0%
Range	-400% to 400%

Communication information

Modbus Instance no/DeviceNet no:	43118
Profibus slot/index	169/22
EtherCAT index (hex)	4c2e
Profinet IO index	19502
Fieldbus format	Long, 1=1%
Modbus format	EInt



* Memorized load torque level, if function activated with parameter [33I] Release Torque.
** Time for operator to set down the load.

Fig. 88 Principle of Brake operation for fault during run and during stop

11.3.5 Speed [340]

Menu with all parameters for settings regarding to speeds, such as Min/Max speeds, Jog speeds, Skip speeds.

Minimum Speed [341]

Sets the minimum speed. The minimum speed will operate as an absolute lower limit. Used to ensure the motor does not run below a certain speed and to maintain a certain performance.

	341 Min Speed Stp A 0rpm
Default:	0 rpm
Range:	0 - Max Speed
Dependent on:	Set/View ref [310]

NOTE: A lower speed value than the set minimum speed can be shown in the display due to motor slip.

Communication information

Modbus Instance no/DeviceNet no:	43121
Profibus slot/index	169/25
EtherCAT index (hex)	4c31
Profinet IO index	19505
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Stop/Sleep when less than Minimum Speed [342]

With this function it is possible to put the AC drive in “sleep mode” when it is running at minimum speed for the length of time set in menu “Stp<MinSpd [342]”. The AC drive will go into sleep mode after programmed time.

When the reference signal or PID Process controller output value (if PID Process controller is used) raises the required speed value above the min speed value, the AC drive will automatically wake up and ramp up to the required speed.

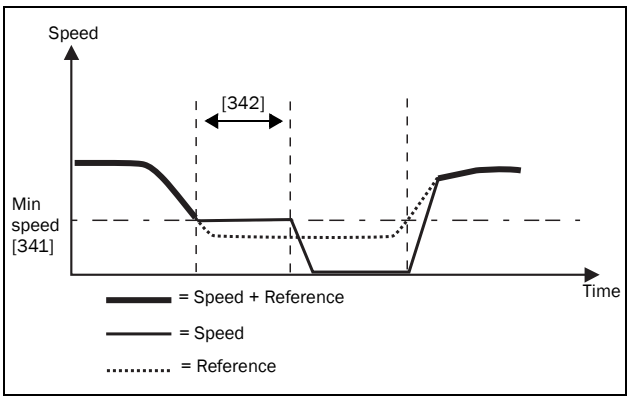


Fig. 89

If you want to use this function when having “process reference” signal via an analogue input, you need to make sure that the concerning analogue input is set up correct, meaning that AnIn Advanced parameter "AnIn1 FcMin [5134]" should be set from "Min" (=default) to "User defined" and “AnIn1 VaMin[5135]” set to a value less than “Min Speed [341]” to make it possible that the analogue input reference can go below the "Min Speed" level to activate the “Sleep mode”. This applies when PID Process controller is not used.

NOTE: If [381] PID Process controller is used, then the PID sleep functionality [386] - [389] is recommended instead of [342]. See further page 124.

NOTE: Menu [386] has higher priority than menu [342].

		342 Stp<MinSpd Stp A Off
Default:		Off
Off	0	Off
1–3600	1–3600	1–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43122
Profibus slot/index	169/26
EtherCAT index (hex)	4c32
Profinet IO index	19506
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

Maximum Speed [343]

Sets the maximum speed. The maximum speed will operate as an absolute maximum limit. This parameter is used to prevent damage due to high speed.
The synchronous speed (Sync-spd) is determined by the parameter motor speed [225].

		343 Max Speed Stp A Sync Speed
Default:		Sync Speed
Sync Speed	0	Synchronous speed, i.e. no load speed, at nominal frequency.
1-24000rpm	1- 24000	Min Speed - 4 x Motor Sync Speed

Communication information

Modbus Instance no/DeviceNet no:	43123
Profibus slot/index	169/27
EtherCAT index (hex)	4c33
Profinet IO index	19507
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

NOTE: It is not possible to set the maximum speed lower than the minimum speed.

Note: Maximum speed [343] has priority over Min Speed [341], i.e. if [343] is set below [341] then the drive will run at [343] Max Speed with acceleration times given by [335] and [336] respectively.

Skip Speed 1 Low [344]

Within the Skip Speed range High to Low, the speed cannot be constant in order to avoid mechanical resonance in the AC drive system.

When Skip Speed Low ≤ Ref Speed ≤ Skip Speed High, then Output Speed=Skip Speed HI during deceleration and Output Speed=Skip Speed LO during acceleration. Fig. 90 shows the function of skip speed hi and low.

Between Skip Speed HI and LO, the speed changes with the set acceleration and deceleration times. Skipspd1 LO sets the lower value for the 1st skip range.

344 SkipSpd 1 Lo Stp A 0rpm	
Default:	0 rpm
Range:	0 - 4 x Motor Sync Speed

Communication information

Modbus Instance no/DeviceNet no:	43124
Profibus slot/index	169/28
EtherCAT index (hex)	4c34
Profinet IO index	19508
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

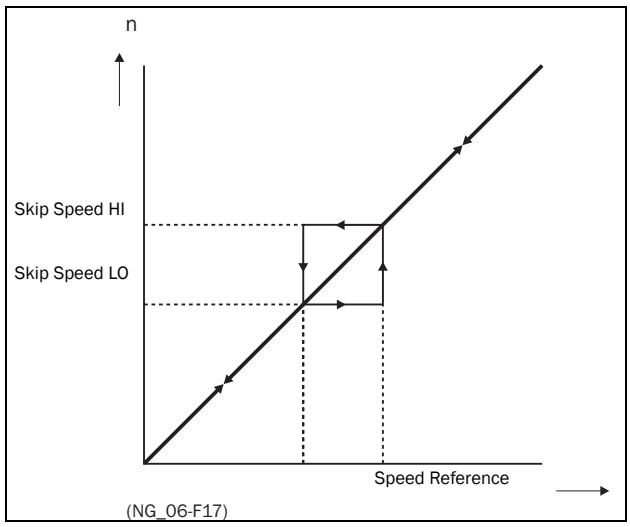


Fig. 90 Skip Speed

NOTE: The two Skip Speed ranges may be overlapped.

Skip Speed 1 High [345]

Skipspd1 HI sets the higher value for the 1st skip range.

345 SkipSpd 1 Hi Stp A 0rpm	
Default:	0 rpm
Range:	0 – 4 x Sync Speed

Communication information

Modbus Instance no/DeviceNet no:	43125
Profibus slot/index	169/29
EtherCAT index (hex)	4c35
Profinet IO index	19509
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Skip Speed 2 Low [346]

The same function as menu [344] for the 2nd skip range.

	346 SkipSpd 2 Lo Stp A 0rpm
Default:	0 rpm
Range:	0 – 4 x Motor Sync Speed

Communication information

Modbus Instance no/DeviceNet no:	43126
Profibus slot/index	169/30
EtherCAT index (hex)	4c36
Profinet IO index	19510
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Skip Speed 2 High [347]

The same function as menu [345] for the 2nd skip range.

	347 SkipSpd 2 Hi Stp A 0rpm
Default:	0 rpm
Range:	0 – 4 x Motor Sync Speed

Communication information

Modbus Instance no/DeviceNet no:	43127
Profibus slot/index	169/31
EtherCAT index (hex)	4c37
Profinet IO index	19511
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Jog Speed [348]

The Jog Speed function is activated by one of the digital inputs. The digital input must be set to the Jog function [520]. The Jog command/function will automatically generate a run command as long as the Jog command/ function is active. This is valid independent of settings in menu [215]. The rotation is determined by the polarity of the set Jog Speed.

Example

If Jog Speed = -10, this will give a Run Left command at 10 rpm regardless of RunL or RunR commands. Fig. 91 shows the function of the Jog command/function.

	348 Jog Speed Stp A 50rpm
Default:	50 rpm
Range:	-4 x motor sync speed to +4 x motor sync speed
Dependent on:	Defined motor sync speed. Max = 400%, normally max=AC drive I_{max}/motor I_{nom} x 100%.

Communication information

Modbus Instance no/DeviceNet no:	43128
Profibus slot/index	169/32
EtherCAT index (hex)	4c38
Profinet IO index	19512
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

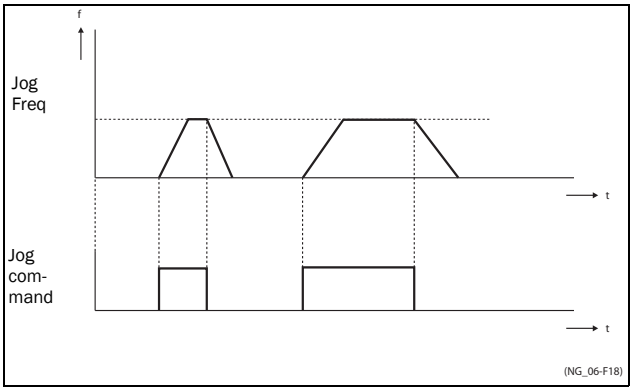


Fig. 91 Jog command

11.3.6 Torques [350]

Menu with all parameters for torque settings.

Maximum Torque [351]

Sets the maximum motor torque (according to menu group "Motor Data [220]"). This Maximum Torque operates as an upper torque limit. A Speed Reference is always necessary to run the motor.

$$T_{MOT}(Nm) = \frac{P_{MOT}(kw)x9550}{n_{MOT}(rpm)} = 100\%$$

351 Max Torque Stp A 120%	
Default:	120% calculated from the motor data
Range:	0–400%

Communication information

Modbus Instance no/DeviceNet no:	43141
Profibus slot/index	169/45
EtherCAT index (hex)	4c45
Profinet IO index	19525
Fieldbus format	Long, 1=1%
Modbus format	EInt

NOTE: The Max Torque parameter will limit the maxmum output current of the AC drive following the relation: 100% Tmot corresponds to 100% Imot.
The maximum possible setting for parameter 351 is limited by Inom/Imot x 120%, but not higher than 400%.

NOTE: The motor temperature increases very quickly due to extensive power losses.

IxR Compensation [352]

This function compensates for the drop in voltage over different resistances such as (very) long motor cables, chokes and motor stator by increasing the output voltage at a constant frequency. IxR Compensation is most important at low frequencies and is used to obtain a higher starting torque. The maximum voltage increase is 25% of the nominal output voltage. See Fig. 92.

Selecting "Automatic" will use the optimal value according to the internal model of motor. "User-Defined" can be selected when the start conditions of the application do not change and a high starting torque is always required. A fixed IxR Compensation value can be set in the menu [353].

NOTE: This menu is visible only in V/Hz mode.

352 IxR Comp Stp A Off		
Default:		Off
Off	0	Function disabled
Automatic	1	Automatic compensation
User Defined	2	User defined value in percent.

Communication information

Modbus Instance no/DeviceNet no:	43142
Profibus slot/index	169/46
EtherCAT index (hex)	4c46
Profinet IO index	19526
Fieldbus format	UInt
Modbus format	UInt

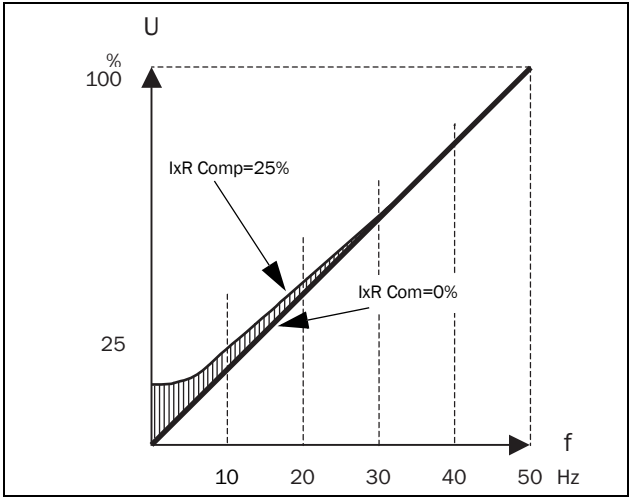


Fig. 92 IxR Comp at Linear V/Hz curve

IxR Comp_user [353]

Only visible if User-Defined is selected in previous menu.

353 IxR CompUsr Stp A 0.0%	
Default:	0.0%
Range:	0-25% x U_{NOM} (0.1% of resolution)

Communication information

Modbus Instance no/DeviceNet no:	43143
Profibus slot/index	169/47
EtherCAT index (hex)	4c47
Profinet IO index	19527
Fieldbus format	Long, 1= 0.1 %
Modbus format	EInt

NOTE: A too high level of IxR Compensation could cause motor saturation. This can cause a "Power Fault" trip. The effect of IxR Compensation is stronger with higher power motors.

NOTE: The motor may be overheated at low speed. Therefore it is important that the Motor I^2t Current [232] is set correctly.

Flux Optimization [354]

Flux Optimization reduces the energy consumption and the motor noise, at low or no load conditions.

Flux Optimization automatically decreases the V/Hz ratio, depending on the actual load of the motor when the process is in a steady situation. Fig. 93 shows the area within which the Flux Optimization is active.

	354 Flux optim Stp A Off	
Default:		Off
Off	0	Function disabled
On	1	Function enabled

Communication information

Modbus Instance no/DeviceNet no:	43144
Profibus slot/index	169/48
EtherCAT index (hex)	4c48
Profinet IO index	19528
Fieldbus format	UInt
Modbus format	UInt

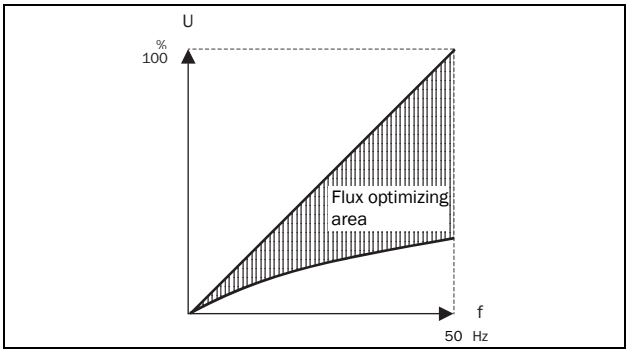


Fig. 93 Flux Optimizing

NOTE: Flux optimization works best at stable situations in slow changing processes.

Maximum power [355]

Sets maximum power. Can be used for limiting motor power in field weakening operation. This function operates as an upper power limit and internally limits the parameter "Max Torque [351]" according to :
Tlimit = Plimit[%] / (Actual Speed / Sync Speed)

	355 Max Power Stp A Off	
Default:		Off
Off	0	Off. No power limit
1 - 400	1 - 400	1 - 400% of motor nominal power

NOTE: The maximum possible setting for parameter [355] is limited by I_{NOM}/I_{MOT} x 120%, but not higher than 400%.

Communication information

Modbus Instance no/DeviceNet no:	43145
Profibus slot/index	169/49
EtherCAT index (hex)	4c49
Profinet IO index	19529
Fieldbus format	Long, 1=1%
Modbus format	EInt

11.3.7 Preset References [360]

Motor Potentiometer [361]

Sets the properties of the motor potentiometer function. See the parameter "DigIn1 [521]" for the selection of the motor potentiometer function.

		361 Motor Pot Stp A Non Volatie
Default:		Non Volatile
Volatile	0	After a stop, trip or power down, the AC drive will start always from zero speed (or minimum speed, if selected).
Non volatile	1	Non Volatile. After a stop, trip or power down of the AC drive, the reference value at the moment of the stop will be memorized. After a new start command the output speed will resume to this saved value.

Communication information

Modbus Instance no/DeviceNet no:	43131
Profibus slot/index	169/35
EtherCAT index (hex)	4c3b
Profinet IO index	19515
Fieldbus format	UInt
Modbus format	UInt

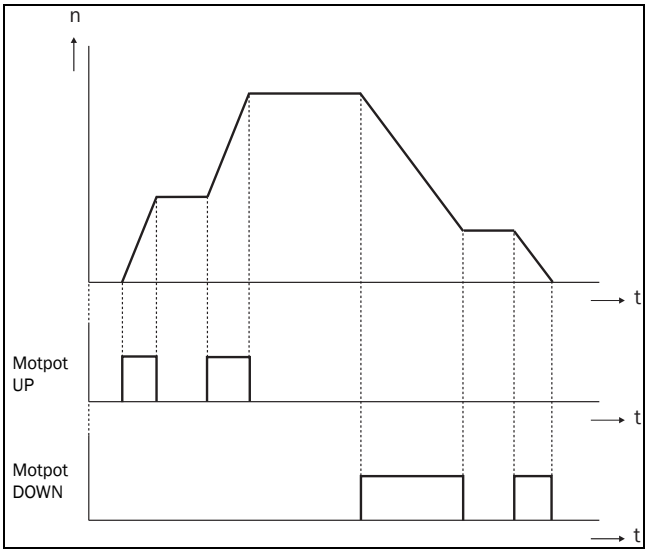


Fig. 94 MotPot function

Preset Ref 1 [362] to Preset Ref 7 [368]

Preset speeds have priority over the analogue inputs. Preset speeds are activated by the digital inputs. The digital inputs must be set to the function Pres. Ref 1, Pres. Ref 2 or Pres. Ref 4.

Depending on the number of digital inputs used, up to 7 preset speeds can be activated per parameter set. Using all the parameter sets, up to 28 preset speeds are possible.

	362 Preset Ref 1 Stp A 0rpm
Default:	Speed, 0 rpm
Dependent on:	Process Source [321] and Process Unit [322]
Speed mode	0 - max speed [343]
Torque mode	0 - max torque [351]
Other modes	Min according to menu [324] - max according to menu [325]

Communication information

Modbus Instance no/DeviceNet no:	43132–43138
Profibus slot/index	169/36–169/42
EtherCAT index (hex)	4c3c - 4c42
Profinet IO index	19516 - 19522
Fieldbus format	Long, 1= 1 rpm, 1 %, 1 °C or 0.001 if Process Value/Process Ref using a [322] unit
Modbus format	EInt

The same settings are valid for the menus:

"[363] Preset Ref 2", with default 250 rpm
"[364] Preset Ref 3", with default 500 rpm
"[365] Preset Ref 4", with default 750 rpm
"[366] Preset Ref 5", with default 1000 rpm
"[367] Preset Ref 6", with default 1250 rpm
"[368] Preset Ref 7", with default 1500 rpm

The selection of the presets is as in Table 28.

Table 28

Preset Ctrl3	Preset Ctrl2	Preset Ctrl1	Output Speed
0	0	0	Analogue reference
0	0	1[1)]	Preset Ref 1
0	1[1)]	0	Preset Ref 2
0	1	1	Preset Ref 3
1[1)]	0	0	Preset Ref 4
1	0	1	Preset Ref 5
1	1	0	Preset Ref 6
1	1	1	Preset Ref 7

1)= selected if only one preset reference is active
1 = active input
0 = non active input

NOTE: If only Preset Ctrl3 is active, then the Preset Ref 4 can be selected. If Presets Ctrl2 and 3 are active, then the Preset Ref 2, 4 and 6 can be selected.

Keyboard reference mode [369]

This parameter sets how the reference value [310] is edited.

		369 Key Ref Mode Stp A MotPot
Default:		MotPot
Normal	0	The reference value is edited as a normal parameter (the new reference value is activated when Enter is pressed after the value has been changed). The “Acc Time [331]” and “Dec Time [332]” are used.
MotPot	1	The reference value is edited using the motor potentiometer function (the new reference value is activated directly when the key + or - is pressed). The “Acc MotPot [333]” and “Dec MotPot [334]” are used.
MotPot+	2	This selection makes it possible to update the reference in “[310]” directly from the [100]-menu. Pressing +/- in the [100]-menu changes the menu to [310] and there you can continue to press +/- to update the reference. When no key has been pressed for a second the menu returns to [100] automatically.

Communication information

Modbus Instance no/DeviceNet no:	43139
Profibus slot/index	169/43
EtherCAT index (hex)	4c43
Profinet IO index	19523
Fieldbus format	UInt
Modbus format	UInt

NOTE: When Key Ref Mode is set to MotPot, the reference value ramp times are according to the “Acc MotPot [333]” and “Dec MotPot [334]” settings. Actual speed ramp will be limited according to “Acc Time [331]” and “Dec Time [332]”.

11.3.8 PI Speed Control [370]

The AC drive has an internal speed controller, which is used to keep the shaft speed equal to the set speed reference. This internal speed controller works without an external feedback.

With the parameters speed P gain [372] and speed I time [373] the controller can be optimized manually.

Speed PI Autotune [371]

The function speed autotune will perform a torque step change, and measures the reaction on shaft speed.

It automatically sets the internal speed I time to its optimum value. The speed PI autotune must be done during operation with the motor load connected and the motor running. “Spd PI Auto” will be flashing in the display during the autotune operation. When the test is successfully concluded, the display will show “Spd PI OK!” for 3 s.

	371 Spd PI Auto Stp A Off	
Default:		Off
Off	0	
On	1	

Communication information

Modbus Instance no/DeviceNet no:	43151
Profibus slot/index	169/55
EtherCAT index (hex)	4c4f
Profinet IO index	19535
Fieldbus format	UInt
Modbus format	UInt

NOTE: Run the autotune at speed lower than 80% of the nominal motor speed. Otherwise autotune will fail.

NOTE: RUN command must be activated manually via Keyboard button.

NOTE: The setting will automatically return to Off when the autotuning is finished.

NOTE: This menu is only visible if AC drive Mode = Speed or V/Hz.

Speed P Gain [372]

For adjusting the P gain of the internal speed controller. The speed P gain must be manually tuned for a faster reaction to load changes. The speed P gain can be increased until there is audible noise from the motor and then decreased until the noise disappears.

372 Spd P Gain Stp A	
Default:	See note
Range:	0.0–60.0

Communication information

Modbus Instance no/DeviceNet no:	43152
Profibus slot/index	169/56
EtherCAT index (hex)	4c50
Profinet IO index	19536
Fieldbus format	Long, 1=0.1
Modbus format	EInt

Speed I Time [373]

To adjust the time of the internal speed controller see parameter Speed PI Autotune [371].

373 Spd I Time Stp A	
Default:	See note
Range:	0.05–100 s

Communication information

Modbus Instance no/DeviceNet no:	43153
Profibus slot/index	169/57
EtherCAT index (hex)	4c51
Profinet IO index	19537
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

NOTE: The default settings are calculated for a standard 4-pole motor without load according to the nominal power of the AC drive.

11.3.9 PID Process Control [380]

The PID controller is used to control an external process via a feedback signal. The reference value can be set via analogue input AnIn1, at the Control Panel [310] by using a Preset Reference, or via serial communication. The feedback signal (actual value) must be connected to an analogue input that is set to the function Process Value.

Process PID Control [381]

This function enables the PID controller and defines the response to a changed feedback signal.

	381 PID Control Stp A Off	
Default:		Off
Off	0	PID control deactivated.
On	1	The speed increases when the feedback value decreases. PID settings according to menus [381] to [385].
Invert	2	The speed decreases when the feedback value decreases. PID settings according to menus [383] to [385].

Communication information

Modbus Instance no/DeviceNet no:	43154
Profibus slot/index	169/58
EtherCAT index (hex)	4c52
Profinet IO index	19538
Fieldbus format	UInt
Modbus format	UInt

PID P Gain [383]

Setting the P gain for the PID controller.

383 PID P Gain Stp A 1.0	
Default:	1.0
Range:	0.0–30.0

Communication information

Modbus Instance no/DeviceNet no:	43156
Profibus slot/index	169/60
EtherCAT index (hex)	4c54
Profinet IO index	19540
Fieldbus format	Long, 1=0.1
Modbus format	EInt

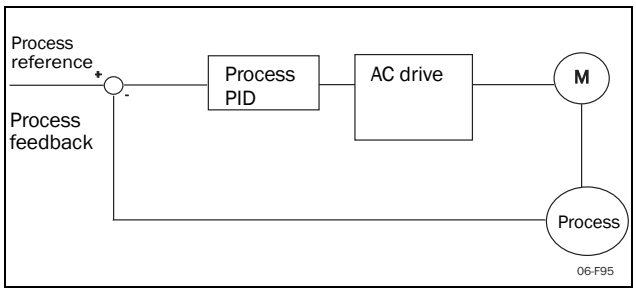


Fig. 95 Closed loop PID control

PID I Time [384]

Setting the integration time for the PID controller.

384 PID I Time Stp A 1.00s	
Default:	1.00 s
Range:	0.01–300 s

Communication information

Modbus Instance no/DeviceNet no:	43157
Profibus slot/index	169/61
EtherCAT index (hex)	4c55
Profinet IO index	19541
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

Process PID D Time [385]

Setting the differentiation time for the PID controller.

385 PID D Time Stp A 0.00s	
Default:	0.00 s
Range:	0.00–30 s

Communication information

Modbus Instance no/DeviceNet no:	43158
Profibus slot/index	169/62
EtherCAT index (hex)	4c56
Profinet IO index	19542
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

PID sleep functionality

This function is controlled via a wait delay and a separate wake-up margin condition. With this function it is possible to put the AC drive in "sleep mode" when the process value is at it's set point and the motor is running at minimum speed for the length of the time set in [386]. By going into sleep mode, the by the application consumed energy is reduced to a minimum. When the process feedback value goes below the set margin on the process reference as set in [387], the AC drive will wake up automatically and normal PID operation continues, see examples.

NOTE: When the drive is in Sleep mode, this is indicated with "slp" in the lower left corner of the display.

PID sleep when less than minimum speed [386]

If the PID output is equal to or less than minimum speed for given delay time, the AC drive will go to sleep.

386 PID<MinSpd slp A Off	
Default:	Off
Range:	Off, 0.01 –3600 s

Communication information

Modbus Instance no/DeviceNet no:	43371
Profibus slot/index	170/20
EtherCAT index (hex)	4d2b
Profinet IO index	19755
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

NOTE: Menu [386] has higher priority than menu [342].

PID Activation Margin [387]

The PID activation (wake-up) margin is related to the process reference and sets the limit when the AC drive should wake-up/start again.

387 PID Act Marg Stp A 0rpm	
Default:	0
Range:	0 –10000 in Process unit

Communication information

Modbus Instance no/DeviceNet no:	43372
Profibus slot/index	170/21
EtherCAT index (hex)	4d2c
Profinet IO index	19756
Fieldbus format	Long, 1= 1 rpm, 1 %, 1°C or 0.001 if Process Value/Process Ref using a [322] unit
Modbus format	EInt

NOTE: The margin is always a positive value.

Example 1 PID control = normal (flow or pressure control)

[321] = F (AnIn)
[322] = Bar
[310] = 20 Bar
[342] = 2 s (inactive since [386] is activated and have higher priority)
[381]= On
[386] = 10 s
[387] = 1 Bar

The AC drive will stop/sleep when the speed (PID output) is below or equal to Min Speed for 10 seconds. The AC drive will activate/wake up when the "Process value" goes below the PID Activation Margin which is related to the process reference, i.e. goes below (20-1) Bar. See Fig. 96.

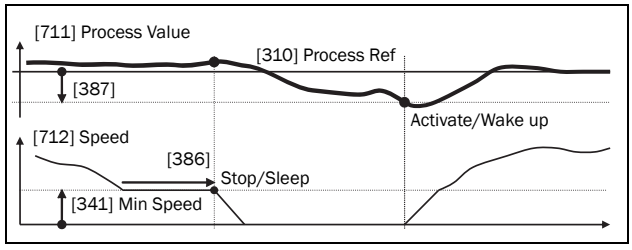


Fig. 96 PID Stop/sleep with normal PID

Example 2 PID control = inverted (tank level control)

[321] = F (AnIn)
[322] = m
[310] = 7 m
[342] = 2 s (inactive since [386] is activated and have higher priority)
[381]= Inverted
[386] = 30 s
[387] = 1 m

The AC drive will stop/sleep when the speed (PID output) is below or equal to Min Speed for 30 seconds. The AC drive will activate/wake up when the "Process value" goes above the PID Activation Margin which is related to the process reference, i.e. goes above (7+1) m. See Fig. 97.

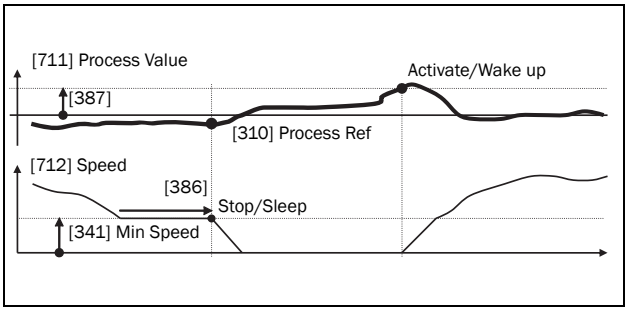


Fig. 97 PID Stop/sleep with inverted PID

PID Steady State Test [388]

In application situations where the feedback can become independent of the motor speed, this PID Steady Test function can be used to overrule the PID operation and force the AC drive to go in sleep mode i.e. the AC drive automatically reduces the output speed while at the same time ensures the process value.

Example: pressure controlled pump systems with low/no flow operation and where the process pressure has become independent of the pump speed, e.g. due to slowly closed valves. By going into Sleep mode, heating of the pump and motor will be avoided and no energy is spilled.

PID Steady state test delay.

NOTE: It is important that the system has reached a stable situation before the Steady State Test is initiated.

388 PID Stdy Tst Stp A Off	
Default:	Off
Range:	Off, 0.01–3600 s

Communication information

Modbus Instance no/DeviceNet no:	43373
Profibus slot/index	170/22
EtherCAT index (hex)	4d2d
Profinet IO index	19757
Fieldbus format	Long, 1=0.01 s
Modbus format	EInt

PID Steady State Margin [389]

PID steady state margin defines a margin band around the reference that defines "steady state operation". During the steady state test the PID operation is overruled and the AC drive is decreasing the speed as long as the PID error is within the steady state margin. If the PID error goes outside the steady state margin the test failed and normal PID operation continues, see example.

389 PID Stdy Mar Stp A 0	
Default:	0
Range:	0–10000 in process unit

Communication information

Modbus Instance no/DeviceNet no:	43374
Profibus slot/index	170/23
EtherCAT index (hex)	4d2e
Profinet IO index	19758
Fieldbus format	Long, 1= 1 rpm, 1 %, 1°C or 0.001 if Process Value/Process Ref using a [322] unit
Modbus format	EInt

Example: The PID Steady Test starts when the process value [711] is within the margin and Steady State Test Wait Delay has expired. The PID output will decrease speed with a step value which corresponds to the margin as long as the Process value [711] stays within steady state margin. When Min Speed [341] is reached the steady state test was successful and stop/sleep is commanded if PID sleep function [386]and [387] is activated. If the Process value [711] goes outside the set steady state margins then the test

failed and normal PID operation will continue, see Fig. 98.

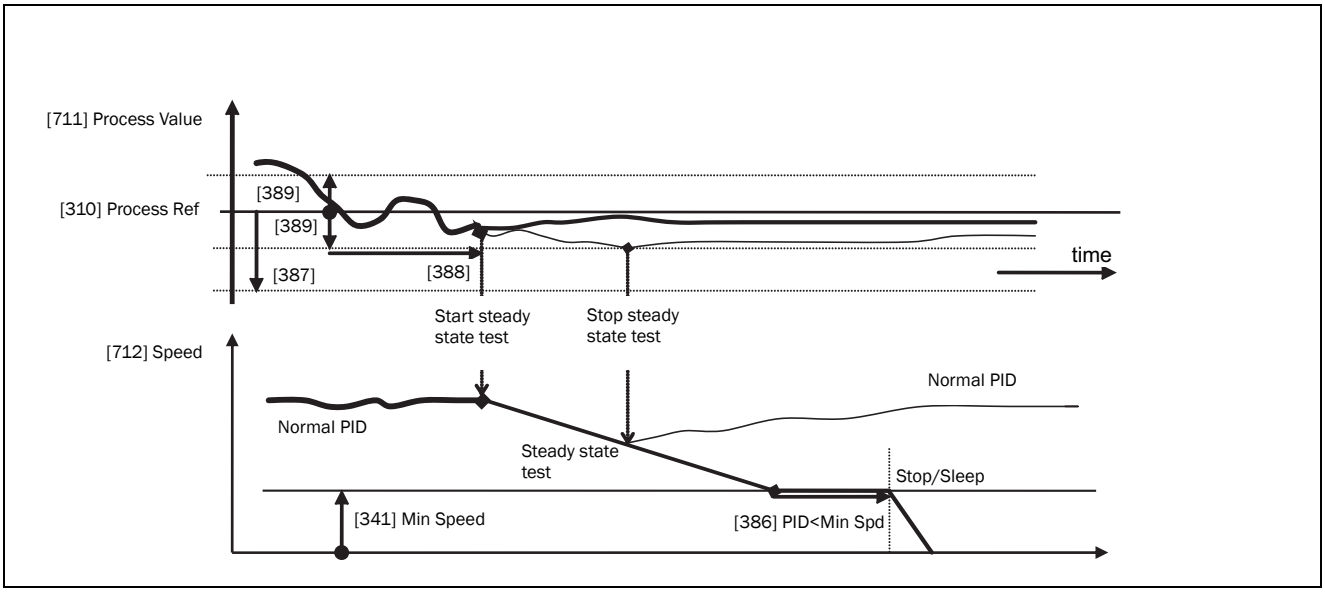


Fig. 98 Steady state test

11.3.10Pump/Fan Control [390]

The Pump Control functions are in menu [390]. The function is used to control a number of drives (pumps, fans, etc.) of which one is always driven by the AC drive.

Pump enable [391]

This function will enable the pump control to set all relevant pump control functions.

		391 Pump enable Stp A Off
Default:		Off
Off	0	Pump control is switched off.
On	1	Pump control is on: - Pump control parameters [392] to [39G] appear and are activated according to default settings. - View functions [39H] to [39M] are added in the menu structure.

Communication information

Modbus Instance no/DeviceNet no:	43161
Profibus slot/index	169/65
EtherCAT index (hex)	4c59
Profinet IO index	19545
Fieldbus format	UInt
Modbus format	UInt

Number of Drives [392]

Sets the total number of drives which are used, including the Master AC drive. The setting here depends on the parameter "Select Drive [393]". After the number of drives is chosen it is important to set the relays for the pump control. If the digital inputs are also used for status feedback, these must be set for the pump control according to; Pump 1 OK– Pump6 OK in menu [520].

	392 No of Drives Stp A 2
Default:	2
1-3	Number of drives if I/O Board is not used.
1-6	Number of drives if 'Alternating MASTER' is used, see Select Drive [393]. (I/O Board is used.)
1-7	Number of drives if 'Fixed MASTER' is used, see Select Drive [393]. (I/O Board is used.)

NOTE: Used relays must be defined as Slave Pump or Master Pump. Used digital inputs must be defined as Pump Feedback.

Communication information

Modbus Instance no/DeviceNet no:	43162
Profibus slot/index	169/66
EtherCAT index (hex)	4c5a
Fieldbus format	UInt
Modbus format	UInt

Select Drive [393]

Sets the main operation of the pump system. 'Sequence' and 'Runtime' are Fixed MASTER operation. 'All' means Alternating MASTER operation.

		393 Select Drive Stp A Sequence
Default:		Sequence
Sequence	0	Fixed MASTER operation: - The additional drives will be selected in sequence, i.e. first pump 1 then pump 2 etc. - A maximum of 7 drives can be used.
Run Time	1	Fixed MASTER operation: - The additional drives will be selected depending on the Run Time. So the drive with the lowest Run Time will be selected first. The Run Time is monitored in menus [39H] to [39M] in sequence. For each drive the Run Time can be reset. - When drives are stopped, the drive with the longest Run Time will be stopped first. - Maximum 7 drives can be used.
All	2	Alternating MASTER operation: - When the drive is powered up, one drive is selected as the Master drive. The selection criteria depends on the Change Condition [394]. The drive will be selected according to the Run Time. So the drive with the lowest Run Time will be selected first. The Run Time is monitored in menus [39H] to [39M] in sequence. For each drive the Run Time can be reset. - A maximum of 6 drives can be used.

Communication information

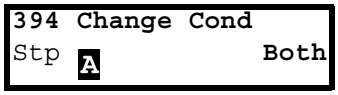
Modbus Instance no/DeviceNet no:	43163
Profibus slot/index	169/67
EtherCAT index (hex)	4c5b
Profinet IO index	19547
Fieldbus format	UInt, 1=1
Modbus format	UInt

NOTE: This menu will NOT be active if only one drive is selected.

Change Condition [394]

This parameter determines the criteria for changing the master. This menu only appears if Alternating MASTER operation is selected. The elapsed run time of each drive is monitored. The elapsed run time always determines which drive will be the 'new' master drive.

This function is only active if the parameter “Select Drive [393]”= “All” is used.

		
Default:		Both
Stop	0	The Runtime of the master drive determines when a master drive has to be changed. The change will only take place after a: - Power Up - Stop - Standby condition - Trip condition.
Timer	1	The master drive will be changed if the timer setting in Change Timer [395] has elapsed. The change will take place immediately. So during operation the additional pumps will be stopped temporarily, the 'new' master will be selected according to the Run Time and the additional pumps will be started again. It is possible to leave 2 pumps running during the change operation. This can be set with Drives on Change [396].
Both	2	The master drive will be changed if the timer setting in Change Timer [395] has elapsed. The 'new' master will be selected according to the elapsed Run Time. The change will only take place after a: - Power Up - Stop - Standby condition. - Trip condition.

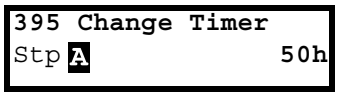
Communication information

Modbus Instance no/DeviceNet no:	43164
Profibus slot/index	169/68
EtherCAT index (hex)	4c5c
Profinet IO index	19548
Fieldbus format	UInt
Modbus format	UInt

NOTE: If the Status feedback inputs (DigIn 9 to Digin 14) are used, the master drive will be changed immediately if the feedback generates an 'Error'.

Change Timer [395]

When the time set here is elapsed, the master drive will be changed. This function is only active if “Select Drive [393]”=All and “Change Cond [394]”= Timer/ Both.

	
Default:	50 h
Range:	1-3000 h

Communication information

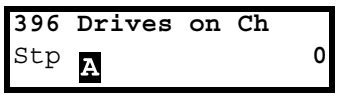
Modbus Instance no/DeviceNet no:	43165
Profibus slot/index	169/69
EtherCAT index (hex)	4c5d
Profinet IO index	19549
Fieldbus format	UInt, 1=1 h
Modbus format	UInt, 1=1 h

Drives on Change [396]

If a master drive is changed according to the timer function (Change Condition=Timer/Both [394]), it is possible to leave additional pumps running during the change operation. With this function the change operation will be as smooth as possible. The maximum number to be programmed in this menu depends on the number of a dditional drives.

Example:

If the number of drives is set to 6, the maximum value will be 4. This function is only active if “Select Drive [393]”=All.

	
Default:	0
Range:	0 to (the number of drives - 2)

Communication information

Modbus Instance no/DeviceNet no:	43166
Profibus slot/index	169/70
EtherCAT index (hex)	4c5e
Profinet IO index	19550
Fieldbus format	UInt
Modbus format	UInt

Upper Band [397]

If the speed of the master drive comes into the upper band, an additional drive will be added after a delay time that is set in “Start delay [399]”.

397 Upper Band Stp A 10%	
Default:	10%
Range:	0-100% of total min speed to max speed

Communication information

Modbus Instance no/DeviceNet no:	43167
Profibus slot/index	169/71
EtherCAT index (hex)	4c5f
Profinet IO index	19551
Fieldbus format	Long, 1=1%
Modbus format	EInt

Example:

Max Speed = 1500 rpm
Min Speed = 300 rpm
Upper Band = 10%

Start delay will be activated:
Range = Max Speed to Min Speed = 1500–300 = 1200 rpm

10% of 1200 rpm = 120 rpm

Start level = 1500–120 = 1380 rpm

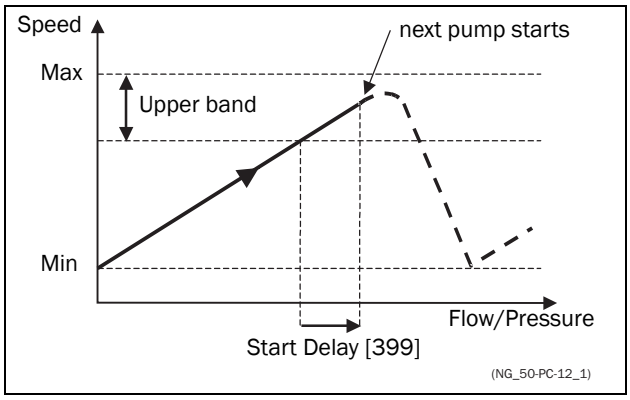


Fig. 99 Upper band

Lower Band [398]

If the speed of the master drive comes into the lower band an additional drive will be stopped after a delay time. This delay time is set in the parameter “Stop Delay [39A]”.

398 Lower Band Stp A 10%	
Default:	10%
Range:	0-100% of total min speed to max speed

Communication information

Modbus Instance no/DeviceNet no:	43168
Profibus slot/index	169/72
EtherCAT index (hex)	4c60
Profinet IO index	19552
Fieldbus format	Long, 1=1%
Modbus format	EInt

Example:

Max Speed = 1500 rpm
Min Speed = 300 rpm
Lower Band = 10%

Stop delay will be activated:
Range = Max Speed - Min Speed = 1500–300 = 1200 rpm

10% of 1200 rpm = 120 rpm

Start level = 300 + 120 = 420 rpm

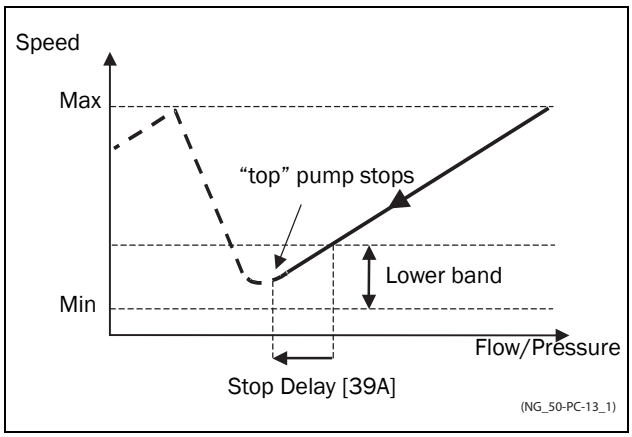


Fig. 100 Lower band

Start Delay [399]

This delay time must have elapsed before the next pump is started. A delay time prevents the nervous switching of pumps.

399 Start Delay Stp A 0s	
Default:	0 s
Range:	0-999 s

Communication information

Modbus Instance no/DeviceNet no:	43169
Profibus slot/index	169/73
EtherCAT index (hex)	4c61
Profinet IO index	19553
Fieldbus format	Long, 1=1s
Modbus format	EInt

Stop Delay [39A]

This delay time must have elapsed before the 'top' pump is stopped. A delay time prevents the nervous switching of pumps.

	39A Stop Delay Stp A 0s
Default:	0 s
Range:	0-999 s

Communication information

Modbus Instance no/DeviceNet no:	43170
Profibus slot/index	169/74
EtherCAT index (hex)	4c62
Profinet IO index	19554
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Upper Band Limit [39B]

If the speed of the pump reaches the upper band limit, the next pump is started immediately without delay. If a start delay is used this delay will be ignored. Range is between 0%, equalling max speed, and the set percentage for the "UpperBand [397]".

	39B Upp Band Lim Stp A 0%
Default:	0%
Range:	0 to Upper Band level. 0% (=max speed) means that the Limit function is switched off.

Communication information

Modbus Instance no/DeviceNet no:	43171
Profibus slot/index	169/75
EtherCAT index (hex)	4c63
Profinet IO index	19555
Fieldbus format	Long, 1=1%
Modbus format	EInt

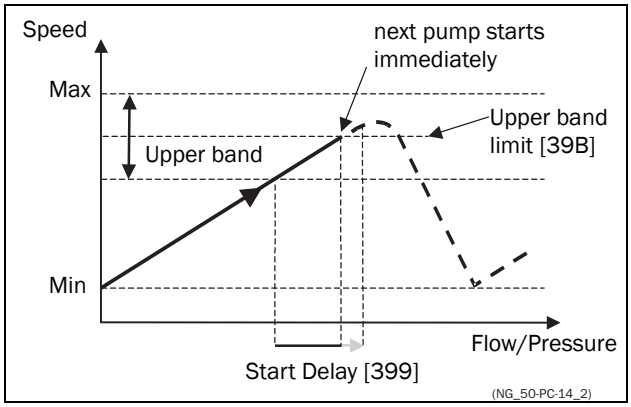


Fig. 101 Upper band limit

Lower Band Limit [39C]

If the speed of the pump reaches the lower band limit, the 'top' pump is stopped immediately without delay. If a stop delay is used this delay will be ignored. Range is from 0%, equalling min speed, to the set percentage for the "Lower Band [398]".

	39C Low Band Lim Stp A 0%
Default:	0%
Range:	0 to Lower Band level. 0% (=min speed) means that he Limit function is switched off.

Communication information

Modbus Instance no/DeviceNet no:	43172
Profibus slot/index	169/76
EtherCAT index (hex)	4c64
Profinet IO index	19556
Fieldbus format	Long, 1=1%
Modbus format	EInt

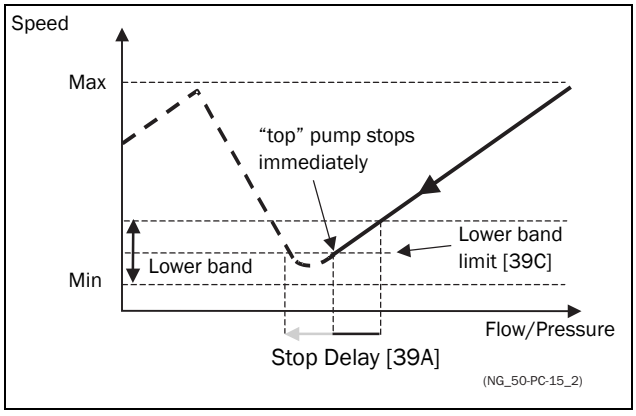


Fig. 102 Lower band limit

Settle Time Start [39D]

The settle start allows the process to settle after a pump is switched on before the pump control continues. If an additional pump is started D.O.L. (Direct On Line) or Y/Δ, the flow or pressure can still fluctuate due to the 'rough' start/stop method. This could cause unnecessary starting and stopping of additional pumps.

During the Settle start:

- PID controller is off.
- The speed is kept at a fixed level after adding a pump.

39D Settle Start Stp A 0s	
Default:	0 s
Range:	0-999 s

Communication information

Modbus Instance no/DeviceNet no:	43173
Profibus slot/index	169/77
EtherCAT index (hex)	4c65
Profinet IO index	19557
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Transition Speed Start [39E]

The transition speed start is used to minimize a flow/pressure overshoot when adding another pump. When an additional pump needs to be switched on, the master pump will slow down to the set transition speed start value, before the additional pump is started. The setting depends on the dynamics of both the master drive and the additional drives.

The transition speed is best set by trial and error.

In general:

- If the additional pump has 'slow' start/stop dynamics, then a higher transition speed should be used.
- If the additional pump has 'fast' start/stop dynamics, then a lower transition speed should be used.

39E TransS Start Stp A 60%	
Default:	60%
Range:	0-100% of total min speed to max speed

Communication information

Modbus Instance no/DeviceNet no:	43174
Profibus slot/index	169/78
EtherCAT index (hex)	4c66
Profinet IO index	19558
Fieldbus format	Long, 1=1%
Modbus format	EInt

NOTE: If set to 100 %, the transition speed, when starting pumps, is ignored and no speed adaption is made.
I.e. the slave pump is started directly and speed of the master pump is maintained.

Example

Max Speed = 1500 rpm
Min Speed = 200 rpm
TransS Start = 60%

When an additional pump is needed, the speed will be controlled down to min speed + (60% x (1500 rpm - 200 rpm)) = 200 rpm + 780 rpm = 980 rpm. When this speed is reached, the additional pump with the lowest run time hours will be switched on.

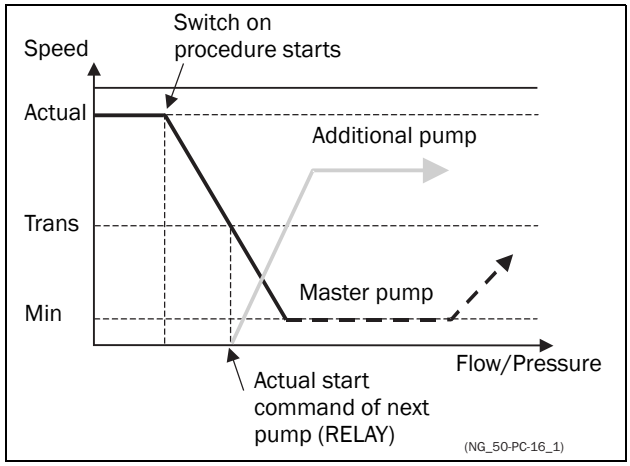


Fig. 103 Transition speed start

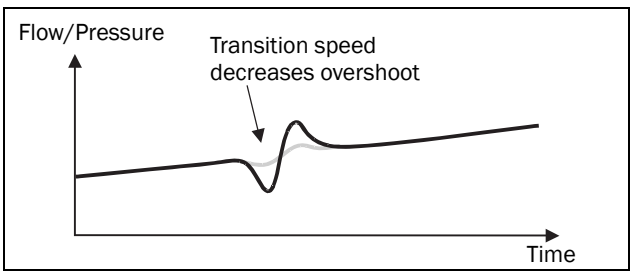


Fig. 104 Effect of transition speed

Settle Time Stop [39F]

The settle stop allows the process to settle after a pump is switched off before the pump control continues. If an additional pump is stopped D.O.L. (Direct On Line) or Y/Δ, the flow or pressure can still fluctuate due to the 'rough' start/stop method. This could cause unnecessary starting and stopping of additional pumps.

During the Settle stop:

- PID controller is off.
- the speed is kept at a fixed level after stopping a pump

39F Settle Stop Stp A 0s	
Default:	0 s
Range:	0–999 s

Communication information

Modbus Instance no/DeviceNet no:	43175
Profibus slot/index	169/79
EtherCAT index (hex)	4c67
Profinet IO index	19559
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Transition Speed Stop [39G]

The transition speed stop is used to minimize a flow/pressure overshoot when shutting down an additional pump. The setting depends on the dynamics of both the master drive and the additional drives.

In general:

- If the additional pump has 'slow' start/stop dynamics, then a higher transition speed should be used.
- If the additional pump has 'fast' start/stop dynamics, then a lower transition speed should be used.

39G TransS Stop Stp A 60%	
Default:	60%
Range:	0-100% of total min speed to max speed

Communication information

Modbus Instance no/DeviceNet no:	43176
Profibus slot/index	169/80
EtherCAT index (hex)	4c68
Profinet IO index	19560
Fieldbus format	Long, 1=1%
Modbus format	EInt

NOTE: If set to 0 %, the transition speed when stopping pumps, is ignored and no speed adaption is made. I.e. the slave pump is stopped directly and speed of the master pump is continued.

Example

Max Speed = 1500 rpm
Min Speed = 200 rpm
TransS Start = 60%

When less additional pumps are needed, the speed will be controlled up to min speed + (60% x (1500 rpm - 200 rpm)) = 200 rpm + 780 rpm = 980 rpm. When this speed is reached, the additional pump with the highest run time hours will be switched off.

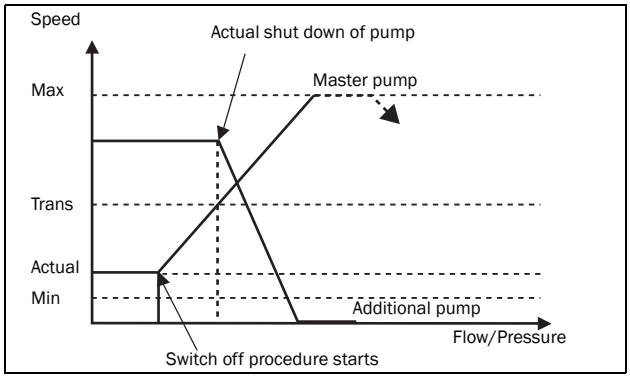
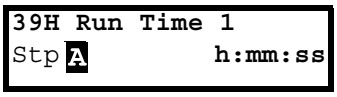


Fig. 105 Transition speed stop

Run Times 1-6 [39H] to [39M]

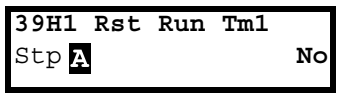


Unit:	h:mm:ss (hours:minutes:seconds)
Range:	0:00:00–262143:59:59

Communication information

Modbus Instance no/ DeviceNet no:	31051 : 31052 : 31053(hr:min:sec) 31054 : 31055: 31056(hr:min:sec) 31057 : 31058: 31059(hr:min:sec) 31060 : 31061: 31062(hr:min:sec) 31063 : 31064: 31065(hr:min:sec) 31066 : 31067: 31068(hr:min:sec)
Profibus slot/index	121/195, 121/196, 121/197, 121/198, 121/199, 121/200, 121/201, 121/202, 121/203, 121/204, 121/205, 121/206, 121/207, 121/208, 121/209, 121/210, 121/211, 121/212
EtherCAT index (hex)	241b : 241c : 241d 241e : 241f : 2420 2421 : 2422 : 2423 2424 : 2425 : 2426 2427 : 2428 : 2429 242a : 242b : 242c
Profinet IO index	1051:1052:1053 - 1068
Fieldbus format	Long, 1=1h/m/s
Modbus format	EInt

Reset Run Times 1-6 [39H1] to [39M1]

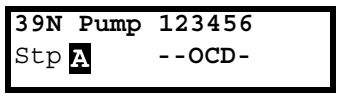


Default:		No
No	0	
Yes	1	

Communication information

Modbus Instance no/DeviceNet no:	38–43, pump 1 -6
Profibus slot/index	0/37–0/42
EtherCAT index (hex)	2026 - 202b
Profinet IO index	38 - 43
Fieldbus format	UInt
Modbus format	UInt

Pump Status [39N]



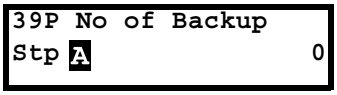
Indication	Description
C	Control, master pump, only when alternating master is used
D	Direct control
O	Pump is off
E	Pump error

Communication information

Modbus Instance no/DeviceNet no:	31069
Profibus slot/index	121/213
EtherCAT index (hex)	242d
Profinet IO index	1069
Fieldbus format	UInt
Modbus format	UInt

Number backup/reserve [39P]

Sets the number of pumps used for backup/reserve which in normal conditions can not be selected. This function can be used for increasing redundancy in the pump system by having pumps in reserve that can be activated when some pumps indicate fault or are shut off for maintenance.



Default:	0
Range:	0-3

Communication information

Modbus Instance no/DeviceNet no:	43177
Profibus slot/index	169/81
EtherCAT index (hex)	4c69
Profinet IO index	19561
Fieldbus format	UInt
Modbus format	UInt

11.3.11 Crane Option [3A0]

Settings for the optional Crane board (Crane Remote Input/ Output card). See also the Crane option instruction manual.

NOTE: This menu is only visible if the crane board is connected to the AC drive.

Crane enable [3A1]

When the crane option board is connected, it is possible to (de)activate the crane option board inputs.

NOTE: Deviation function is active even if [3A1]=off.

	3A1 Crane enable Stp A On	
Default:		Off
Off	0	Crane option board deactivated
On	1	Crane option board activated

Communication information

Modbus Instance no/DeviceNet no:	43181
Profibus slot/index	169/85
EtherCAT index (hex)	4c6d
Profinet IO index	19565
Fieldbus format	UInt
Modbus format	UInt

Control [3A2]

To select the type of crane joystick control.

	3A2 Control Stp A 4-Speeds	
Default:		4-Speeds
4-Speeds	0	4-Speed joystick
3-Pos	1	3-Position switch
Analogue	2	Analogue joystick

Communication information

Modbus Instance no/DeviceNet no:	43182
Profibus slot/index	169/86
EtherCAT index (hex)	4c6e
Profinet IO index	19566
Fieldbus format	UInt
Modbus format	UInt

Crane Relay CR1 [3A3]

Crane Relay CR1 on the Crane option board is fixed to the No Trip function.

3A3 Crane Relay1 Stp A No Trip	
Default:	No Trip
Selections	Fixed to No Trip

Communication information

Modbus Instance no/DeviceNet no:	43183
Profibus slot/index	169/87
EtherCAT index (hex)	4c6f
Profinet IO index	19567
Fieldbus format	UInt
Modbus format	UInt

Crane Relay CR2 [3A4]

To select the function of Crane Relay CR2 on the Crane option board. Same selections as for the relays on the control board.

3A4 Crane Relay2 Stp A Brake	
Default:	Brake
Selections	Same selections as for the relays on the control board

Communication information

Modbus Instance no/DeviceNet no:	43184
Profibus slot/index	169/88
EtherCAT index (hex)	4c70
Profinet IO index	19568
Fieldbus format	UInt
Modbus format	UInt

Pre Limit Switch Speed [3A5]

To set the speed used when Pre-Limit Switch on the Crane option board is active.

3A5 PreLimSwSpd Stp A rpm	
Default:	0 rpm
Range:	0 – 4 x Motor Sync speed

Communication information

Modbus Instance no/DeviceNet no:	43185
Profibus slot/index	169/89
EtherCAT index (hex)	4c71
Profinet IO index	19569
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Crawl speed H/R [3A6]

To set the speed used when crawling (min. speed) during a hoisting operation. Activated with input A1, Crawl H/R=Start in positive speed direction

3A6 CrawlSpd H/R Stp A rpm	
Default:	0
Range:	0 – 4 x Sync speed

Communication information

Modbus Instance no/DeviceNet no:	43189
Profibus slot/index	169/93
EtherCAT index (hex)	4c75
Profinet IO index	19573
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Crawl speed L/L [3A7]

To set the speed used when crawling (min. speed) during lowering operation. Activated with input A2, Crawl L/L=Start in negative speed direction.

3A7 CrawlSpd L/L Stp A rpm	
Default:	0
Range:	0 – 4 x Sync speed

Communication information

Modbus Instance no/DeviceNet no:	43190
Profibus slot/index	169/94
EtherCAT index (hex)	4c76
Profinet IO index	19574
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Speed 2 [3A8]

To set the speed used when the input B1, Speed 2 on the Crane option board is active.

3A8 Speed 2 Stp A rpm	
Default:	0
Range:	0 – 4 x Sync speed

Communication information

Modbus Instance no/DeviceNet no:	43186
Profibus slot/index	169/90
EtherCAT index (hex)	4c72
Profinet IO index	19570
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Speed 3 [3A9]

To set the speed used when the input B2, Speed 3 on the Crane option board is active.

3A9 Speed 3 Stp A rpm	
Default:	0
Range:	0 – 4 x Motor Sync speed

Communication information

Modbus Instance no/DeviceNet no:	43187
Profibus slot/index	169/91
EtherCAT index (hex)	4c73
Profinet IO index	19571
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Speed 4 [3AA]

To set the speed used when the input B3, Speed 4 on the Crane option board is active.

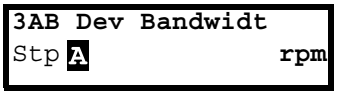
3AA Speed 4 Stp A rpm	
Default:	0
Range:	0 – 4 x Motor Sync speed

Communication information

Modbus Instance no/DeviceNet no:	43188
Profibus slot/index	169/92
EtherCAT index (hex)	4c74
Profinet IO index	19572
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Deviation Band width [3AB]

To define the speed deviation window within which the AC drive is in control of the motor.



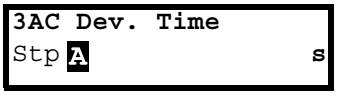
Default:	0
Range:	0 – 4 x Sync speed

Communication information

Modbus Instance no/DeviceNet no:	43191
Profibus slot/index	169/95
EtherCAT index (hex)	4c77
Profinet IO index	19575
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Deviation Time [3AC]

To set the time during which the deviation condition must be active, before the inverter trips.



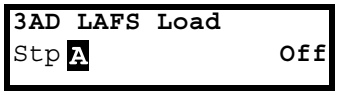
Default:	0.10 s
Range:	0.05 – 1 s

Communication information

Modbus Instance no/DeviceNet no:	43192
Profibus slot/index	169/96
EtherCAT index (hex)	4c78
Profinet IO index	19576
Fieldbus format	Long, 1=0.001 s
Modbus format	EInt

LAFS Load [3AD]

To set the load below which the VFB/VFX goes into load dependent field weakening operation.



Default:		Off
Off	0	Off
1–100	1–100	1% – 100%

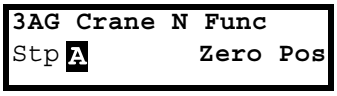
Communication information

Modbus Instance no/DeviceNet no:	43193
Profibus slot/index	169/97
EtherCAT index (hex)	4c79
Profinet IO index	19577
Fieldbus format	Long, 1=1%
Modbus format	EInt

When set to OFF, the load dependent field weakening function is switched off.

CRIO N input function [3AG]

Sets the function of CRIO/Crane I/O interface N(Null) input.



Default:		Zero Pos
Off	0	N input not used
Zero Pos	1	N input used for joystick zero position indication.
Brk Ackn	2	N input used for Brake Acknowledge. see page 111.

Communication information

Modbus Instance no/DeviceNet no:	43194
Profibus slot/index	169/98
EtherCAT index (hex)	4c7a
Profinet IO index	19578
Fieldbus format	UInt
Modbus format	UInt

Note: Brake Acknowledge via Crane I/O has priority (and overrules) Brake acknowledge via control board I/O ([521 DigIn1] - [528 Dig In8]).

11.4 Load Monitor and Process Protection [400]

11.4.1 Load Monitor [410]

The monitor functions enable the AC drive to be used as a load monitor. Load monitors are used to protect machines and processes against mechanical overload and underload, e.g. a conveyer belt or screw conveyer jamming, belt failure on a fan and a pump dry running. See explanation in Chapter 7.5 page 57.

Alarm Select [411]

Selects the types of alarms that are active.

411 Alarm Select Stp A Off		
Default:		Off
Off	0	No alarm functions active.
Min	1	Min Alarm active. The alarm output functions as an underload alarm.
Max	2	Max Alarm active. The alarm output functions as an overload alarm.
Max+Min	3	Both Max and Min alarm are active. The alarm outputs function as overload and underload alarms.

Communication information

Modbus Instance no/DeviceNet no:	43321
Profibus slot/index	169/225
EtherCAT index (hex)	4cf9
Profinet IO index	19705
Fieldbus format	UInt
Modbus format	UInt

Alarm Trip [412]

Selects which alarm must cause a trip to the AC drive.

412 Alarm trip Stp A Off	
Default:	Off
Selection:	Same as in menu [411]

Communication information

Modbus Instance no/DeviceNet no:	43322
Profibus slot/index	169/226
EtherCAT index (hex)	4cfa
Profinet IO index	19706
Fieldbus format	UInt
Modbus format	UInt

Ramp Alarm [413]

This function inhibits the (pre) alarm signals during acceleration/deceleration of the motor to avoid false alarms.

413 Ramp Alarm Stp A Off		
Default:		Off
Off	0	(Pre) alarms are inhibited during acceleration/deceleration.
On	1	(Pre) alarms active during acceleration/ deceleration.

Communication information

Modbus Instance no/DeviceNet no:	43323
Profibus slot/index	169/227
EtherCAT index (hex)	4cfb
Profinet IO index	19707
Fieldbus format	UInt
Modbus format	UInt

Alarm Start Delay [414]

This parameter is used if, for example, you want to override an alarm during the start-up procedure.

Sets the delay time after a run command, after which the alarm may be given.

- If Ramp Alarm=On. The start delay begins after a RUN command.
- If Ramp Alarm=Off. The start delay begins after the acceleration ramp.

414 Start Delay Stp A 2s	
Default:	2 s
Range:	0-3600 s

Communication information

Modbus Instance no/DeviceNet no:	43324
Profibus slot/index	169/228
EtherCAT index (hex)	4cfc
Profinet IO index	19708
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Load Type [415]

In this menu you select monitor type according to the load characteristic of your application. By selecting the required monitor type, the overload and underload alarm function can be optimized according to the load characteristic.

When the application has a constant load over the whole speed range, i.e. extruder or screw compressor, the load type can be set to basic. This type uses a single value as a reference for the nominal load. This value is used for the complete speed range of the AC drive. The value can be set or automatically measured. See Autoset Alarm [41A] and "Normal Load [41B]" about setting the nominal load reference.

The Load Curve mode uses an interpolated curve with 9 load values at 8 equal speed intervals. This curve is populated by a test run with a real load. This can be used with any smooth load curve including constant load.

The Load Curve R is a relative load curve in % of Load set in the Load Curve . There is also a minimum margine set in menu "Minimum Absolute Margin [41D]".

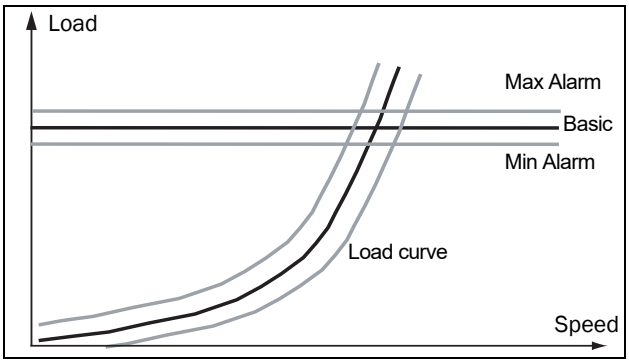


Fig. 106 Basic load type and Load curve

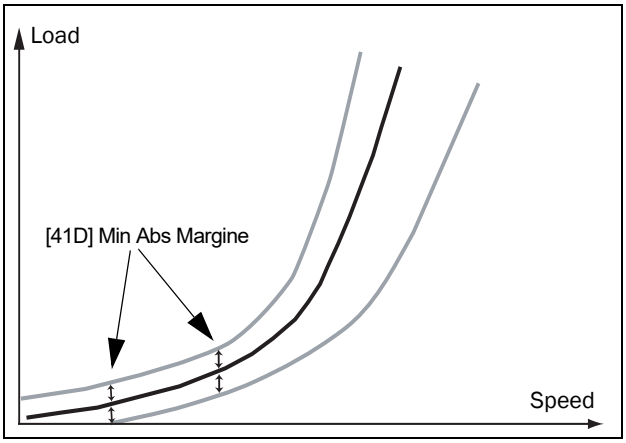


Fig. 107 Load Curve R with Min ABS margin.

	415 Load Type Stp A Basic	
Default:		Basic
Basic	0	Uses a fixed maximum and minimum load level over the full speed range. Can be used in situations where the torque is independent of the speed.
Load Curve	1	Uses the measured actual load characteristic of the process over the speed range.
Load Curv R	2	Uses a relative load margin with a minimum margin set in menu [41D].

Communication information

Modbus Instance no/DeviceNet no:	43325
Profibus slot/index	169/229
EtherCAT index (hex)	4cfd
Profinet IO index	19709
Fieldbus format	UInt
Modbus format	UInt

Max Alarm [416]

Max Alarm Margin [4161]

With load type Basic, [415], used the Max Alarm Margin sets the band above the "Normal Load [41B]" menu that does not generate an alarm. With load type Load Curve [415] used, the Max Alarm Margin sets the band above the Load Curve [41C], that does not generate an alarm. The Max Alarm Margin is a percentage of nominal motor torque.
In case of Load Curve R, the margin is percentage of Load curve torque at the actual speed.

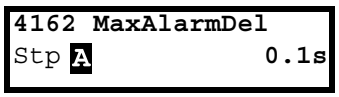
4161 MaxAlarmMar Stp A 15%	
Default:	15%
Range:	0–400%

Communication information

Modbus Instance no/DeviceNet no:	43326
Profibus slot/index	169/230
EtherCAT index (hex)	4cfe
Profinet IO index	19710
Fieldbus format	Long, 1=1%
Modbus format	Eint

Max Alarm delay [4162]

When the load level without interruption exceeds the alarm level longer than set “Max Alarm delay” time, an alarm is activated.



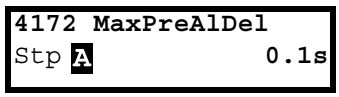
Default:	0.1 s
Range:	0-90 s

Communication information

Modbus Instance no/DeviceNet no:	43330
Profibus slot/index	169/234
EtherCAT index (hex)	4d02
Profinet IO index	19714
Fieldbus format	Long, 1=0.1 s
Modbus format	EInt

Max Pre Alarm delay [4172]

When the load level without interruption exceeds the alarm level longer than set “Max PreAlarm delay” time, a warning is activated.



Default:	0.1 s
Range:	0–90 s

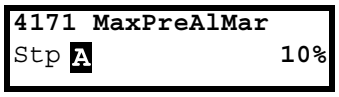
Communication information

Modbus Instance no/DeviceNet no:	43331
Profibus slot/index	169/235
EtherCAT index (hex)	4d03
Profinet IO index	19715
Fieldbus format	Long, 1=0.1 s
Modbus format	EInt

Max Pre Alarm [417]

Max Pre AlarmMargin [4171]

With load type Basic [415], used the Max Pre-Alarm Margin sets the band above the Normal Load, [41B], menu that does not generate a pre-alarm. With load type Load Curve, [415], used the Max Pre-Alarm Margin sets the band above the Load Curve, [41C], that does not generate a pre-alarm. The Max Pre-Alarm Margin is a percentage of nominal motor torque.
In case of Load Curve R, the margin is percentage of Load curve torque at the actual speed.



Default:	10%
Range:	0–400%

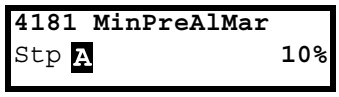
Communication information

Modbus Instance no/DeviceNet no:	43327
Profibus slot/index	169/231
EtherCAT index (hex)	4cff
Profinet IO index	19711
Fieldbus format	Long, 1=1%
Modbus format	EInt

Min Pre Alarm [418]

Min Pre Alarm Margin [4181]

With load type Basic, [415], used the Min Pre-Alarm Margin sets the band under the Normal Load, [41B], menu that does not generate a pre-alarm. With load type Load Curve, [415], used the Min Pre-Alarm Margin sets the band under the Load Curve, [41C], that does not generate a pre-alarm. The Min Pre-Alarm Margin is a percentage of nominal motor torque.
In case of Load Curve R, the margin is percentage of Load curve torque at the actual speed.



Default:	10%
Range:	0-400%

Communication information

Modbus Instance no/DeviceNet no:	43328
Profibus slot/index	169/232
EtherCAT index (hex)	4d00
Profinet IO index	19712
Fieldbus format	Long, 1=1%
Modbus format	EInt

Min Pre Alarm Response delay [4182]

When the load level without interruption is below the alarm level longer than set “Min PreAlarm delay” time, a warning is activated.

	4182 MinPreAlDel Stp A 0.1s
Default:	0.1 s
Range:	0-90 s

Communication information

Modbus Instance no/DeviceNet no:	43332
Profibus slot/index	169/236
EtherCAT index (hex)	4d04
Profinet IO index	19716
Fieldbus format	Long, 1=0.1 s
Modbus format	EInt

Min Alarm [419]

Min Alarm Margin [4191]

With load type Basic, [415], used the Min Alarm Margin sets the band under the “Normal Load [41B]”, menu that does not generate an alarm. With load type “Load Curve [415]”, used the Min Alarm Margin sets the band under the “Load Curve [41C]”, that does not generate an alarm. The Max Alarm Margin is a percentage of nominal motor torque.
In case of Load Curve R, the margin is percentage of Load curve torque at the actual speed.

	4191 MinAlarmMar Stp A 15%
Default:	15%
Range:	0-400%

Communication information

Modbus Instance no/DeviceNet no:	43329
Profibus slot/index	169/233
EtherCAT index (hex)	4d01
Profinet IO index	19713
Fieldbus format	Long, 1=1%
Modbus format	EInt

Min Alarm Response delay [4192]

When the load level without interruption is below the alarm level longer than set “Min Alarm delay” time, an alarm is activated.

	4192 MinAlarmDel Stp A 0.1s
Default:	0.1 s
Range:	0-90 s

Communication information

Modbus Instance no/DeviceNet no:	43333
Profibus slot/index	169/237
EtherCAT index (hex)	4d05
Profinet IO index	19717
Fieldbus format	Long, 1=0.1 s
Modbus format	EInt

Autoset Alarm [41A]

The Autoset Alarm function can measure the nominal load that is used as reference for the alarm levels. If the selected “Load Type [415]” is Basic it copies the load the motor is running with to the menu “Normal Load [41B]”. The motor must run on the speed that generates the load that needs to be recorded. If the selected “Load Type [415]” is Load Curve it performs a test-run and populates the “Load Curve [41C]” with the found load values.



WARNING!
When autoset does a test run the motor and application/machine will ramp up to maximum speed.

NOTE: The motor must be running for the Autoset Alarm function to succeed. A not running motor generates a “Failed!” message.

		41A AutoSet Alrm Stp A No
Default:		No
No	0	
Yes	1	

Communication information

Modbus Instance no/DeviceNet no:	43334
Profibus slot/index	169/238
EtherCAT index (hex)	4d06
Profinet IO index	19718
Fieldbus format	UInt
Modbus format	UInt

The default set levels for the (pre)alarms are:

Overload	Max Alarm	menu [4161] + [41B]
	Max Pre Alarm	menu [4171] + [41B]
Underload	Min Pre Alarm	menu [41B] - [4181]
	Min Alarm	menu [41B] - [4191]

These default set levels can be manually changed in menus [416] to [419]. After execution the message "Autoset OK!" is displayed for 1s and the selection reverts to "No".

Normal Load [41B]

Set the level of the normal load. The alarm or pre alarm will be activated when the load is above/under normal load ± margin.

	41B Normal Load Stp A 100%
Default:	100%
Range:	0-400% of max torque

NOTE: 100% Torque means: I_{NOM}= I_{MOT}. The maximum depends on the motor current and AC drive max current settings, but the absolute maximum adjustment is 400%.

Communication information

Modbus Instance no/DeviceNet no:	43335
Profibus slot/index	169/239
EtherCAT index (hex)	4d07
Profinet IO index	19719
Fieldbus format	Long, 1=1%
Modbus format	EInt

Load Curve [41C]

The load curve function can be used with any smooth load curve. The curve can be populated with a test-run or the values can be entered or changed manually.

Load Curve 1-9 [41C1]-[41C9]

The measured load curve is based on 9 stored samples. The curve starts at minimum speed and ends at maximum speed, the range in between is divided into 8 equal steps. The measured values of each sample are displayed in [41C1] to [41C9] and can be adapted manually. The value of the 1st sampled value on the load curve is displayed.

	41C1 Load Curve1 Stp A 0rpm 100%
Default:	100%
Range:	0–400% of max torque

Communication information

Modbus Instance no/DeviceNet no:	43336%, 43337 rpm, 43338 %, 43339 rpm, 43340 %, 43341 rpm, 43342 %, 43343 rpm, 43344 %, 43345 rpm, 43346 %, 43347 rpm, 43348 %, 43349 rpm, 43350 %, 43351 rpm, 43352 %, 43353 rpm
Profibus slot/index	169/240, 169/242, 169/244, 169/246, 169/248, 169/250, 169/252, 169/254, 170/1
EtherCAT index (hex)	4d08 %, 4d09 rpm, 4d0a %, 4d0b rpm, 4d0c %, 4d0d rpm, 4d0e %, 4d0f rpm, 4d10 %, 4d11 rpm, 4d12 %, 4d13 rpm, 4d14 %, 4d15 rpm, 4d16 %, 4d17 rpm, 4d18 %, 4d19 rpm
Profinet IO index	19720 %, 19721 rpm, 19722 %, 19723 rpm, 19724 %, 19725 rpm, 19726 %, 19727 rpm, 19728 %, 19729 rpm, 19730 %, 19731 rpm, 19732 %, 19733 rpm, 19734 %, 19735 rpm, 19736 %, 19738 rpm,
Fieldbus format	Long, 1= 1 %, Int 1=1 rpm
Modbus format	EInt

NOTE: The speed values depend on the Min- and Max Speed values. they are read only and cannot be changed.

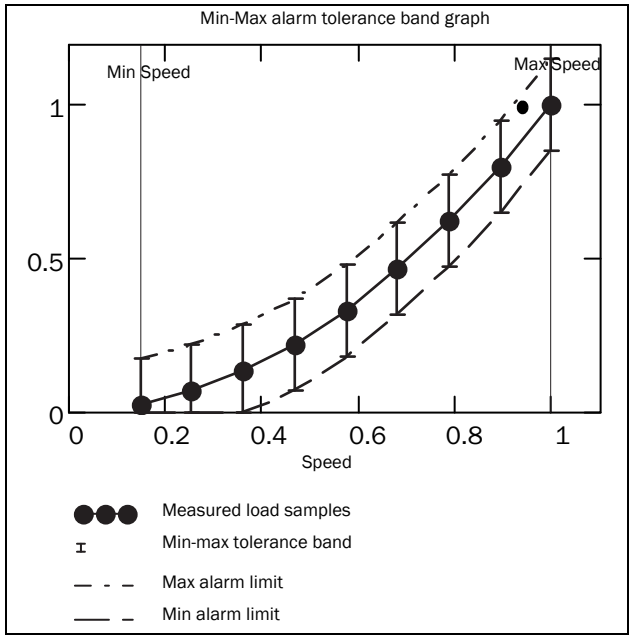


Fig. 108

Minimum Absolute Margin [41D]

This menu is displayed when using “Load Curve R”
Set absolute minimum margin of the Load Curve in % of nominal motor torque.

	41D MinAbsMarg Stp A 3%
Default:	3 %
Range:	0 - 31 %

Communication information

Modbus Instance no/DeviceNet no:	43354
Profibus slot/index	170/3
EtherCAT index (hex)	4d1a
Profinet IO index	19738
Fieldbus format	Long, 1 = 1%
Modbus format	EInt

11.4.2 Process Protection [420]

Submenu with settings regarding protection functions for the AC drive and the motor.

Low Voltage Override [421]

If a dip in the mains supply occurs and the low voltage override function is enabled, the AC drive will automatically decrease the motor speed to keep control of the application and prevent an under voltage trip until the input voltage rises again. Therefore the rotating energy in the motor/load is used to keep the DC link voltage level at the override level, for as long as possible or until the motor comes to a standstill. This is dependent on the inertia of the motor/load combination and the load of the motor at the time the dip occurs, see Fig. 109.

		421 Low Volt OR Stp A On
Default:		On
Off	0	At a voltage dip the low voltage trip will protect.
On	1	At mains dip, AC drive ramps down until voltage rises.

Communication information

Modbus Instance no/DeviceNet no:	43361
Profibus slot/index	170/10
EtherCAT index (hex)	4d21
Profinet IO index	19745
Fieldbus format	UInt
Modbus format	UInt

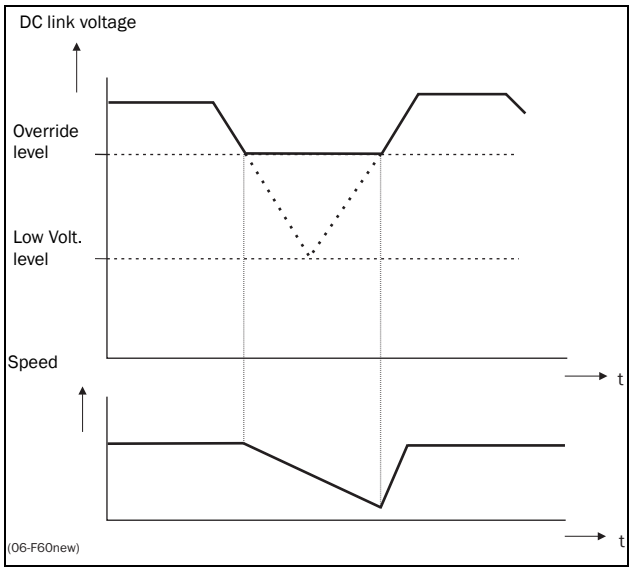
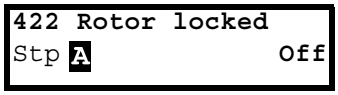


Fig. 109 Low voltage override

NOTE: During the low voltage override the LED trip/limit blinks.

Rotor locked [422]

With the rotor locked function enabled, the AC drive will protect the motor and application when this is stalled whilst increasing the motor speed from standstill. This protection will coast the motor to stop and indicate a fault when the Torque Limit has been active at very low speed for more than 5 seconds.



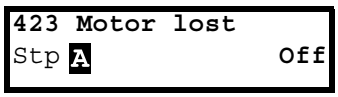
Default:		Off
Off	0	No detection
On	1	AC drive will trip when locked rotor is detected. Trip message “Locked Rotor”.

Communication information

Modbus Instance no/DeviceNet no:	43362
Profibus slot/index	170/11
EtherCAT index (hex)	4d22
Profinet IO index	19746
Fieldbus format	UInt
Modbus format	UInt

Motor lost [423]

With the motor lost function enabled, the AC drive is able to detect a fault in the motor circuit: motor, motor cable, thermal relay or output filter. Motor lost will cause a trip, and the motor will coast to standstill, when a missing motor phase is detected during a period of 500 ms. The detection time during DC-start is 50 ms and during Fast-start 10 ms.



Default:		Off
Off	0	Function switched off to be used if no motor or very small motor connected.
Trip	1	AC drive will trip when the motor is disconnected. Trip message “Motor Lost”.
Start	2	Test for disconnected motor will only be performed during start routine.

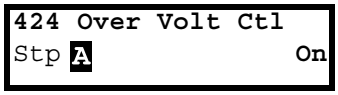
Communication information

Modbus Instance no/DeviceNet no:	43363
Profibus slot/index	170/12
EtherCAT index (hex)	4d23
Profinet IO index	19747
Fieldbus format	UInt
Modbus format	UInt

Overvolt control [424]

Used to switch off the overvoltage control function when only braking by brake chopper and resistor is required. The overvoltage control function, limits the braking torque so that the DC link voltage level is controlled at a high, but safe, level. This is achieved by limiting the actual deceleration rate during stopping. In case of a defect at the brake chopper or the brake resistor the AC drive will trip for “Overvoltage” to avoid a fall of the load e.g. in crane applications.

NOTE: Overvoltage control should not be activated if brake chopper is used.



Default:		On
On	0	Overvoltage control activated
Off	1	Overvoltage control off

Communication information

Modbus Instance no/DeviceNet no:	43364
Profibus slot/index	170/13
EtherCAT index (hex)	4d24
Profinet IO index	19748
Fieldbus format	UInt
Modbus format	UInt

11.5 I/Os and Virtual Connections [500]

Main menu with all the settings of the standard inputs and outputs of the AC drive.

11.5.1 Analogue Inputs [510]

Submenu with all settings for the analogue inputs.

AnIn1 Function [511]

Sets the function for Analogue input 1. Scale and range are defined by AnIn1 Advanced settings [513].

		511 AnIn1 Fc Stp A Process Ref
Default:		Process Ref
Off	0	Input is not active
Max Speed	1	The input acts as an upper speed limit.
Max Torque	2	The input acts as an upper torque limit.
Process Val	3	The input value equals the actual process value (feedback) and is compared to the reference signal (set point) by the PID controller, or can be used to display and view the actual process value.
Process Ref	4	Reference value is set for control in process units, see Process Source [321] and Process Unit [322].
Min Speed	5	The input acts as a lower speed limit.

Communication information

Modbus Instance no/DeviceNet no:	43201
Profibus slot/index	169/105
EtherCAT index (hex)	4c81
Profinet IO index	19585
Fieldbus format	UInt
Modbus format	UInt

NOTE: When AnInX Func=Off, the connected signal will still be available for Comparators [610].

Adding analogue inputs

If more than one analogue input is set to the same function, the values of the inputs can be added together. In the following examples we assume that Process Source [321] is set to Speed.

Example 1: Add signals with different weight (fine tuning).

Signal on AnIn1 = 10 mA
Signal on AnIn2 = 5 mA

[511] AnIn1 Function = Process Ref.
[512] AnIn1 Setup = 4-20 mA
[5134] AnIn1 Function Min = Min (0 rpm)
[5136] AnIn1 Function Max = Max (1500 rpm)
[5138] AnIn1 Operation = Add+
[514] AnIn2 Function = Process Ref.
[515] AnIn2 Setup = 4-20 mA
[5164] AnIn2 Function Min = Min (0 rpm)
[5166] AnIn2 Function Max = User defined
[5167] AnIn2 Value Max = 300 rpm
[5168] AnIn2 Operation = Add+

Calculation:

AnIn1 = (10-4) / (20-4) x (1500-0) + 0 = 562.5 rpm

AnIn2 = (5-4) / (20-4) x (300-0) + 0 = 18.75 rpm

The actual process reference will be:
+562.5 + 18.75 = 581 rpm

Analogue Input Selection via Digital Inputs:

When two different external Reference signals are used, e.g. 4-20mA signal from control centre and a 0-10 V locally mounted potentiometer, it is possible to switch between these two different analogue input signals via a Digital Input set to “AnIn Select”.

AnIn1 is 4-20 mA
AnIn2 is 0-10 V

DigIn3 is controlling the AnIn selection; HIGH is 4-20 mA, LOW is 0-10 V

“[511] AnIn1 Fc” = Process Ref;
set AnIn1 as reference signal input

“[512] AnIn1 Setup” = 4-20mA;
set AnIn1 for a current reference signal

“[513A] AnIn1 Enabl” = DigIn;
set AnIn1 to be active when DigIn3 is HIGH

“[514] AnIn2 Fc” = Process Ref;
set AnIn2 as reference signal input

“[515] AnIn2 Setup” = 0-10V;
set AnIn2 for a voltage reference signal

“[516A] AnIn2 Enabl” = !DigIn;
set AnIn2 to be active when DigIn3 is LOW

“[523] DigIn3=AnIn”;
set DIgIn3 as input fot selection of AI reference

Subtracting analogue inputs

Example 2: Subtract two signals

Signal on AnIn1 = 8 V
Signal on AnIn2 = 4 V

[511] AnIn1 Function = Process Ref.
[512] AnIn1 Setup = 0-10 V
[5134] AnIn1 Function Min = Min (0 rpm)
[5136] AnIn1 Function Max = Max (1500 rpm)
[5138] AnIn1 Operation = Add+
[514] AnIn2 Function = Process Ref.
[515] AnIn2 Setup = 0-10 V
[5164] AnIn2 Function Min = Min (0 rpm)
[5166] AnIn2 Function Max = Max (1500 rpm)
[5168] AnIn2 Operation = Sub-

Calculation:
AnIn1 = (8-0) / (10-0) x (1500-0) + 0 = 1200 rpm
AnIn2 = (4-0) / (10-0) x (1500-0) + 0 = 600 rpm

The actual process reference will be:
+1200 - 600 = 600 rpm

AnIn1 Setup [512]

The analogue input setup is used to configure the analogue input in accordance with the signal used that will be connected to the analogue input. With this selection the input can be determined as current (4-20 mA) or voltage (0-10 V) controlled input. Other selections are available for using a threshold (live zero), a bipolar input function, or a user defined input range. With a bipolar input reference signal, it is possible to control the motor in two directions. See Fig. 110.

NOTE: The selection of voltage or current input is done with S1. When the switch is in voltage mode only the voltage menu items are selectable. With the switch in current mode only the current menu items are selectable.

		512 AnIn1 Setup Stp A 4-20mA
Default:		4-20 mA
Dependent on		Setting of switch S1
4–20mA	0	The current input has a fixed threshold (Live Zero) of 4 mA and controls the full range for the input signal. See Fig. 81.
0–20mA	1	Normal full current scale configuration of the input that controls the full range for the input signal. See Fig. 80.
User mA	2	The scale of the current controlled input, that controls the full range for the input signal. Can be defined by the advanced AnIn Min and AnIn Max menus.
User Bipol mA	3	Sets the input for a bipolar current input, where the scale controls the range for the input signal. Scale can be defined in advanced menu AnIn Bipol.
0–10V	4	Normal full voltage scale configuration of the input that controls the full range for the input signal. See Fig. 80.
2–10V	5	The voltage input has a fixed threshold (Live Zero) of 2 V and controls the full range for the input signal. See Fig. 81.
User V	6	The scale of the voltage controlled input, that controls the full range for the input signal. Can be defined by the advanced AnIn Min and AnIn Max menus.
User Bipol V	7	Sets the input for a bipolar voltage input, where the scale controls the range for the input signal. Scale can be defined in advanced menu AnIn Bipol.

NOTE: For bipol function, input RunR and RunL needs to be active and Rotation, [219] must be set to "R+L".

NOTE: Always check the needed set up when the setting of S1 is changed; selection will not adapt automatically.

Communication information

Modbus Instance no/DeviceNet no:	43202
Profibus slot/index	169/106
EtherCAT index (hex)	4c82
Profinet IO index	19586
Fieldbus format	UInt
Modbus format	UInt

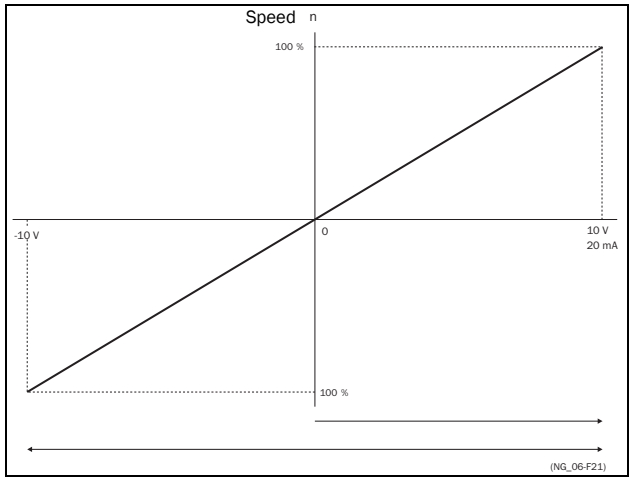


Fig. 110

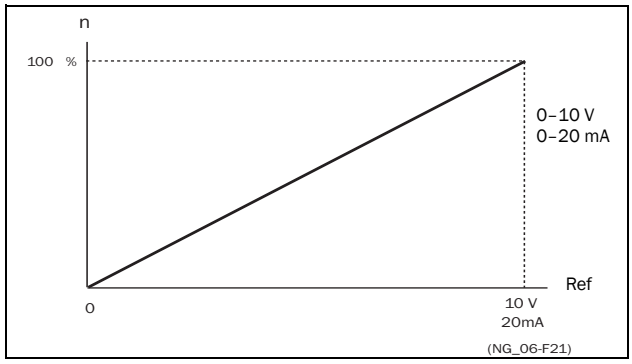


Fig. 111 Normal full-scale configuration

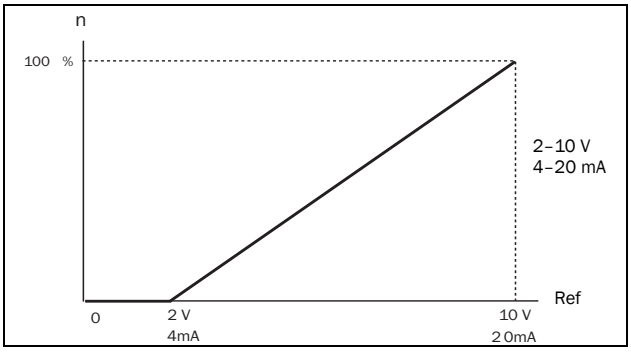


Fig. 112 2–10 V/4–20 mA (Live Zero)

AnIn1 Advanced [513]

NOTE: The different menus will automatically be set to either "mA" or "V", based on the selection in AnIn 1 Setup [512].

513 AnIn1 Advan Stp A

AnIn1 Min [5131]

Parameter to set the minimum value of the external reference signal. Only visible if [512] = User mA/V.

5131 AnIn1 Min Stp A 0V/4.00mA	
Default:	0 V/4.00 mA
Range:	0.00–20.00 mA 0–10.00 V

Communication information

Modbus Instance no/DeviceNet no:	43203
Profibus slot/index	169/107
EtherCAT index (hex)	4c83
Profinet IO index	19587
Fieldbus format	Long, 1=0.01 mA, 0.01 V
Modbus format	EInt

AnIn1 Max [5132]

Parameter to set the maximum value of the external reference signal. Only visible if [512] = User mA/V.

5132 AnIn1 Max Stp 10.0V/20.00mA	
Default:	10.00 V/20.00 mA
Range:	0.00–20.00 mA 0–10.00 V

Communication information

Modbus Instance no/DeviceNet no:	43204
Profibus slot/index	169/108
EtherCAT index (hex)	4c84
Profinet IO index	19588
Fieldbus format	Long, 1=0.01 mA, 0.01 V
Modbus format	EInt

Special function: Inverted reference signal

If the AnIn minimum value is higher than the AnIn maximum value, the input will act as an inverted reference input, see Fig. 113.

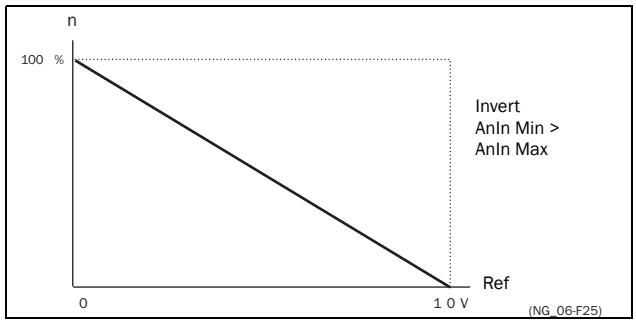


Fig. 113 Inverted reference

AnIn1 Bipol [5133]

This menu is automatically displayed if AnIn1 Setup is set to User Bipol mA or User Bipol V. The window will automatically show mA or V range according to selected function. The range is set by changing the positive maximum value; the negative value is automatically adapted accordingly. Only visible if [512] = User Bipol mA/V. The inputs RunR and RunL input need to be active, and "Rotation [219]", must be set to "R+L", to operate the bipolar function on the analogue input.

5133 AnIn1 Bipol Stp A10.00V/20.00mA	
Default:	10.00 V/20.00 mA
Range:	0.0–20.0 mA, 0.00–10.00 V

Communication information

Modbus Instance no/DeviceNet no:	43205
Profibus slot/index	169/109
EtherCAT index (hex)	4c85
Profinet IO index	19589
Fieldbus format	Long, 1=0.01 mA, 0.01 V
Modbus format	EInt

AnIn1 Function Min [5134]

With AnIn1 Function Min the physical minimum value is scaled to selected process unit. The default scaling is dependent of the selected function of AnIn1 [511].

		5134 AnIn1 FcMin Stp A Min
Default:		Min
Min	0	Min value
Max	1	Max value
User-defined	2	Define user value in menu [5135]

Table 29 shows corresponding values for the min and max selections depending on the function of the analogue input [511].

Table 29

AnIn Function	Min	Max
Speed	Min Speed [341]	Max Speed [343]
Torque	0%	Max Torque [351]
Process Ref	Process Min [324]	Process Max [325]
Process Value	Process Min [324]	Process Max [325]

Communication information

Modbus Instance no/DeviceNet no:	43206
Profibus slot/index	169/110
EtherCAT index (hex)	4c86
Profinet IO index	19590
Fieldbus format	UInt
Modbus format	UInt

AnIn1 Function Value Min [5135]

With AnIn1 Function ValMin you define a user-defined value for the signal. Only visible when user-defined is selected in menu [5134].

	5135 AnIn1 VaMin Stp A 0.000
Default:	0.000
Range:	-10000.000 – 10000.000

Communication information

Modbus Instance no/DeviceNet no:	43541
Profibus slot/index	170/190
EtherCAT index (hex)	4dd5
Profinet IO index	19925
Fieldbus format	Long, 1=1 rpm, 1 %, 1° or 0.001 if Process Value/ Process Ref using a [322] unit
Modbus format	EInt

AnIn1 Function Max [5136]

With AnIn1 Function Max the physical maximum value is scaled to selected process unit. The default scaling is dependent of the selected function of AnIn1 [511]. See Table 29.

		5136 AnIn1 FcMax Stp A Max
Default:		Max
Min	0	Min value
Max	1	Max value
User-defined	2	Define user value in menu [5137]

Communication information

Modbus Instance no/DeviceNet no:	43207
Profibus slot/index	169/111
EtherCAT index (hex)	4c87
Profinet IO index	19591
Fieldbus format	UInt
Modbus format	UInt

AnIn1 Function Value Max [5137]

With AnIn1 Function VaMax you define a user-defined value for the signal. Only visible when user-defined is selected in menu [5136].

	5137 AnIn1 VaMax Stp A 0.000
Default:	0.000
Range:	-10000.000 – 10000.000

Communication information

Modbus Instance no/DeviceNet no:	43551
Profibus slot/index	170/200
EtherCAT index (hex)	4ddf
Profinet IO index	19935
Fieldbus format	Long, 1=1 rpm, 1 %, 1° or 0.001 if Process Value/ Process Ref using a [322] unit
Modbus format	EInt

NOTE: With AnIn Min, AnIn Max, AnIn Function Min and AnIn Function Max settings, loss of feedback signals (e.g. voltage drop due to long sensor wiring) can be compensated to ensure an accurate process control.

Example:

Process sensor is a sensor with the following specification:

Range: 0–3 bar
Output: 2–10 mA

Analogue input should be set up according to:

[512] AnIn1 Setup = User mA
[5131] AnIn1 Min = 2 mA
[5132] AnIn1 Max = 10 mA
[5134] AnIn1 Function Min = User-defined
[5135] AnIn1 VaMin = 0.000 bar
[5136] AnIn 1 Function Max = User-defined
[5137] AnIn1 VaMax = 3.000 bar

AnIn1 Operation [5138]

		5138 AnIn1 Oper Stp A Add+
Default:		Add+
Add+	0	Analogue signal is added to selected function in menu [511].
Sub-	1	Analogue signal is subtracted from selected function in menu [511].

Communication information

Modbus Instance no/DeviceNet no:	43208
Profibus slot/index	169/112
EtherCAT index (hex)	4c88
Profinet IO index	19592
Fieldbus format	UInt
Modbus format	UInt

AnIn1 Filter [5139]

If the input signal is unstable (e.g. fluctuation reference value), the filter can be used to stabilize the signal. A change of the input signal will reach 63% on AnIn1 within the set AnIn1 Filter time. After 5 times the set time, AnIn1 will have reached 100% of the input change. See Fig. 114.

	5139 AnIn1 Filt Stp A 0.1s
Default:	0.1 s
Range:	0.001 – 10.0 s

Communication information

Modbus Instance no/DeviceNet no:	43209
Profibus slot/index	169/113
EtherCAT index (hex)	4c89
Profinet IO index	19593
Fieldbus format	Long, 1=0.001 s
Modbus format	EInt

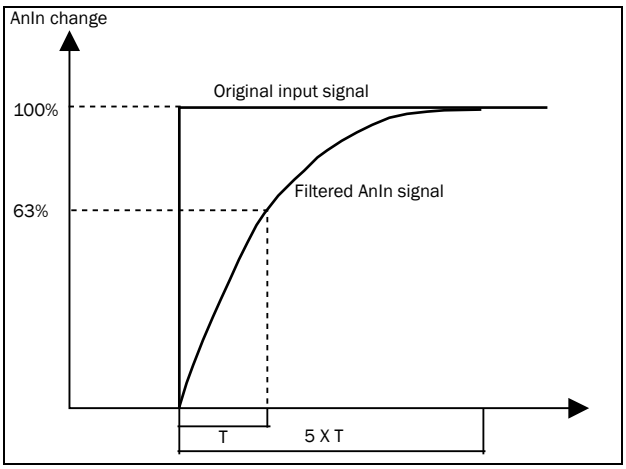


Fig. 114

AnIn1 Enable [513A]

Parameter for enable/disable analogue input selection via digital inputs (DigIn set to function AnIn Select).

	513A AnIn1 Enabl Stp **A** **On**	
Default:		On
On	0	AnIn1 is always active
!DigIn	1	AnIn1 is only active if the digital input is low.
DigIn	2	AnIn1 is only active if the digital input is high.

Communication information

Modbus Instance no/DeviceNet no:	43210
Profibus slot/index	169/114
EtherCAT index (hex)	4c8a
Profinet IO index	19594
Fieldbus format	UInt
Modbus format	UInt

AnIn2 Function [514]

Parameter for setting the function of Analogue Input 2.

Same function as “AnIn1 Fc [511]”.

514 AnIn2 Fc Stp **A** **Off**	
Default:	Off
Selection:	Same as in menu [511]

Communication information

Modbus Instance no/DeviceNet no:	43211
Profibus slot/index	169/115
EtherCAT index (hex)	4c8b
Profinet IO index	19595
Fieldbus format	UInt
Modbus format	UInt

AnIn2 Setup [515]

Parameter for setting the function of Analogue Input 2.

Same functions as “AnIn1 Setup [512]”.

515 AnIn2 Setup Stp **A** **4-20mA**	
Default:	4 – 20 mA
Dependent on	Setting of switch S2
Selection:	Same as in menu [512].

Communication information

Modbus Instance no/DeviceNet no:	43212
Profibus slot/index	169/116
EtherCAT index (hex)	4c8c
Profinet IO index	19596
Fieldbus format	UInt
Modbus format	UInt

AnIn2 Advanced [516]

Same functions and submenus as under “AnIn1 Advan [513]”.

516 AnIn2 Advan Stp **A**

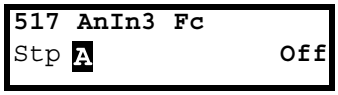
Communication information

Modbus Instance no/DeviceNet no:	43213–43220, 43542, 43552
Profibus slot/index	169/117–124, 170/191, 170/201
EtherCAT index (hex)	4c8d - 4c94, 4dd6, 4de0
Profinet IO index	19597-19604, 19926, 19936
Fieldbus format	See [5131] - [5137].
Modbus format	

AnIn3 Function [517]

Parameter for setting the function of Analogue Input 3.

Same function as “AnIn1 Fc [511]”.



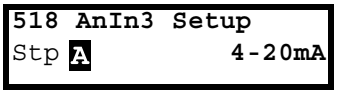
Default:	Off
Selection:	Same as in menu [511]

Communication information

Modbus Instance no/DeviceNet no:	43221
Profibus slot/index	169/125
EtherCAT index (hex)	4c95
Profinet IO index	19605
Fieldbus format	UInt
Modbus format	UInt

AnIn3 Setup [518]

Same functions as “AnIn1 Setup [512]”.



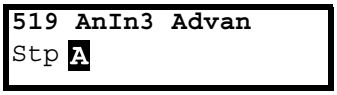
Default:	4–20 mA
Dependent on	Setting of switch S3
Selection:	Same as in menu [512].

Communication information

Modbus Instance no/DeviceNet no:	43222
Profibus slot/index	169/126
EtherCAT index (hex)	4c96
Profinet IO index	19606
Fieldbus format	UInt
Modbus format	UInt

AnIn3 Advanced [519]

Same functions and submenus as under “AnIn1 Advan [513]”.



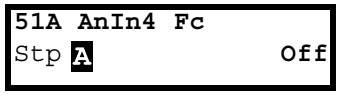
Communication information

Modbus Instance no/DeviceNet no:	43223–43230, 43543, 43553
Profibus slot/index	169/127–169/134, 170/192, 170/202
EtherCAT index (hex)	4c97 - 4c9e, 4dd7, 4de1
Profinet IO index	19607-19614, 19927, 19937
Fieldbus format	See [5131] - [5137].
Modbus format	

AnIn4 Function [51A]

Parameter for setting the function of Analogue Input 4.

Same function as “AnIn1 Fc [511].”



Default:	Off
Selection:	Same as in menu [511]

Communication information

Modbus Instance no/DeviceNet no:	43231
Profibus slot/index	169/135
EtherCAT index (hex)	4c9f
Profinet IO index	19615
Fieldbus format	UInt
Modbus format	UInt

AnIn4 Set-up [51B]

Same functions as “AnIn1 Setup [512]”.

	51B AnIn4 Setup Stp A 4-20mA
Default:	4-20 mA
Dependent on	Setting of switch S4
Selection:	Same as in menu [512].

Communication information

Modbus Instance no/DeviceNet no:	43232
Profibus slot/index	169/136
EtherCAT index (hex)	4ca0
Profinet IO index	19616
Fieldbus format	UInt
Modbus format	UInt

AnIn4 Advanced [51C]

Same functions and submenus as under “AnIn1 Advan[513]”.

51C AnIn4 Advan Stp A

Communication information

Modbus Instance no/DeviceNet no:	43233–43240, 43544, 43554
Profibus slot/index	169/137–144, 170/193, 170/203
EtherCAT index (hex)	4ca1 - 4ca8, 4dd8, 4de2
Profinet IO index	19617-19624, 19928, 19938
Fieldbus format	See [5131] - [5137].
Modbus format	

11.5.2 Digital Inputs [520]

Submenu with all the settings for the digital inputs.

NOTE: Additional inputs will become available when the I/O option boards are connected.

Digital Input 1 [521]

To select the function of the digital input.

On the standard control board there are eight digital inputs.

If the same function is programmed for more than one input that function will be activated according to “OR” logic if nothing else is stated.

		521 DigIn 1 Stp A RunL
Default:		RunL
Off	0	The input is not active.
Lim Switch+	1	AC drive ramps to stop and prevents rotation in “R” direction (clockwise), when the signal is low! NOTE: The Lim Switch+ is active low. NOTE: Activated according to “AND” logic.
Lim Switch -	2	AC drive ramps to stop and prevents rotation in “L” direction (counter clockwise) when the signal is low! NOTE: The Lim Switch- is active low. NOTE: Activated according to “AND” logic.
Ext. Trip	3	Be aware that if there is nothing connected to the input, the AC drive will trip at “External trip” immediately. NOTE: The External Trip is active low. NOTE: Activated according to “AND” logic.
Stop	4	Stop command according to the selected Stop mode in menu [33B]. **NOTE: The Stop command is active low.** NOTE: Activated according to “AND” logic.
Enable	5	Enable command. General start condition to run the AC drive. If made low during running the output of the AC drive is cut off immediately, causing the motor to coast to zero speed. **NOTE: If none of the digital inputs are programmed to “Enable”, the internal enable signal is active.** NOTE: Activated according to “AND” logic.
RunR	6	Run Right command (positive speed). The output of the AC drive will be a clockwise rotary field.
RunL	7	Run Left command (negative speed). The output of the AC drive will be a counter-clockwise rotary field.
Reset	9	Reset command. To reset a Trip condition and to enable the Autoreset function.
Preset Ctrl1	10	To select the Preset Reference.

Preset Ctrl2	11	To select the Preset Reference.
Preset Ctrl3	12	To select the Preset Reference.
MotPot Up	13	Increases the internal reference value according to the set AccMotPot time [333]. Has the same function as a “real” motor potentiometer, see Table 94.
MotPot Down	14	Decreases the internal reference value according to the set DecMotPot time [334]. See MotPot Up.
Pump1 Feedb	15	Feedback input pump1 for Pump/Fan control and informs about the status of the auxiliary connected pump/fan.
Pump2 Feedb	16	Feedback input pump 2 for Pump/Fan control and informs about the status of the auxiliary connected pump/fan.
Pump3 Feedb	17	Feedback input pump3 for Pump/Fan control and informs about the status of the auxiliary connected pump/fan.
Pump4 Feedb	18	Feedback input pump 4 for Pump/Fan control and informs about the status of the auxiliary connected pump/fan.
Pump5 Feedb	19	Feedback input pump5 for Pump/Fan control and informs about the status of the auxiliary connected pump/fan.
Pump6 Feedb	20	Feedback input pump 6 for Pump/Fan control and informs about the status of the auxiliary connected pump/fan.
Timer 1	21	Timer 1 Delay [643] will be activated on the rising edge of this signal.
Timer 2	22	Timer 2 Delay [653] will be activated on the rising edge of this signal.
Set Ctrl 1	23	Activates other parameter set. See Table 30 for selection possibilities.
Set Ctrl 2	24	Activates other parameter set. See Table 30 for selection possibilities.
Mot PreMag	25	Pre-magnetises the motor. Used for faster motor start.
Jog	26	To activate the Jog function. Gives a Run command with the set Jog speed and Direction, page 117.
Ext Mot Temp	27	Be aware that if there is nothing connected to the input, the AC drive will trip at “External Motor Temp” immediately. NOTE: The External Motor Temp is active low.
Loc/Rem	28	Activate local mode defined in [2171] and [2172].
AnIn select	29	Activate/deactivate analogue inputs defined in [513A], [516A], [519A] and [51CA]
LC Level	30	Liquid cooling low level signal. **NOTE: The Liquid Cooling Level is active low.**
Brk Ackn	31	Brake acknowledge input for Brake Fault control. Function is activated via this selection see menu [33H] page 113
Sleep	32	Possible to enter sleep mode through DigIn

NOTE: For bipol function, input RunR and RunL needs to be active and “Rotation [219]” must be set to “R+L”.

Communication information

Modbus Instance no/DeviceNet no:	43241
Profibus slot/index	169/145
EtherCAT index (hex)	4ca9
Profinet IO index	19625
Fieldbus format	UInt
Modbus format	UInt

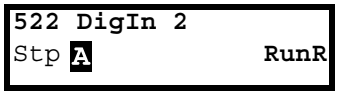
Table 30

Parameter Set	Set Ctrl 1	Set Ctrl 2
A	0	0
B	1	0
C	0	1
D	1	1

NOTE: To activate the parameter set selection, menu 241 must be set to DigIn.

Digital Input 2 [522] to Digital Input 8 [528]

Same function as “DigIn 1[521]”. Default function for DigIn 8 is Reset. For DigIn 3 to 7 the default function is Off.



Default:	RunR
Selection:	Same as in menu [521]

Communication information

Modbus Instance no/DeviceNet no:	43242 – 43248
Profibus slot/index	169/146 – 169/152
EtherCAT index (hex)	4caa - 4cb0
Profinet IO index	19626 - 19632
Fieldbus format	UInt
Modbus format	UInt

Additional digital inputs [529] to [52H]

Additional digital inputs with I/O option board installed, “B1 DigIn 1 [529]” - “B3 DigIn 3 [52H]”. B stands for board and 1 to 3 is the number of the board which is related to the position of the I/O option board on the option mounting plate. The functions and selections are the same as “DigIn 1 [521]”.

Communication information

Modbus Instance no/DeviceNet no:	43501–43509
Profibus slot/index	170/150–170/158
EtherCAT index (hex)	4dad - 4db5
Profinet IO index	19885 - 19893
Fieldbus format	UInt
Modbus format	UInt

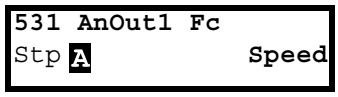
11.5.3 Analogue Outputs [530]

Submenu with all settings for the analogue outputs. Selections can be made from application and AC drive values, in order to visualize actual status. Analogue outputs can also be used as a mirror of the analogue input. Such a signal can be used as:

- a reference signal for the next AC drive in a Master/Slave configuration (see Fig. 115).
- a feedback acknowledgement of the received analogue reference value.

AnOut1 Function [531]

Sets the function for the Analogue Output 1. Scale and range are defined by AnOut1 Advanced settings [533].



Default:		Speed
Process Val	0	Actual process value according to Process feedback signal.
Speed	1	Actual speed.
Torque	2	Actual torque.
Process Ref	3	Actual process reference value.
Shaft Power	4	Actual shaft power.
Frequency	5	Actual frequency.
Current	6	Actual current.
El power	7	Actual electrical power.
Output volt	8	Actual output voltage.
DC-voltage	9	Actual DC link voltage.
AnIn1	10	Mirror of received signal value on AnIn1.
AnIn2	11	Mirror of received signal value on AnIn2.
AnIn3	12	Mirror of received signal value on AnIn3.
AnIn4	13	Mirror of received signal value on AnIn4.
Speed Ref	14	Actual internal speed reference Value after ramp and V/Hz.
Torque Ref	15	Actual torque reference value (=0 in V/Hz mode)

NOTE: When selections AnIn1, AnIn2 .... AnIn4 is selected, the setup of the AnOut (menu [532] or [535]) has to be set to 0-10V or 0-20mA. When the AnOut Setup is set to e.g. 4-20mA, the mirroring is not working correct.

Communication information

Modbus Instance no/DeviceNet no:	43251
Profibus slot/index	169/155
EtherCAT index (hex)	4cb3
Profinet IO index	19635
Fieldbus format	UInt
Modbus format	UInt

AnOut 1 Setup [532]

Preset scaling and offset of the output configuration.

		532 AnOut1 Setup Stp A 4-20mA
Default:		4-20mA
4–20mA	0	The current output has a fixed threshold (Live Zero) of 4 mA and controls the full range for the output signal. See Fig. 112.
0–20mA	1	Normal full current scale configuration of the output that controls the full range for the output signal. See Fig. 111.
User mA	2	The scale of the current controlled output that controls the full range for the output signal. Can be defined by the advanced AnOut Min and AnOut Max menus.
User Bipol mA	3	Sets the output for a bipolar current output, where the scale controls the range for the output signal. Scale can be defined in advanced menu AnOut Bipol.
0-10V	4	Normal full voltage scale configuration of the output that controls the full range for the output signal. See Fig. 111.
2–10V	5	The voltage output has a fixed threshold (Live Zero) of 2 V and controls the full range for the output signal. See Fig. 112.
User V	6	The scale of the voltage controlled output that controls the full range for the output signal. Can be defined by the advanced AnOut Min and AnOut Max menus.
User Bipol V	7	Sets the output for a bipolar voltage output, where the scale controls the range for the output signal. Scale can be defined in advanced menu AnOut Bipol.

Communication information

Modbus Instance no/DeviceNet no:	43252
Profibus slot/index	169/156
EtherCAT index (hex)	4cb4
Profinet IO index	19636
Fieldbus format	UInt
Modbus format	UInt

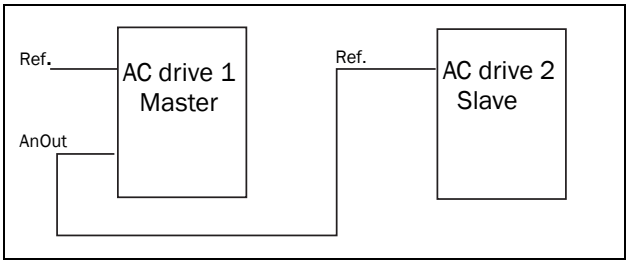


Fig. 115

AnOut1 Advanced [533]

With the functions in the AnOut1 Advanced menu, the output can be completely defined according to the application needs. The menus will automatically be adapted to “mA” or “V”, according to the selection in “AnOut1 Setup [532]”.

533 AnOut 1 Adv
Stp A

AnOut1 Min [5331]

This parameter is automatically displayed if User mA or User V is selected in menu “AnOut 1 Setup [532]”. The menu will automatically adapt to current or voltage setting according to the selected setup. Only visible if [532] = User mA/V.

	5331 AnOut 1 Min Stp A 4mA
Default:	4 mA
Range:	0.00 – 20.00 mA, 0 – 10.00 V

Communication information

Modbus Instance no/DeviceNet no:	43253
Profibus slot/index	169/157
EtherCAT index (hex)	4cb5
Profinet IO index	19637
Fieldbus format	Long, 1=0.01 V, 0.01 mA
Modbus format	EInt

AnOut1 Max [5332]

This parameter is automatically displayed if User mA or User V is selected in menu "AnOut1 Setup [532]". The menu will automatically adapt to current or voltage setting a ccording to the selected setup. Only visible if [532] = User mA/V.

	5332 AnOut 1 Max Stp A 20.0mA
Default:	20.00 mA
Range:	0.00–20.00 mA, 0–10.00 V

Communication information

Modbus Instance no/DeviceNet no:	43254
Profibus slot/index	169/158
EtherCAT index (hex)	4cb6
Profinet IO index	19638
Fieldbus format	Long, 1=0.01 V, 0.01 mA
Modbus format	EInt

AnOut1 Bipol [5333]

Automatically displayed if User Bipol mA or User Bipol V is selected in menu AnOut1 Setup. The menu will automatically show mA or V range according to the selected function. The range is set by changing the positive maximum value; the negative value is automatically adapted accordingly. Only visible if [512] = User Bipol mA/V.

	5333 AnOut1Bipol Stp A -10.00-10.00V
Default:	-10.00–10.00 V
Range:	-10.00–10.00 V, -20.0–20.0 mA

Communication information

Modbus Instance no/DeviceNet no:	43255
Profibus slot/index	169/159
EtherCAT index (hex)	4cb7
Profinet IO index	19639
Fieldbus format	Long, 1=0.01 V, 0.01 mA
Modbus format	EInt

AnOut1 Function Min [5334]

With AnOut1 Function Min the physical minimum value is scaled to selected presentation. The default scaling is dependent of the selected function of "AnOut1 [531]".

		5334 AnOut1FCMin Stp A Min
Default:		Min
Min	0	Min value
Max	1	Max value
User-defined	2	Define user value in menu [5335]

Table 31 shows corresponding values for the min and max selections depending on the function of the analogue output [531].

Table 31

AnOut Function	Min Value	Max Value
Process Value	Process Min [324]	Process Max [325]
Speed	Min Speed [341]	Max Speed [343]
Torque	0%	Max Torque [351]
Process Ref	Process Min [324]	Process Max [325]
Shaft Power	0%	Motor Power [223]
Frequency	Fmin *	Motor Frequency [222]
Current	0 A	Motor Current [224]
El Power	0 W	Motor Power [223]
Output Voltage	0 V	Motor Voltage [221]
DC voltage	0 V	1000 V
AnIn1	AnIn1 Function Min	AnIn1 Function Max
AnIn2	AnIn2 Function Min	AnIn2 Function Max
AnIn3	AnIn3 Function Min	AnIn3 Function Max
AnIn4	AnIn4 Function Min	AnIn4 Function Max

*) Fmin is dependent on the set value in menu "Minimum Speed [341]".

Communication information

Modbus Instance no/DeviceNet no:	43256
Profibus slot/index	169/160
EtherCAT index (hex)	4cb8
Profinet IO index	19640
Fieldbus format	UInt
Modbus format	UInt

Example

Set the AnOut function for Motorfrequency to 0Hz, set AnOut functionMin [5334] to “User-defined” and AnOut1 VaMin[5335] = 0.0. This results in an anlogue output signal from 0/4 mA to 20mA: 0Hz to Fmot.
This principle is valid for all Min to Max settings.

AnOut1 Function Value Min [5335]

With AnOut1 Function VaMin you define a user-defined value for the signal. Only visible when user-defined is selected in menu [5334].

	5335 AnOut1VaMin Stp A 0.000
Default:	0.000
Range:	-10000.000–10000.000

Communication information

Modbus Instance no/DeviceNet no:	43545
Profibus slot/index	170/194
EtherCAT index (hex)	4dd9
Profinet IO index	19929
Fieldbus format	Long, 1=1 rpm, 1 %, 1W, 0.1 Hz, 0.1 V, 0.1 A or 0.001 via process value [322]
Modbus format	EInt

AnOut1 Function Max [5336]

With AnOut1 Function Min the physical minimum value is scaled to selected presentation. The default scaling is dependent on the selected function of AnOut1 [531]. See Table 31.

		5336 AnOut1FCMax Stp A Max
Default:		Max
Min	0	Min value
Max	1	Max value
User defined	2	Define user value in menu [5337]

Communication information

Modbus Instance no/DeviceNet no:	43257
Profibus slot/index	169/161
EtherCAT index (hex)	4cb9
Profinet IO index	19641
Fieldbus format	UInt
Modbus format	UInt

NOTE: It is possible to set AnOut1 up as an inverted output signal by setting AnOut1 Min > AnOut1 Max. See Fig. 113, page 146.

AnOut1 Function Value Max [5337]

With AnOut1 Function VaMax you define a user-defined value for the signal. Only visible when user-defined is selected in menu [5334].

	5337 AnOut1VaMax Stp A 0.000
Default:	0.000
Range:	-10000.000–10000.000

Communication information

Modbus Instance no/DeviceNet no:	43555
Profibus slot/index	170/204
EtherCAT index (hex)	4de3
Profinet IO index	19939
Fieldbus format	Long, 1=1 rpm, 1 %, 1W, 0.1 Hz, 0.1 V, 0.1 A or 0.001 via process value [322]
Modbus format	EInt

AnOut2 Function [534]

Sets the function for the Analogue Output 2.

	534 AnOut2 Fc Stp A Torque
Default:	Torque
Selection:	Same as in menu [531]

Communication information

Modbus Instance no/DeviceNet no:	43261
Profibus slot/index	169/165
EtherCAT index (hex)	4cbd
Profinet IO index	19645
Fieldbus format	UInt
Modbus format	UInt

AnOut2 Setup [535]

Preset scaling and offset of the output configuration for analogue output 2.

	535 AnOut2 Setup Stp A 4-20mA
Default:	4-20mA
Selection:	Same as in menu [532]

Communication information

Modbus Instance no/DeviceNet no:	43262
Profibus slot/index	169/166
EtherCAT index (hex)	4cbe
Profinet IO index	19646
Fieldbus format	UInt
Modbus format	UInt

AnOut2 Advanced [536]

Same functions and submenus as under AnOut1 Advanced [533].

536 AnOut2 Advan Stp A

Communication information

Modbus Instance no/DeviceNet no:	43263–43267, 43546, 43556
Profibus slot/index	169/167–169/171, 170/195, 170/205
EtherCAT index (hex)	4cbf - 4cc3, 4dda, 4de4
Profinet IO index	19647 - 19651, 19930, 19940
Fieldbus format	See [533]- [5367].
Modbus format	

11.5.4 Digital Outputs [540]

Submenu with all the settings for the digital outputs.

Digital Out 1 [541]

Sets the function for the digital output 1.

NOTE: The definitions described here are valid for the active output condition.

		541 DigOut 1 Stp A Ready
Default:		Ready
Off	0	Output is not active and constantly low.
On	1	Output is made constantly high, i.e. for checking circuits and trouble shooting.
Run	2	Running. The AC drive output is active = produces current for the motor.
Stop	3	The AC drive output is not active.
0Hz	4	The output frequency=0±0.1Hz when in Run condition.
Acc/Dec	5	The speed is increasing or decreasing along the acc. ramp dec. ramp.
At Process	6	The output = Reference.
At Max spd	7	The frequency is limited by the Maximum Speed.
No Trip	8	No Trip condition active.
Trip	9	A Trip condition is active.
AutoRst Trip	10	Autoreset trip condition active.
Limit	11	A Limit condition is active.
Warning	12	A Warning condition is active.
Ready	13	The AC drive is ready for operation. This means that the AC drive is powered up and healthy.
T= T_{lim}	14	The torque is limited by the torque limit function.
I>I_{nom}	15	The output current is higher than the motor nominal current [224], reduced according to Motor ventilation [228], see Fig. 78, page 81.
Brake	16	The output is used to control a mechanical brake.
SgnI<Offset	17	One of the AnIn input signals is lower than 75% of the threshold level.
Alarm	18	The max or min alarm level has been reached.
Pre-Alarm	19	The max or min pre alarm level has been reached.

Max Alarm	20	The max alarm level has been reached.
Max PreAlarm	21	The max pre alarm level has been reached.
Min Alarm	22	The min alarm level has been reached.
Min PreAlarm	23	The min pre alarm Level has been reached.
LY	24	Logic output Y.
!LY	25	Logic output Y inverted.
LZ	26	Logic output Z.
!LZ	27	Logic output Z inverted.
CA 1	28	Analogue comparator 1 output.
!A1	29	Analogue comp 1 inverted output.
CA 2	30	Analogue comparator 2 output.
!A2	31	Analogue comp 2 inverted output.
CD 1	32	Digital comparator 1 output.
!D1	33	Digital comp 1 inverted output.
CD 2	34	Digital comparator 2 output.
!D2	35	Digital comp 2 inverted output.
Operation	36	Run command is active or AC drive running. The signal can be used to control the mains contactor if the AC drive is equipped with Standby supply option.
T1Q	37	Timer1 output
!T1Q	38	Timer1 inverted output
T2Q	39	Timer2 output
!T2Q	40	Timer2 inverted output
Sleeping	41	Sleeping function activated
Crane Deviat	42	Tripped on deviation
PumpSlave1	43	Activate pump slave 1
PumpSlave2	44	Activate pump slave 2
PumpSlave3	45	Activate pump slave 3
PumpSlave4	46	Activate pump slave 4
PumpSlave5	47	Activate pump slave 5
PumpSlave6	48	Activate pump slave 6
PumpMaster1	49	Activate pump master 1
PumpMaster2	50	Activate pump master 2
PumpMaster3	51	Activate pump master 3
PumpMaster4	52	Activate pump master 4
PumpMaster5	53	Activate pump master 5
PumpMaster6	54	Activate pump master 6
All Pumps	55	All pumps are running
Only Master	56	Only the master is running
Loc/Rem	57	Local/Rem function is active

Standby	58	Standby supply option is active
PTC Trip	59	Trip when function is active
PT100 Trip	60	Trip when function is active
Overvolt	61	Overvoltage due to high main voltage
Overvolt G	62	Overvoltage due to generation mode
Overvolt D	63	Overvoltage due to deceleration
Acc	64	Acceleration along the acc. ramp
Dec	65	Deceleration along the dec. ramp
I^2t	66	I^2t limit protection active
V-Limit	67	Overvoltage limit function active
C-Limit	68	Overcurrent limit function active
Overtemp	69	Over temperature warning
Low voltage	70	Low voltage warning
DigIn 1	71	Digital input 1
DigIn 2	72	Digital input 2
DigIn 3	73	Digital input 3
DigIn 4	74	Digital input 4
DigIn 5	75	Digital input 5
DigIn 6	76	Digital input 6
DigIn 7	77	Digital input 7
DigIn 8	78	Digital input 8
ManRst Trip	79	Active trip that needs to be manually reset
Com Error	80	Serial communication lost
External Fan	81	The AC drive requires external cooling. Internal fans are active.
LC Pump	82	Activate liquid cooling pump
LC HE Fan	83	Activate liquid cooling heat exchanger fan
LC Level	84	Liquid cooling low level signal active
Run Right	85	Positive speed (>0.5%), i.e. forward/ clockwise direction.
Run Left	86	Negative speed (<0.5%), i.e. reverse counter clockwise direction.
Com Active	87	Fieldbus communication active.
Brk Fault	88	Tripped on brake fault (not released)
BrkNotEngage	89	Warning and continued operation (keep torque) due to Brake not engaged during stop.
Option	90	Failure occurred in built-in option board.
CA3	91	Analogue comparator 3 output
!A3	92	Analogue comparator 3 inverted output
CA4	93	Analogue comparator 4 output
!A4	94	Analogue comparator 4 inverted output

CD3	95	Digital comparator 3 output
!D3	96	Digital comparator 3 inverted output
CD4	97	Digital comparator 4 output
!D4	98	Digital comparator 4 inverted output
C1Q	99	Counter 1 output
!C1Q	100	Counter 1 inverted output
C2Q	101	Counter 2 output
!C2Q	102	Counter 2 Inverted output
Enc Error	103	Tripped on Encoder error
Crane Comm	104	CRIO Communication lost
Spin Start	105	Spin start is active

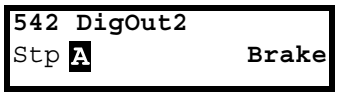
Communication information

Modbus Instance no/DeviceNet no:	43271
Profibus slot/index	169/175
EtherCAT index (hex)	4cc7
Profinet IO index	19655
Fieldbus format	UInt
Modbus format	UInt

Digital Out 2 [542]

NOTE: The definitions described here are valid for the active output condition.

Sets the function for the digital output 2.



Default:	Brake
Selection:	Same as in menu [541]

Communication information

Modbus Instance no/DeviceNet no:	43272
Profibus slot/index	169/176
EtherCAT index (hex)	4cc8
Profinet IO index	19656
Fieldbus format	UInt
Modbus format	UInt

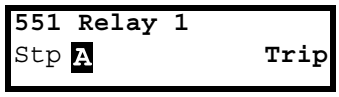
11.5.5 Relays [550]

Submenu with all the settings for the relay outputs. The relay mode selection makes it possible to establish a "fail safe" relay operation by using the normal closed contact to function as the normal open contact.

NOTE: Additional relays will become available when I/O option boards are connected. Maximum 3 boards with 3 relays each.

Relay 1 [551]

Sets the function for the relay output 1. Same function as digital output 1 [541] can be selected.



Default:	Trip
Selection:	Same as in menu [541]

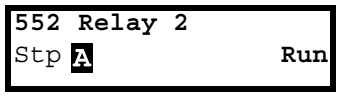
Communication information

Modbus Instance no/DeviceNet no:	43273
Profibus slot/index	169/177
EtherCAT index (hex)	4cc9
Profinet IO index	19657
Fieldbus format	UInt
Modbus format	UInt

Relay 2 [552]

NOTE: The definitions described here are valid for the active output condition.

Sets the function for the relay output 2.



Default:	Run
Selection:	Same as in menu [541]

Communication information

Modbus Instance no/DeviceNet no:	43274
Profibus slot/index	169/178
EtherCAT index (hex)	4cca
Profinet IO index	19658
Fieldbus format	UInt
Modbus format	UInt

Relay 3 [553]

Sets the function for the relay output 3.

	553 Relay 3 Stp A Off
Default:	Off
Selection:	Same as in menu [541]

Communication information

Modbus Instance no/DeviceNet no:	43275
Profibus slot/index	169/179
EtherCAT index (hex)	4ccb
Profinet IO index	19659
Fieldbus format	UInt
Modbus format	UInt

Board Relay [554] to [55C]

These additional relays are only visible if an I/O option board is fitted in slot 1, 2, or 3. The outputs are named B1 Relay 1–3, B2 Relay 1–3 and B3 Relay 1–3. B stands for board and 1–3 is the number of the board which is related to the position of the I/O option board on the option mounting plate.

NOTE: Visible only if optional board is detected or if any input/output is activated.

Communication information

Modbus Instance no/DeviceNet no:	43511–43519
Profibus slot/index	170/160–170/168
EtherCAT index (hex)	4db7 - 4dbf
Profinet IO index	19895 - 19903
Fieldbus format	UInt
Modbus format	UInt

Relay Advanced [55D]

This function makes it possible to ensure that the relay will also be closed when the AC drive is malfunctioning or powered down.

Example

A process always requires a certain minimum flow. To control the required number of pumps by the relay mode NC, the e.g. the pumps can be controlled normally by the pump control, but are also activated when the AC drive is tripped or powered down.

55D Relay Adv Stp A

Relay 1 Mode [55D1]

		55D1 Relay1 Mode Stp A N.O
Default:		N.O
N.O	0	The normal open contact of the relay will be activated when the function is active.
N.C	1	The normally closed contact of the relay will act as a normal open contact. The contact will be opened when function is not active and closed when function is active.

Communication information

Modbus Instance no/DeviceNet no:	43276
Profibus slot/index	169/180
EtherCAT index (hex)	4ccc
Profinet IO index	19660
Fieldbus format	UInt
Modbus format	UInt

Relay Modes [55D2] to [55DC]

Same function as for “Relay 1 Mode [55D1]”.

Communication information

Modbus Instance no/DeviceNet no:	43277, 43278, 43521–43529
Profibus slot/index	169/181, 169/182, 170/170–170/178
EtherCAT index (hex)	4ccd, 4cce, 4dc1 - 4dc9
Profinet IO index	19661, 19662, 19905 - 19913
Fieldbus format	UInt
Modbus format	UInt

11.5.6 Virtual Connections [560]

Functions to enable eight internal connections of comparator, timer and digital signals, without occupying physical digital in/outputs. Virtual connections are used to wireless connection of a digital output function to a digital input function. Available signals and control functions can be used to create your own specific functions.

Example of start delay

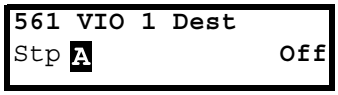
The motor will start in RunR 10 seconds after DigIn1 gets high. DigIn1 has a time delay of 10 s.

Menu	Parameter	Setting
[521]	DigIn1	Timer 1
[561]	VIO 1 Dest	RunR
[562]	VIO 1 Source	T1Q
[641]	Timer1 Trig	DigIn 1
[642]	Timer1 Mode	Delay
[643]	Timer1 Delay	0:00:10

NOTE: When a digital input and a virtual destination are set to the same function, this function will act as an OR logic function.

Virtual Connection 1 Destination [561]

With this function the destination of the virtual connection is established. When a function can be controlled by several sources, e.g. VC destination or Digital Input, the function will be controlled in conformity with "OR logic". See DigIn for descriptions of the different selections.

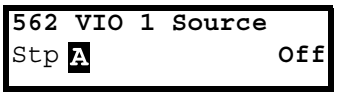
	
Default:	Off
Selection:	Same selections as for Digital Input 1, menu [521].

Communication information

Modbus Instance no/DeviceNet no:	43281
Profibus slot/index	169/185
EtherCAT index (hex)	4cd1
Profinet IO index	19665
Fieldbus format	UInt
Modbus format	UInt

Virtual Connection 1 Source [562]

With this function the source of the virtual connection is defined. See DigOut 1 for description of the different selections.

	
Default:	Off
Selection:	Same as for menu [541].

Communication information

Modbus Instance no/DeviceNet no:	43282
Profibus slot/index	169/186
EtherCAT index (hex)	4cd2
Profinet IO index	19666
Fieldbus format	UInt
Modbus format	UInt

Virtual Connections 2-8 [563] to [56G]

Same function as virtual connection 1 [561] and [562].

Communication information for virtual connections 2-8 Destination.

Modbus Instance no/DeviceNet no:	43283, 43285, 43287, 43289, 43291, 43293, 43295
Profibus slot/index	169/ 187, 189, 191, 193, 195, 197, 199
EtherCAT index (hex)	4cd3, 4cd5, 4cd17, 4cd9, 4cdb, 4cdd, 4cdf
Profinet IO index	19667, 19669, 19671, 19673, 19675, 19677, 19679
Fieldbus format	UInt
Modbus format	UInt

Communication information for virtual connections 2-8 Source.

Modbus Instance no/DeviceNet no:	43284, 43286, 43288, 43290, 43292, 43294, 43296
Profibus slot/index	169/ 188, 190, 192, 194, 196, 198, 200
EtherCAT index (hex)	4cd4, 4cd6, 4cd8, 4cda, 4cdc, 4cde, 4ce0
Profinet IO index	19668, 19670, 19672, 19674, 19676, 19678, 19680
Fieldbus format	UInt
Modbus format	UInt

11.6 Logical Functions and Timers [600]

With the Comparators, Logic Functions and Timers, conditional signals can be programmed for control or signalling features. This gives you the ability to compare different signals and values in order to generate monitoring/ controlling features.

11.6.1 Comparators [610]

The comparators available make it possible to monitor different internal signals and values, and visualize via digital relay outputs, when a specific value or status is reached or established.

Analogue comparators [611] - [614]

There are 4 analogue comparators that compare any available analogue value (including the analogue reference inputs) with two adjustable levels. The two levels available are Level HI and Level LO. There are two analogue comparator types selectable, an analogue comparator with hysteresis and an analogue window comparator.
The analogue hysteresis type comparator uses the two available levels to create a hysteresis for the comparator between setting and resetting the output. This function gives a clear difference in switching levels, which lets the process adapt until a certain action is started. With such a hysteresis, even an unstable analogue signal can be monitored without getting a nervous comparator output signal. Another feature is the possibility to get a fixed indication that a certain level has been passed. The comparator can latch by setting Level LO to a higher value than Level HI.

The analogue window comparator uses the two available levels to define the window in which the analogue value should be within for setting the comparator output.
The input analogue value of the comparator can also be selected as bipolar, i.e. treated as signed value or unipolar, i.e. treated as absolute value.

Refer to Fig. 120, page 167 where these functions are illustrated.

Digital comparators [615]

There are 4 digital comparators that compare any available digital signal.

The output signals of these comparators can be logically tied together to yield a logical output signal.

All the output signals can be programmed to the digital or relay outputs or used as a source for the virtual connections [560].

CA1 Setup [611]

Analogue comparator 1, parameter group.

Analogue Comparator 1, Value [6111]

Selection of the analogue value for Analogue Comparator 1 (CA1).

Analogue comparator 1 compares the selectable analogue value in menu [6111] with the constant Level HI in menu [6112] and constant Level LO in menu [6113]. If Bipolar type[6115] input signal is selected then the comparison is made with sign otherwise if unipolar selected then comparison is made with absolute values.

For Hysteresis comparator type [6114], when the value exceeds the upper limit level high, the output signal CA1 is set high and !A1 low, see Fig. 116. When the value decreases below the lower limit, the output signal CA1 is set low and !A1 high.

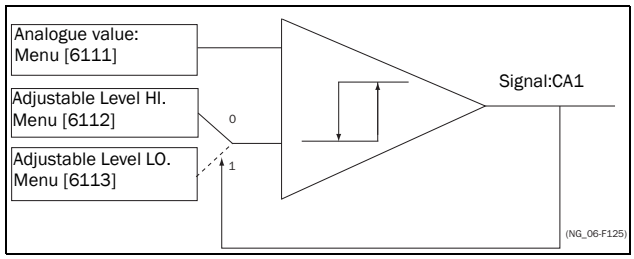


Fig. 116 Analogue comparator type Hysteresiss

For Window comparator type [6114], when the value is between the lower and upper levels, the output signal value CA1 is set high and !A1 low, see Fig. 119, page 165. When the value is outside the band of lower and upper levels, the output CA1 is set low and !A1 high.

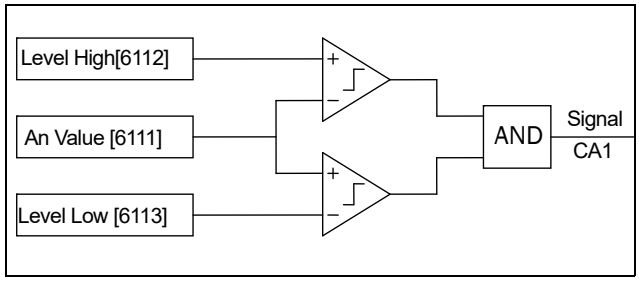


Fig. 117 Analogue comparator type "Window"

The output signal can be programmed as a virtual connection source and to the digital or relay outputs.

		6111 CA1 Value Stp A Speed
Default:		Speed
Process Val	0	Set by Process settings [321] and [322]
Speed	1	rpm
Torque	2	%
Shaft Power	3	kW
El Power	4	kW
Current	5	A
Output Volt	6	V
Frequency	7	Hz
DC Voltage	8	V
Heatsink Tmp	9	°C
PT100_1	10	°C
PT100_2	11	°C
PT100_3	12	°C
Energy	13	kWh
Run Time	14	h
Mains Time	15	h
AnIn1	16	%
AnIn2	17	%
AnIn3	18	%
AnIn4	19	%
Process Ref	20	Set by Process settings [321] and [322]
Process Err	21	

Communication information

Modbus Instance no/DeviceNet no:	43401
Profibus slot/index	170/50
EtherCAT index (hex)	4d49
Profinet IO index	19758
Fieldbus format	UInt
Modbus format	UInt

Example

Create automatic RUN/STOP signal via the analogue reference signal. Analogue current reference signal, 4-20 mA, is connected to Analogue Input 1. “AnIn1 Setup”, menu [512] = 4-20 mA and the threshold is 4 mA. Full scale (100%) input signal on “AnIn 1” = 20 mA. When the reference signal on “AnIn1” increases 80% of the threshold (4 mA x 0.8 = 3.2 mA), the AC drive will be set in RUN mode. When the signal on “AnIn1” goes below 60% of the threshold (4 mA x 0.6 = 2.4 mA) the AC drive is set to STOP mode. The output of CA1 is used as a virtual connection source that controls the virtual connection destination RUN.

Menu	Function	Setting
511	AnIn1 Function	Process reference
512	AnIn1 Set-up	4-20 mA, threshold is 4 mA
341	Min Speed	0
343	Max Speed	1500
6111	CA1 Value	AnIn1
6112	CA1 Level HI	16% (3.2mA/20mA x 100%)
6113	CA1 Level LO	12% (2.4mA/20mA x 100%)
6114	CA1 Type	Hysteresis
561	VIO 1 Dest	RunR
562	VIO 1 Source	CA1
215	Run/Stp Ctrl	Remote

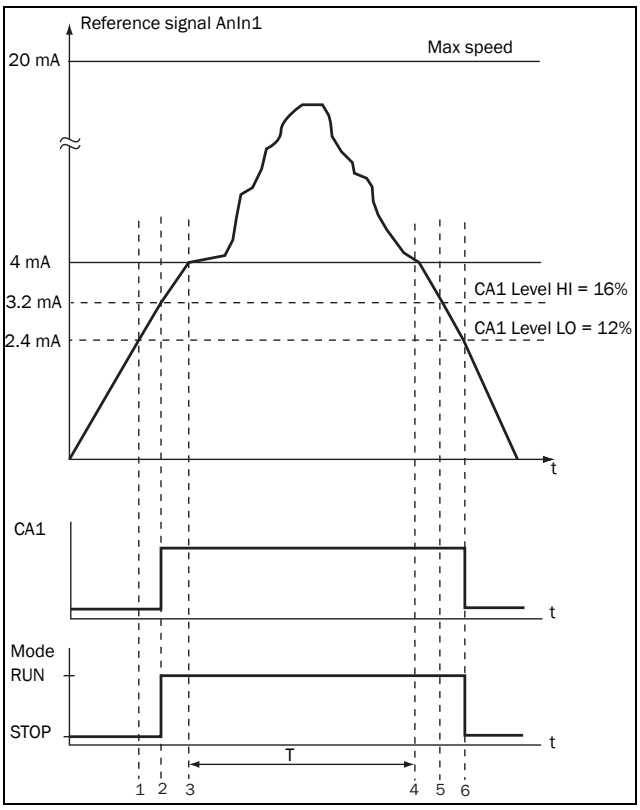


Fig. 118

No.	Description
1	The reference signal passes the Level LO value from below (positive edge), the comparator CA1 output stays low, mode=RUN.
2	The reference signal passes the Level HI value from below (positive edge), the comparator CA1 output is set high, mode=RUN.
3	The reference signal passes the threshold level of 4 mA, the motor speed will now follow the reference signal.
T	During this period the motor speed will follow the reference signal.
4	The reference signal reaches the threshold level, motor speed is 0 rpm, mode = RUN.
5	The reference signal passes the Level HI value from above (negative edge), the comparator CA1 output stays high, mode =RUN.
6	The reference signal passes the Level LO value from above (negative edge), the comparator CA1 output=STOP.

Analogue Comparator 1, Level High [6112]

Sets the analogue comparator high level, with range according to the selected value in menu [6111].

	6112 CA1 Level HI Stp A 300rpm
Default:	300 rpm
Range:	See min/max in table below.

Min/Max setting range for menu [6112]

Mode	Min	Max	Decimals
Process Val	Set by Process settings [321] and [322]		3
Speed, rpm	0	Max speed	0
Torque, %	0	Max torque	0
Shaft Power, kW	0	Motor P_nx4	0
El Power, kW	0	Motor P_nx4	0
Current, A	0	Motor I_nx4	1
Output volt, V	0	1000	1
Frequency, Hz	0	400	1
DC voltage, V	0	1250	1
Heatsink temp, °C	0	100	1
PT 100_1_2_3, °C	-100	300	1
Energy, kWh	0	1000000	0
Run time, h	0	65535	0
Mains time, h	0	65535	0
AnIn 1-4%	0	100	0
Process Ref	Set by Process settings [321] and [322]		3
Process Err	Set by Process settings [321] and [322]		3

NOTE: If Bipolar selected [6115] then Min value is equal to -Max in the table.

Communication information

Modbus Instance no/DeviceNet no:	43402
Profibus slot/index	170/51
EtherCAT index (hex)	4d4a
Profinet IO index	19786
Fieldbus format	Long, 1=1 W, 0.1 A, 0.1 V, 0.1 Hz, 0.1°C, 1 kWh, 1H, 1%, 1 rpm or 0.001 via process value
Modbus format	EInt

Example

This example describes, both for hysteresis and window type comparator, the normal use of the constant level high and low.

Menu	Function	Setting
343	Max Speed	1500
6111	CA1 Value	Speed
6112	CA1 Level HI	300 rpm
6113	CA1 Level LO	200 rpm
6114	CA1 Type	Hysteresis
561	VC1 Dest	Timer 1
562	VC1 Source	CA1

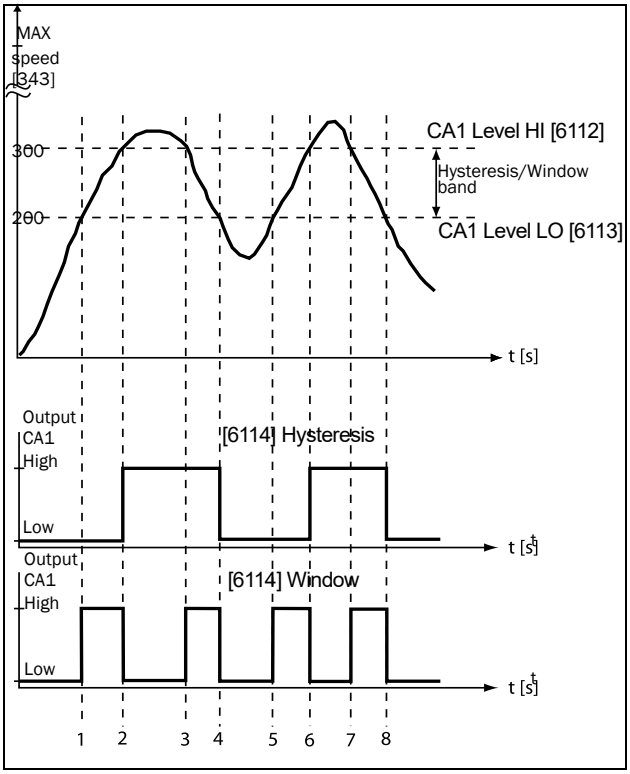


Fig. 119

Table 32 Comments to Fig. 119 regarding Hysteresis selection.

No.	Description	Hysteresis
1	The reference signal passes the Level LO value from below (positive edge), the comparator CA1 does not change, output stays low.	—
2	The reference signal passes the Level HI value from below (positive edge), the comparator CA1 output is set high.	↑
3	The reference signal passes the Level HI value from above (negative edge), the comparator CA1 does not change, output stays high.	—
4	The reference signal passes the Level LO value from above (negative edge), the comparator CA1 is reset, output is set low.	↓
5	The reference signal passes the Level LO value from below (positive edge), the comparator CA1 does not change, output stays low.	—
6	The reference signal passes the Level HI value from below (positive edge), the comparator CA1 output is set high.	↑
7	The reference signal passes the Level HI value from above (negative edge), the comparator CA1 does not change, output stays high.	—
8	The reference signal passes the Level LO value from above (negative edge), the comparator CA1 is reset, output is set low.	↓

Table 33 Comments to Fig. 119 regarding Window selection.

No.	Description	Window
1	The reference signal passes the Level LO value from below (signal inside Window band), the comparator CA1 output is set high.	
2	The reference signal passes the Level LO value from above (signal outside Window band), the comparator CA1 is reset, output is set low.	
3	The reference signal passes the Level HI value from above (signal inside Window band), the comparator CA1 output is set high.	
4	The reference signal passes the Level LO value from above (signal outside Window band), the comparator CA1 is reset, output is set low.	
5	The reference signal passes the Level LO value from below (signal inside Window band), the comparator CA1 output is set high.	
6	The reference signal passes the Level HI value from below (signal outside Window band),the comparator CA1 is reset, output is set low.	
7	The reference signal passes the Level HI value from above (signal inside Window band), the comparator CA1 output is set high.	
8	The reference signal passes the Level LO value from above (signal outside Window band), the comparator CA1 is reset, output is set low.	

Analogue Comparator 1, Level Low [6113]

Sets the analogue comparator low level, with unit and range according to the selected value in menu [6111].

	6113 CA1 Level LO Stp A 200rpm
Default:	200 rpm
Range:	Range as [6112].

Communication information

Modbus Instance no/DeviceNet no:	43403
Profibus slot/index	170/52
EtherCAT index (hex)	4d4b
Profinet IO index	19787
Fieldbus format	Long, 1=1 W, 0.1 A, 0.1 V, 0.1 Hz, 0.1°C, 1 kWh, 1H, 1%, 1 rpm or 0.001 via process value
Modbus format	EInt

Analogue Comparator 1, Type [6114]

Selects the analogue comparator type, i.e. Hysteresis or Window type. See Fig. 120 and Fig. 121.

		6114 CA1 Type Stp A Hysteresis
Default:		Hysteresis
Hysteresis	0	Hysteresis type comparator
Window	1	Window type comparator

Communication information

Modbus Instance no/DeviceNet no:	43481
Profibus slot/index	170/130
EtherCAT index (hex)	4d99
Profinet IO index	19865
Fieldbus format	UInt
Modbus format	UInt

Analogue Comparator 1, Polarity[6115]

Selects how the selected value in [6111] should be handled prior to the analogue comparator , i.e. as absolute value or handled with sign. See Fig. 120

		6115 CA1 Polar Stp A Unipolar
Default:		Unipolar
Unipolar	0	Absolute value of [6111] used
Bipolar	1	Signed value of [6111] used

Communication information

Modbus Instance no/DeviceNet no:	43486
Profibus slot/index	170/135
EtherCAT index (hex)	4d9e
Profinet IO index	19870
Fieldbus format	UInt
Modbus format	UInt

Example

See Fig. 120 and Fig. 121 for different principle functionality of comparator features 6114 and 6115.

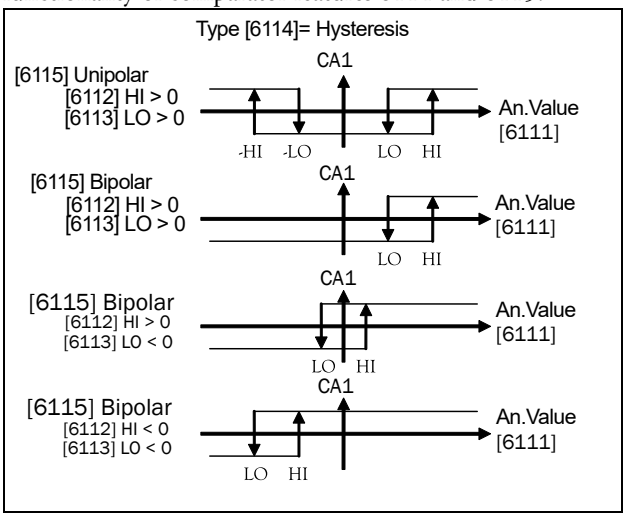


Fig. 120 Principle functionality of comparator features for "Type [6114] = Hysteresis " and "Polar [6115]".

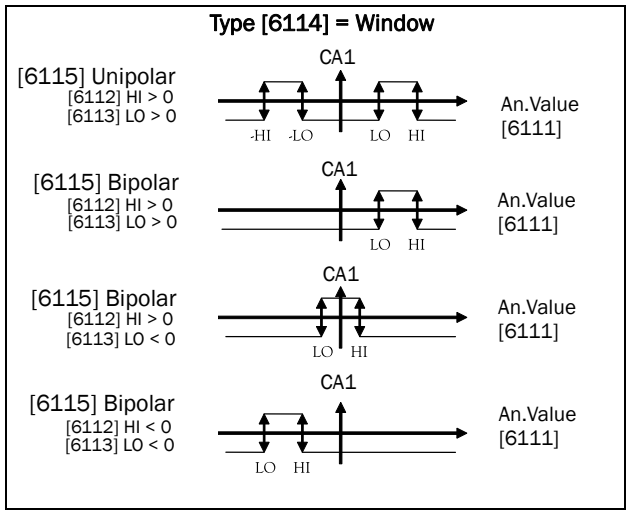


Fig. 121 Principle functionality of comparator features for "Type [6114] =Window " and "Polar [6115]".

NOTE: When "Unipolar " is selected, absolute value of signal is used.

NOTE: When "Bipolar" is selected in [6115] then:
1. Functionality is not symmetrical .
2. Ranges for high/low are bipolar

CA2 Setup [612]

Analogue comparator 2, parameter group.

Analogue Comparator 2, Value [6121]

Function is identical to analogue comparator 1, value [6111].

	6121 CA2 Value Stp A Torque
Default:	Torque
Selections:	Same as in menu [6111]

Communication information

Modbus Instance no/DeviceNet no:	43404
Profibus slot/index	170/53
EtherCAT index (hex)	4d4c
Profinet IO index	19788
Fieldbus format	UInt
Modbus format	UInt

Analogue Comparator 2, Level High [6122]

Function is identical to analogue comparator 1, level high [6112].

	6122 CA2 Level HI Stp A 20%
Default:	20%
Range:	Enter a value for the high level.

Communication information

Modbus Instance no/DeviceNet no:	43405
Profibus slot/index	170/54
EtherCAT index (hex)	4d4d
Profinet IO index	19789
Fieldbus format	Long 1=1 W, 0.1 A, 0.1 V, 0.1 Hz, 0.1°C, 1 kWh, 1H, 1%, 1 rpm or 0.001 via process value
Modbus format	EInt

Analogue Comparator 2, Level Low [6123]

Function is identical to analogue comparator 1, level low [6113].

	6123 CA2 Level LO Stp A 10%
Default:	10%
Range:	Enter a value for the low level.

Communication information

Modbus Instance no/DeviceNet no:	43406
Profibus slot/index	170/55
EtherCAT index (hex)	4d4e
Profinet IO index	19790
Fieldbus format	Long, 1=1 W, 0.1 A, 0.1 V, 0.1 Hz, 0.1°C, 1 kWh, 1H, 1%, 1 rpm or 0.001 via process value
Modbus format	EInt

Analogue Comparator 2, Type [6124]

Function is identical to analogue comparator 1, Type [6114].

		6124 CA2 Type Stp A Hysteresis
Default:		Hysteresis
Hysteresis	0	Hysteresis type comparator
Window	1	Window type comparator

Communication information

Modbus Instance no/DeviceNet no:	43482
Profibus slot/index	170/131
EtherCAT index (hex)	4d9a
Profinet IO index	19866
Fieldbus format	UInt
Modbus format	UInt

Analogue Comparator 2, Polar [6125]

Function is identical to analogue comparator 1, Polar [6115].

		6125 CA2 Polar Stp A Unipolar
Default:		Unipolar
Unipolar	0	Absolute value of [6111] used
Bipolar	1	Signed value of [6111] used

Communication information

Modbus Instance no/DeviceNet no:	43487
Profibus slot/index	170/136
EtherCAT index (hex)	4d9f
Profinet IO index	19871
Fieldbus format	UInt
Modbus format	UInt

CA3 Setup [613]

Analogue comparators 3, parameter group.

Analogue Comparator 3, Value [6131]

Function is identical to analogue comparator 1, value [6111].

	6131 CA3 Value Stp A Process Val
Default:	Process Value
Selections:	Same as in menu [6111]

Communication information

Modbus Instance no/DeviceNet no:	43471
Profibus slot/index	170/120
EtherCAT index (hex)	4d8f
Profinet IO index	19855
Fieldbus format	UInt
Modbus format	UInt

Analogue Comparator 3, Level High [6132]

Function is identical to analogue comparator 1, level high [6112].

	6132 CA3 Level HI Stp A 300rpm
Default:	300rpm
Range:	Enter a value for the high level.

Communication information

Modbus Instance no/DeviceNet no:	43472
Profibus slot/index	170/121
EtherCAT index (hex)	4d90
Profinet IO index	19856
Fieldbus format	Long 1=1 W, 0.1 A, 0.1 V, 0.1 Hz, 0.1°C, 1 kWh, 1H, 1%, 1 rpm or 0.001 via process value
Modbus format	EInt

Analogue Comparator 3, Level Low [6133]

Function is identical to analogue comparator 1, level low [6113].

	6133 CA3 Level LO Stp A 200rpm
Default:	200 rpm
Range:	Enter a value for the low level.

Communication information

Modbus Instance no/DeviceNet no:	43473
Profibus slot/index	170/122
EtherCAT index (hex)	4d91
Profinet IO index	19857
Fieldbus format	Long, 1=1 W, 0.1 A, 0.1 V, 0.1 Hz, 0.1°C, 1 kWh, 1H, 1%, 1 rpm or 0.001 via process value
Modbus format	EInt

Analogue Comparator, 3 Type [6134]

Function is identical to analogue comparator 1, level Type [6114].

		6134 CA3 Type Stp A Hysteresis
Default:		Hysteresis
Hysteresis	0	Hysteresis type comparator
Window	1	Window type comparator

Communication information

Modbus Instance no/DeviceNet no:	43483
Profibus slot/index	170/132
EtherCAT index (hex)	4d9b
Profinet IO index	19867
Fieldbus format	UInt
Modbus format	UInt

Analogue Comparator 3, Polar [6135]

Function is identical to analogue comparator 1, Polar [6115].

		6135 CA3 Polar Stp A Unipolar
Default:		Unipolar
Unipolar	0	Absolute value of [6111] used
Bipolar	1	Signed value of [6111] used

Communication information

Modbus Instance no/DeviceNet no:	43488
Profibus slot/index	170/137
EtherCAT index (hex)	4da0
Profinet IO index	19872
Fieldbus format	UInt
Modbus format	UInt

CA4 Setup [614]

Analogue comparators 4, parameter group.

Analogue Comparator 4, Value [6141]

Function is identical to analogue comparator 1, value [6111].

	6141 CA4 Value Stp A Process Err
Default:	Process Error
Selections:	Same as in menu [6111]

Communication information

Modbus Instance no/DeviceNet no:	43474
Profibus slot/index	170/123
EtherCAT index (hex)	4d92
Profinet IO index	19858
Fieldbus format	UInt
Modbus format	UInt

Analogue Comparator 4, Level High [6142]

Function is identical to analogue comparator 1 level high [6112].

	6142 CA4 Level HI Stp A 100rpm
Default:	100rpm
Range:	Enter a value for the high level.

Communication information

Modbus Instance no/DeviceNet no:	43475
Profibus slot/index	170/124
EtherCAT index (hex)	4d93
Profinet IO index	19859
Fieldbus format	Long 1=1 W, 0.1 A, 0.1 V, 0.1 Hz, 0.1°C, 1 kWh, 1H, 1%, 1 rpm or 0.001 via process value
Modbus format	EInt

Analogue Comparator 4, Level Low [6143]

Function is identical to analogue comparator 1, level low [6113].

	6143 CA4 Level LO Stp A -100rpm
Default:	-100 rpm
Range:	Enter a value for the low level.

Communication information

Modbus Instance no/DeviceNet no:	43476
Profibus slot/index	170/125
EtherCAT index (hex)	4d94
Profinet IO index	19860
Fieldbus format	Long, 1=1 W, 0.1 A, 0.1 V, 0.1 Hz, 0.1°C, 1 kWh, 1H, 1%, 1 rpm or 0.001 via process value
Modbus format	EInt

Analogue Comparator 4, Type [6144]

Function is identical to analogue comparator 1, level Type [6114]

		6144 CA4 Type Stp A Window
Default:		Window
Hysteresis	0	Hysteresis type comparator
Window	1	Window type comparator

Communication information

Modbus Instance no/DeviceNet no:	43484
Profibus slot/index	170/133
EtherCAT index (hex)	4d9c
Profinet IO index	19868
Fieldbus format	UInt
Modbus format	UInt

Analogue Comparator 4, Polar [6145]

Function is identical to analogue comparator 1, Polar [6115]

		6145 CA4 Polar Stp A Bipolar
Default:		Bipolar
Unipolar	0	Absolute value of [6111] used
Bipolar	1	Signed value of [6111] used

Communication information

Modbus Instance no/DeviceNet no:	43489
Profibus slot/index	170/138
EtherCAT index (hex)	4da1
Profinet IO index	19873
Fieldbus format	UInt
Modbus format	UInt

Digital comparator Setup [615]

Digital comparators, parameter group.

Digital Comparator 1 [6151]

Selection of the input signal for digital comparator 1 (CD1).

The output signal CD1 is set high if the selected input signal is active. See Fig. 122.

The output signal can be programmed to the digital or relay outputs or used as a source for the virtual connections [560].

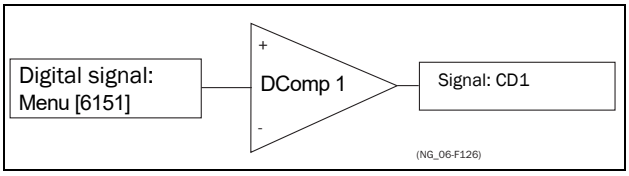


Fig. 122 Digital comparator

	6151 CD1 Stp A Run
Default:	Run
Selection:	Same selections as for “DigOut 1 [541]”.

Communication information

Modbus Instance no/DeviceNet no:	43407
Profibus slot/index	170/56
EtherCAT index (hex)	4d4f
Profinet IO index	19791
Fieldbus format	UInt
Modbus format	UInt

Digital Comparator 2 [6152]

Function is identical to digital comparator 1 [6151].

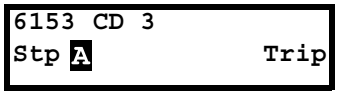
	6152 CD 2 Stp A DigIn 1
Default:	DigIn 1
Selection:	Same selections as for “DigOut 1 [541]”.

Communication information

Modbus Instance no/DeviceNet no:	43408
Profibus slot/index	170/57
EtherCAT index (hex)	4d50
Profinet IO index	19792
Fieldbus format	UInt
Modbus format	UInt

Digital Comparator 3 [6153]

Function is identical to digital comparator 1 [6151].

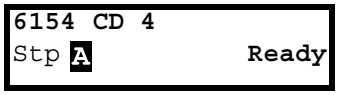
	
Default:	Trip
Selection:	Same selections as for “DigOut 1 [541]”.

Communication information

Modbus Instance no/DeviceNet no:	43477
Profibus slot/index	170/126
EtherCAT index (hex)	4d95
Profinet IO index	19861
Fieldbus format	UInt
Modbus format	UInt

Digital Comparator 4 [6154]

Function is identical to digital comparator 1 [6151].

	
Default:	Ready
Selection:	Same selections as for “DigOut 1 [541]”.

Communication information

Modbus Instance no/DeviceNet no:	43478
Profibus slot/index	170/127
EtherCAT index (hex)	4d96
Profinet IO index	19862
Fieldbus format	UInt
Modbus format	UInt

11.6.2 Logic Output Y [620]

By means of an expression editor, the comparator signals can be logically combined into the Logic Y function.

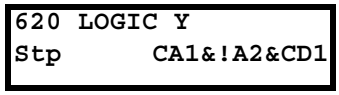
The expression editor has the following features:

- The following signals can be used:
  CA1, CA2, CD1, CD2 or LZ (or LY)
- The following signals can be inverted:
  !A1, !A2, !D1, !D2, or !LZ (or !LY)
- The following logical operators are available:
  "+" : OR operator
  "&" : AND operator
  "^" : EXOR operator

Expressions according to the following truth table can be made:

Input		Result		
A	B	& (AND)	+ (OR)	^(EXOR)
0	0	0	0	0
0	1	0	1	1
1	0	0	1	1
1	1	1	1	0

The output signal can be programmed to the digital or relay outputs or used as a Virtual Connection Source [560].



The expression must be programmed by means of the menus [621] to [625].

Example:

Broken belt detection for Logic Y

This example describes the programming for a so-called “broken belt detection” for fan applications.

The comparator CA1 is set for frequency>10Hz.

The comparator !A2 is set for load < 20%.

The comparator CD1 is set for Run.

The 3 comparators are all AND-ed, given the “broken belt detection”.

In menus [621]-[625] expression entered for Logic Y is visible.

Set menu [621] to CA1
Set menu [622] to &
Set menu [623] to !A2
Set menu [624] to &
Set menu [625] to CD1

Menu [620] now holds the expression for Logic Y:

CA1&!A2&CD1

which is to be read as:

(CA1&!A2)&CD1

NOTE: Set menu [624] to "." to finish the expression when only two comparators are required for Logic Y.

Y Comp 1 [621]

Selects the first comparator for the logic Y function.

	621 Y Comp 1 Stp A CA1	
Default:		CA1
CA1	0	
!A1	1	
CA2	2	
!A2	3	
CD1	4	
!D1	5	
CD2	6	
!D2	7	
LZ/LY	8	
!LZ/!LY	9	
T1	10	
!T1	11	
T2	12	
!T2	13	
CA3	14	
!A3	15	
CA4	16	
!A4	17	
CD3	18	
!D3	19	
CD4	20	
!D4	21	
C1	22	
!C1	23	
C2	24	
!C2	25	

Communication information

Modbus Instance no/DeviceNet no:	43411
Profibus slot/index	170/60
EtherCAT index (hex)	4d53
Profinet IO index	19795
Fieldbus format	UInt
Modbus format	UInt

Y Operator 1 [622]

Selects the first operator for the logic Y function.

	622 Y Operator 1 Stp A &	
Default:		&
&	1	&=AND
+	2	+=OR
^	3	^=EXOR

Communication information

Modbus Instance no/DeviceNet no:	43412
Profibus slot/index	170/61
EtherCAT index (hex)	4d54
Profinet IO index	19796
Fieldbus format	UInt
Modbus format	UInt

Y Comp 2 [623]

Selects the second comparator for the logic Y function.

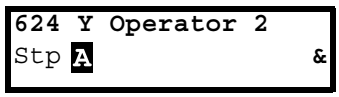
623 Y Comp 2 Stp A !A2	
Default:	!A2
Selection:	Same as menu [621]

Communication information

Modbus Instance no/DeviceNet no:	43413
Profibus slot/index	170/62
EtherCAT index (hex)	4d55
Profinet IO index	19797
Fieldbus format	UInt
Modbus format	UInt

Y Operator 2 [624]

Selects the second operator for the logic Y function.



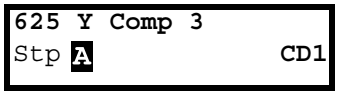
Default:		&
.	0	When · (dot) is selected, the Logic Y expression is finished (when only two expressions are tied together).
&	1	&=AND
+	2	+=OR
^	3	^=EXOR

Communication information

Modbus Instance no/DeviceNet no:	43414
Profibus slot/index	170/63
EtherCAT index (hex)	4d56
Profinet IO index	19798
Fieldbus format	UInt
Modbus format	UInt

Y Comp 3 [625]

Selects the third comparator for the logic Y function.

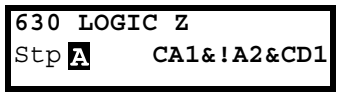


Default:	CD1
Selection:	Same as menu [621]

Communication information

Modbus Instance no/DeviceNet no:	43415
Profibus slot/index	170/64
EtherCAT index (hex)	4d57
Profinet IO index	19799
Fieldbus format	UInt
Modbus format	UInt

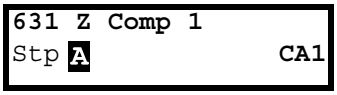
11.6.3 Logic Output Z [630]



The expression must be programmed by means of the menus [631] to [635].

Z Comp 1 [631]

Selects the first comparator for the logic Z function.



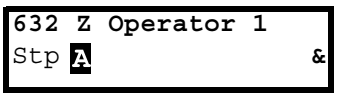
Default:	CA1
Selection:	Same as menu [621]

Communication information

Modbus Instance no/DeviceNet no:	43421
Profibus slot/index	170/70
EtherCAT index (hex)	4d5d
Profinet IO index	19805
Fieldbus format	UInt
Modbus format	UInt

Z Operator 1 [632]

Selects the first operator for the logic Z function.



Default:	&
Selection:	Same as menu [622]

Communication information

Modbus Instance no/DeviceNet no:	43422
Profibus slot/index	170/71
EtherCAT index (hex)	4d5e
Profinet IO index	19806
Fieldbus format	UInt
Modbus format	UInt

Z Comp 2 [633]

Selects the second comparator for the logic Z function.

	633 Z Comp 2 Stp A !A2
Default:	!A2
Selection:	Same as menu [621]

Communication information

Modbus Instance no/DeviceNet no:	43423
Profibus slot/index	170/72
EtherCAT index (hex)	4d5f
Profinet IO index	19807
Fieldbus format	UInt
Modbus format	UInt

Z Operator 2 [634]

Selects the second operator for the logic Z function.

	634 Z Operator 2 Stp A &
Default:	&
Selection:	Same as menu [624]

Communication information

Modbus Instance no/DeviceNet no:	43424
Profibus slot/index	170/73
EtherCAT index (hex)	4d60
Profinet IO index	19808
Fieldbus format	UInt
Modbus format	UInt

Z Comp 3 [635]

Selects the third comparator for the logic Z function.

	635 Z Comp 3 Stp A CD1
Default:	CD1
Selection:	Same as menu [621]

Communication information

Modbus Instance no/DeviceNet no:	43425
Profibus slot/index	170/74
EtherCAT index (hex)	4d61
Profinet IO index	19809
Fieldbus format	UInt
Modbus format	UInt

11.6.4 Timer1 [640]

The Timer functions can be used as a delay timer or as an interval with separate On and Off times (alternate mode). In delay mode, the output signal T1Q becomes high if the set delay time is expired. See Fig. 123.

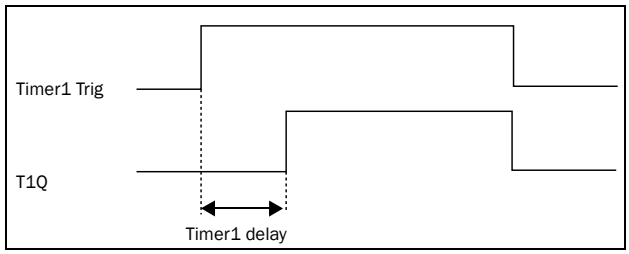


Fig. 123

In alternate mode, the output signal T1Q will switch automatically from high to low etc. according to the set interval times “Timer1 T1” and “Timer 1 T2”. See Fig. 124.

The output signal can be programmed to the digital or relay outputs used in logic functions [620] and [630], or as a virtual connection source [560].

NOTE: The actual timers are common for all parameter sets. If the actual set is changed, the timer functionality [641] to [645] will change according set settings but the timer value will stay unchanged. So initialization of the timer might differ for a set change compared to normal triggering of a timer.

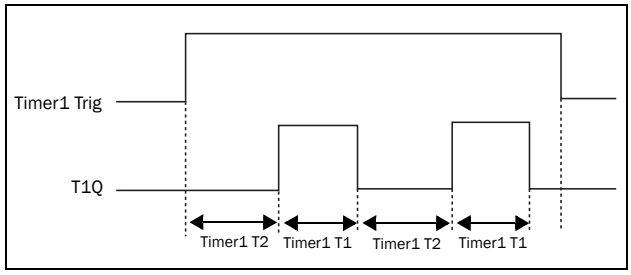
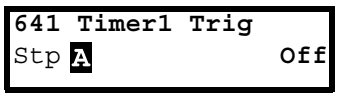


Fig. 124

Timer 1 Trig [641]

Selection of the Timer input trigger signal.



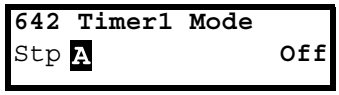
Default:	Off
Selection:	Same selections as Digital Output 1 menu [541].

Communication information

Modbus Instance no/DeviceNet no:	43431
Profibus slot/index	170/80
EtherCAT index (hex)	4d67
Profinet IO index	19815
Fieldbus format	UInt
Modbus format	UInt

Timer 1 Mode [642]

Selection of mode of operation for Timer.



Default:		Off
Off	0	
Delay	1	
Alternate	2	

Communication information

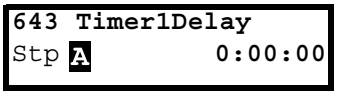
Modbus Instance no/DeviceNet no:	43432
Profibus slot/index	170/81
EtherCAT index (hex)	4d68
Profinet IO index	19816
Fieldbus format	UInt
Modbus format	UInt

Timer 1 Delay [643]

This menu is only visible when timer mode is set to delay.

This menu can only be edited as in alternative 2, see section Chapter 9.5 page 65.

Timer 1 delay sets the time that will be used by the first timer after it is activated. Timer 1 can be activated by a high signal on a DigIn that is set to Timer 1 or via a virtual destination [560].



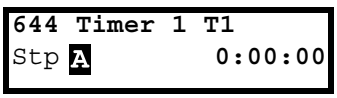
Default:	0:00:00 (hr:min:sec)
Range:	0:00:00–9:59:59

Communication information

Modbus Instance no/DeviceNet no:	43433 hours 43434 minutes 43435 seconds
Profibus slot/index	170/82, 170/83, 170/84
EtherCAT index (hex)	4d69, 4d6a, 4d6b
Profinet IO index	19817, 19818, 19819
Fieldbus format	UInt, 1=1 h/m/s
Modbus format	UInt, 1=1 h/m/s

Timer 1 T1 [644]

When timer mode is set to Alternate and Timer 1 is enabled, this timer will automatically keep on switching according to the independently programmable on and off times. The Timer 1 in Alternate mode can be enabled by a digital input or via a virtual connection. See Fig. 124. Timer 1 T1 sets the on time in the alternate mode.



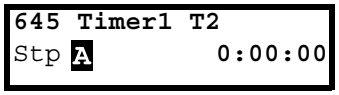
Default:	0:00:00 (hr:min:sec)
Range:	0:00:00–9:59:59

Communication information

Modbus Instance no/DeviceNet no:	43436 hours 43437 minutes 43438 seconds
Profibus slot/index	170/85, 170/86, 170/87
EtherCAT index (hex)	4d6c, 4d6d, 4d6e
Profinet IO index	19820, 19821, 19822
Fieldbus format	UInt, 1=1 h/m/s
Modbus format	UInt, 1=1 h/m/s

Timer 1 T2 [645]

Timer 1 T2 sets the off time in the alternate mode.

	
Default:	0:00:00, hr:min:sec
Range:	0:00:00–9:59:59

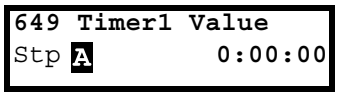
Communication information

Modbus Instance no/DeviceNet no:	43439 hours 43440 minutes 43441 seconds
Profibus slot/index	170/88, 170/89, 170/90
EtherCAT index (hex)	4d6f, 4d70, 4d71
Profinet IO index	19823, 19824, 19825
Fieldbus format	UInt, 1=1 h/m/s
Modbus format	UInt, 1=1 h/m/s

NOTE: "Timer 1 T1 [644]" and "Timer 1 T2 [645]" are only visible when Timer Mode is set to Alternate.

Timer 1 Value [649]

Timer 1 Value shows actual value of the timer.

	
Default:	0:00:00, hr:min:sec
Range:	0:00:00–9:59:59

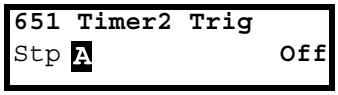
Communication information

Modbus Instance no/DeviceNet no:	42921 hours 42922 minutes 42923 seconds
Profibus slot/index	168/80, 168/81, 168/82
EtherCAT index (hex)	4b69, 4b6a, 4b6b
Profinet IO index	19305, 19306, 19307
Fieldbus format	UInt, 1=1 h/m/s
Modbus format	UInt, 1=1 h/m/s

11.6.5 Timer2 [650]

Refer to the descriptions for Timer1.

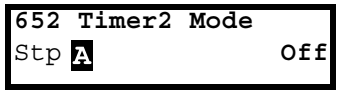
Timer 2 Trig [651]

	
Default:	Off
Selection:	Same selections as Digital Output 1 menu [541].

Communication information

Modbus Instance no/DeviceNet no:	43451
Profibus slot/index	170/100
EtherCAT index (hex)	4d7b
Profinet IO index	19835
Fieldbus format	UInt
Modbus format	UInt

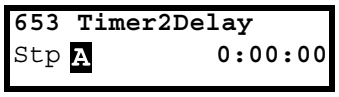
Timer 2 Mode [652]

	
Default:	Off
Selection:	Same as in menu [642]

Communication information

Modbus Instance no/DeviceNet no:	43452
Profibus slot/index	170/101
EtherCAT index (hex)	4d7c
Profinet IO index	19836
Fieldbus format	UInt
Modbus format	UInt

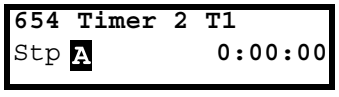
Timer 2 Delay [653]

	
Default:	0:00:00, hr:min:sec
Range:	0:00:00–9:59:59

Communication information

Modbus Instance no/DeviceNet no:	43453 hours 43454 minutes 43455 seconds
Profibus slot/index	170/102, 170/103, 170/104
EtherCAT index (hex)	4d7d, 4d7e, 4d7f
Profinet IO index	19837, 19838, 19839
Fieldbus format	UInt, 1=1 h/m/s
Modbus format	UInt, 1=1 h/m/s

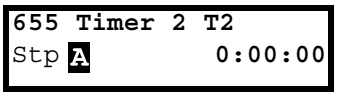
Timer 2 T1 [654]

	
Default:	0:00:00, hr:min:sec
Range:	0:00:00–9:59:59

Communication information

Modbus Instance no/DeviceNet no:	43456 hours 43457 minutes 43458 seconds
Profibus slot/index	170/105, 170/106, 170/107
EtherCAT index (hex)	4d80, 4d81, 4d82
Profinet IO index	19840, 19841, 19842
Fieldbus format	UInt, 1=1 h/m/s
Modbus format	UInt, 1=1 h/m/s

Timer 2 T2 [655]

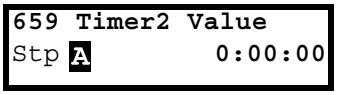
	
Default:	0:00:00, hr:min:sec
Range:	0:00:00–9:59:59

Communication information

Modbus Instance no/DeviceNet no:	43459 hours 43460 minutes 43461 seconds
Profibus slot/index	170/108, 170/109, 170/110
EtherCAT index (hex)	4d83, 4d84, 4d85
Profinet IO index	19843, 19844, 19845
Fieldbus format	UInt, 1=1 h/m/s
Modbus format	UInt, 1=1 h/m/s

Timer 2 Value [659]

Timer 2 Value shows actual value of the timer.

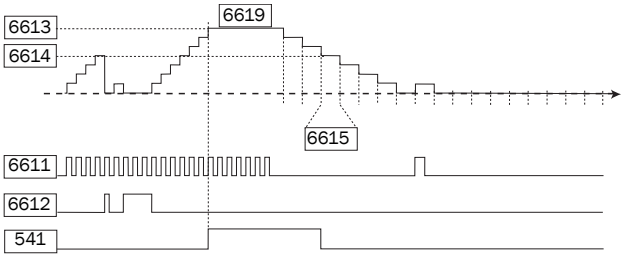
	
Default:	0:00:00, hr:min:sec
Range:	0:00:00–9:59:59

Communication information

Modbus Instance no/DeviceNet no:	42924 hours 42925 minutes 42926 seconds
Profibus slot/index	168/83, 168/84, 168/84
EtherCAT index (hex)	4b6c, 4b6d, 4b6f
Profinet IO index	19308, 19309, 19310
Fieldbus format	UInt, 1=1 h/m/s
Modbus format	UInt, 1=1 h/m/s

11.6.6 Counters [660]

Counter functions for counting pulses and signalling on digital output when counter reaches specified high and low limit levels.
The counter is counting up on positive flanks on the triggered signal, the counter is cleared as long as the Reset signal is active.
The counter can be automatically decremented with specified decrement time, if no new trigger signal has occurred within the decrement time.
The counter value is clamped to the high limit value and the digital output function (C1Q or C2Q) is active when counter value equals high limit value.
See Fig. 125 for more information of the counters.



541 = Digital Out 1 function
6611= Counter 1 trigger
6612= Counter 1 reset
6613= Counter 1 High value
6614= Counter 1 Low value
6615= Counter 1 Decrement timer
6619= Counter 1 value

Fig. 125 Counters, operating principle.

Counter 1 [661]

Counter 1 parameter group.

Counter 1 Trigger [6611]

Selection of the digital output signal used as trigger signal for counter 1. Counter 1 is incremented by 1 on every positive flank on the trigger signal.

NOTE: Maximum counting frequency is 8 Hz.

	6611 C1 Trig Stp A Off
Default:	Off
Selection:	Same selections as “Digital Out 1 [541]”.

Communication information

Modbus Instance no/DeviceNet no:	43571
Profibus slot/index	170/220
EtherCAT index (hex)	4df3
Profinet IO index	19955
Fieldbus format	UInt
Modbus format	UInt

Counter 1 Reset [6612]

Selection of the digital signal used as reset signal for counter 1. Counter 1 is cleared to 0 and held to 0 as long as reset input is active (high).

NOTE: Reset input has top priority.

	6612 C1 Reset Stp A Off
Default:	Off
Selection:	Same selections as “Digital Out 1 [541]”.

Communication information

Modbus Instance no/DeviceNet no:	43572
Profibus slot/index	170/221
EtherCAT index (hex)	4df4
Profinet IO index	19956
Fieldbus format	UInt
Modbus format	UInt

Counter 1 High value [6613]

Sets counter 1 high limit value. Counter 1 value is clamped to selected high limit value and the counter 1 output (C1Q) is active (high) when the counter value equals the high value.

NOTE: Value 0 means that counter output is always true (high).

	6613 C1 High Val Stp A 0
Default:	0
Range:	0 - 10000

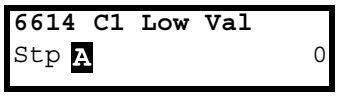
Communication information

Modbus Instance no/DeviceNet no:	43573
Profibus slot/index	170/222
EtherCAT index (hex)	4df5
Profinet IO index	19957
Fieldbus format	Long, 1=1
Modbus format	EInt

Counter 1 Low value [6614]

Sets counter 1 low limit value. Counter 1 output (C1Q) is de-activated (low) when the counter value is equal or smaller than the low value.

NOTE: Counter high value has priority so if high and low values are equal then the counter output is de-activated when the value is smaller than the low value.



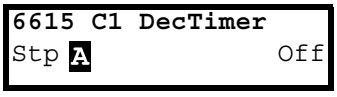
Default:	0
Range:	0 - 10000

Communication information

Modbus Instance no/DeviceNet no:	43574
Profibus slot/index	170/223
EtherCAT index (hex)	4df6
Profinet IO index	19958
Fieldbus format	Long, 1=1
Modbus format	EInt

Counter 1 Decrement timer [6615]

Sets counter 1 automatic decrement timer value. The counter 1 is decremented by 1 after elapsed decrement time and if no new trigger has happened within the decrement time. The decrement timer is reset to 0 at every counter 1 trig pulse



Default:		Off
Off	0	Off
1 - 3600	1 - 3600	1 - 3600 s

Communication information

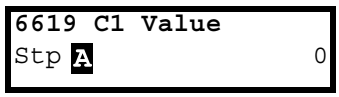
Modbus Instance no/DeviceNet no:	43575
Profibus slot/index	170/224
EtherCAT index (hex)	4df7
Profinet IO index	19959
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Counter 1 Value [6619]

Parameter shows the actual value of counter 1.

NOTE: Counter 1 value is common for all parameter sets.

NOTE: The value is volatile and lost at power down.



Default:	0
Range:	0 - 10000

Communication information

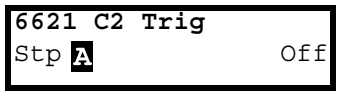
Modbus Instance no/DeviceNet no:	42927
Profibus slot/index	168/86
EtherCAT index (hex)	4b6f
Profinet IO index	19311
Fieldbus format	UInt, 1=1
Modbus format	UInt

Counter 2 [662]

Refer to description for Counter 1 [661].

Counter 2 Trigger [6621]

Function is identical to Counter 1 Trigger [6611].



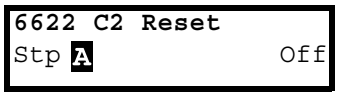
Default:	Off
Selection:	Same selections as Digital Out 1 [541].

Communication information

Modbus Instance no/DeviceNet no:	43581
Profibus slot/index	170/230
EtherCAT index (hex)	4dfd
Profinet IO index	19965
Fieldbus format	UInt
Modbus format	UInt

Counter 2 Reset [6622]

Function is identical to Counter 1 Reset [6612].



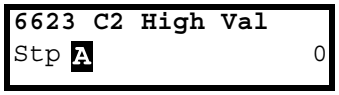
Default:	Off
Selection:	Same selections as Digital Out 1 [541].

Communication information

Modbus Instance no/DeviceNet no:	43582
Profibus slot/index	170/231
EtherCAT index (hex)	4dfe
Profinet IO index	19966
Fieldbus format	UInt
Modbus format	UInt

Counter 2 High value [6623]

Function is identical to Counter 1 High value [6613].



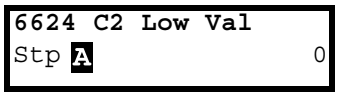
Default:	0
Range:	0 - 10000

Communication information

Modbus Instance no/DeviceNet no:	43583
Profibus slot/index	170/232
EtherCAT index (hex)	4dff
Profinet IO index	19967
Fieldbus format	Long, 1=1
Modbus format	EInt

Counter 2 Low value [6624]

Function is identical to Counter 1 Low value [6614].



Default:	0
Range:	0 - 10000

Communication information

Modbus Instance no/DeviceNet no:	43584
Profibus slot/index	170/233
EtherCAT index (hex)	4e00
Profinet IO index	19968
Fieldbus format	Long, 1=1
Modbus format	EInt

Counter 2 Decrement timer [6625]

Function is identical to Counter 1 Decrement timer [6615].

Default:		Off
Off	0	Off
1 - 3600	1 - 3600	1 - 3600 s

Communication information

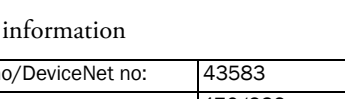
Modbus Instance no/DeviceNet no:	43585
Profibus slot/index	170/234
EtherCAT index (hex)	4e01
Profinet IO index	19969
Fieldbus format	Long, 1=1 s
Modbus format	EInt

Counter 2 Value [6629]

Parameter shows the actual value of counter 2.

NOTE: Counter 2 value is common for all parameter sets.

NOTE: The value is volatile and lost at power down.



Default:	0
Range:	0 - 10000

Communication information

Modbus Instance no/DeviceNet no:	42928
Profibus slot/index	168/87
EtherCAT index (hex)	4b70
Profinet IO index	19312
Fieldbus format	UInt, 1=1
Modbus format	UInt

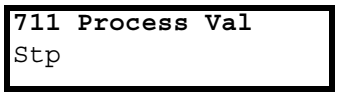
11.7 View Operation/Status [700]

Menu with parameters for viewing all actual operational data, such as speed, torque, power, etc.

11.7.1 Operation [710]

Process Value [711]

The process value is showing the process actual value, depending on selection done in chapter, Process Source [321].

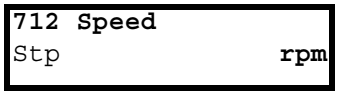
	
Unit	Depends on selected Pocess source [321] and Process Unit [322].
Resolution	Speed: 1 rpm, 4 digits Other units: 3 digits

Communication information

Modbus Instance no/DeviceNet no:	31001
Profibus slot/index	121/145
EtherCAT index (hex)	23e9
Profinet IO index	1001
Fieldbus format	Long, 1=1rpm, 1%, 1 °C or 0.001 if Process Value/ Process Ref using a [322] unit
Modbus format	EInt

Speed [712]

Displays the actual shaft speed.

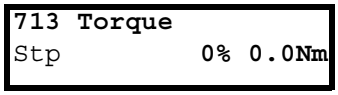
	
Unit:	rpm
Resolution:	1 rpm, 4 digits

Communication information

Modbus Instance no/DeviceNet no:	31002
Profibus slot/index	121/146
EtherCAT index (hex)	23ea
Profinet IO index	1002
Fieldbus format	Int, 1=1 rpm
Modbus format	Int, 1=1 rpm

Torque [713]

Displays the actual shaft torque.

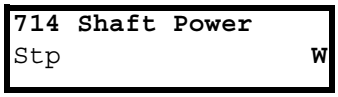
	
Unit:	%, Nm
Resolution:	1 %, 0.1 Nm

Communication information

Modbus Instance no/DeviceNet no:	31003 Nm 31004 %
Profibus slot/index	121/147 121/148
EtherCAT index (hex)	23eb Nm 23ec %
Profinet IO index	1003 Nm 1004 %
Fieldbus format	Long, 1=0.1 Nm Long, 1=1 %
Modbus format	EInt

Shaft power [714]

Displays the actual shaft power.

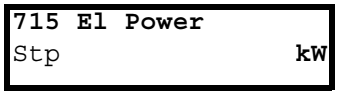
	
Unit:	W
Resolution:	1W

Communication information

Modbus Instance no/DeviceNet no:	31005
Profibus slot/index	121/149
EtherCAT index (hex)	23ed
Profinet IO index	1005
Fieldbus format	Long, 1=1W
Modbus format	EInt

Electrical Power [715]

Displays the actual electrical output power.



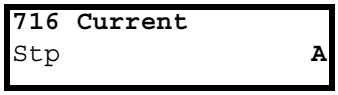
Unit:	kW
Resolution:	1 W

Communication information

Modbus Instance no/DeviceNet no:	31006
Profibus slot/index	121/150
EtherCAT index (hex)	23ee
Profinet IO index	1006
Fieldbus format	Long, 1=1W
Modbus format	EInt

Current [716]

Displays the actual output current.



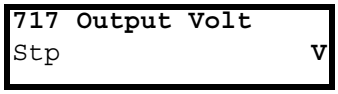
Unit:	A
Resolution:	0.1 A

Communication information

Modbus Instance no/DeviceNet no:	31007
Profibus slot/index	121/151
EtherCAT index (hex)	23ef
Profinet IO index	1007
Fieldbus format	Long, 1=0.1 A
Modbus format	EInt

Output Voltage [717]

Displays the actual output voltage.



Unit:	V
Resolution:	0.1 V

Communication information

Modbus Instance no/DeviceNet no:	31008
Profibus slot/index	121/152
EtherCAT index (hex)	23f0
Profinet IO index	1008
Fieldbus format	Long, 1=0.1 V
Modbus format	EInt

Frequency [718]

Displays the actual output frequency.



Unit:	Hz
Resolution:	0.1 Hz

Communication information

Modbus Instance no/DeviceNet no:	31009
Profibus slot/index	121/153
EtherCAT index (hex)	23f1
Profinet IO index	1009
Fieldbus format	Long, 1=0.1 Hz
Modbus format	EInt

DC Link Voltage [719]

Displays the actual DC link voltage.



Unit:	V
Resolution:	0.1 V

Communication information

Modbus Instance no/DeviceNet no:	31010
Profibus slot/index	121/154
EtherCAT index (hex)	23f2
Profinet IO index	1010
Fieldbus format	Long, 1=0.1 V
Modbus format	EInt

Heatsink Temperature [71A]

Displays the actual heatsink temperature, measured. The signal is generated by a sensor in the IGBT module.



Unit:	°C
Resolution:	0.1 °C

Communication information

Modbus Instance no/DeviceNet no:	31011
Profibus slot/index	121/155
EtherCAT index (hex)	23f3
Profinet IO index	1011
Fieldbus format	Long, 1=0.1 °C
Modbus format	EInt

PT100_1_2_3 Temp [71B]

Displays the actual PT100 temperature.

	71B PT100 1,2,3 Stp °C
Unit:	°C
Resolution:	1°C

Communication information

Modbus Instance no/DeviceNet no:	31012, 31013, 31014
Profibus slot/index	121/156 121/157 121/158
EtherCAT index (hex)	23f4, 23f5, 23f6
Profinet IO index	1012, 1013, 1014
Fieldbus format	Long, 1=1 °C
Modbus format	EInt

11.7.2 Status [720]

VSD Status [721]

Indicates the overall status of the AC drive.

```
721 VSD Status
Stp 1/222/333/44
```

Fig. 126 AC drive status

Display position	Function	Status value
1	Parameter Set	A,B,C,D
222	Source of reference value	-Rem (remote) -Key (keyboard) -Com (Serial comm.) -Opt (option)
333	Source of Run/Stop command	-Rem (remote) -Key (keyboard) -Com (Serial comm.) -Opt (option)
44	Limit functions	- - - -No limit active -VL (Voltage Limit) -SL (Speed Limit) -CL (Current Limit) -TL (Torque Limit)

Example: “A/Key/Rem/TL”

This means:

A: Parameter Set A is active.

Key: Reference value comes from the keyboard (CP).

Rem: Run/Stop commands come from terminals 1-22.

TL: Torque Limit active.

Communication information

Modbus Instance no/DeviceNet no:	31015
Profibus slot/index	121/159
EtherCAT index (hex)	23f7
Profinet IO index	1015
Fieldbus format	UInt
Modbus format	UInt

Description of communication format

Integer values and bits used

Bit	Integer representation
1 - 0	Active Parameter set, where 0=A, 1=B, 2=C, 3=D
4 - 2	Source of Reference control value, where 0=Rem, 1=Key, 2=Com, 3=Option
7 - 5	Source of Run/Stop/Reset command, where 0=Rem, 1=Key, 2=Com, 3=Option
13 - 8	Active limit functions, where 0=No limit, 1=VL, 2=SL, 3=CL, 4=TL
14	Inverter is in warning (A warning condition is active)
15	Inverter is tripped (A Trip condition is active)

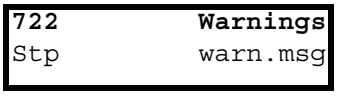
Example:
Previous example “A/Key/Rem/TL”
is interpreted “ 0/1/0/4”
In bit format this is presented as

Bit	Interpretation	Integer representation	
0 LSB	0	A(0)	Parameter set
1	0		
2	1	Key (1)	Source of control
3	0		
4	0		
5	0	Rem (0)	Source of command
6	0		
7	0		
8	0	TL (4)	Limit functions
9	0		
10	1		
11	0		
12	0		
13	0		
14	0		Warning condition
15 MSB	0		Trip condition

In the example above it is assumed that we have no trip or warning condition (the alarm LED on the control panel is off).

Warning [722]

Display the actual or last warning condition. A warning occurs if the AC drive is close to a trip condition but still in operation. During a warning condition the red trip LED will start to blink as long as the warning is active.



The active warning message is displayed in menu [722]. If no warning is active the message “No Error” is displayed.

The following warnings are possible:

Communi-cation integer value	Warning message
0	No Error
1	Motor I²t
2	PTC
3	Motor lost
4	Locked rotor
5	Ext trip
6	Mon MaxAlarm
7	Mon MinAlarm
8	Comm error
9	PT100
10	Crane Dev
11	Pump
12	Ext Mot Temp
13	LC Level
14	Brake
15	Option
16	Over temp
17	Over curr F
18	Over volt D
19	Over volt G
20	Over volt M
21	Over speed
22	Under voltage
23	Power fault
24	Desat
25	DClink error
26	Int error
27	Ovolt m cut
28	Over voltage

Communication integer value	Warning message
29	Not used
30	CRIO Comm
31	Encoder

Communication information

Modbus Instance no/DeviceNet no:	31016
Profibus slot/index	121/160
EtherCAT index (hex)	23f8
Profinet IO index	1016
Fieldbus format	UInt
Modbus format	UInt

See also the Chapter 12. page 195.

Digital Input Status [723]

Indicates the status of the digital inputs. See Fig. 127.

1 DigIn 1
2 DigIn 2
3 DigIn 3
4 DigIn 4
5 DigIn 5
6 DigIn 6
7 DigIn 7
8 DigIn 8

The positions one to eight (read from left to right) indicate the status of the associated input:

1 High

0 Low

The example in Fig. 127 indicates that DigIn 1, DigIn 3 and DigIn 6 are active at this moment.

```
723 DigIn Status
Stp        1010 0100
```

Fig. 127 Digital input status example

Communication information

Modbus Instance no/DeviceNet no:	31017
Profibus slot/index	121/161
EtherCAT index (hex)	23f9
Profinet IO index	1017
Fieldbus format	UInt, bit 0=DigIn1, bit 8=DigIn8
Modbus format	

Digital Output Status [724]

Indicates the status of the digital outputs and relays. See Fig. 128.

RE indicate the status of the relays on position:

1 Relay1
2 Relay2
3 Relay3

DO indicate the status of the digital outputs on position:

1 DigOut1
2 DigOut2

The status of the associated output is shown.

1 High
0 Low

The example in Fig. 128 indicates that DigOut1 is active and Digital Out 2 is not active. Relay 1 is active, relay 2 and 3 are not active.

```
724 DigOutStatus
Stp     RE 100 DO 10
```

Fig. 128 Digital output status example

Communication information

Modbus Instance no/DeviceNet no:	31018
Profibus slot/index	121/162
EtherCAT index (hex)	23fa
Profinet IO index	1018
Fieldbus format	UInt, bit 0=DigOut1, bit 1=DigOut2 bit 8=Relay1 bit 9=Relay2 bit 10=Relay3
Modbus format	

Analogue Input Status [725]

Indicates the status of the analogue inputs 1 and 2.

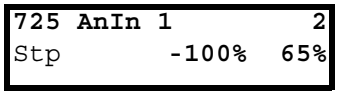


Fig. 129 Analogue input status

Communication information

Modbus Instance no/DeviceNet no:	31019, 31020
Profibus slot/index	121/163, 121/164
EtherCAT index (hex)	23fb, 23fc
Profinet IO index	1019, 1020
Fieldbus format	Long, 1=1%
Modbus format	EInt

The first row indicates the analogue inputs.

1 AnIn 1
2 AnIn 2

Reading downwards from the first row to the second row the status of the belonging input is shown in %:

-100% AnIn1 has a negative 100% input value
65% AnIn2 has a 65% input value

So the example in Fig. 129 indicates that both the Analogue inputs are active.

NOTE: The shown percentages are absolute values based on the full range/scale of the in- or output; so related to either 0–10 V or 0–20 mA.

Analogue Input Status [726]

Indicates the status of the analogue inputs 3 and 4.

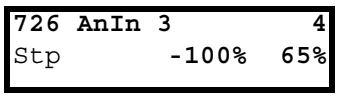


Fig. 130 Analogue input status

Communication information

Modbus Instance no/DeviceNet no:	31021, 31022
Profibus slot/index	121/165, 121/166
EtherCAT index (hex)	23fd, 23fe
Profinet IO index	1021, 1022
Fieldbus format	Long, 1=1%
Modbus format	EInt

Analogue Output Status [727]

Indicates the status of the analogue outputs. Fig. 131. E.g. if 4-20 mA output is used, the value 20% equals to 4 mA.

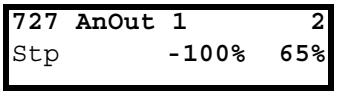


Fig. 131 Analogue output status

Communication information

Modbus Instance no/DeviceNet no:	31023, 31024
Profibus slot/index	121/167, 121/168
EtherCAT index (hex)	23ff, 2400
Profinet IO index	1023, 1024
Fieldbus format	Long, 1=1%
Modbus format	EInt

The first row indicates the Analogue outputs.

1 AnOut 1
2 AnOut 2

Reading downwards from the first row to the second row the status of the belonging output is shown in %:

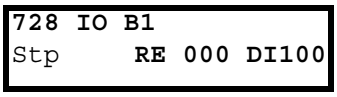
-100%AnOut1 has a negative 100% output value
65%AnOut2 has a 65% output value

The example in Fig. 131 indicates that both the Analogue outputs are active.

NOTE: The shown percentages are absolute values based on the full range/scale of the in- or output; so related to either 0–10 V or 0–20 mA.

I/O board Status [728] - [72A]

Indicates the status for the additional I/O on option boards 1 (B1), 2 (B2) and 3 (B3).



Communication information

Modbus Instance no/DeviceNet no:	31025 - 31027
Profibus slot/index	121/170 - 172
EtherCAT index (hex)	2401 - 2403
Profinet IO index	1025 - 1027
Fieldbus format	UInt,
Modbus format	bit 0=DigIn1 bit 1=DigIn2 bit 2=DigIn3 bit 8=Relay1 bit 9=Relay2 bit 10=Relay3

Area D Stat[72B]

These menus are not visible in the control panel display. Only used in EmoSoftCom PC-tool (optional) and can be read via fieldbus or serial communication.

Area D LSB[72B1]

Status bits 0 to 15.
see Chapter 9.2.1 page 61

Communication information

Modbus Instance no/DeviceNet no:	30180
Profibus slot/index	118/89
EtherCAT index (hex)	20b4
Profinet IO index	180
Fieldbus format	UInt
Modbus format	UInt

Area D MSB[72B2]

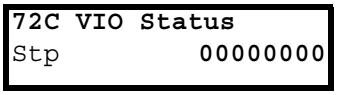
Status bits 16 and up.
see Chapter 9.2.1 page 61

Communication information

Modbus Instance no/DeviceNet no:	30182
Profibus slot/index	118/91
EtherCAT index (hex)	20b6
Profinet IO index	182
Fieldbus format	UInt
Modbus format	UInt

VIO Status[72C]

Shows the values of the 8 Virtual IO´s in menu[560]



Communication information

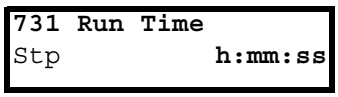
Modbus Instance no/DeviceNet no:	30181
Profibus slot/index	118/90
EtherCAT index (hex)	20b5
Profinet IO index	181
Fieldbus format	UInt
Modbus format	UInt

11.7.3 Stored values [730]

The shown values are the actual values built up over time. Values are stored at power down and updated again at power up.

Run Time [731]

Displays the total time that the AC drive has been in the Run Mode.



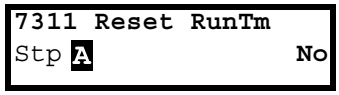
Unit:	h: mm:ss (hours: minutes: seconds)
Range:	00: 00: 00–262143: 59: 59

Communication information

Modbus Instance no/DeviceNet no:	31028:31029:31030 (hr:min:sec)
Profibus slot/index	121/172:121/173: 121/174
EtherCAT index (hex)	2404:2405:2406
Profinet IO index	1028:1029:1030
Fieldbus format	Long, 1=1h:m:s
Modbus format	Eint

Reset Run Time [7311]

Reset the run time counter. The stored information will be erased and a new registration period will start.



Default:		No
No	0	
Yes	1	

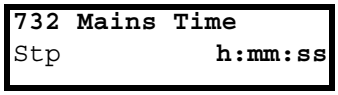
Communication information

Modbus Instance no/DeviceNet no:	7
Profibus slot/index	0/6
EtherCAT index (hex)	2007
Profinet IO index	7
Fieldbus format	UInt
Modbus format	UInt

NOTE: After reset the setting automatically reverts to "No".

Mains time [732]

Displays the total time that the AC drive has been connected to the mains supply. This timer cannot be reset.



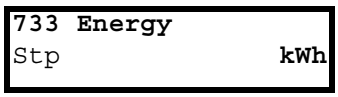
Unit:	h: mm:ss (hours: minutes: seconds)
Range:	00: 00: 00–262143: 59: 59

Communication information

Modbus Instance no/DeviceNet no:	31031:31032:31033 (hr:min:sec)
Profibus slot/index	121/175:121/176: 121/177
EtherCAT index (hex)	2407 : 2408 : 2409
Profinet IO index	1031:1032:1033
Fieldbus format	Long, 1=1h:m:s
Modbus format	Eint

Energy [733]

Displays the total energy consumption since the last energy reset [7331] took place.



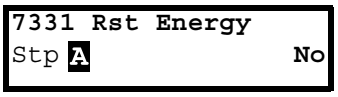
Unit:	Wh (shows Wh, kWh, MWh or GWh)
Range:	0.0–1GWh, Counter will restart at 0 after 1GWh

Communication information

Modbus Instance no/DeviceNet no:	31034
Profibus slot/index	121/178
EtherCAT index (hex)	240a
Profinet IO index	1034
Fieldbus format	Long, 1=1 Wh
Modbus format	EInt

Reset Energy [7331]

Resets the energy counter. The stored information will be erased and a new registration period will start.



Default:	No
Selection:	No, Yes

Communication information

Modbus Instance no/DeviceNet no:	6
Profibus slot/index	0/5
EtherCAT index (hex)	2006
Profinet IO index	6
Fieldbus format	UInt
Modbus format	UInt

NOTE: After reset the setting automatically goes back to "No".

11.8 View Trip Log [800]

Main menu with parameters for viewing all the logged trip data. In total the AC drive saves the last 10 trips in the trip memory. The trip memory refreshes on the FIFO principle (First In, First Out). Every trip in the memory is logged on the time of the "Run Time [731]" counter. At every trip, the actual values of several parameter are stored and available for troubleshooting.

11.8.1 Trip Message log [810]

Display the cause of the trip and what time that it occurred. When a trip occurs the status menus are copied to the trip message log. There are nine trip message logs [810]–[890]. When the tenth trip occurs the oldest trip will disappear.

After reset of occurred trip, the trip message will be removed and menu [100] will be indicated.

	8x0 Trip message Stp h:mm:ss
Unit:	h: m (hours: minutes)
Range:	0h: 0m–65355h: 59m

```
810 Ext Trip
Stp        132:12:14
```

For fieldbus integer value of trip message, see message table for warnings, [722].

NOTE: Bits 0–5 used for trip message value. Bits 6–15 for internal use.

Communication information

Modbus Instance no/DeviceNet no:	31101
Profibus slot/index	121/245
EtherCAT index (hex)	244d
Profinet IO index	1101
Fieldbus format	UInt, 1=1
Modbus format	UInt

Trip message [811]-[81P]

The information from the status menus are copied to the trip message log when a trip occurs.

Trip menu	Copied from	Description
811	711	Process Value
812	712	Speed
813	712	Torque
814	714	Shaft Power
815	715	Electrical Power
816	716	Current
817	717	Output voltage
818	718	Frequency
819	719	DC Link voltage
81A	71A	Heatsink Temperature
81B	71B	PT100_1, 2, 3
81C	721	AC drive Status
81D	723	Digital input status
81E	724	Digital output status
81F	725	Analogue input status 1-2
81G	726	Analogue input status 3-4
81H	727	Analogue output status 1-2
81I	728	I/O status option board 1
81J	729	I/O status option board 2
81K	72A	I/O status option board 3
81L	731	Run Time
81M	732	Mains Time
81N	733	Energy
81O	310	Process reference
81P	72C	VIO Status

Communication information

Modbus Instance no/DeviceNet no:	31102 - 31135
Profibus slot/index	121/246 - 254, 122/0 - 24
EtherCAT index (hex)	244e - 246f
Profinet IO index	1102 - 1135
Fieldbus format	Depends on parameter, see respective parameter.
Modbus format	Depends on parameter, see respective parameter.

Example:
Fig. 132 shows the third trip memory menu [830]: Over temperature trip occurred after 1396 hours and 13 minutes in Run time.

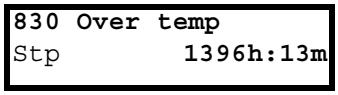


Fig. 132 Trip 3

11.8.2 Trip Messages [82P] - [89P]

Same information as for menu [810].

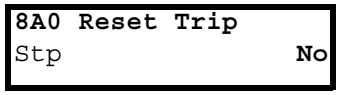
Communication information

Modbus Instance no/ DeviceNet no:	31151–31185 31201–31235 31251–31285 31301–31335 31351–31385 31401–31435 31451–31485 31501–31535	Trip log list 2 3 4 5 6 7 8 9
Profibus slot/index	122/40–122/74 122/90–122/124 122/140–122/174 122/190–122/224 122/240–123/18 123/35 - 123/68 123/85–123/118 123/135–123/168	Trip log list 2 3 4 5 6 7 8 9
EtherCAT index (hex)	247e - 24b0 24b1 - 24e2 24e3 - 2514 2515 - 2546 2547 - 2578 2579 - 25aa 25ab - 25dc 25dd - 260e	Trip log list 2 3 4 5 6 7 8 9
Profinet IO index	1151 - 1185 1201 - 1235 1251 - 1285 1301 - 1335 1351 - 1385 1401 - 1435 1451 - 1485 1501 - 1535	Trip log list 2 3 4 5 6 7 8 9
Fieldbus format	See Trip 811 - 810	
Modbus format		

All nine alarm lists contain the same type of data. For example DeviceNet parameter 31101 in alarm list 1 contains the same data information as 31151 in alarm list 2.

11.8.3 Reset Trip Log [8A0]

Resets the content of the 10 trip memories.



Default:		No
No	0	
Yes	1	

Communication information

Modbus Instance no/DeviceNet no:	8
Profibus slot/index	0/7
EtherCAT index (hex)	2008
Profinet IO index	8
Fieldbus format	UInt
Modbus format	UInt

NOTE: After the reset the setting goes automatically back to "NO". The message "OK" is displayed for 2 sec.

11.9 System Data [900]

Main menu for viewing all the AC drive system data.

11.9.1 VSD Data [920]

VSD Type [921]

Shows the AC drive type according to the type number.

The options are indicated on the type plate of the AC drive.

NOTE: If the control board is not configured, then type type shown is VFX40-XXX.



Example of type

Communication information

Modbus Instance no/DeviceNet no:	31037
Profibus slot/index	121/181
EtherCAT index (hex)	240d
Profinet IO index	1037
Fieldbus format	UInt, 1=1
Modbus format	UInt

Examples:

VFX48-046AC drive-series suited for 380-480 volt mains supply, and a rated output current of 46 A.

Software [922]

Shows the software version number of the AC drive.

Fig. 133 gives an example of the version number.

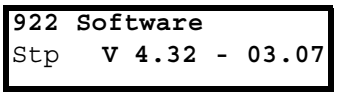


Fig. 133 Example of software version

V 4.32 = Software version

- 03.07 = option version, is only visible and valid for special software, type OEM adapted software.
  03 = (major) special software variant number
  07= (minor) revision of this special software

Communication information

Modbus Instance no/DeviceNet no:	31038 software version 31039 option version
Profibus slot/index	121/182-183
EtherCAT index (hex)	240e, 240f
Profinet IO index	1038, 1039
Fieldbus format	UInt
Modbus format	UInt

Table 34 Information for Modbus and Profibus number, software version

Bit	Example	Description
7–0	32	minor
13–8	4	major
15–14		release 00: V, release version 01: P, pre-release version 10: β, Beta version 11: α, Alpha version

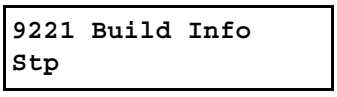
Table 35 Information for Modbus and Profibus number, option version

Bit	Example	Description
7–0	07	Minor option version
15–8	03	Major option version

NOTE: It is important that the software version displayed in menu [922] is the same software version number as the software version number written on the title page of this instruction manual. If not, the functionality as described in this manual may differ from the functionality of the AC drive.

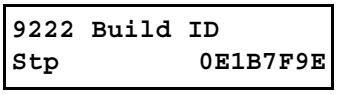
Build Info [9221]

Software version created, Date and time.

	
Default:	YY:MM:DD:HH:MM:SS

Build ID [9222]

Software identification code.

	
Example:	0E1B7F9E

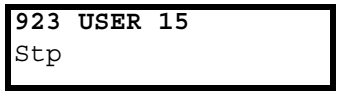
Unit name [923]

Option to enter a name of the unit for service use or customer identity. The function enables the user to define a name with max 12 characters. Use the Prev and Next key to move the cursor to the required position. Then use the + and - keys to scroll in the character list. Confirm the character by moving the cursor to the next position by pressing the Next key. See section User-defined Unit [323].

Example

Create user name USER 15.

1. When in the menu [923] press Next to move the cursor to the right most position.
2. Press the + key until the character U is displayed.
3. Press Next.
4. Then press the + key until S is displayed and confirm with Next.
5. Repeat until you have entered USER15.



Default:	No characters shown

Communication information

Modbus Instance no/DeviceNet no:	42301–42312
Profibus slot/index	165/225–236
EtherCAT index (hex)	48fd - 4908
Profinet IO index	18685 - 18696
Fieldbus format	UInt
Modbus format	UInt

When sending a unit name you send one character at a time starting at the right most position.

12. Troubleshooting, Diagnoses and Maintenance

12.1 Trips, warnings and limits

In order to protect the AC drive the principal operating variables are continuously monitored by the system. If one of these variables exceeds the safety limit an error/warning message is displayed. In order to avoid any possibly dangerous situations, the inverter sets itself into a stop Mode called Trip and the cause of the trip is shown in the display.

Trips will always stop the AC drive. Trips can be divided into normal and soft trips, depending on the setup Trip Type, see menu "[250] Autoreset". Normal trips are default. For normal trips the AC drive stops immediately, i.e. the motor coasts naturally to a standstill. For soft trips the AC drive stops by ramping down the speed, i.e. the motor decelerates to a standstill.

"Normal Trip"

- The AC drive stops immediately, the motor coasts to a standstill.
- The Trip relay or output is active (if selected).
- The Trip LED is on.
- The accompanying trip message is displayed.
- The "TRP" status indication is displayed (area D of the display).
- After reset command, the trip message will disappear and menu [100] will be indicated.

"Soft Trip"

- the AC drive stops by decelerating to a standstill.

During the deceleration.

- The accompanying trip message is displayed, including an additional soft trip indicator "S" before the trip time.
- The Trip LED is flashing.
- The Warning relay or output is active (if selected).

After standstill is reached.

- The Trip LED is on.
- The Trip relay or output is active (if selected).
- The "TRP" status indication is displayed (area D of the display).
- After reset command, the trip message will disappear and menu [100] will be indicated.

Apart from the TRIP indicators there are two more indicators to show that the inverter is in an "abnormal" situation.

"Warning"

- The inverter is close to a trip limit.
- The Warning relay or output is active (if selected).
- The Trip LED is flashing.
- The accompanying warning message is displayed in window "[722] Warning".
- One of the warning indications is displayed (area F of the display).

"Limits"

- The inverter is limiting torque and/or frequency to avoid a trip.
- The Limit relay or output is active (if selected).
- The Trip LED is flashing.
- One of the Limit status indications is displayed (area D of the display).

Table 36 List of trips and warnings

Trip/Warning messages	Selections	Trip (Normal/ Soft)	Warning indicators (Area D)
Motor I^2t	Trip/Off/Limit	Normal/Soft	I^2t
PTC	Trip/Off	Normal/Soft	
Motor PTC	On	Normal	
PT100	Trip/Off	Normal/Soft	
Motor lost	Trip/Off	Normal	
Locked rotor	Trip/Off	Normal	
Ext trip	Via DigIn	Normal/Soft	
Ext Mot Temp	Via DigIn	Normal/Soft	
Mon MaxAlarm	Trip/Off/Warn	Normal/Soft	
Mon MinAlarm	Trip/Off/Warn	Normal/Soft	
Comm error	Trip/Off/Warn	Normal/Soft	
CRIO Dev	Via Option	Normal	
CRIO Comm	Via Option	Normal	
Encoder	Trip/Off	Normal	
Pump	Via Option	Normal	
Over temp	On	Normal	OT
Over curr F	On	Normal	
Over volt D	On	Normal	
Over volt G	On	Normal	
Over volt	On	Normal	
Over speed	On	Normal	
Under voltage	On	Normal	LV
LC Level	Trip/Off/Warn Via DigIn	Normal/Soft	LCL
Desat ### *	On	Normal	
DClink error	On	Normal	
Power Fault PF #### *	On	Normal	
Ovolt m cut	On	Normal	
Over voltage	Warning		VL
Safe stop	Warning		SST
Brake	Trip/Off/Warn	Normal	
OPTION	On	Normal	

*) Refer to table Table 37regarding which Desat or Power Fault is triggered.

12.2 Trip conditions, causes and remedial action

The table later on in this section must be seen as a basic aid to find the cause of a system failure and to how to solve any problems that arise. An AC drive is mostly just a small part of a complete AC drive system. Sometimes it is difficult to determine the cause of the failure, although the AC drive gives a certain trip message it is not always easy to find the right cause of the failure. Good knowledge of the complete drive system is therefore necessary. Contact your supplier if you have any questions.

The AC drive is designed in such a way that it tries to avoid trips by limiting torque, overvolt etc.

Failures occurring during commissioning or shortly after commissioning are most likely to be caused by incorrect settings or even bad connections.

Failures or problems occurring after a reasonable period of failure-free operation can be caused by changes in the system or in its environment (e.g. wear).

Failures that occur regularly for no obvious reasons are generally caused by Electro Magnetic Interference. Be sure that the installation fulfils the demands for installation stipulated in the EMC directives. See chapter, EMC and standards.

Sometimes the so-called “Trial and error” method is a quicker way to determine the cause of the failure. This can be done at any level, from changing settings and functions to disconnecting single control cables or replacing entire drives.

The Trip Log can be useful for determining whether certain trips occur at certain moments. The Trip Log also records the time of the trip in relation to the run time counter.



WARNING!
If it is necessary to open the AC drive or any part of the system (motor cable housing, conduits, electrical panels, cabinets, etc.) to inspect or take measure-ments as suggested in this instruction manual, it is absolutely necessary to read and follow the safety instructions in the manual.

12.2.1 Technically qualified personnel

Installation, commissioning, demounting, making measurements, etc., of or at the AC drive may only be carried out by personnel technically qualified for the task.

12.2.2 Opening the AC drive



WARNING!
Always switch the mains voltage off if it is necessary to open the AC drive and wait at least 7 minutes to allow the capacitors to discharge.



WARNING!
In case of malfunctioning always check the DC-link voltage, or wait one hour after the mains voltage has been switched off, before dismantling the AC drive for repair.

The connections for the control signals and the switches are isolated from the mains voltage. Always take adequate precautions before opening the AC drive.

12.2.3 Precautions to take with a connected motor

If work must be carried out on a connected motor or on the driven machine, the mains voltage must always first be disconnected from the AC drive. Wait at least 7 minutes before continuing.

12.2.4 Autoreset Trip

If the maximum number of Trips during Autoreset has been reached, the trip message hour counter is marked with an "A".

```
830 OVERVOLT G
Trp A 345:45:12
```

Fig. 134 Autoreset trip

Fig. 134 shows the 3rd trip memory menu [830]: Overvoltage G trip after the maximum Autoreset attempts took place after 345 hours, 45 minutes and 12 seconds of run time.

Table 37 Trip condition, their possible causes and remedial action

Trip condition	Possible Cause	Remedy	Size**
Motor I^2t "I^2t"	I^2t value is exceeded. - Overload on the motor according to the programmed I^2t settings.	- Check on mechanical overload on the motor or the machinery (bearings, gearboxes, chains, belts, etc.) - Change the Motor I^2t Current setting in menu group [230]	
PTC	Motor thermistor (PTC) exceeds maximum level. **NOTE: Only valid if option board PTC/ PT100 is used.**	- Check on mechanical overload on the motor or the machinery (bearings, gearboxes, chains, belts, etc.) - Check the motor cooling system. - Self-cooled motor at low speed, too high load. - Set PTC, menu [234] to OFF	
Motor PTC	Motor thermistor (PTC) exceeds maximum level. **NOTE: Only valid if [237] is enabled.**	- Check on mechanical overload on the motor or the machinery (bearings, gearboxes, chains, belts, etc.) - Check the motor cooling system. - Self-cooled motor at low speed, too high load. - Set PTC, menu [237] to OFF	003 - 088
PT100	Motor PT100 elements exceeds maximum level. **NOTE: Only valid if option board PTC/ PT100 is used.**	- Check on mechanical overload on the motor or the machinery (bearings, gearboxes, chains, belts, etc.) - Check the motor cooling system. - Self-cooled motor at low speed, too high load. - Set PT100 to OFF, menu [234]	
Motor lost	Phase loss or too great imbalance on the motor phases	- Check the motor voltage on all phases. - Check for loose or poor motor cable connections - If all connections are OK, contact your supplier - Set motor lost alarm to OFF.	
Locked rotor	Torque limit at motor standstill: - Mechanical blocking of the rotor.	- Check for mechanical problems at the motor or the machinery connected to the motor - Set locked rotor alarm to OFF.	
Ext trip	External input (DigIn 1-8) active: - active low function on the input.	- Check the equipment that initiates the external input - Check the programming of the digital inputs DigIn 1-8	
Ext Mot Temp	External input (DigIn 1-8) active: - active low function on the input.	- Check the equipment that initiates the external input - Check the programming of the digital inputs DigIn 1-8	
Mon MaxAlarm	Max alarm level (overload) has been reached.	- Check the load condition of the machine - Check the monitor setting in section 11.4.1, page 142.	
Mon MinAlarm	Min alarm level (underload) has been reached.	- Check the load condition of the machine - Check the monitor setting in section 11.4.1, page 142.	
Comm error	Error on serial communication (option)	- Check cables and connection of the serial communication. - Check all settings with regard to the serial communication - Restart the equipment including the AC drive	

Table 37 Trip condition, their possible causes and remedial action

Trip condition	Possible Cause	Remedy	Size**
Crane Deviat	CRANE board detecting deviation in motor operation. **NOTE: Only used in Crane Control.**	- Check encoder signals - Check Deviation jumper on Crane option board. - Check the settings in menus [3AB] & [3AC]	
CraneComm	Lost communication with CRANE board. **NOTE: Only used in Crane Control.**	- Check CRIO board - Check CRIO cable and signals.	
Encoder	Lost encoder board, encoder cable or encoder pulses. Motor speed deviation in between reference and measured speed detected. **NOTE: Only valid if option board Encoder is used.**	- Check encoder board. - Check encoder cable and signals. - Check motor operation. - Check speed deviation settings [22G#]. - Check speed PI controller settings [37#]. - Check torque limit setting [351] - Disable encoder, set menu [22B] to OFF.	
Pump	No master pump can be selected due to error in feedback signalling. **NOTE: Only used in Pump Control.**	- Check cables and wiring for Pump feedback signals - Check settings with regard to the pump feedback digital inputs	
Over temp	Heatsink temperature too high: - Too high ambient temperature of the AC drive - Insufficient cooling - Too high current - Blocked or stuffed fans	- Check the cooling of the AC drive cabinet. - Check the functionality of the built-in fans. The fans must switch on automatically if the heatsink temperature gets too high. At power up the fans are briefly switched on. - Check AC drive and motor rating - Clean fans	
Over curr F	Motor current exceeds the peak AC drive current: - Too short acceleration time. - Too high motor load - Excessive load change - Soft short-circuit between phases or phase to earth - Poor or loose motor cable connections - Too high IxR Compensation level	- Check the acceleration time settings and make them longer if necessary. - Check the motor load. - Check on bad motor cable connections - Check on bad earth cable connection - Check on water or moisture in the motor housing and cable connections. - Lower the level of IxR Compensation [352]	
Over volt D(eceleration)	Too high DC Link voltage: - Too short deceleration time with respect to motor/machine inertia. - Too small brake resistor malfunctioning Brake chopper	- Check the deceleration time settings and make them longer if necessary. - Check the dimensions of the brake resistor and the functionality of the Brake chopper (if used)	
Over volt G(eneration)			
Over volt (Mains)	Too high DC Link voltage, due to too high mains voltage	- Check the main supply voltage - Try to take away the interference cause or use other main supply lines.	
O(ver) volt M(ains) cut			
Over speed	Motor speed measurement exceeds maximum level. 110% of max speed (all parameter sets).	Check encoder cables, wiring and setup Check motor data setup [22x] Perform short ID-run	
Under voltage	Too low DC Link voltage: - Too low or no supply voltage - Mains voltage dip due to starting other major power consuming machines on the same line.	- Make sure all three phases are properly connected and that the terminal screws are tightened. - Check that the mains supply voltage is within the limits of the AC drive. - Try to use other mains supply lines if dip is caused by other machinery - Use the function low voltage override [421]	
LC Level	Low liquid cooling level in external reservoir. External input (DigIn 1-8) active: - active low function on the input. **NOTE:** Only valid for AC drive types with Liquid Cooling option.	- Check liquid cooling - Check the equipment and wiring that initiates the external input - Check the programming of the digital inputs DigIn 1-8	

Table 37 Trip condition, their possible causes and remedial action

Trip condition	Possible Cause	Remedy	Size**
OPTION	If an Option specific trip occurs	Check the description of the specific option	
Desat	Failure in output stage, - desaturation of IGBTs - Hard short circuit between phases or phase to earth - Earth fault - For size B - D also the Brake IGBT	- Check on bad motor cable connections - Check on bad earth cable connections - Check on water and moisture in the motor housing and cable connections - Check that the rating plate data of the motor is correctly entered. - Check the brake resistor, brake IGBT and wiring. - For size G and up, check the cables from the PEBBs to the motor, that all are in correct order in parallell connection	003 - 088
Desat U+ *			090 & Up
Desat U- *			
Desat V+ *			
Desat V- *			
Desat W+ *			
Desat W- *			
Desat BCC *			
DC link error	DC link voltage ripple exceeds maximum level	- Make sure all three phases are properly connected and that the terminal screws are tightened. - Check that the mains supply voltage is within the limits of the AC drive. - Try to use other mains supply lines if dip is caused by other machinery.	
Power Fault	One of the PF (Power Fault) trips below has occured, but could not be determined.	- Check the PF errors and try to determine the cause. The trip history can be helpful.	
PF Fan Err *	Error in fan module	- Check for clogged air inlet filters in panel door and blocking material in fan module.	090 & Up
PF HCB Err*	Error in controlled rectifier module (HCB)	- Check mains supply voltage	060 & Up
PF Curr Err *	Error in current balancing: - between different modules. - between two phases within one module.	- Check motor. - Check fuses and line connections - Check the individual motor current leads with an clamp on amp meter.	300 & Up
PF Overvolt *	Error in voltage balancing, overvoltage detected in one of the power modules (PEBB)	- Check motor. - Check fuses and line connections.	300 & Up
PF Comm Err *	Internal communication error	Contact service	
PF Int Temp *	Internal temperature too high	Check internal fans	
PF Temp Err *	Malfunction in temperature sensor	Contact service	
PF DC Err *	DC-link error and mains supply fault	- Check mains supply voltage - Check fuses and line connections.	060 & Up
PF Sup Err *	Mains supply fault	- Check mains supply voltage - Check fuses and line connections.	
Brake	Brake tripped on brake fault (not released) or Brake not engaged during stop.	- Check Brake acknowledge signal wiring to selected digital input. - Check programming of digital input DigIn 1-8, [520]. - Check circuit breaker feeding mechanical brake circuit. - Check mechanical brake if acknowledge signal is wired from brake limit switch. - Check brake contactor. - Check settings [33C], [33D], [33E], [33F].	

* = 2...6 Module number if parallel power units (size 300–3000 A)

** = If no size is mentioned in this column, the information is valid for all sizes.

12.3 Maintenance

The AC drive is designed to require minimum of servicing and maintenance. There are however some things which must be checked regularly in order to optimise product life time.

- Keep the AC drive unit clean and cooling efficient (clean air inlets, heatsink profile, parts, components, etc)
- There is an internal fan that should be inspected and cleaned from dust if necessary.
- If AC drives are built into cabinets, also check and clean the dust filters of the cabinets regularly.
- Check external wiring, connections and control signals.
- Check tightening of all terminal screws regularly, especially important are power and motor cable connections

Preventive maintenance can optimise the product life time and secure trouble free operation without interruptions.

For more information on maintenance, please contact your CG Drives & Automation service partner.

Precautions to take with a connected motor

NOTE: Refer to motor manufacturers instruction manual for motor maintenance requirements.

If work must be carried out on a connected motor or on the driven machine, the mains voltage must always first be disconnected from the drive unit.

If your drive is connected to a PMSM (Permanent magnet motor) it is most important that you also disconnect the motor before performing any maintenance on the drive unit.



WARNING!
Do not work on a drive when a rotating PMSM- permanent magnet motor is connected to it.
A rotating PMSM motor energizes the drive including its power terminals.

13. 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.

13.1 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.

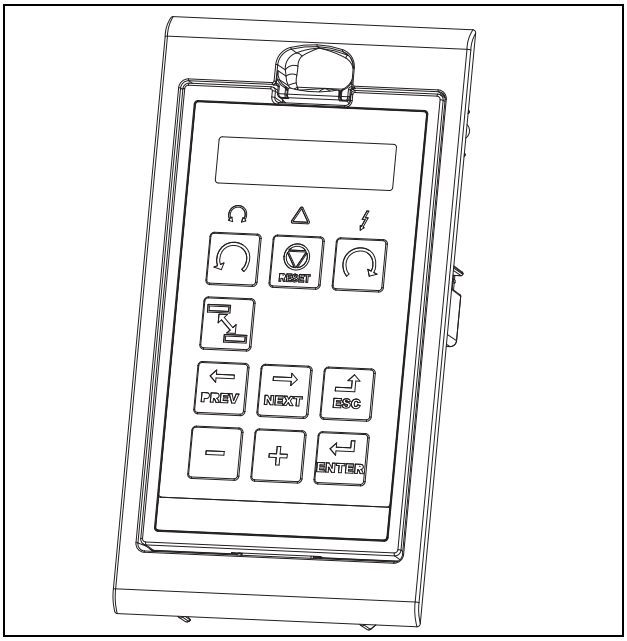


Fig. 135 Control panel in mounting cassette

13.2 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

13.3 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

13.4 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.

13.5 Brake chopper

All AC drive sizes AC drives with cable inlet on short side can be fitted with an optional built-in brake chopper. The brake resistor must be mounted outside the AC drive. The choice of the resistor depends on the application switch-on duration and duty-cycle. This option can not be after mounted.



WARNING!
The table gives the minimum values of the brake resistors. Do not use resistors lower than this value. The AC drive can trip or even be damaged due to high braking currents.

The following formula can be used to define the power of the connected brake resistor:

$$P_{resistor} = \frac{(\text{Brake level } V_{DC})^2}{R_{min}} \text{ x ED}$$

Where:

$P_{resistor}$required power of brake resistor

Brake level VDCDC brake voltage level (see Table 31)

Rminminimum allowable brake resistor (see Table 39, Table 40 and Table 41

EDeffective braking period. Defined as:

$$ED = \frac{t_{br}}{120\ [s]}$$

t_{br} Active braking time at nominal braking power during a 2 minute operation cycle.

Maximum value of ED = 1, meaning continuous braking.

Table 38

Supply voltage (V_{AC}) (set in menu [21B]	Brake level (V_{DC})
220–240	380
380–415	660
440–480	780
500–525	860
550–600	1000
660–690	1150

Table 39 Brake resistorVFX48 V types

Type	Rmin [ohm] if supply 380–415 V_{AC}	Rmin [ohm] if supply 440–480 V_{AC}
VFX48-003	43	50
-004	43	50
-006	43	50
-008	43	50
-010	43	50
-013	43	50
-018	43	50
-025	26	30
-026	26	30
-030	26	30
-031	26	30
-036	17	20
-037	17	20
-045	17	20
-046	17	20
-060	10	12
-061	10	12
-072	10	12
-074	10	12
-088	7.5	9
-090	3.8	4.4
-106	3.8	4.4
-109	3.8	4.4
-142	3.8	4.4
-146	3.8	4.4
-171	3.8	4.4
-175	3.8	4.4
-205	2.7	3.1
-210	2.7	3.1
-244	2.7	3.1
-250	2.7	3.1
-300	2 x 3.8	2 x 4.4
-375	2 x 3.8	2 x 4.4
-430	2 x 2.7	2 x 3.1
-500	2 x 2.7	2 x 3.1
-600	3 x 2.7	3 x 3.1
-650	3 x 2.7	3 x 3.1
-750	3 x 2.7	3 x 3.1
-860	4 x 2.7	4 x 3.1
-1K0	4 x 2.7	4 x 3.1
-1K15	5 x 2.7	5 x 3.1
-1K25	5 x 2.7	5 x 3.1
-1K35	6 x 2.7	6 x 3.1
-1K5	6 x 2.7	6 x 3.1
-1K75	7 x 2.7	7 x 3.1
-2K0	8 x 2.7	8 x 3.1
-2K25	9 x 2.7	9 x 3.1
-2K5	10 x 2.7	10 x 3.1

Table 40 Brake resistor VFX52 V types

Type	Rmin [ohm] if supply 440–480 V_{AC}	Rmin [ohm] if supply 500–525 V_{AC}
VFX52-003	50	55
-004	50	55
-006	50	55
-008	50	55
-010	50	55
-013	50	55
-018	50	55
-026	30	32
-031	30	32
-037	20	22
-046	20	22
-061	12	14
-074	12	14

Table 41 Brake resistor VFX69 V types

Type	Rmin [ohm] if supply 500–525 V_{AC}	Rmin [ohm] if supply 550–600 V_{AC}	Rmin [ohm] if supply 660–690 V_{AC}
VFX69-090	4.9	5.7	6.5
-109	4.9	5.7	6.5
-146	4.9	5.7	6.5
-175	4.9	5.7	6.5
-200	4.9	5.7	6.5
-250	2 x 4.9	2 x 5.7	2 x 6.5
-300	2 x 4.9	2 x 5.7	2 x 6.5
-375	2 x 4.9	2 x 5.7	2 x 6.5
-400	2 x 4.9	2 x 5.7	2 x 6.5
-430	3 x 4.9	3 x 5.7	3 x 6.5
-500	3 x 4.9	3 x 5.7	3 x 6.5
-595	3 x 4.9	3 x 5.7	3 x 6.5
-650	4 x 4.9	4 x 5.7	4 x 6.5
-720	4 x 4.9	4 x 5.7	4 x 6.5
-800	4 x 4.9	4 x 5.7	4 x 6.5
-905	5 x 4.9	5 x 5.7	5 x 6.5
-995	5 x 4.9	5 x 5.7	5 x 6.5
-1K2	6 x 4.9	6 x 5.7	6 x 6.5
-1K4	7 x 4.9	7 x 5.7	7 x 6.5
-1K6	8 x 4.9	8 x 5.7	8 x 6.5
-1K8	9 x 4.9	9 x 5.7	9 x 6.5
-2K0	10 x 4.9	10 x 5.7	10 x 6.5
-2K2	11 x 4.9	11 x 5.7	11 x 6.5
-2K4	12 x 4.9	12 x 5.7	12 x 6.5
-2K6	13 x 4.9	13 x 5.7	13 x 6.5
-2K8	14 x 4.9	14 x 5.7	14 x 6.5
-3K0	15 x 4.9	15 x 5.7	15 x 6.5

NOTE: Although the AC drive will detect a failure in the brake electronics, the use of resistors with a thermal overload which will cut off the power at overload is strongly recommended.

The brake chopper option is built-in by the manufacturer and must be specified when the AC drive is ordered.

13.6 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.

13.7 Encoder

Part number	Description
01-3876-03	Encoder 2.0 option board

The Encoder 2.0 option board, used for connection of feedback signal of the actual motor speed via an incremental encoder is described in a separate manual.
For Emotron FDU this function is for speed read-out only or for spin start function. No speed control.

13.8 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.

13.9 Crane option board

Part number	Description
590059	Crane interface board, 230 V_{AC}
590060	Crane interface board, 24 V_{DC}

This option is used in crane applications. The crane option board 2.0 is described in a separate manual.

13.10 Serial communication and fieldbus

Part number	Description	From VFX software version (see menu [922])
01-3876-04	RS232/485	4.0
01-3876-05	Profibus DP	4.0
01-3876-06	DeviceNet	4.0
01-3876-09	Modbus/TCP, Industrial Ethernet	4.11
01-3876-10	EtherCAT, Industrial Ethernet	4.32
01-3876-11	Profinet IO, one port Industrial Ethernet	4.32
01-3876-12	Profinet IO, two port Industrial Ethernet	4.32
01-3876-13	EtherNet/IP, two port industrial EtherNet	4.36

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.

13.11 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.

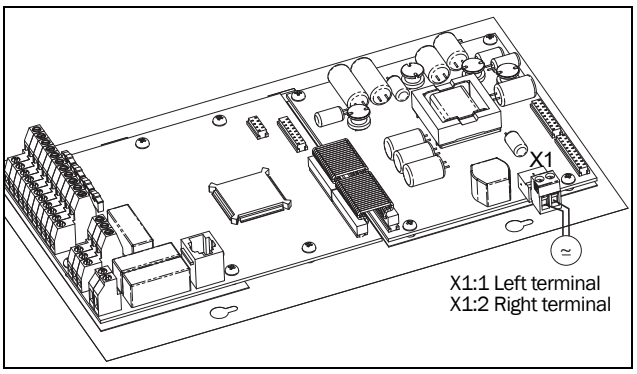


Fig. 136 Connection of standby supply optionon frame sizes B, C, C2, E, E2, F and F2.

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		

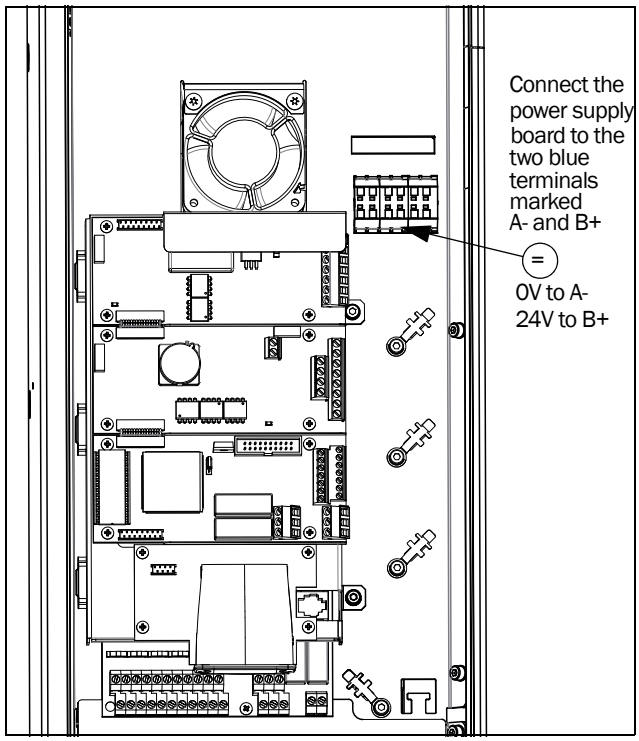


Fig. 137 Connection of standby supply option on frame size D and D2

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		

13.12 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. 140.
- High signal on the digital input, e.g. terminal 10 in Fig. 140, which is set to "Enable". For setting the digital input please refer to "11.5.2 Digital Inputs [520]" on page 151.

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 42 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 Table 140, please refer to "11.5.4 Digital Outputs [540]" on page 157.

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.

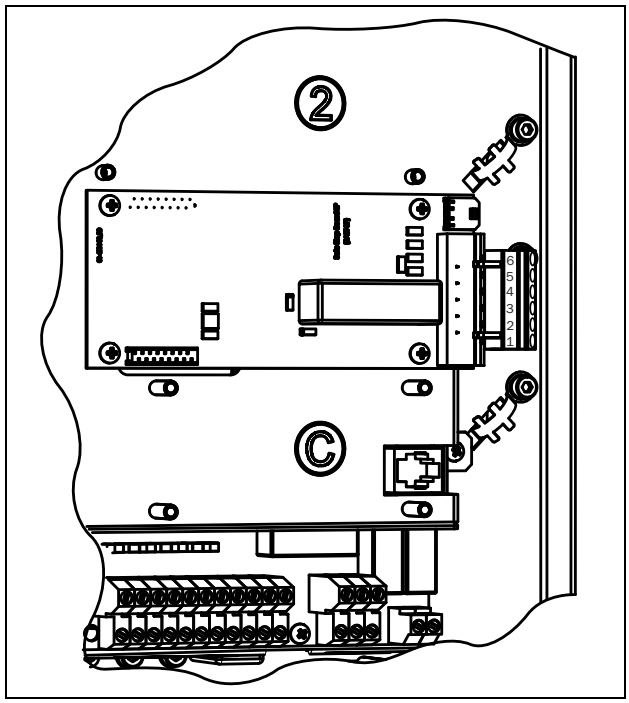


Fig. 138 Connection of safe stop option in size B - D.

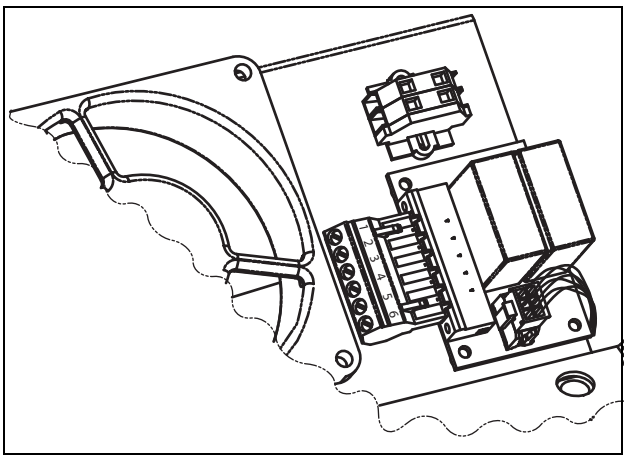


Fig. 139 Connection of safe stop option in size E and up.

Table 42 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

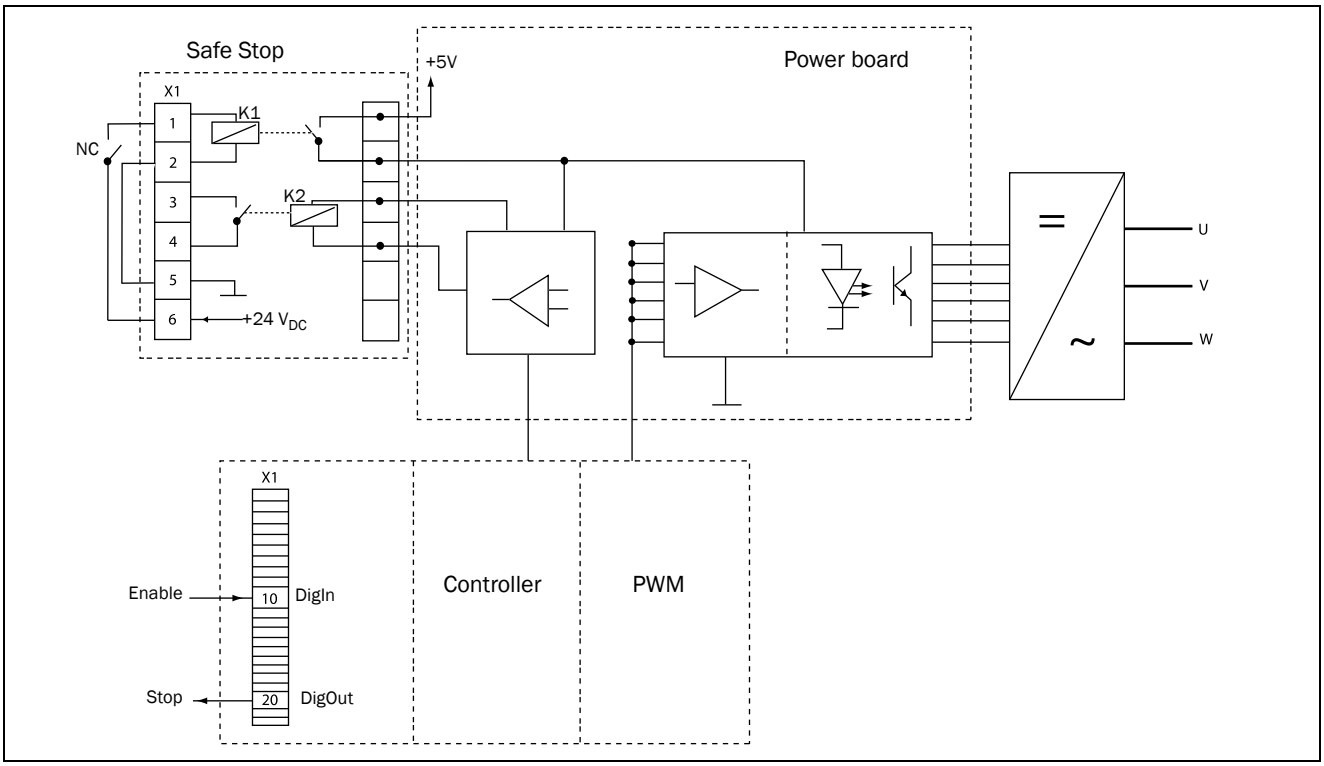


Fig. 140 Safe Stop connection

13.13 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 B,C, C2, D and D2, the filter is mounted inside the drive module.
For sizes E and up, 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.

13.14 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.

13.15 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.

13.16 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.

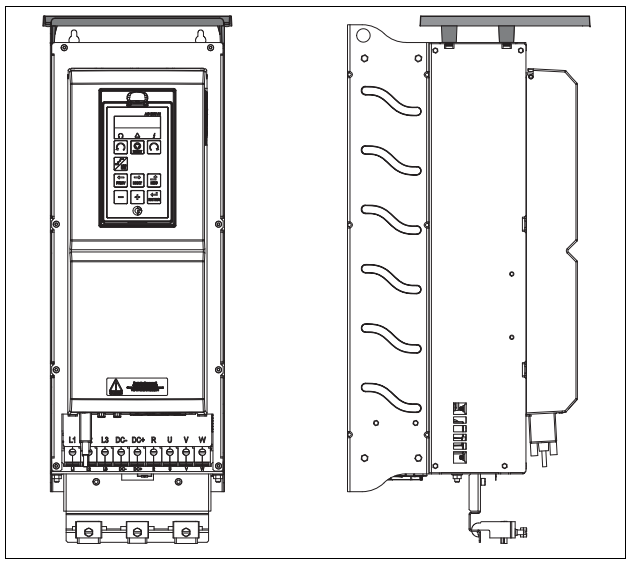


Fig. 141 Optional top cover mounted on frame size D2

13.17 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

13.18 AFE - Active Front End

Emotron AC Drives from CG Drives & Automation are also available as Low harmonic drives and Regenerative drives. You will find more information on www.emotron.com / www.cgglobal.com.

14. Technical Data

14.1 Electrical specifications related to model

Emotron VFX 2.0 - IP20/21 version

Table 43 Typical motor power at mains voltage 230 V. AC drive main voltage range 230 - 480 V.

Model	Max. output current [A]*	Normal duty (120%, 1 min every 10 min)			Heavy duty (150%, 1 min every 10 min)			Frame size
		Power @230V [kW]	Power @230V [HP]	Rated current [A]	Power @230V [kW]	Power @230V [HP]	Rated current [A]	
VFX48-025-20	38	5.5	7.5	25	4	5	20	C2
VFX48-030-20	45	7.5	10	30	5.5	7.5	24	
VFX48-036-20	54	7.5	10	36	7.5	10	29	
VFX48-045-20	68	11	15	45	7.5	10	36	
VFX48-058-20	68	15	20	58	11	15	46	
VFX48-060-20	90	15	20	60	11	15	48	D2
VFX48-072-20	108	18.5	25	72	15	20	58	
VFX48-088-20	132	22	30	88	18.5	25	70	
VFX48-105-20	132	30	40	105	22	30	84	
VFX48-142-20	170	37	50	142	30	40	114	E2
VFX48-171-20	205	45	60	171	37	50	137	
VFX48-205-20	246	55	75	205	45	60	164	F2
VFX48-244-20	293	75	100	244	55	75	195	
VFX48-293-20	352	90	125	293	75	100	235	

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

Table 44 Typical motor power at mains voltage 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)			Heavy duty (150%, 1 min every 10 min)			Frame size
		Power @400V [kW]	Power @460V [hp]	Rated current [A]	Power @400V [kW]	Power @460V [hp]	Rated current [A]	
VFX48-025-20	38	11	15	25	7.5	10	20	C2
VFX48-030-20	45	15	20	30	11	15	24	
VFX48-036-20	54	18.5	25	36	15	20	29	
VFX48-045-20	68	22	30	45	18.5	25	36	
VFX48-058-20	68	30	40	58	22	30	46	
VFX48-060-20	90	30	40	60	22	30	48	D2
VFX48-072-20	108	37	50	72	30	40	58	
VFX48-088-20	132	45	60	88	37	50	70	
VFX48-105-20	132	55	75	105	45	60	84	
VFX48-142-20	170	75	100	142	55	75	114	E2
VFX48-171-20	205	90	125	171	75	100	137	
VFX48-205-20	246	110	150	205	90	125	164	F2
VFX48-244-20	293	132	200	244	110	150	195	
VFX48-293-20	352	160	250	293	132	200	235	

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

Table 45 Typical motor power at mains voltage 230 V. AC drive main voltage range 230 - 480 V.

Model	Max. output current [A]*	Normal duty (120%, 1 min every 10 min)			Heavy duty (150%, 1 min every 10 min)			Frame size (Number of PEBB´s **)	IP klass
		Power @230V [kW]	Power @230V [HP]	Rated current [A]	Power @230V [kW]	Power @230V [HP]	Rated current [A]		
VFX48-003-54	3.8	0.37	0.5	2.5	0.37	0.5	2.0	B	IP 54 wall mounted
VFX48-004-54	6.0	0.75	1	4.0	0.55	0.75	3.2		
VFX48-006-54	9.0	1.1	1.5	6.0	0.75	1	4.8		
VFX48-008-54	11.3	1.5	2	7.5	1.1	1.5	6.0		
VFX48-010-54	14.3	2.2	3	9.5	1.5	2	7.6		
VFX48-013-54	19.5	2.2	3	13.0	2.2	3	10.4		
VFX48-018-54	27.0	4	5	18.0	3	3	14.4		
VFX48-026-54	39	5.5	7.5	26	4	5	21	C	
VFX48-031-54	46	7.5	10	31	5.5	7.5	25		
VFX48-037-54	55	7.5	10	37	7.5	10	29.6		
VFX48-046-54	69	11	15	46	7.5	10	37		
VFX48-061-54	92	15	20	61	11	15	49	D	
VFX48-074-54	111	18.5	25	74	15	20	59		
VFX48-090-54	108	22	30	90	18.5	25	72	E	
VFX48-109-54	131	30	40	109	22	30	87		
VFX48-146-54	175	37	50	146	30	40	117		
VFX48-175-54	210	45	60	175	37	50	140		
VFX48-210-54	252	55	75	210	45	60	168	F	
VFX48-228-54	300	55	75	228	55	60	182		
VFX48-250-54	300	75	100	250	55	75	200		
VFX48-295-54	354	90	125	295	75	100	236		
VFX48-300-20	360	90	125	300	75	100	240	G(2)	IP 20 module or IP54 cabinet
VFX48-375-20	450	110	150	375	90	125	300		
VFX48-430-20	516	110	150	430	110	125	344	H(2)	
VFX48-500-20	600	160	200	500	110	150	400		
VFX48-600-20	720	200	250	600	132	200	480	I(3)	
VFX48-650-20	780	200	250	650	160	200	520		
VFX48-750-20	900	220	300	750	200	250	600		
VFX48-860-20	1032	250	350	860	220	300	688	J(4)	
VFX48-1K0-20	1200	300	400	1000	250	350	800		
VFX48-1K15-20	1380	355	450	1150	250	400	920	KA(5)	
VFX48-1K25-20	1500	400	500	1250	315	400	1000		
VFX48-1K35-20	1620	400	550	1350	355	450	1080	K(6)	
VFX48-1K5-20	1800	450	600	1500	400	500	1200		
VFX48-1K75-20	2100	560	750	1750	450	600	1400	L(7)	
VFX48-2K0-20	2400	630	800	2000	500	650	1600	M(8)	
VFX48-2K25-20	2700	710	900	2250	560	750	1800	N(9)	
VFX48-2K5-20	3000	800	1000	2500	630	800	2000	O(10)	
Larger sizes available on request									

* Available during limited time and as long as allowed by drive temperature.
** PEBB= Power Electronic Building Block (power module).

Table 46 Typical motor power at mains voltage 400 V. AC drive main voltage range 230 - 480 V.

Model	Max. output current [A]*	Normal duty (120%, 1 min every 10 min)		Heavy duty (150%, 1 min every 10 min)		Frame size (Number of PEBB´s)**	IP class
		Power @400V [kW]	Rated current [A]	Power @400V [kW]	Rated current [A]		
VFX48-003-54	3.8	0.75	2.5	0.55	2.0	B	IP 54 wall mounted
VFX48-004-54	6.0	1.5	4.0	1.1	3.2		
VFX48-006-54	9.0	2.2	6.0	1.5	4.8		
VFX48-008-54	11.3	3	7.5	2.2	6.0		
VFX48-010-54	14.3	4	9.5	3	7.6		
VFX48-013-54	19.5	5.5	13.0	4	10.4		
VFX48-018-54	27.0	7.5	18.0	5.5	14.4		
VFX48-026-54	39	11	26	7.5	21	C	
VFX48-031-54	46	15	31	11	25		
VFX48-037-54	55	18.5	37	15	29.6		
VFX48-046-54	69	22	46	18.5	37		
VFX48-061-54	92	30	61	22	49	D	
VFX48-074-54	111	37	74	30	59		
VFX48-090-54	108	45	90	37	72	E	
VFX48-109-54	131	55	109	45	87		
VFX48-146-54	175	75	146	55	117		
VFX48-175-54	210	90	175	75	140		
VFX48-210-54	252	110	210	90	168	F	
VFX48-228-54	300	110	228	90	182		
VFX48-250-54	300	132	250	110	200		
VFX48-295-54	354	160	295	132	236		
VFX48-300-20	360	160	300	132	240	G(2)	IP 20 module or IP54 cabinet
VFX48-375-20	450	200	375	160	300		
VFX48-430-20	516	220	430	200	344	H(2)	
VFX48-500-20	600	250	500	220	400		
VFX48-600-20	720	315	600	250	480	I(3)	
VFX48-650-20	780	355	650	315	520		
VFX48-750-20	900	400	750	355	600		
VFX48-860-20	1032	450	860	400	688	J(4)	
VFX48-1K0-20	1200	560	1000	450	800		
VFX48-1K15-20	1380	630	1150	500	920	KA(5)	
VFX48-1K25-20	1500	710	1250	560	1000		
VFX48-1K35-20	1620	710	1350	600	1080	K(6)	
VFX48-1K5-20	1800	800	1500	630	1200		
VFX48-1K75-20	2100	900	1750	800	1400	L(7)	
VFX48-2K0-20	2400	1120	2000	900	1600	M(8)	
VFX48-2K25-20	2700	1250	2250	1000	1800	N(9)	
VFX48-2K5-20	3000	1400	2500	1120	2000	O(10)	
Larger sizes available on request							

* Available during limited time and as long as allowed by drive temperature.
** PEBB= Power Electronic Building Block (power module).

Table 47 Typical motor power at mains voltage 460 V. AC drive main voltage range 230 - 480 V.

Model	Max. output current [A]*	Normal duty (120%, 1 min every 10 min)		Heavy duty (150%, 1 min every 10 min)		Frame size (Number of PEBB´s)**	IP class
		Power @460V [HP]	Rated current [A]	Power @460V [HP]	Rated current [A]		
VFX48-003-54	3.8	1	2.5	1	2.0	B	IP 54 wall mounted
VFX48-004-54	6.0	2	4.0	1.5	3.2		
VFX48-006-54	9.0	3	6.0	2	4.8		
VFX48-008-54	11.3	3	7.5	3	6.0		
VFX48-010-54	14.3	5	9.5	3	7.6		
VFX48-013-54	19.5	7.5	13.0	5	10.4		
VFX48-018-54	27.0	10	18.0	7.5	14.4		
VFX48-026-54	39	15	26	10	21	C	
VFX48-031-54	46	20	31	15	25		
VFX48-037-54	55	25	37	20	29.6		
VFX48-046-54	69	30	46	25	37		
VFX48-061-54	92	40	61	30	49	D	
VFX48-074-54	111	50	74	40	59		
VFX48-090-54	108	60	90	50	72	E	
VFX48-109-54	131	75	109	60	87		
VFX48-146-54	175	100	146	75	117		
VFX48-175-54	210	125	175	100	140		
VFX48-210-54	252	150	210	125	168	F	
VFX48-228-54	300	200	228	150	182		
VFX48-250-54	300	200	250	150	200		
VFX48-295-54	354	250	295	200	236		
VFX48-300-20	360	250	300	200	240	G(2)	IP 20 module or IP54 cabinet
VFX48-375-20	450	300	375	250	300		
VFX48-430-20	516	350	430	250	344	H(2)	
VFX48-500-20	600	400	500	350	400		
VFX48-600-20	720	500	600	400	480	I(3)	
VFX48-650-20	780	550	650	400	520		
VFX48-750-20	900	600	750	500	600		
VFX48-860-20	1032	700	860	550	688	J(4)	
VFX48-1K0-20	1200	800	1000	650	800		
VFX48-1K15-20	1380	900	1150	750	920	KA(5)	
VFX48-1K25-20	1500	1000	1250	800	1000		
VFX48-1K35-20	1620	1100	1350	900	1080	K(6)	
VFX48-1K5-20	1800	1250	1500	1000	1200		
VFX48-1K75-20	2100	1500	1750	1200	1400	L(7)	
VFX48-2K0-20	2400	1700	2000	1300	1600	M(8)	
VFX48-2K25-20	2700	1900	2250	1500	1800	N(9)	
VFX48-2K5-20	3000	2100	2500	1700	2000	O(10)	
Larger sizes available on request							

* Available during limited time and as long as allowed by drive temperature.
** PEBB= Power Electronic Building Block (power module).

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

Table 48 Typical motor power at mains voltage 525 V.
AC drive main voltage range, for VFX52: 440 - 525 V and for VFX69: 500 - 690 V.

Model	Max. output current [A]*	Normal duty (120%, 1 min every 10 min)		Heavy duty (150%, 1 min every 10 min)		Frame size (Number of PEBB´s)**	IP class
		Power @525V [kW]	Rated current [A]	Power @525V [kW]	Rated current [A]		
VFX52-003-54	3.8	1.1	2.5	1.1	2.0	B	IP 54 wall mounted
VFX52-004-54	6.0	2.2	4.0	1.5	3.2		
VFX52-006-54	9.0	3	6.0	2.2	4.8		
VFX52-008-54	11.3	4	7.5	3	6.0		
VFX52-010-54	14.3	5.5	9.5	4	7.6		
VFX52-013-54	19.5	7.5	13.0	5.5	10.4		
VFX52-018-54	27.0	11	18.0	7.5	14.4		
VFX52-026-54	39	15	26	11	21	C	
VFX52-031-54	46	18.5	31	15	25		
VFX52-037-54	55	22	37	18.5	29.6		
VFX52-046-54	69	30	46	22	37		
VFX52-061-54	92	37	61	30	49	D	
VFX52-074-54	111	45	74	37	59		
VFX69-090-54	108	55	90	45	72	F69	
VFX69-109-54	131	75	109	55	87		
VFX69-146-54	175	90	146	75	117		
VFX69-175-54	210	110	175	90	140		
VFX69-200-54	240	132	200	110	160		
VFX69-250-20	300	160	250	132	200	H69 (2)	IP 20 module or IP54 cabinet
VFX69-300-20	360	200	300	160	240		
VFX69-375-20	450	250	375	200	300		
VFX69-400-20	480	250	400	220	320		
VFX69-430-20	516	300	430	250	344	I69 (3)	
VFX69-500-20	600	315	500	300	400		
VFX69-595-20	720	400	600	315	480		
VFX69-650-20	780	450	650	355	520	J69 (4)	
VFX69-720-20	864	500	720	400	576		
VFX69-800-20	960	560	800	450	640		
VFX69-995-20	1200	630	1000	500	800	KA69 (5)	
VFX69-1K2-20	1440	800	1200	630	960	K69 (6)	
VFX69-1K4-20	1680	1000	1400	800	1120	L69 (7)	
VFX69-1K6-20	1920	1100	1600	900	1280	M69 (8)	
VFX69-1K8-20	2160	1300	1800	1000	1440	N69 (9)	
VFX69-2K0-20	2400	1400	2000	1100	1600	O69 (10)	
VFX69-2K2-20	2640	1600	2200	1200	1760	P69 (11)	
VFX69-2K4-20	2880	1700	2400	1400	1920	Q69 (12)	
VFX69-2K6-20	3120	1900	2600	1500	2080	R69 (13)	
VFX69-2K8-20	3360	2000	2800	1600	2240	S69 (14)	
VFX69-3K0-20	3600	2200	3000	1700	2400	T69 (15)	

* Available during limited time and as long as allowed by drive temperature.
** PEBB= Power Electronic Building Block (power module).

Table 49 Typical motor power at mains voltage 575 V. AC drive main voltage range 500 - 690 V.

Model	Max. output current [A]*	Normal duty (120%, 1 min every 10 min)		Heavy duty (150%, 1 min every 10 min)		Frame size (Number of PEBB´s)**	IP class
		Power @575V [HP]	Rated current [A]	Power @575V [HP]	Rated current [A]		
VFX69-090-54	108	75	90	60	72	F69	IP 54 wall mounted
VFX69-109-54	131	100	109	75	87		
VFX69-146-54	175	125	146	100	117		
VFX69-175-54	210	150	175	125	140		
VFX69-200-54	240	200	200	150	160		
VFX69-250-20	300	250	250	200	200	H69 (2)	IP 20 module or IP54 cabinet
VFX69-300-20	360	300	300	250	240		
VFX69-375-20	450	350	375	300	300		
VFX69-400-20	480	400	400	300	320		
VFX69-430-20	516	400	430	350	344	I69 (3)	
VFX69-500-20	600	500	500	400	400		
VFX69-595-20	720	600	600	500	480		
VFX69-650-20	780	650	650	550	520	J69 (4)	
VFX69-720-20	864	750	720	600	576		
VFX69-800-20	960	850	800	650	640		
VFX69-905-20	1080	950	900	750	720	KA69 (5)	
VFX69-995-20	1200	1000	1000	850	800		
VFX69-1K2-20	1440	1200	1200	1000	960	K69 (6)	
VFX69-1K4-20	1680	1500	1400	1200	1120	L69 (7)	
VFX69-1K6-20	1920	1700	1600	1300	1280	M69 (8)	
VFX69-1K8-20	2160	1900	1800	1500	1440	N69 (9)	
VFX69-2K0-20	2400	2100	2000	1700	1600	O69 (10)	
VFX69-2K2-20	2640	2300	2200	1800	1760	P69 (11)	
VFX69-2K4-20	2880	2500	2400	2000	1920	Q69 (12)	
VFX69-2K6-20	3120	2700	2600	2200	2080	R69 (13)	
VFX69-2K8-20	3360	3000	2800	2400	2240	S69 (14)	
VFX69-3K0-20	3600	3200	3000	2500	2400	T69 (15)	

* Available during limited time and as long as allowed by drive temperature.
** PEBB= Power Electronic Building Block (power module).

Table 50 Typical motor power at mains voltage 690 V. AC drive main voltage range 500 - 690 V.

Model	Max. output current [A]*	Normal duty (120%, 1 min every 10 min)		Heavy duty (150%, 1 min every 10 min)		Frame size (Number of PEBB´s)**	IP class
		Power @690V [kW]	Rated current [A]	Power @690V [kW]	Rated current [A]		
VFX69-090-54	108	90	90	75	72	F69	IP 54 wall mounted
VFX69-109-54	131	110	109	90	87		
VFX69-146-54	175	132	146	110	117		
VFX69-175-54	210	160	175	132	140		
VFX69-200-54	240	200	200	160	160		
VFX69-250-20	300	250	250	200	200	H69 (2)	IP 20 module or IP54 cabinet
VFX69-300-20	360	315	300	250	240		
VFX69-375-20	450	355	375	315	300		
VFX69-400-20	480	400	400	315	320		
VFX69-430-20	516	450	430	315	344	I69 (3)	
VFX69-500-20	600	500	500	355	400		
VFX69-595-20	720	600	600	450	480		
VFX69-650-20	780	630	650	500	520	J69 (4)	
VFX69-720-20	864	710	720	560	576		
VFX69-800-20	960	800	800	630	640		
VFX69-905-20	1080	900	900	710	720	KA69 (5)	
VFX69-995-20	1200	1000	1000	800	800		
VFX69-1K2-20	1440	1200	1200	900	960	K69 (6)	
VFX69-1K4-20	1680	1400	1400	1120	1120	L69 (7)	
VFX69-1K6-20	1920	1600	1600	1250	1280	M69 (8)	
VFX69-1K8-20	2160	1800	1800	1400	1440	N69 (9)	
VFX69-2K0-20	2400	2000	2000	1600	1600	O69 (10)	
VFX69-2K2-20	2640	2200	2200	1700	1760	P69 (11)	
VFX69-2K4-20	2880	2400	2400	1900	1920	Q69 (12)	
VFX69-2K6-20	3120	2600	2600	2000	2080	R69 (13)	
VFX69-2K8-20	3360	2800	2800	2200	2240	S69 (14)	
VFX69-3K0-20	3600	3000	3000	2400	2400	T69 (15)	

* Available during limited time and as long as allowed by drive temperature.
** PEBB= Power Electronic Building Block (power module).

14.2 General electrical specifications

Table 51 General electrical specifications

General	
Mains voltage: VFX48 VFX52 VFX69 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 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)

14.3 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 VFX48-074
74 A - (5% x 74) = 70.3 A; this is not enough.

Calculation for model VFX48-090
90 A - (5% x 90) = 85.5 A

In this example we select the VFX48-090.

14.4 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.
The models 300 to 3K0 consist of 2, 3, 4 .... 15 paralleled power electronic building block (PEBB) available in IP20 as wall mounted modules and in IP54 mounted standard cabinet.
Protection class IP54 is according to the EN 60529 standard.

Table 52 Mechanical specifications, VFX48, VFX52

Models	Frame size	IP20 Dim. H x W x D mm (in)	IP54 Dim. H x W x D mm (in)	IP20 Weight kg (lb)	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 295	F	–	950 x 345 x 314 (37.4 x 13.6 x 12.4)	–	75 (165.4)
300 to 375	G (2xE)	1036 x 500 x 390 (40.8 x 19.7x 15.4)	2250 x 600 x 600 (88.6 x 23.6 x 23.6)	140 (308.6)	350 (771.6)
430 to 500	H (2xF)	1036 x 500 x 450 (40.8 x 19.7x 17.7)	2250 x 600 x 600 (88.6 x 23.6 x 23.6)	170 (374.8)	380 (837.8)
600 to 750	I (3xF)	1036 x 730 x 450 (40.8 x 28.7x 17.7)	2250x 900 x 600 (88.6 x 35.4 x 23.6)	248 (546.7)	506 (1116)
860 to 1K0	J (2xH)	1036 x 1100 x 450 (40.8 x 43.3x 17.7)	2250 x 1200 x 600 (88.6 x 47.2 x 23.6)	340 (749.6)	697 (1537)
1K15 to 1K25	KA (H+I)	1036 x 1365 x 450 (40.8 x 53.7x 17.7)	2250 x 1500 x 600 (88.6 x 59.1 x 23.6)	418 (921.5)	838 (1847)
1K35 to 1K5	K (2xI)	1036 x 1630 x 450 (40.8 x 64.2x 17.7)	2250 x 1800 x 600 (88.6 x 70.9 x 23.6)	496 (1093)	987 (2176)
1K75	L (2xH+I)	1036 x 2000 x 450 (40.8 x 78.7x 17.7)	2250 x 2100 x 600 (88.6 x 82.7 x 23.6)	588 (1296)	1190 (2624)
2K0	M(H+2xI)	1036 x 2230 x 450 (40.8 x 87.8x 17.7)	2250 x 2400 x 600 (88.6 x 94.5 x 23.6)	666 (1468)	1323 (2917)
2K25	N (3xI)	1036 x 2530 x 450 (40.8 x 99.6x 17.7)	2250 x 2700 x 600 (88.6 x 106.3 x 23.6)	744 (1640)	1518 (3347)
2K5	O (2xH+2xI)	1036 x 2830 x 450 (40.8 x 111.4x 17.7)	2250 x 3000 x 600 (88.6 x 118.1 x 23.6)	836 (1834)	1772 (3907)

Table 53 Mechanical specifications, VFX69

Models	Frame size	IP20 Dim. H x W x D mm (in)	IP54 Dim. H x W x D mm (in)	Weight IP20 kg (lb)	Weight IP54 kg (lb)
90 to 200	F69	–	1090 x 345 x 314 (42.9 x 13.6 x 12.4)	–	77 (169.8)
250 to 375	H69 (2xF69)	1176 x 500 x 450 (46.3 x 19.7 x 17.7)	2250 x 600 x 600 (88.6 x 23.6 x 23.6)	176 (388)	399 (879.6)
430 to 595	I69 (3xF69)	1176 x 730 x 450 (46.3 x 28.7 x 17.7)	2250 x 900 x 600 (88.6 x 35.4 x 23.6)	257 (566.6)	563 (1241)
650 to 800	J69 (2xH69)	1176 x 1100 x 450 (46.3 x 43.3 x 17.7)	2250 x 1200 x 600 (88.6 x 47.2 x 23.6)	352 (776)	773 (1704)
905 to 995	KA69 (H69+I69)	1176 x 1365 x 450 (46.3 x 53.7 x 17.7)	2250 x 1500 x 600 (88.6 x 59.1 x 23.6)	433 (954.6)	937 (2066)
750 to 1K2	K69 (2xI69)	1176 x 1630 x 450 (46.3 x 64.2 x 17.7)	2250 x 1800 x 600 (88.6 x 70.9 x 23.6)	514 (1133)	1100 (2425)
1K4	L69 (2xH69+I69)	1176 x 2000 x 450 (46.3 x 78.7 x 17.7)	2250 x 2100 x 600 (88.6 x 82.7 x 23.6)	609 (1343)	1311 (2890)
1K6	M69 (H69+2xI69)	1176 x 2230 x 450 (46.3 x 87.8 x 17.7)	2250 x 2400 x 600 (88.6 x 94.5 x 23.6)	690 (1521)	1481 (3265)
1K8	N69 (3xI69)	1176 x 2530 x 450 (46.3 x 99.6 x 17.7)	2250 x 2700 x 600 (88.6 x 106.3 x 23.6)	771 (1700)	1651 (3640)
2K0	O69 (2xH69+2xI69)	1176 x 2830 x 450 (46.3 x 111.4 x 17.7)	2250 x 3000 x 600 (88.6 x 118.1 x 23.6)	866 (1909)	1849 (4076)
2K2	P69 (H69+3xI69)	1176 x 3130 x 450 (46.3 x 123.2 x 17.7)	2250 x 3300 x 600 (88.6 x 129.9 x 23.6)	947 (2088)	2050 (4519)
2K4	Q69 (4xI69)	1176 x 3430 x 450 (46.3 x 135 x 17.7)	2250 x 3600 x 600 (88.6 x 141.7 x 23.6)	1028 (2266)	2214 (4881)
2K6	R69 (2xH69+3xI69)	1176 x 3730 x 450 (46.3 x 146.9 x 17.7)	2250 x 3900 x 600 (88.6 x 153.5 x 23.6)	1123 (2476)	2423 (5342)
2K8	S69 (H69+4xI69)	1176 x 4030 x 450 (46.3 x 158.7 x 17.7)	2250 x 4200 x 600 (88.6 x 165.4 x 23.6)	1204 (2654)	2613 (5761)
3K0	T69 (5xI69)	1176 x 4330 x 450 (46.3 x 170.5 x 17.7)	2250 x 4500 x 600 (88.6 x 177.2 x 23.6)	1285 (2833)	2777 (6122)

Dimensions and weights for models Emotron VFX48 - IP20/21 version

The table below gives an overview of the dimensions and weights of the Emotron VFX 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 54 Mechanical specifications, VFX48 - 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)
060 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)	69 (152)

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

14.5 Environmental conditions

Table 55 Operation

Parameter	Normal operation
Nominal ambient temperature	0 °C–40 °C (32 °F - 104 °F) See table, see chapter 14.3 page 219 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 56 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.

14.6 Fuses and glands

14.6.1 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 57 Fuses, cable cross-sections and glands

Model	Nominal input current [A]	Maximum value fuse [A]	Cable glands (clamping range) *	
			mains / motor	Brake
VFX##-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))
VFX##-004	3.5	4		
VFX##-006	5.2	6		
VFX##-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))
VFX##-010	8.7	10		
VFX##-013	11.3	16	M32 (16–25)/M32 (13–18)	
VFX##-018	15.6	20		
VFX##-025	22	25	- (12 - 16 mm(0.55 - 0.63 in))	
VFX##-026	22	25	M32 (15–21 mm(0.59 - 0.83 in))	M25
VFX##-030	26	35	- (16 - 20 mm (0.63 - 0.79 in))	
VFX##-031	26	35	M32 (15–21 mm(0.59 - 0.83 in))	M25
VFX##-036	31	35	- (20 - 24 mm(0.79 - 0.94))	
VFX##-037	31	35	M40 (19–28 mm (0.75 - 1.1 in))	M32
VFX##-045	38	50	- (24 - 28 mm(0.94 - 1.1 in))	
VFX##-046	38	50	M40 (19–28 mm (0.75 - 1.1 in))	M32
VFX##-058	50	63	- (24 - 28 mm(0.94 - 1.1 in))	
VFX##-060	52	63	- (28 - 32 mm(1.1 - 1.26 in))	
VFX##-061	52	63	M50 (27 - 35 mm(1.06 - 1.38 in))	M40 (19–28 mm (0.75 - 1.1 in))
VFX##-072	64	80	- (28 - 32 mm(1.1 - 1.26 in))	
VFX##-074	65	80	M50 (27 - 35 mm(1.06 - 1.38 in))	M40 (19–28 mm(0.75 - 1.1 in))
VFX##-088	78	100	- (32 - 36 mm(1.26 - 1.42 in))	
VFX##-090	78	100	VFX48: (Ø17-42 mm (0.67 - 1.65 in)) cable flexible leadthrough or M50 opening. VFX69: (Ø23-55 mm (0.9 - 2.16 in)) Cable flexible leadthrough or M63 opening.	FX48: (Ø11-32 mm(0.43 - 1.26 in)) Cable flexible leadthrough or M40 opening. VFX69: (Ø17-42 mm (0.67 - 1.65 in)) Cable flexible leadthrough or M50 opening.
VFX##-105	91	100	- (32 - 36 mm(1.26 - 1.42 in))	

Table 57 Fuses, cable cross-sections and glands

Model	Nominal input current [A]	Maximum value fuse [A]	Cable glands (clamping range) *	
			mains / motor	Brake
VFX##-109	94	100	VFX48: (Ø17-42 mm (0.67 - 1.65 in)) cable flexible leadthrough or M50 opening. VFX69: (Ø23-55 mm (0.9 - 2.16 in)) Cable flexible leadthrough or M63 opening.	FX48: (Ø11-32 mm(0.43 - 1.26 in)) Cable flexible leadthrough or M40 opening. VFX69: (Ø17-42 mm (0.67 - 1.65 in)) Cable flexible leadthrough or M50 opening.
VFX##-142	126	160	- (40 - 44 mm (1.57 - 1.73 in))	- (36 - 40 mm(1.42 - 1.57 in))
VFX##-146	126	160	VFX48: (Ø17-42 mm (0.67 - 1.65 in)) cable flexible leadthrough or M50 opening. VFX69: (Ø23-55 mm (0.9 - 2.16 in)) Cable flexible leadthrough or M63 opening.	FX48: (Ø11-32 mm(0.43 - 1.26 in)) Cable flexible leadthrough or M40 opening. VFX69: (Ø17-42 mm (0.67 - 1.65 in)) Cable flexible leadthrough or M50 opening.
VFX##-171	152	160	- (40 - 44 mm (1.57 - 1.73 in))	- (36 - 40 mm(1.42 - 1.57 in))
VFX##-175	152	160	VFX48: (Ø17-42 mm (0.67 - 1.65 in)) cable flexible leadthrough or M50 opening. VFX69: (Ø23-55 mm (0.9 - 2.16 in)) Cable flexible leadthrough or M63 opening.	FX48: (Ø11-32 mm(0.43 - 1.26 in)) Cable flexible leadthrough or M40 opening. VFX69: (Ø17-42 mm (0.67 - 1.65 in)) Cable flexible leadthrough or M50 opening.
VFX##-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))
VFX69-200	173	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.
VFX##-210	182	200		
VFX##-228	197	250		
VFX##-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))
VFX##-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.
VFX##-295	256	300		
VFX##-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))
VFX##-300	260	300	--	--
VFX##-375	324	355		
VFX69-400	346	400		
VFX##-430	372	400		
VFX##-500	432	500		
VFX69-595	516	630		
VFX##-600	520	630		
VFX##-650	562	630		
VFX##- 720, 750	648	710		
VFX69-800	692	800		
VFX##-860	744	800		
VFX##-900	795	900		
VFX69-900	860	1000		
VFX##-1K0	864	1000		
VFX##-1K15	996	1250		
VFX##-1K2	1037	1250		
VFX##-1K25	1037	1250		
VFX##-1K35	1170	1250		
VFX69-1K4	1213	1500		
VFX##-1K5	1296	1500		
VFX69-1K6	1382	1600		
VFX##-1K75	1516	1600		

Table 57 Fuses, cable cross-sections and glands

Model	Nominal input current [A]	Maximum value fuse [A]	Cable glands (clamping range) *	
			mains / motor	Brake
VFX69-1K8	1555	2 x 900	-	-
VFX##-2K0	1732	2 x 900		
VFX69-2K2	1900	2 x 1000		
VFX##-2K25	1949	2 x 1000		
VFX69-2K4	2074	2 x 1250		
VFX##-2K5	2165	2 x 1250		
VFX69-2K6	2246	2 x 1250		
VFX69-2K8	2419	2 x 1500		
VFX69-3K0	2592	2 x 1500		

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 30

14.6.2 Fuses according to NEMA ratings

Table 58 Types and fuses

Model	Input current [Arms]	Mains input fuses	
		UL Class J TD (A)	Ferraz-Shawmut type
VFX48-003	2.2	6	AJT6
VFX48-004	3.5	6	AJT6
VFX48-006	5.2	6	AJT6
VFX48-008	6.9	10	AJT10
VFX48-010	8.7	10	AJT10
VFX48-013	11.3	15	AJT15
VFX48-018	15.6	20	AJT20
VFX48-025	21.7	25	AJT25
VFX48-026	22	25	AJT25
VFX48-030	26	30	AJT30
VFX48-031	26	30	AJT30
VFX48-036	31	35	AJT35
VFX48-037	31	35	AJT35
VFX48-045	39	45	AJT45
VFX48-046	40	45	AJT45
VFX48-058	50	60	AJT60
VFX48-060	52	60	AJT60
VFX48-061	52	60	AJT60
VFX48-072	64	80	AJT80
VFX48-074	65	80	AJT80
VFX48-088	78	100	AJT100
VFX48-090	78	100	AJT100
VFX48-105	91	110	AJT110
VFX48-109	94	110	AJT110
VFX48-142	126	125	AJT150
VFX48-146	126	150	AJT150
VFX48-171	152	175	AJT175
VFX48-175	152	175	AJT175
VFX48-205	178	200	AJT200
VFX48-210	182	200	AJT200
VFX48-228	197	250	AJT250
VFX48-244	211	250	AJT250
VFX48-250	216	250	AJT250
VFX48-293	254	300	AJT300
VFX48-295	256	300	AJT300
VFX48-300	260	300	AJT300
VFX48-375	324	350	AJT350
VFX48-430	372	400	AJT400
VFX48-500	432	500	AJT500
VFX48-600	520	600	AJT600
VFX48-650	562	600	AJT600
VFX48-720	648	700	A4BQ700
VFX48-750	648	700	A4BQ700
VFX48-860	744	800	A4BQ800
VFX48-900	795	800	A4BQ800

Table 58 Types and fuses

Model	Input current [Arms]	Mains input fuses	
		UL Class J TD (A)	Ferraz-Shawmut type
VFX48-1K0	864	1000	A4BQ1000
VFX48-1K15	996	1000	A4BQ1000
VFX48-1K2	1037	1200	A4BQ1200
VFX48-1K25	1037	1200	A4BQ1200
VFX48-1K35	1170	1200	A4BQ1200
VFX48-1K5	1296	1500	A4BQ1500
VFX48-1K75	1516	1600	A4BQ1600
VFX48-2K0	1732	1800	A4BQ1800
VFX48-2K25	1949	2000	A4BQ2000
VFX48-2K5	2165	2500	A4BQ2500

14.7 Control signals

Table 59

Terminal X1	Name:	Function (Default):	Signal:	Type:
1	+10 V	+10 VDC Supply voltage	+10 VDC, max 10 mA	output
2	AnIn1	Process reference	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	RunL	0-8/24 VDC	digital input
9	DigIn 2	RunR	0-8/24 VDC	digital input
10	DigIn 3	Off	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	Off	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	Brake	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	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.

15. Menu List

On our home page in the download area, you could find a "Communication information" list and a list to note Parameter set information .

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	120	2nd Line			Torque		
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	210	Operation					73
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		212	Select Motor		M1		
		213	Drive Mode		Speed		
		214	Ref Control		Remote		
		215	Run/Stp Ctrl		Remote		
		216	Reset Ctrl		Remote		
		217	Local/Rem				
			2171	LocRefCtrl	Standard		
			2172	LocRunCtrl	Standard		
		218	Lock Code?		0		
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		21A	Level/Edge		Level		
		21B	Supply Volts		Not Defined		
		21C	Supply Type		AC Supply		
	220	Motor Data					79
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		223	Motor Power		(P_{NOM}) W		
		224	Motor Curr		(I_{MOT}) A		
		225	Motor Speed		(n_{MOT}) rpm		
		226	Motor Poles		4		
		227	Motor Cosφ		$Cos\varphi_{NOM}$		
		228	Motor Vent		Self		
		229	Motor ID-Run		Off		
		22B	Encoder		Off		
		22C	Enc Pulses		1024		
		22D	Enc Speed		0rpm		
		22F	Enc Puls Ctr		0		
		22G	Enc Fault				
			22G1	Enc F Delay	Off		
			22G2	Enc F Band	10%		
			22G3	Max EncFCtr	0.000s		
		22H	Phase order		Normal		
		22I	Motor type		Async		
	230	Mot Protect					84
		231	Mot I^2t Type		Trip		
		232	Mot I^2t Curr		100%		
		233	Mot I^2t Time		60s		
		234	Thermal Prot		Off		
		235	Motor Class		F 140°C		
		236	PT100 Inputs		PT100 1+2+3		
		237	Motor PTC		Off		

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	244	Copy to CP			No Copy		
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250	Autoreset						90
	251	No of Trips			0		
	252	Overtemp			Off		
	253	Overvolt D			Off		
	254	Overvolt G			Off		
	255	Overvolt			Off		
	256	Motor Lost			Off		
	257	Locked Rotor			Off		
	258	Power Fault			Off		
	259	Undervoltage			Off		
	25A	Motor I^2t			Off		
	25B	Motor I^2t TT			Trip		
	25C	PT100			Off		
	25D		PT100 TT		Trip		
	25E	PTC			Off		
	25F	PTC TT			Trip		
	25G	Ext Trip			Off		
	25H	Ext Trip TT			Trip		
	25I	Com Error			Off		
	25J	Com Error TT			Trip		
	25K	Min Alarm			Off		
	25L	Min Alarm TT			Trip		
	25M	Max Alarm			Off		
	25N	Max Alarm TT			Trip		
	25O	Over curr F			Off		
	25P	Pump			Off		
	25Q	Over speed			Off		
	25R	Ext Mot Temp			Off		
	25S	Ext Mot TT			Trip		
	25T	LC Level			Off		
	25U	LC Level TT			Trip		
	25V	Brk Fault			Off		
	25W	Encoder			Off		
	25X	Crane Deviat			Off		
	25Y	Crane Comm			Off		
260	Serial Com						98
	261	Com Type			RS232/485		
	262	RS232/485					98
		2621	Baudrate		9600		
		2622	Address		1		
	263	Fieldbus					99
		2631	Address		62		
		2632	PrData Mode		Basic		
		2633	Read/Write		RW		
		2634	AddPrValue		0		
	264	Comm Fault					100
		2641	ComFlt Mode		Off		
		2642	ComFlt Time		0.5 s		

				Factory setting	Customer	Page
265	Ethernet					100
	2651	IP Address	0.0.0.0			
	2652	MAC Address	000000000000			
	2653	Subnet Mask	0.0.0.0			
	2654	Gateway	0.0.0.0			
	2655	DHCP	Off			
266	FB Signal					101
	2661	FB Signal 1	0			
	2662	FB Signal 2	0			
	2663	FB Signal 3	0			
	2664	FB Signal 4	0			
	2665	FB Signal 5	0			
	2666	FB Signal 6	0			
	2667	FB Signal 7	0			
	2668	FB Signal 8	0			
	2669	FB Signal 9	0			
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	266B	FB Signal 11	0			
	266C	FB Signal 12	0			
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321	Proc Source		Speed			
322	Proc Unit		rpm			
323	User Unit		0			
324	Process Min		0			
325	Process Max		0			
326	Ratio		Linear			
327	F(Val) PrMin		Min			
328	F(Val) PrMax		Max			
330	Start/Stop					107
331	Acc Time		10.00s			
332	Dec Time		10.00s			
333	Acc MotPot		16.00s			
334	Dec MotPot		16.00s			
335	Acc>Min Spd		10.00s			
336	Dec<Min Spd		10.00s			
337	Acc Rmp		Linear			
338	Dec Rmp		Linear			
339	Start Mode		Normal DC			
33A	Spinstart		Off			
33B	Stop Mode		Decel			
33C	Brk Release		0.00s			
33D	Release Spd		0rpm			
33E	Brk Engage		0.00s			
33F	Brk Wait		0.00s			
33G	Vector Brake		Off			
33H	Brk Fault		1.00s			
33I	Release Torque		0%			
340	Speed					115
341	Min Speed		0rpm			
342	Stp<MinSpd		Off			
343	Max Speed		Sync Speed			

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344	SkipSpd 1 Lo		0rpm			
345	SkipSpd 1 Hi		0rpm			
346	SkipSpd 2 Lo		0rpm			
347	SkipSpd 2 Hi		0rpm			
348	Jog Speed		50rpm			
350	Torques					118
351	Max Torque		120%			
352	IxR Comp		Off			
353	IxR CompUsr		0%			
354	Flux optim		Off			
355	Max Power		Off			
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361	Motor Pot		Non Volatile			
362	Preset Ref 1		0 rpm			
363	Preset Ref 2		250 rpm			
364	Preset Ref 3		500 rpm			
365	Preset Ref 4		750 rpm			
366	Preset Ref 5		1000 rpm			
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382	PID Autotune		Off			
383	PID P Gain		1.0			
384	PID I Time		1.00s			
385	PID D Time		0.00s			
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387	PID Act Marg		0			
388	PID Stdy Tst		Off			
389	PID Stdy Mar		0			
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391	Pump enable		Off			
392	No of Drives		2			
393	Select Drive		Sequence			
394	Change Cond		Both			
395	Change Timer		50h			
396	Drives on Ch		0			
397	Upper Band		10%			
398	Lower Band		10%			
399	Start Delay		0s			
39A	Stop Delay		0s			
39B	Upp Band Lim		0%			
39C	Low Band Lim		0%			
39D	Settle Start		0s			
39E	TransS Start		60%			
39F	Settle Stop		0s			
39G	TransS Stop		60%			
39H	Run Time 1		00:00:00			
39H1	Rst Run Tm1		No			
39I	Run Time 2		00:00:00			
39I1	Rst Run Tm2		No			
39J	Run Time 3		00:00:00			
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		39K1	Rst Run Tm4		No		
	39L	Run Time05			00:00:00		
		39L1	Rst Run Tm5		No		
	39M	Run Time 6			00:00:00		
		39M1	Rst Run Tm6		No		
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CG Drives & Automation Sweden AB
Mörsaregatan 12
Box 222 25
SE-250 24 Helsingborg
Sweden
T +46 42 16 99 00
F +46 42 16 99 49
www.emotron.com/www.cgglobal.com

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