emotron®
DEDICATED DRIVE

Valid for the following inverter Models:
VFB40-004 to VFB40-046
VFX40-018 to VFX40-749
VFX50-018 to VFX50-749
Software version: 3.xx

VECTORFLUX™ VFB
VECTORFLUX™ VFX

INSTRUCTION MANUAL

Document number: 01-1887-01
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Instruction manual
Read the instruction manual first!

Software version
Check always that the software version number on the title page of this instruction manual is the same as the software used in the inverter. This can easily be checked in the Setup menu in window [920] Software, see § 5.10.2, page 68.

Technically qualified personnel
Installation, commissioning, demounting, making measurements, etc, of or on the frequency inverter may only be carried out by personnel technically qualified for the task.

Installation
The installation must be made by authorised personnel and must be made according to the local standards.

Opening the frequency inverter

DANGER! ALWAYS SWITCH OFF THE MAINS VOLTAGE BEFORE OPENING THE INVERTER AND WAIT AT LEAST 5 MINUTES TO ALLOW THE BUFFER CAPACITORS TO DISCHARGE.

Always take adequate precautions before opening the frequency inverter. Although the connections for the control signals and the jumpers are isolated from the mains voltage, always take adequate precautions before opening the frequency inverter.

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 first be disconnected from the frequency inverter. Wait at least 5 minutes before starting work.

Earthing
The frequency inverter must always be earthed via the mains safety earth connection, indicated by "PE".

EMC Regulations
In order to comply with the EMC directive, it is absolutley necessary to follow the installation instructions. See § 3.4, page 13.

Mains voltage selection
The frequency inverter is suitable for use with the main voltages listed in § 8.1, page 77. Adjustment of the mains voltage is not necessary!

Voltage tests (Megger)
Do not carry out voltage tests (megger) on the motor, before all the motor cables are disconnected from the frequency inverter.

Condensation
If the frequency inverter 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 dampnesses have evaporated.

Incorrect connection
The frequency inverter is not protected against incorrect connection of the main voltage, and in particular against connection of the mains voltage to the motor outlets U, V, W. The frequency inverter 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. More information on causes of tripping and recovery can be found in Chapter 6. page 69.

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

IT Mains supply
Before connecting the inverter to a IT mains supply, (non-earthed neutral), please contact your supplier.

ID Run
Take all necessary precautions before the ID Run is performed. During the EXTENDED ID Run the motor will run in both directions.

Small motors
Do not connect motors smaller than 25% of the nominal power of the inverter. This may disrupt the control of the motor.

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1. GENERAL INFORMATION

1.1 Introduction

The frequency inverter is intended for controlling speed and torque of standard three phase asynchronous electrical motors. The inverter is equipped with a sophisticated vector control which uses 2 built-in DSPs, giving the inverter 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 speeds, high torque and high-speed accuracy are demanded. In "simpler" application such as fans or pumps, the VFB/VFX vector control offers other great advantages such as insensitivity to mains disturbances or load shocks.

Read this instruction manual carefully before starting installation, connection or working with the frequency inverter.

The following indications can appear in this manual. Always read these first before continuing:

NOTE! Additional information as an aid to avoiding problems.

CAUTION  **Failure to follow these instructions can result in malfunction or damage to the frequency inverter.**

WARNING  **Failure to follow these instructions can result in serious injury to the user in addition to serious damage to the frequency inverter.**

DANGER  **The life of the user is in danger.**

1.2 Description

This instruction manual describes the installation and use of the frequency inverters with the following type codes:
VFB40-004 to VFB40-016
VFX40-018 to VFX40-749
VFX50-018 to VFX50-749

1.2.1 Users

This instruction manual is intended for:
- installation engineers
- maintenance engineers
- operators
- designers
- service engineers

1.2.2 Motors

The frequency inverter is suitable for use with standard 3-phase asynchronous motors. In certain conditions it is possible that other types of motors may be used. Contact your supplier for details.

WARNING! Do not connect motors smaller than 25% of the nominal power of the inverter. This may disrupt the control of the motor.

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

1.2.3 Standards

For the applicable standards, see § 1.6, page 9.

CAUTION! In order to comply fully with the standards stated in the Manufacturer's Declara-tion, the installation instructions detailed in this instruction manual must be strictly followed.

1.3 Use of the instruction manual

Within this instruction manual the word "inverter" is used to indicate the complete frequency inverter as a single unit.

Check that the software version number on the first page of this manual complies with the software version in the frequency inverter. See § 5.10.2, page 68.

Chapter 2. page 10 explains how to get started easily. It explaines what is absolutely necessary to do before the inverter can be started.

Chapter 3. page 12 describes the installation of the inverter with regard to the EMC Directives. Used together with the Setup Menu List and the Quick Setup Card this chapter makes setting up of the frequency inverter quick and easy.

Chapter 4. page 22 explains the operation of the frequency inverter.

Chapter 5. page 30 is the main "data base" for all the functions. They appear in this chapter in the same order as they appear in the Setup Menu.

With help of the Index and the Contents it is easy to track individual functions and to find out how to use and set them.

Chapter 6. page 69 gives information about troubleshooting, fault finding and diagnoses.

Chapter 7. page 73 gives information about the use of optional cards and functions. For some options, reference is made to the separate instruction manual for that option.

Chapter 8. page 77 lists all technical data concerning the complete power range.

The Quick Setup Card can be put in a cabinet door, so that it is always easy to access in case of emergency.

1.4 Delivery and unpacking

Check for any visible signs of damage. Inform your supplier immediately of any damage found. Do not install the inverter if damage is found.

The inverters are delivered with a template for positioning the fixing holes on a flat surface. Check that all items are present and that the type number is correct. See § 1.5.

If the inverter is temporarily stored before being connected, see § 8.5, page 80. If the inverter is moved from a cold storage room to the room where it is to be installed, condensation can form on it. Allow the inverter to become fully acclimatised and wait until any visible condensation has evaporated before connecting the mains voltage.

1.5 Type number

Fig. 1 gives an example of the type code numbering used on all inverters.

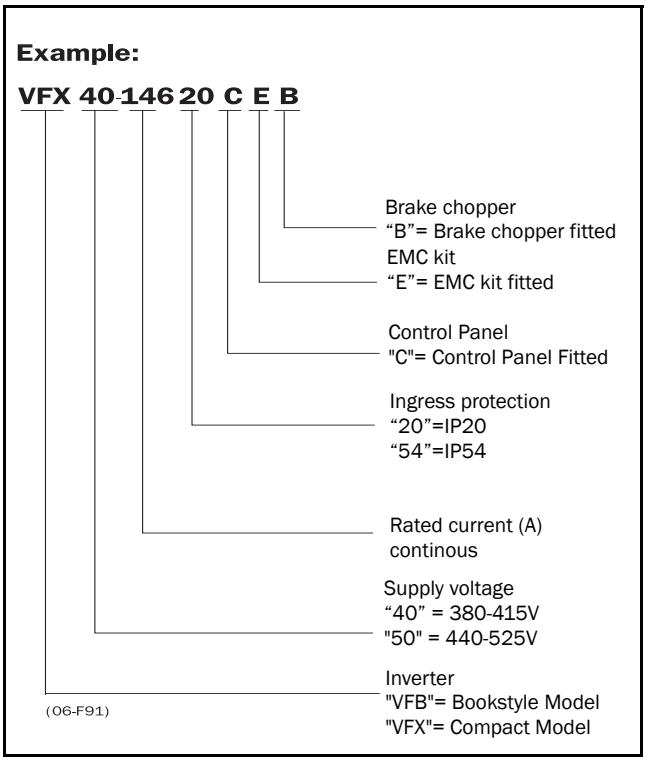


Fig. 1 Type number

1.6 Standards

The inverters described in this instruction manual comply with the standards as listed in Table 1, with regard to the Machine Directive, EMC Directive and the Low Voltage Directive. See the declarations of conformity and manufacturers certificate. Contact your supplier for more information.

Table 1 Standards

Standard	Description
EN60204-1	Safety of machinery - Electrical equipment of machines Part 1: General requirements. **Machine Directive: Manufacturer's certificate acc. to Appendix IIB**
EN61800-3 A11 2nd Environment	Adjustable speed electrical power drive systems Part 3: EMC product standard including specific test methods. **EMC Directive: Declaration of Conformity and CE-marking**
EN50178	Electronic equipment for use in power installations. **Low Voltage Directive: Declaration of Conformity and CE-marking**

1.6.1 Product standard for EMC

The product standard EN 61800-3 defines the **First Environment** 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.

Second Environment includes all other establishments.

The VFB/VFX complies with the product standard EN 61800-3 including amendment A11 (Any kind of metal screened cable may be used). The standard VFB/VFX is designed to meet the requirements for the **Second Environment**.

WARNING! This is a product of the restricted sales distribution class according to EN 61800-3. In a domestic environment this product may cause radio interference in ehich case the user may be required to take adequate measures.

1.7 Dismantling and scrapping

The enclosures of the inverters are made of recyclable material as aluminium, iron and plastic. The inverter 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 disposal and recycling of these materials must be complied with.

This chapter describes in the shortest way the minimum efforts needed to get the motor shaft turning. It is based on the standard speed mode and the default settings for I/O, etc. For other drive modes, I/O settings, controller functions, etc., please refer to Chapter 5. page 30.

2.1 Making the first start

- Check that the mains and motor wiring are correct according to Chapter 3. page 12.
- The motor data (taken from the motor name plate) should be entered in menu 220, see § 5.3.7, page 33. It is also recommended to do a Motor ID run, see § 5.3.15, page 34.

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

- To run the motor, there must be a reference value and a start command present. See also Fig. 2.
- The default for a speed reference value is input AnIn1 on terminal 2, 0-10VDC. Connect a potentiometer or a 0-10V variable signal between inputs 2 and 3 (a +10V reference for the potentiometer is available on terminal 1). There must also be a wire bridge between terminals 3 and 7 if the reference signal is not differential.
- The reference value coming into the inverter can be viewed in window 500, see § 5.6, page 57.
- The run command (RunR) is given by making input terminal 9 high, i.e. a closed contact between terminals 9 and 11. This run command will only be accepted if the Enable Input (terminal 10) is made active.
- Set the reference value to a low value (about 10% of nominal speed) and start the motor as indicated above. The motor will now run, the reference value can be changed up and down, and the operational data can be viewed in menu 600, see § 5.7, page 58.
- This operation will indicate that the main connections are OK that the motor runs the load. The next step will be to adjust other settings to optimize the system for the application, please refer to Chapter 5. page 30.

2.2 Control via the Control Panel

The test run can also be performed via the Control Panel. The procedure differs from that described in § 2.1 as follows:

- Set the Reference control in window [212] (see § 5.3.3, page 31) and the Run/Stop control in window [213] (§ 5.3.4, page 32) to "Keyboard".
- The only wiring needed on the control board is closed contact between terminals 10 and 11 (Enable).
- The reference value is entered directly in window [500] see § 5.6, page 57.
- The drive can be started by pressing one of the Run keys (RunL and RunR available) on the Control Panel.

2.3 Minimum wiring for starting

Fig. 2 shows the minimum control wiring needed to get started. The input AnIn1 is used as normal (non-differential input) with a 2 kΩ potentiometer. The Enable input must be active together with RunR or RunL. The potentiometer will work as a Speed Reference (default).

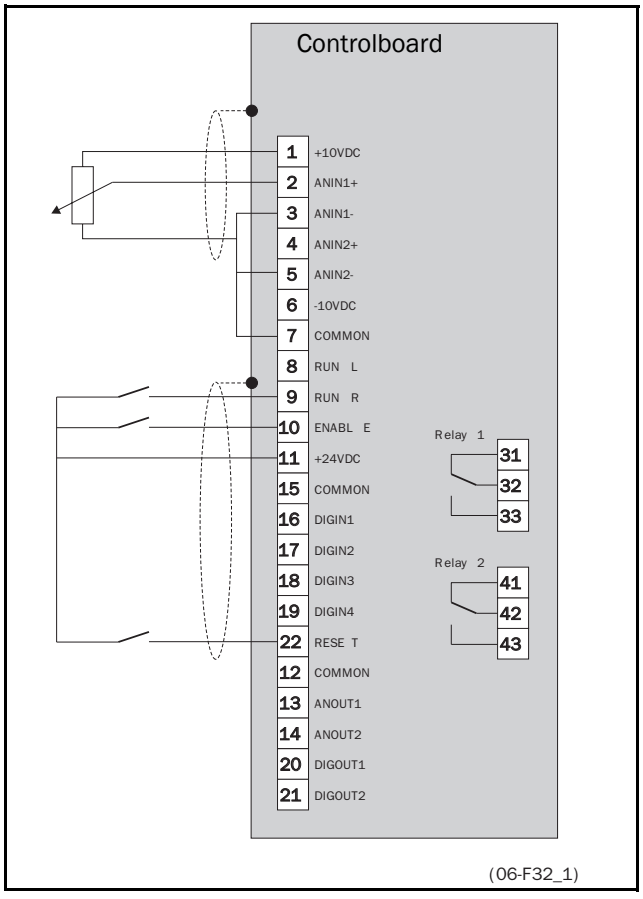


Fig. 2 Minimum control wiring.

2.4 Use of the differential analogue inputs

The inputs AnIn1 and AnIn2 are differential inputs. This means that the common of the signal is not connected with the common of the inverter, nor with the common of any other input or output. The advantage of this is that the input is less sensitive to external interference as only the difference in signal on the two wires is used. Another advantage is that control signals from different PLCs with a different common potential can be connected without any problem. To use the differential input for a non-differential signal it is necessary to connect the negative signal to the common of the inverter.

Fig. 3 shows 2 ways of using the differential inputs AnIn1 and AnIn2.

- Input AnIn2 is used as differential input (wire bridge terminal 5.7 is off).
- Input AnIn1 is used as normal (non-differential) input with a potentiometer.

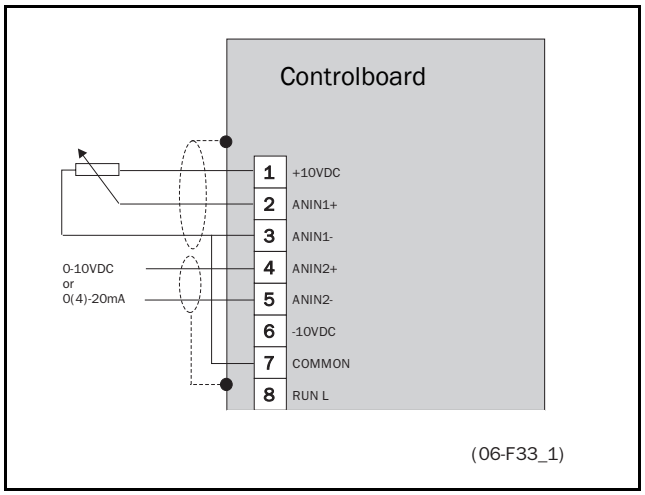


Fig. 3 Using differential inputs.

2.5 Setting the motor data

This inverter is primary designed to operate with one motor only (multi-motor applications are only possible in V/Hz Mode). To have the best performance with respect to accuracy, torque and speed response so that the internal control loops and algorithms perform at their best, it is essential for the inverter to know the exact motor data. Apart from the motor data the inverter can perform an identification run which determines and saves the measured motor data.

If no specific motor data is entered, the inverter will operate on the default motor data. This default data is based on a standard 4-pole motor and set to the same power as the nominal power as the inverter itself.

NOTE! Although the inverter will run on its default motor data it is strongly advised to set the motor data according to the data of the connected motor and to perform the Identification Run, to achieve the best possible dynamic performance.

See § 5.3.7, page 33 to set the motor data.

2.6 Setting the Drive Mode

It is essential to set the Drive Mode to ensure correct operation of the inverter. Drive Mode sets the internal control loops according to the selected mode. It essential that if the Speed Mode is used, the analogue input is also set to speed; the same is valid for Torque Mode.

The default setting is Speed Mode. In this mode the inverter will control the shaft speed of the motor, but it is still possible to limit the torque via an external signal.

In Torque Mode, the input (torque) will act directly on the Torque loop, thus bypassing the speed loop.

In V/Hz Mode, the inverter works as an open loop frequency controlled inverter. All reference settings are related to frequency but given in rpm. In this mode multi-motor applications are possible.

NOTE! In the V/Hz Mode, all the functions and window read-out with regard to speed and rpm (e.g. Max Speed=1500rpm, Min Speed=0rpm, etc) remain for speed and rpm, although they represent the output frequency.

NOTE! In the V/Hz mode multi-motor applications are possible. Special care must be taken with regards to setting of the Motor Data. Please contact your supplier.

See § 5.3.2, page 31 to set the Drive Mode.

2.7 Performing an Identification Run

To get the optimum performance out of your inverter/ motor combination, the inverter must measure the electrical parameters (resistance of stator windings, etc.) of the connected motor.

It is recommended to use the extended ID run 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 will rotate. Take safety measures to avoid unexpected dangerous situations.

WARNING! Always switch off the mains voltage before opening the inverter and wait at least 5 minutes to allow the DC-link capacitors to discharge.

Although the connections for the control signals and the jumpers are isolated from the main voltage, always take adequate precautions before opening the frequency inverter.

3.1 Mounting and cooling

The inverter must be mounted vertically against a flat surface.

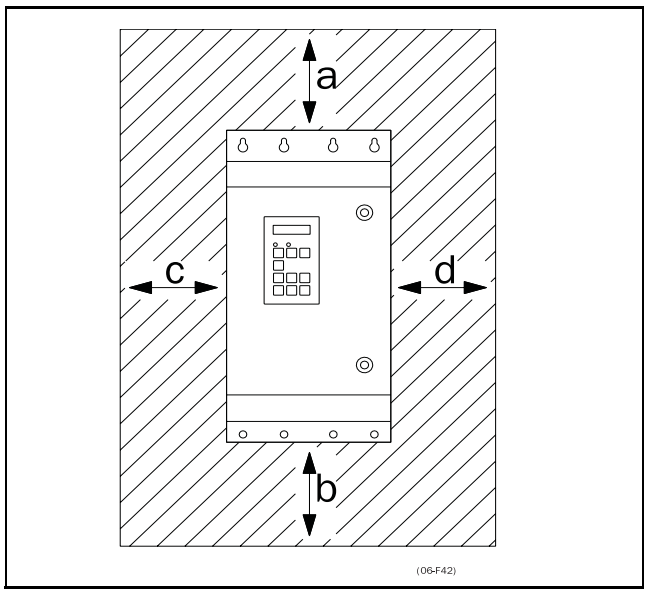


Fig. 4 Frequency inverter mounting model 004 to 374

Fig. 4 show the minimum free space required around the inverter of the models 004 to 374 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 frequency inverters, an inverter and a non-dissipating wall must be maintained:

Table 2 Mounting and cooling

		004-016	018-037	046-374
VFB/VFX-VFB/VFX	a	200 mm	200 mm	200 mm
	b	200 mm	200 mm	200 mm
	c	0 mm	0 mm	30 mm
	d	0 mm	0 mm	30 mm
VFB/VFX-wall	a	100 mm	100 mm	100 mm
	b	100 mm	100 mm	100 mm
	c	0 mm	0 mm	30 mm
	d	0 mm	0 mm	30 mm

Fig. 75, page 76 - Fig. 83, page 83 give the size and fixing sizes of the inverters. The models 004 to 016 (VFB) are mounted with help of omega- or DIN-rail. For the other models up to model 374 the enclosed template can be used to easily determine the position of the fixing holes.

3.2 Flow rates cooling fans

If the frequency inverter is installed in a cabinet, account must be taken of the rate of airflow supplied by the cooling fans.

Table 3 Flow rates cooling fans

VFB/VFX model	Flow rate [m^3/hour]
004 – 016	140
018 – 037	150
046 – 060, 073	165
061 – 090	510
109 – 175	800
175 – 374	975

3.3 Mains and motor connections

Fig. 5 show the positions of the mains connectors and the motor connectors. For the models 018 to 175 (VFX) the front panel can be opened with the supplied key. The front panel is hinged on one side. The front panel of the models 004 to 016 (VFB) is fixed with 2 screws on the bottom of the inverter. After unscrewing, the front can easily be taken away by pushing it upwards.

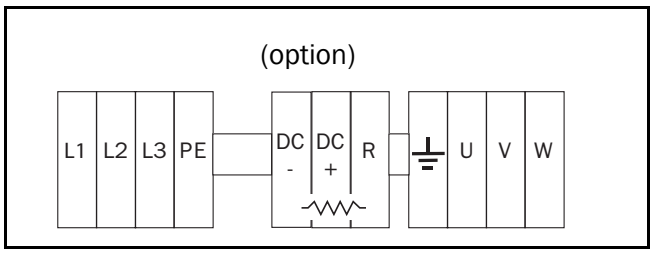


Fig. 5 Mains and motor connections for model 004 to 016 and 018 to 037.

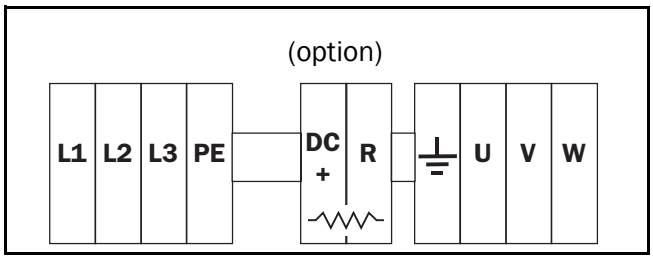


Fig. 6 Mains and motor connection for model 046 to 749.

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

Table 4 Mains and motor connection

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

NOTE! The Brake and DC-link Terminals are only fitted if the Brake Chopper Option is built-in. The VFX inverters are only fitted with the DC+ and R terminals.

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

3.4 Mains and motor connections in accordance with EMC directives

CAUTION! In order to comply with the EMC directive, it is absolutely necessary to follow the installation instructions as described in this man-ual. For further detailed information about EMC directives and frequency inverters please refer to the installation instructions "EMC directive and frequency inverters". Please contact your supplier.

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

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. 7 and Fig. 8.

Fig. 7 shows an example of how to connect a frequency inverter on a mounting plate. The litze connection is only necessary if the mounting plate is painted. All the inverters have an unpainted back side and are therefore suitable for mounting on an unpainted mounting plate.

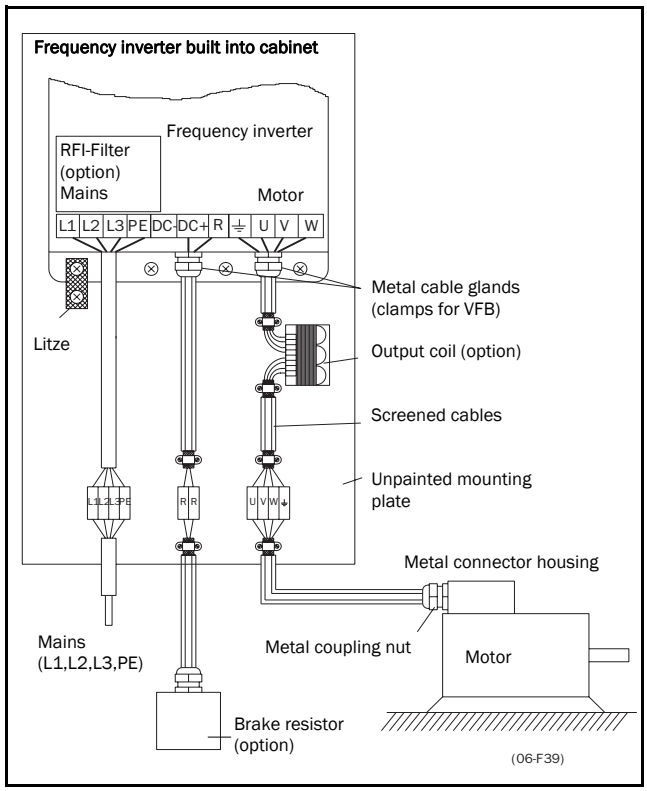


Fig. 7 Frequency inverter in a cabinet on a mounting plate.

Fig. 8 shows an example when there is no metal mounting plate used (e.g.: if IP54 inverters are used). It is important to keep the "ground circuit" closed, by using metal housing and cable glands.

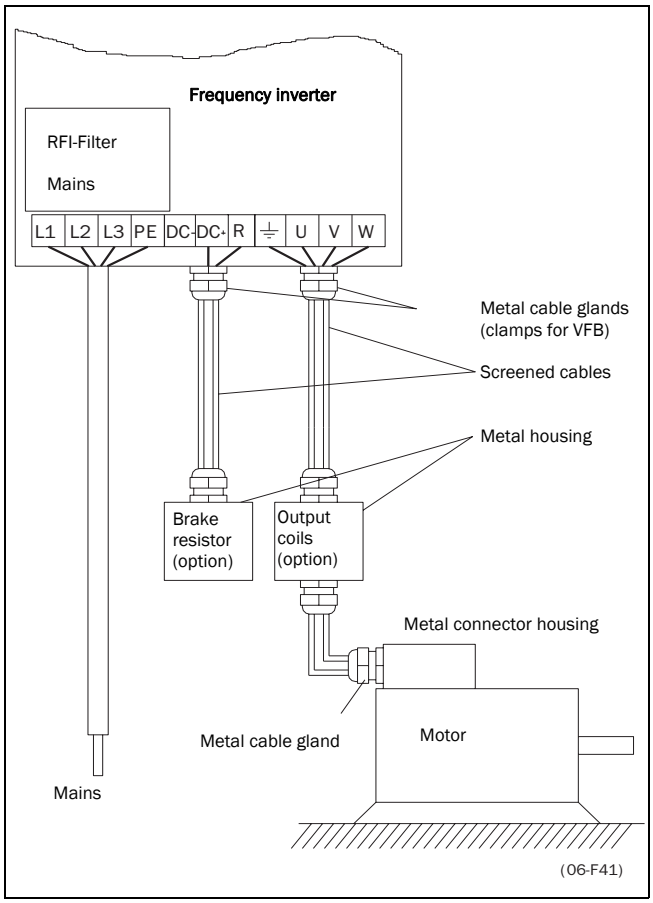


Fig. 8 Frequency inverter as stand alone.

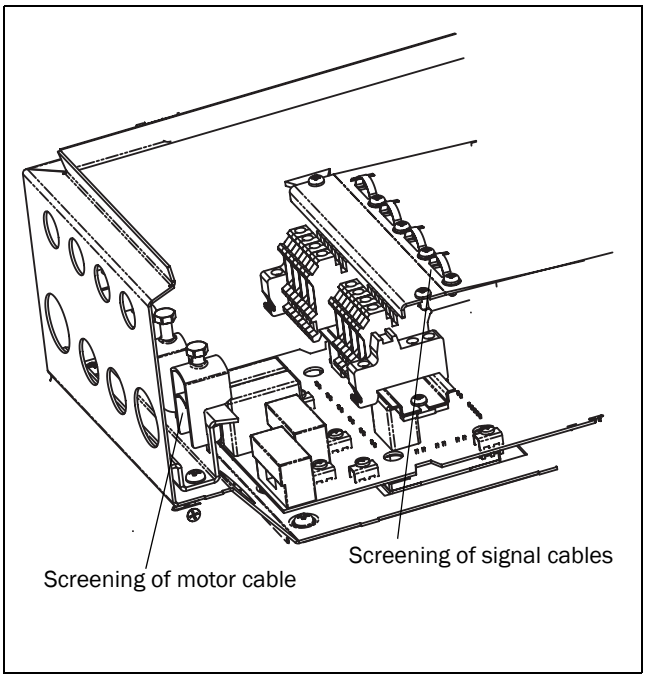


Fig. 9 Screening of cables with size S2.

Pay special attention to the following points:

- Any kind of metal screened cable may be used.
- All cable screening must be properly connected (360°) at both ends to the metal casing. 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.
  If paint must be removed, steps must be taken to prevent subsequent corrosion. Repaint after making connections!
- The fastening of the whole frequency inverter housing must be electrically connected with the mounting plate over an area as large as possible. For this purpose the removal of paint is necessary. An alternative method is to connect the frequency inverter housing to the mounting plate with an length of litze wire as short as possible.
- Try to avoid interruptions in the screening wherever possible.
- The power supply cable doesn't need to be screened.

The inverters of model 500 to 749 and up are mounted in a standard cabinet. The internal wiring complies with the EMC standard. Fig. 10 shows an example of a large size inverter built-in, in a cabinet.

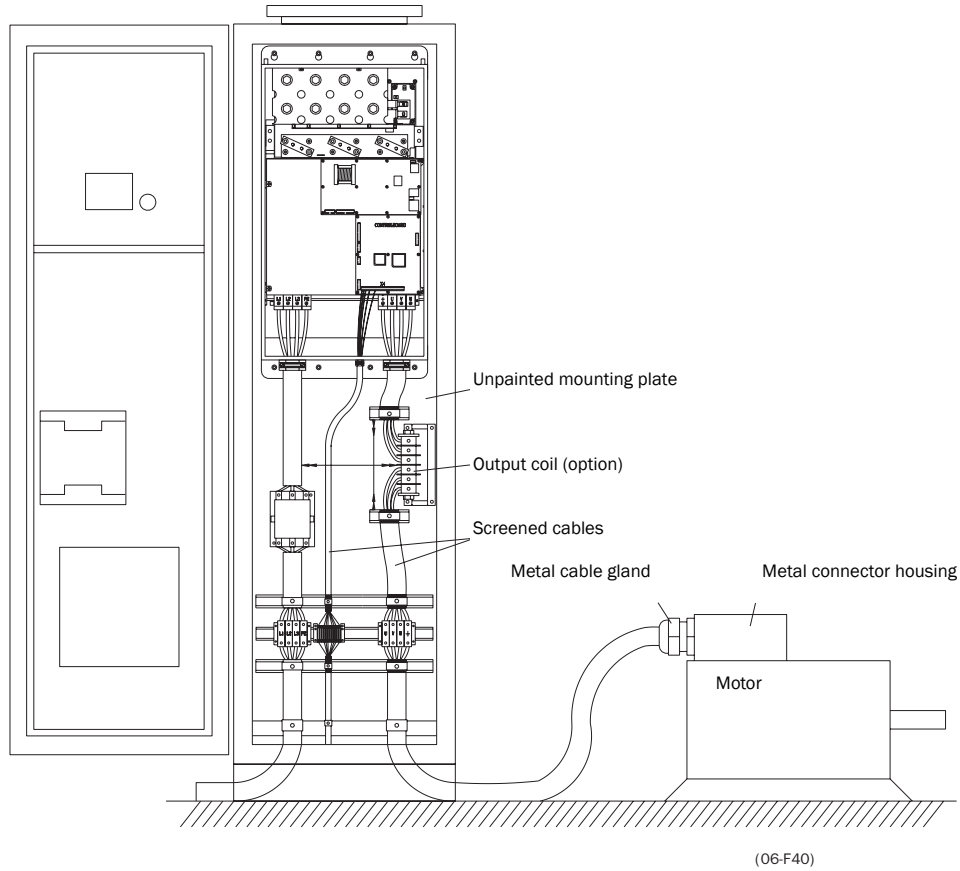


Fig. 10 Big size inverter in cabinet.

3.5 Stripping lengths for cables

Fig. 12 indicates the recommended stripping lengths for motor and power supply cables.

Table 5 Stripping lengths for mains and motor cables

Model VFB/VFX	Mains cable		Motor cable		
	a (mm)	b (mm)	c (mm)	d (mm)	e (mm)
004 – 016	210	12	210	12	35
018 – 037	115	12	115	12	32
046 – 060, 073	130	11	130	11	34
061 – 090	160	16	160	16	41
109 – 146	170	24	170	24	46
VFX 40 – 175	170	33	170	33	46
VFX 50 – 175 210 – 374	–	40	–	40	–

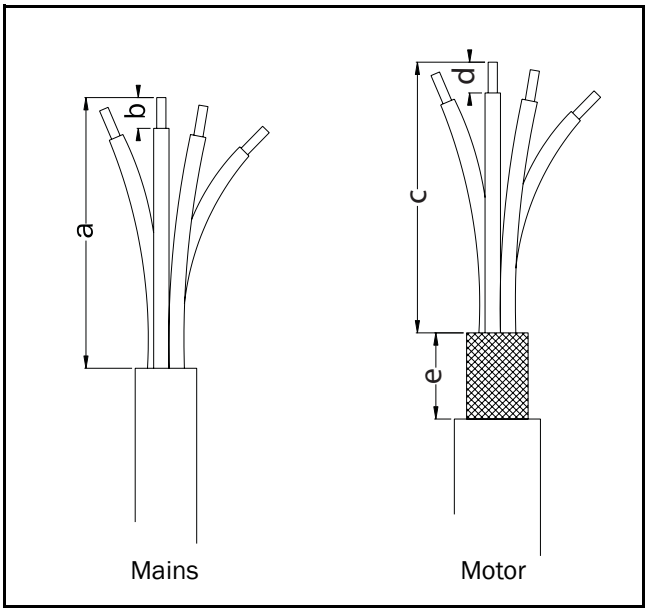


Fig. 11 Stripping lengths for cables - VFX.

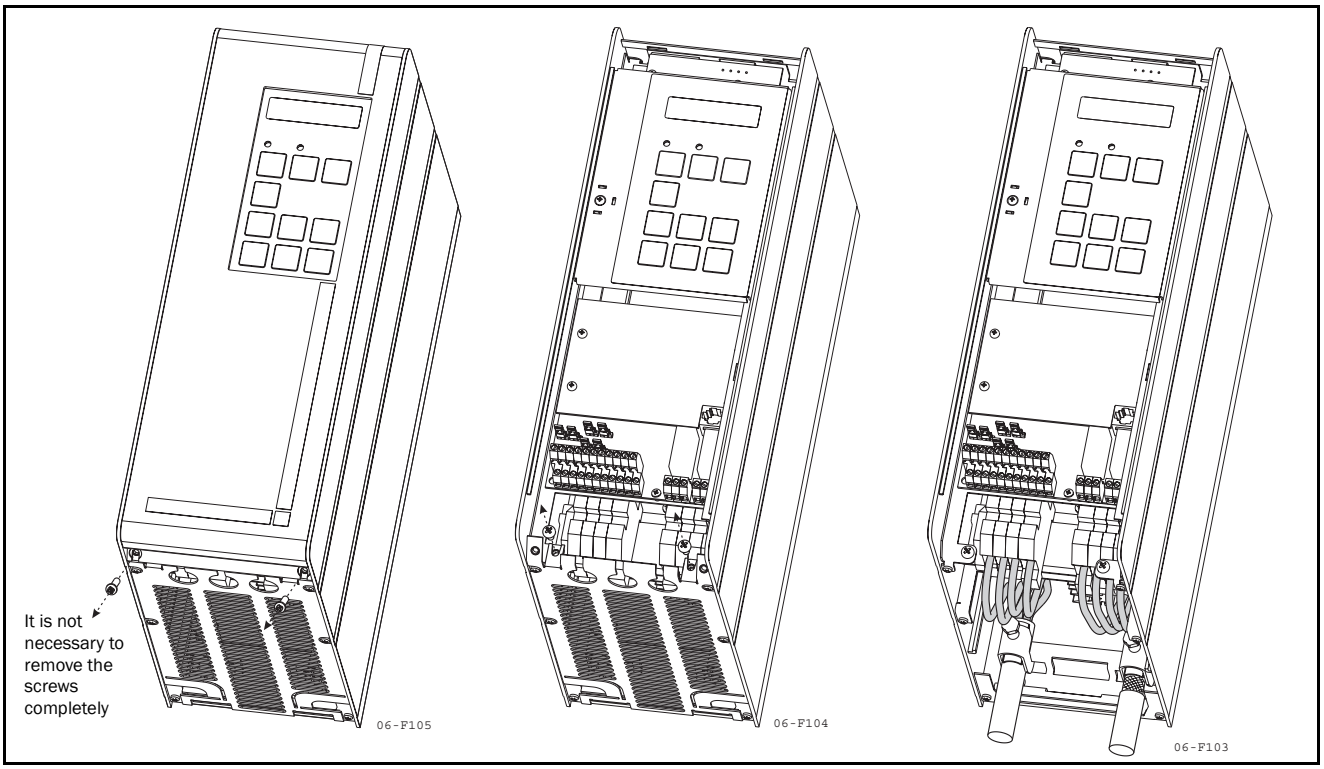


Fig. 12 Mounting power cables - VFB

3.6 Control board

Fig. 13 shows the layout of the control board where the most important parts for 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! If the frequency inverter must be opened, for example, to make connections or change the positions of the jumpers, always switch off the mains voltage and wait at least 5 minutes to allow the buffer capacitors to discharge. Although the connections for the control signals and the jumpers are isolated from the main voltage, always take adequate precautions before opening the frequency inverter.

- Jumpers S1 to S6: These are used to set the analogue inputs and outputs to voltage or current.
- Terminal 1-22: Incoming and outgoing analogue and digital control signals
- Terminal 31-33: Relay outputs
- Terminal 41-43: Communication connector.
- X4 connector: Only used if communication options like RS485, fieldbus etc. are built in.
- X5 connector: Option connector, only used if options are built in.
- X8 connector: Control Panel connection.

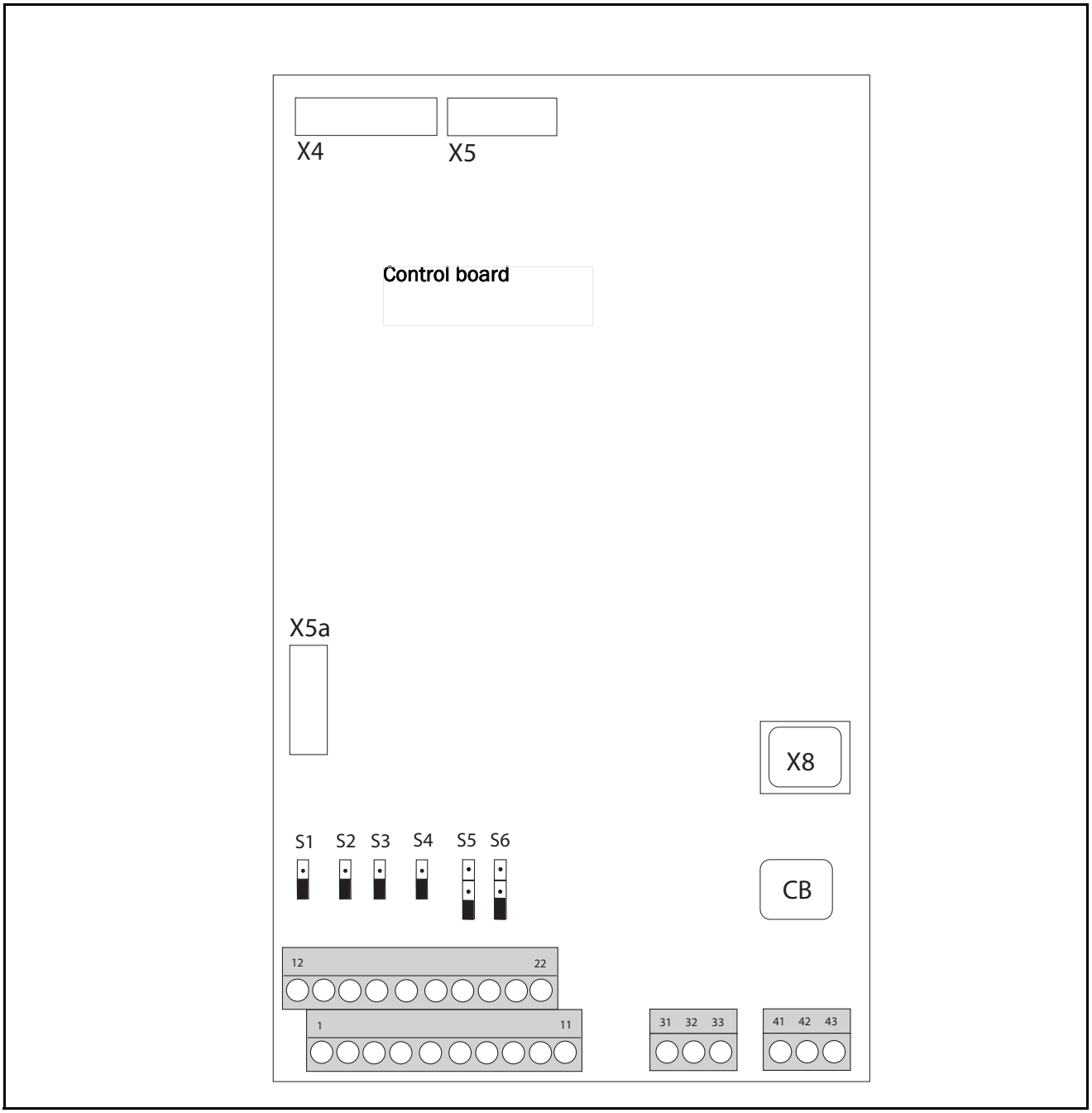


Fig. 13 Control board layout

3.7 Control signals connections, default settings

The connections for the control signals are accessible after opening the front panel. See Fig. 75-Fig. 83. The control signal connections are suitable for plaited flexible wire up to 1.5 mm^2 and for solid wire up to 2.5 mm^2. See Fig. 13 and Table 6 for details of the connections.

NOTE! The function of the inputs and outputs described in Table 6 are the default settings. Please refer to Chapter 5. page 30 for the other functions of each in and output. The inputs 8, 9, 10 and 22 are dedicated inputs and therefore not programmable for other functions.

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

Table 6 Control signals connections, default settings

Terminal	Name:	Function (Default):	Signal:	Type:
1	+10V	+10VDC Supply voltage	+10VDC, max 10mA	output
2	AnIn 1+	Speed reference, positive signal	0 ±10VDC or 0/4 - ±20mA	differential analogue input
3	AnIn 1-	Speed reference, negative signal	0 ±10VDC or 0/4 - ±20mA	differential analogue input
4	AnIn 2+	Off positive signal	0 ±10VDC or 0/4 - ±20mA	differential analogue input
5	AnIn 2-	Off negative signal	0 ±10VDC or 0/4 - ±20mA	differential analogue input
6	-10V	-10VDC Supply voltage	-10VDC, max 10mA	output
7	Common	Signal ground	0V	output
8	RunL	Run with rotation left	0-8/24VDC	digital input
9	RunR	Run with rotation right	0-8/24VDC	digital input
10	Enable	Enable for start	0-8/24VDC	digital input
11	+24V	+24VDC Supply voltage	+24VDC, 100 mA, see note	output
12	Common	Signal ground	0V	output
13	AnOut 1	0 - Max Speed	0 ±10VDC or 0/4 - +20mA	analogue output
14	AnOut 2	0 - 400% T_{nom}	0 ±10VDC or 0/4 - +20mA	analogue output
15	Common	Signal ground	0V	output
16	DigIn 1	Off	0-8/24VDC	digital input
17	DigIn 2	Off	0-8/24VDC	digital input
18	DigIn 3	Off	0-8/24VDC	digital input
19	DigIn 4	Off	0-8/24VDC	digital input
20	DigOut 1	Run, active if motor runs	24VDC, 50mA, see note	digital output
21	DigOut 2	Brake, to control mechanical brake	24VDC, 50mA, see note	digital output
22	RESET	Reset from error condition	0-8/24VDC	digital input
Terminal				
31	N/C 1	Relay 1 output Ready, active when the inverter is ready to start	potential free change over 2A/250VAC/AC1	relay output
32	COM 1			
33	N/O 1			
Terminal				
41	N/C 2	Relay 2 Output Trip, active when the inverter is in a TRIP condition	potential free change over 2A/250VAC/AC1	relay output
42	COM 2			
43	N/O 2			

3.8 Control signal connections in accordance with EMC-directives

CAUTION! In order to comply with the EMC directive (see § 1.6, page 9) it is absolutely necessary that the installation instructions, as described in this manual, are followed correctly. For further detailed information about EMC Direc-tives and frequency inverters please refer to the installation instructions "EMC Directive and frequency inverters". Please contact your supplier.

The screening of control signal cables is necessary to comply with the immunity levels given in the EMC Directive.

3.8.1 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 frequency inverter.

We can distinguish the following types of control signals:

- Analogue: Voltage or current signals, (0-10V, 0/4-20mA) which change slowly or only occasionally in value. In general, these are control or measurement signals.
- Digital: Voltage or current signals (0-10V, 0-24V, 0/4-20mA) which can have only two values (high or low) and only occassionally change in value.
- Data: Usually voltage signals (0-5V, 0-10V) which change rapidly and at a high frequency, generally data signals such as RS232, RS485, Profibus, etc.
- Relay: Relay contacts (0-220VAC) can switch highly inductive loads (auxiliary relay, lamp, valve, brake, etc.).

Example:
The relay output from a frequency inverter 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.

3.8.2 Single-ended or double-ended connection?

In principle, the same measures as applied to power supply cables must be applied to all control signal cables, in accordance with EMC-Directives, see § 3.4, page 13.

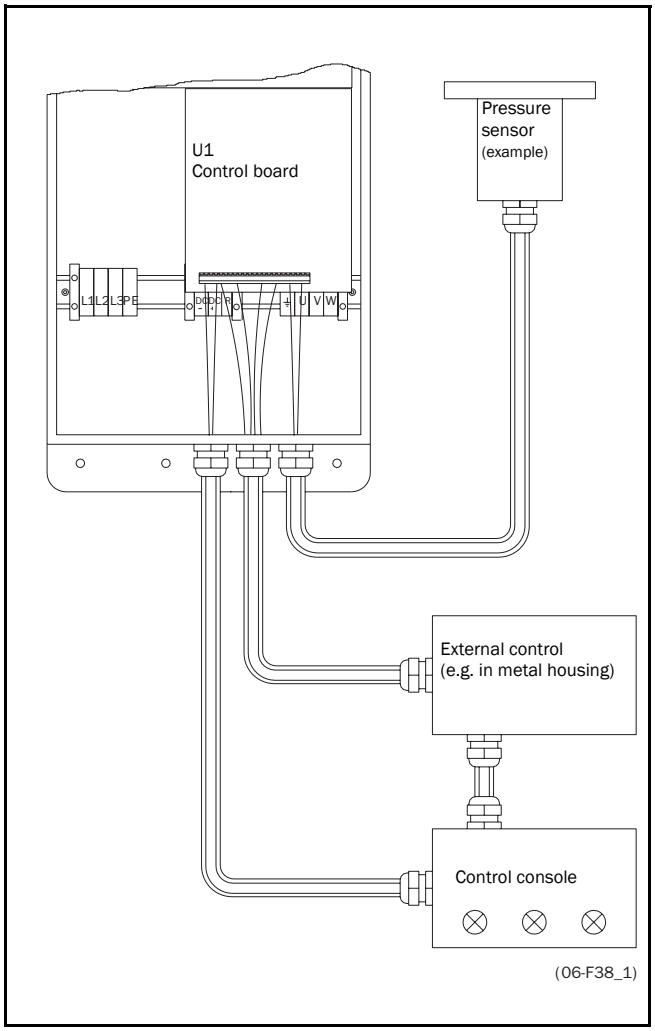


Fig. 14 Electro Magnetic (EM) screening of control signal cables.

In practice it is not always possible to screen control signal cables in a consistent manner.

If long control cables are used, the wavelength (¼ λ) of the noise signal can be shorter than the cable length. If the screening is connected at one end only, the noise frequency can be coupled to the signal wires.

For all signal cables as mentioned in § 3.8.1 the best results are obtained if the screening is connected to both ends. See Fig. 14.

NOTE! Each installation must be examined carefully before applying the proper EMC measures.

3.8.3 Current control (0-20mA)

A current signal like 0-20mA is less sensitive than a 0-10V signal, because it has low impedance (250Ω) compared with a voltage signal (21kΩ). It is therefore strongly advised to use current controlled signals if the cables are longer than a few meters.
When using mA analog input, the signals must be connected as follows:

Input	Terminals
AnIn1	2 and 7
AnIn2	4 and 7

3.8.4 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 no screening can be used as described in § 3.8.2, page 19. 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°.

3.9 Connection example

Fig. 15 gives an overall view of a connection example of the inverter.

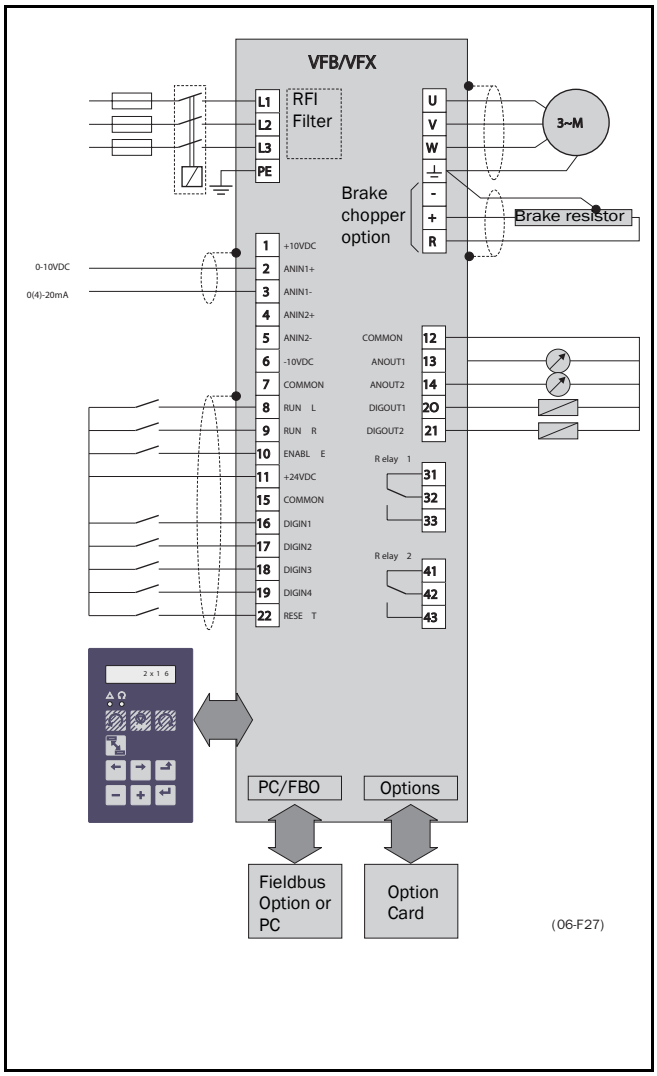


Fig. 15 Connection example.

3.10 Connection options

The option cards are connected by the optional connectors X4 or X5 on the control board and mounted above or beside the control board depending on the version and size of the inverter. For the inputs and outputs of the option cards the same measures with regard to the EMC directives must be taken as mentioned in § 3.8, page 19.

See also Chapter 7. page 73.

3.11 Inputs/outputs configuration with the jumpers

The jumpers S1 to S6 are used to set the input and output configuration for the 2 analogue inputs AnIn1 and AnIn2 and the 2 analogue outputs AnOut1 and AnOut2 as described in Table 7

Table 7 Jumper settings

Input/ Output	Type	Jumper(s)	Setting
AnOut1	0-10 V (default)	S1	U
	0-20mA	S1	I
AnOut2	0-10 V (default)	S2	U
	0-20mA	S2	I
AnIn1	0-10 V (default)	S3 & S4	U U
	0-20mA	S3 & S4	I I
AnIn2	0-10 V (default)	S5 & S6	U U
	0-20mA	S5 & S6	I I

.

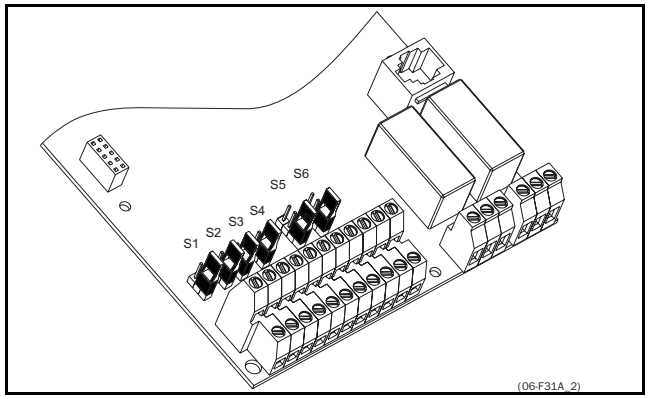


Fig. 16 Location of connectors and jumpers.

3.12 Long motor cables

If the connection to the motor is longer than 100 m, it is possible that capacitive current peaks will cause the inverter over-current trip to operate. Using output coils can prevent this. Contact the supplier for appropriate coils.

3.13 Switching in motor cables

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

3.14 Small motors

It is not possible to run motors which are smaller than 25% of the nominal power of the inverter. The limit is also set by function Motor Power [221].

WARNING! Even with the minimum limit set in window [221] the motor control can by disrupted if a smaller motor is still connected.

3.15 Motors in parallel

Parallelling motors is only possible in the V/Hz Mode. In the Speed or Torque Mode the inverter can only operate with a single motor. See also § 2.6, page 11.

3.16 Use of a thermal overload and thermistors

The inverter is designed to operate the motor at low speeds with high torques for longer periods of time. Standard motors are normally fitted with an internal fan. The cooling capacity of this built in fan is dependent on the speed of the motor. At low speeds, the cooling capacity will be insufficient for nominal loads. Please contact the motor supplier for the cooling characteristics of the motor at lower speeds.

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 PTC option (see § 7.5, page 75) 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 Vent [227] § 5.3.14, page 34, I^2t type [354] § 5.4.44, page 47 and I^2t current [355] § 5.4.45, page 48.

3.17 Stop categories and emergency stop

The following information is important if emergency circuits are used or needed in the installation where a frequency inverter 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 realised with the help of a frequency inverter or its inputs or output signals.
- **Category 1: Controlled STOP:**
  Stopping until the motor has come to rest, after which the power supply is switched off. This STOP may not be realised with the help of a frequency inverter or its input or output signals.
- **Category 2: Controlled STOP:**
  Stopping while the supply voltage is still present. This STOP can be implemented with every STOP command of the frequency inverter.

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. In addition, 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 dangers. 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.

3.18 Definitions

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

Table 8 Definitions

Name	Description	Quantity
I_{IN}	Nominal input current of inverter	A, RMS
I_{NOM}	Nominal output current of inverter	A, RMS
I_{MOT}	Nominal Motor current	A, RMS
P_{NOM}	Nominal power of inverter	kW
P_{MOT}	Motor power	kW
P_{NMOT}	Nominal power of motor	kW
T_{NOM}	Nominal torque of motor	Nm
T_{MOT}	Motor torque	Nm
f_{OUT}	Output frequency of inverter	Hz
f_{MOT}	Nominal frequency of motor	Hz
n_{MOT}	Nominal speed of motor	rpm
I_{max}	150% I_{NOM}, 60s	A, RMS
I_{TRIP}	Peak motor current 290% I_{NOM}	A
Speed	Actual motor speed	rpm
Torque	Actual motor torque	Nm

When the mains voltage is applied, all settings will be loaded from a non-volatile memory (E^2PROM). After charging of the DC-link capacitors and the initialisation of the inverter, the LCD-display will show the Start Window [100]. (See also § 5.2, page 30). Depending on the size of the inverter this will take a few seconds.

The default Start Window will appear as follows:

```
100                0rpm
Stp          0%  0.0Nm
```

4.1 Operating the control panel

Fig. 17 shows the Control Panel (CP). The Control Panel displays the status of the inverter and is used to program all the settings. It is also possible to control the motor directly from the Control Panel.

NOTE! The inverter can run without the CP connected. However the programming must be such, that all control signals are programmed for external use.

The inverter can be ordered without the CP. Instead of the CP there will be a 3 LED indication. See also § 4.1.2, page 23 and § 7.2, page 74.

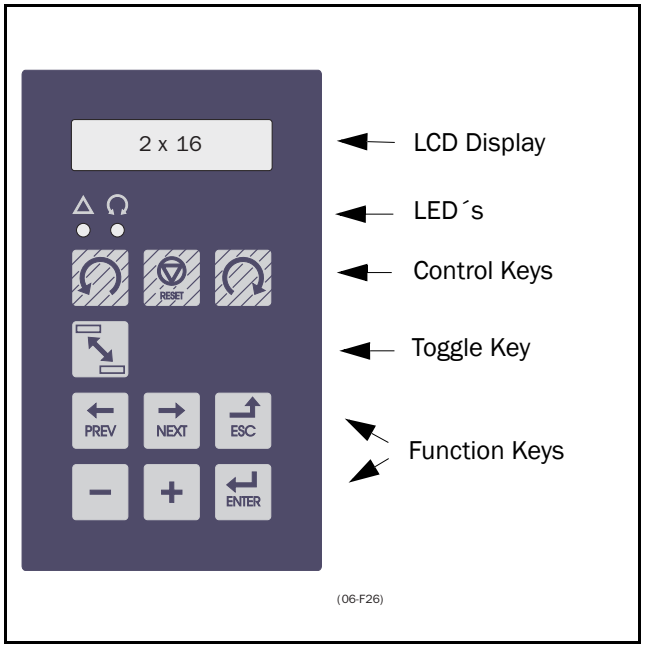


Fig. 17 Control Panel.

4.1.1 LCD display

The LCD display consists of a 2 row 16-character display with backlight. The display is divided in four areas. The different areas in the start window are described below:

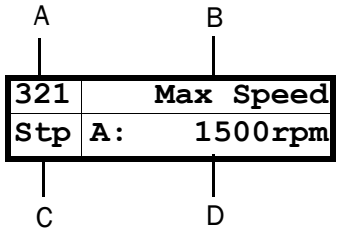


Fig. 18 The Display

Area A: Shows the actual window number (3 positions).
Area B: Shows the heading of the active window.
Area C: Shows the status of the inverter (3 positions).

The following status indications are possible:

Acc : Acceleration
Dec: : Deceleration
I^2t: : Active I^2t protection (see par.5.2)
Run : Motor runs
Trp : Tripped
Stp : Motor is stopped
VL : Voltage limit
SL : Speed limit
CL : Current limit
TL : Torque limit
OT : Overtemperature warning
OVG : Overvoltage G warning (Generator)
OVD : Overvoltage D warning (Deceleration)
OVL : Overvoltage L warning (Line)
OC : Overcurrent warning
LV : Low Voltage warning

Area D: Shows the setting or selection in the active window. This area is empty at the 1st level (hundreds) and 2nd level (tens) menu.

```
300 PARAM SETS
Stp
```

Fig. 19 Example upper level menu (Main Menu)

```
330 Torques
Stp
```

Fig. 20 Example mid level menu (Submenu tens)

```
331 Max Torque
Stp A:        150%
```

Fig. 21 Example lower level menu (Submenu units)

4.1.2 LED indication

The green and the red LEDs on the Control Panel have the following functions:

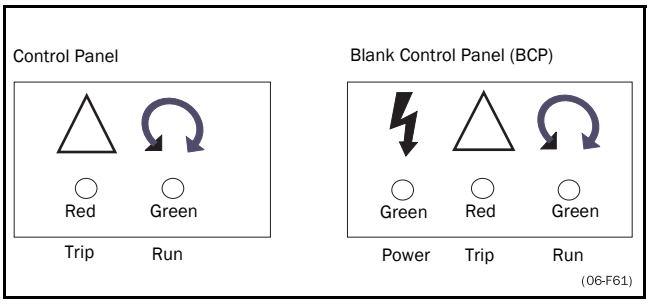


Fig. 22 LED indications

Table 9 LED indication

LED	Function		
	ON	BLINKING	OFF
POWER (green)	Power on	----------	Power off
TRIP (red)	Inverter tripped	Warning/Limit	No trip
RUN (green)	Motor shaft rotates	Motor shaft acc/dec	Motor stopped

NOTE! If the CP is built in, the backlight of the LCD display has the same function as the Power LED in table 9 (Blank Control Panel LEDs).

4.1.3 The Toggle Key

With the Toggle key up to the last four selected windows can be quickly accessed. The default window is "100" for one toggle window. Select a toggle window by pressing the toggle key when you are in the selected window. The next toggle window will be displayed automatically. The toggle memory will be erased at power-down. If a trip occurs, the trip message (window [710]) is automatically added to the toggle list.

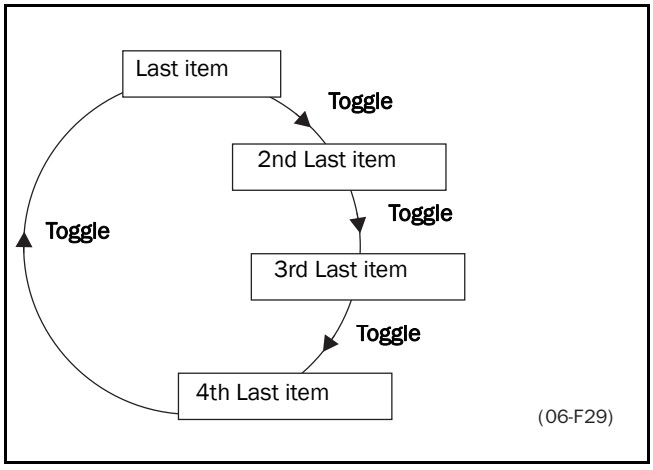


Fig. 23 Toggle memory

4.1.4 Control keys

The control keys give Run, Stop or Reset commands directly from the Control Panel. As default the keys are disabled. With function Run/Stop Ctrl [213], the keys can be activated. The Enable input (terminal 10) must be active to allow Run/Stop commands from the Control Panel (see § 3.7, page 18).

Table 10 Control keys

	RUN L:	gives a start with rotation left
	STOP/RESET:	to stop the motor or reset the inverter after a trip
	RUN R:	gives a start with rotation right

NOTE! It is not possible to activate the Run/Stop/Reset commands from the keyboard and remotely from the terminal strip (terminal 1-22).

4.1.5 Function keys

The function keys operates the Setup Menu to program and read-out all the settings in the menu.

Table 11 Function keys

	ENTER key:	- to step to a lower menu level - to confirm a changed setting
	ESCAPE key:	- to step to a higher menu level - to ignore a changed setting, without confirming
	PREVIOUS key:	- to step to a previous menu window within the same level
	NEXT key:	- to step to a next menu window within the same level
	- key:	- to decrease a value - to change a selection
	+ key:	- to increase a value - to change a selection

4.1.6 Menu structure

The Menu consists of 3 levels.

- Main Menu: This is the upper level (counts in hundreds)
- Submenu 1: This is the mid level (counts in tens)
- Submenu 2: This is the lower level (counts in units)

The Main Menu contains the following main functions:

100	Startup Window
200	Main Setup
300	Parameter Sets
400	I/O
500	Set/View Reference Value
600	View Operation
700	View Trip Log
800	Monitor
900	View System Data

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

So e.g.: a menu can have only one selectable window (window Set/View Reference Value [500]), or it can have 17 selectable windows (window Speeds [320]).

NOTE! If within one level there are more than 10 windows the numbering continues in alphabetic order.

Example 1:
Submenu speeds [320] counts from 321 to 32H.

Example 2:
Main menu View Operation [600] counts from 610 to 6H0.

Fig. 24 shows that within every level the Enter and the Escape keys are used to step up or step down from each level and each menu window within a level can be selected with the Previous and Next keys.

4.1.7 Short description of the setup menu

The main menu contains the following main functions:

100 STARTUP WINDOW

Displayed at power-up. It displays the actual speed and torque as default. Programmable for many other read-outs

200 MAIN SETUP

Most important settings to get the inverter operable. Most important are the motor data. Further utility and settings for the options.

300 PARAMETER SETS

4 sets of parameters like Acc/Dec times, speed setting, torque setting, PID control settings etc. Each Parameter Set can be selected externally via a digital input. Parameter sets can be changed during operation and stored in the Control Panel.

400 I/O

All settings for inputs and outputs are made here.

500 SET/VIEW REFERENCE VALUE

Setting or viewing the reference value. Depending on the selected Drive Mode (speed, torque, V/Hz) the reference value concerned can be viewed. If reference value setting is programmed for operation via the Control Panel the reference is set in this window (Motor Potentiometer).

600 VIEW OPERATION

Viewing all the operational data like speed, torque, power, current etc.

700 VIEW TRIP LOG

Viewing the last 10 trips in the trip memory.

800 MONITOR

Alarm functions at over - and underload condition.

900 VIEW SYSTEM DATA

Electronic type label for viewing the software version and inverter type.

4.1.8 Programming during operation

Many functions can be changed during operation, without stopping the inverter. These functions are indicated with an asterisk (*) in the Setup Menu List (Chapter 9. page 84) and in Chapter 5. page 30.

NOTE! If a function is changed during operation of the inverter the message "Stop First!" is displayed, to indicate that this function can only be changed when the motor is stopped.

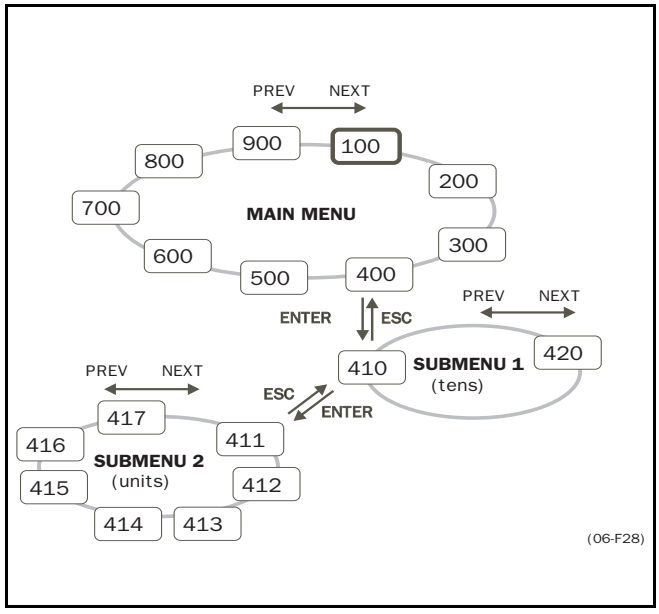


Fig. 24 Menu structure.

4.1.9 Programming example

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

The blinking 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 key to proceed and to go to other menus.

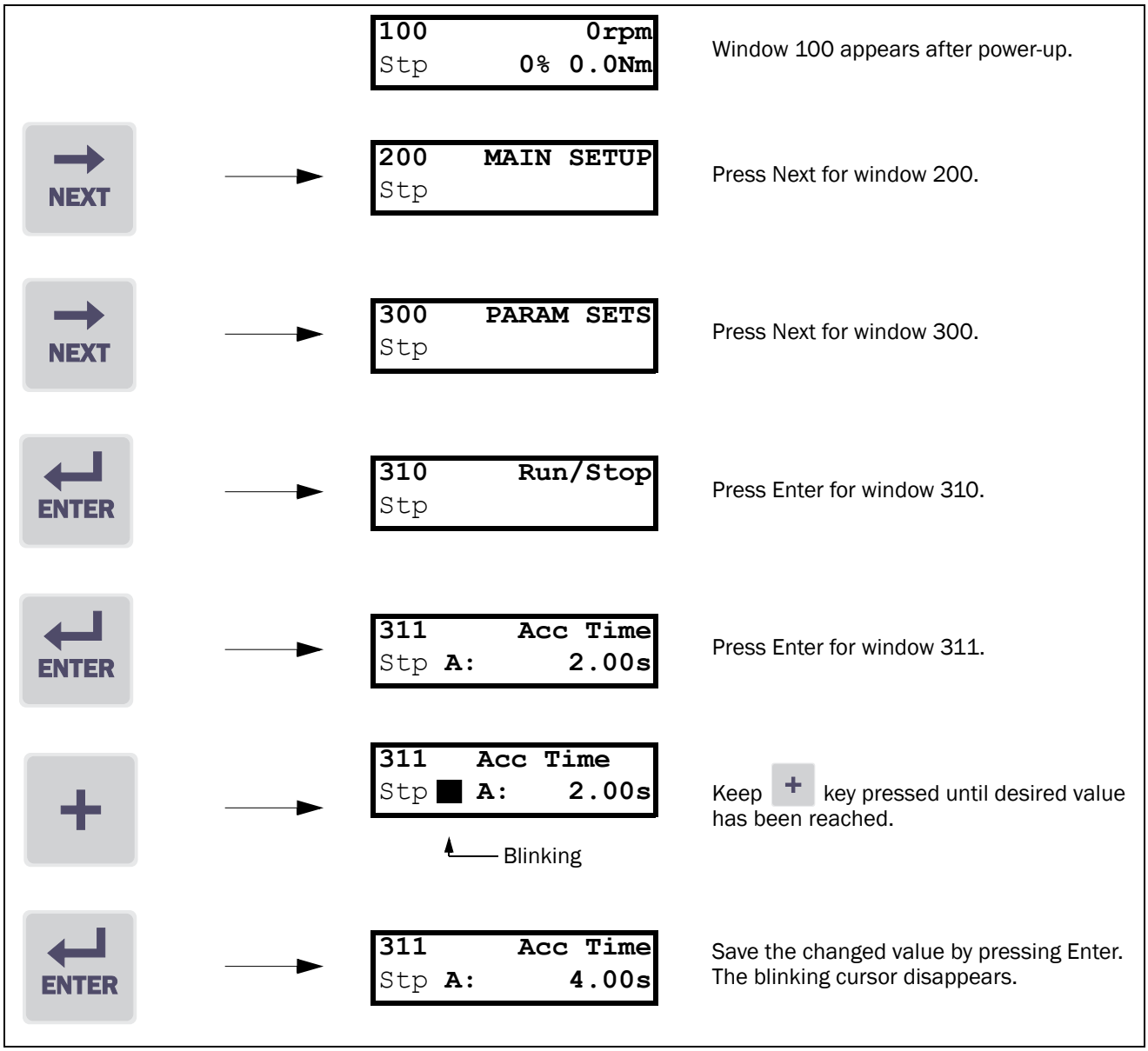


Fig. 25 Programming example

4.2 Operation of the Run/Stop/ Enable/Reset functions

As default all the run/stop related commands are programmed for remote operation via the inputs on the terminal strip (terminal 1-22) on the control board. With function Run/Stp Ctrl [213] this can be selected for keyboard or serial communication control, see § 5.3.4, page 32.

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

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

The default settings are shown in Fig. 26. In this example the inverter is started and stopped with the Run R or Run L inputs and a reset after trip can be given with the Reset input.

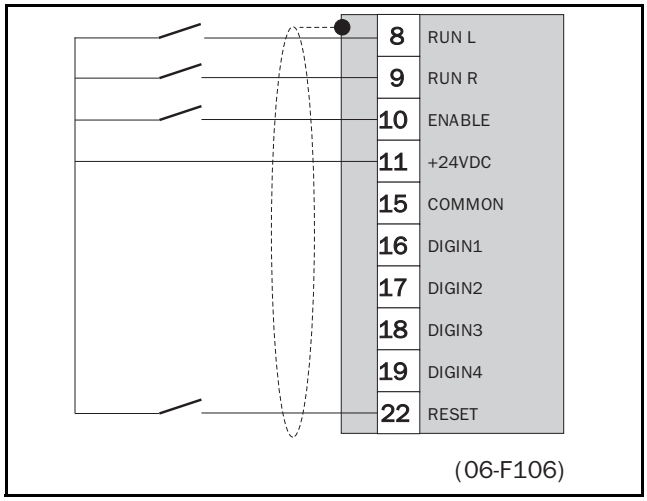


Fig. 26 Wiring example Run/Stop/Enable/Reset inputs

The inputs are default set for level-control (see § 5.3.6, page 33).

4.2.2 Enable and Stop functions

Both functions can be used separate or simultaneously. The choice of which function must be used depends on the application and the control mode of the inputs (Level/Edge [215], see § 5.3.6, page 33).

NOTE! In the Edge mode, at least one stop function must be programmed, because the Run commands are then only able to start the inverter.

Stop functions:

Enable

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

Stop

If the input is made LO then the inverter will stop according to the selected stop mode set in window [315] (see § 5.4.6, page 39).
Fig shows the function of the Enable and the Stop input and the Stop Mode=Decel [315]. to Run the input must be HI.

NOTE! The Stop Mode=Coast [315] will give the same behavior as the Enable input.

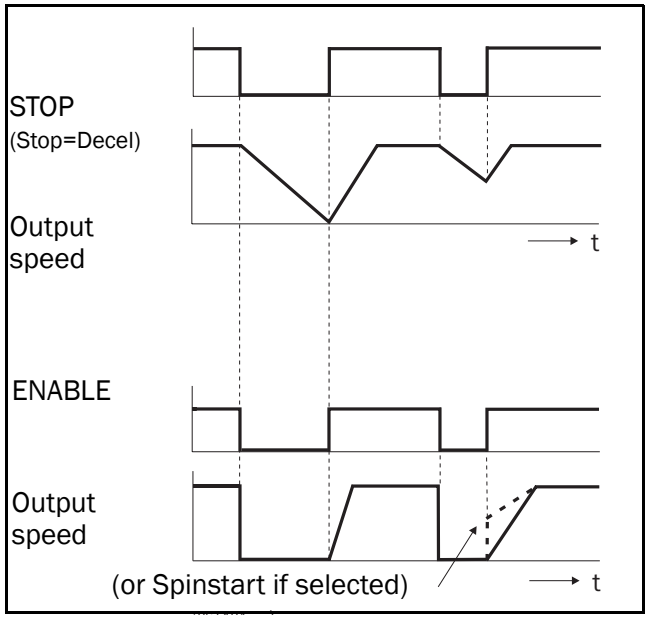


Fig. 27 Functionality of the Stop and Enable input.

4.2.3 Run Inputs Level-controlled.

The inputs are set as default for level-control (see function Level Edge [215], § 5.3.6, page 33). This means that an input is activated by making the input continuously "High". This way of operation is commonly used if, for example, PLCs are used to operate the inverter.

CAUTION! Level controlled inputs DO NOT comply with the Machine Directive (see § 1.6, page 9), if the inputs are directly used to start and stop the machine.

The examples given in this and the following paragraph have the input selection as shown in Fig. 28.

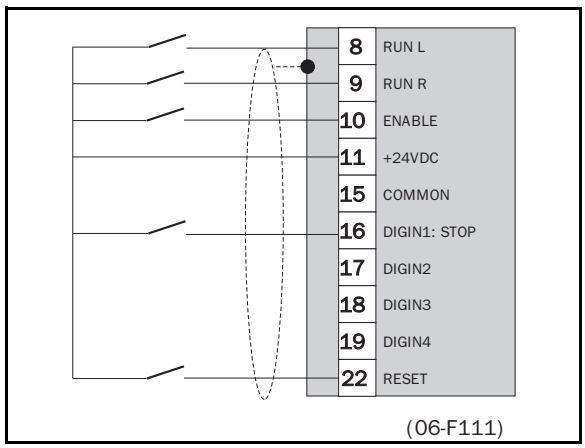


Fig. 28 Wiring example Run/Stop/Enable/Reset inputs.

The Enable and Stop inputs must be continuously HI in order to accept any run-right or run-left command. If both RunR and RunL inputs are active, then the inverter stops according to the selected Stop Mode. Fig. 29 gives an example of a possible sequence.

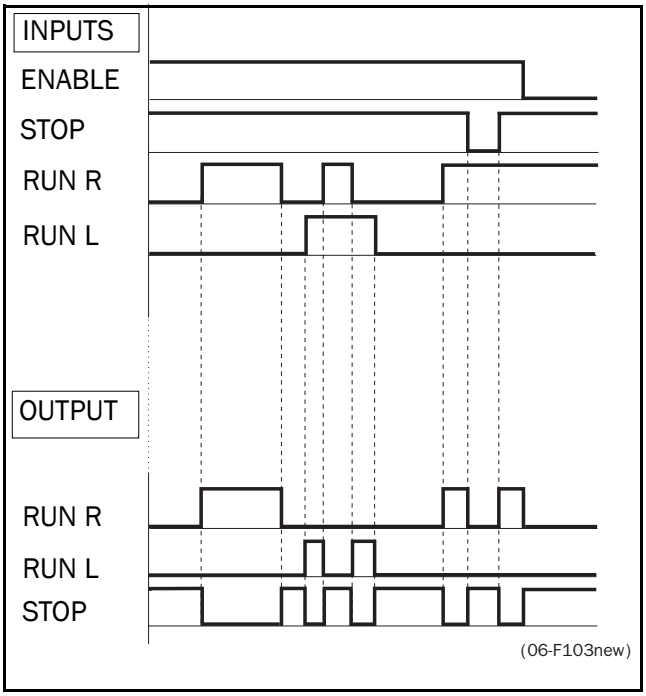


Fig. 29 Run/Stop/Enable functions Level-controlled.

4.2.4 Run Inputs Edge-controlled

Window 215 Level/Edge must be set to Edge to activate edge control (§ 5.3.6, page 33) This means that an input is activated by a "low" to "high" transition. Now the inputs can be wired as a so-called "3-wire" operation. 3-wire operation requires 4-wires for two directions.

NOTE! Edge controlled inputs comply with the Machine Directive (see § 1.6, page 9), if the inputs are directly used to start and stop the machine.

The Enable and Stop inputs must be continuously HI in order to accept any run-right or run-left command, see Fig. 28. The last edge is valid (Run R or Run L) Fig. 30 gives an example of a possible sequence.

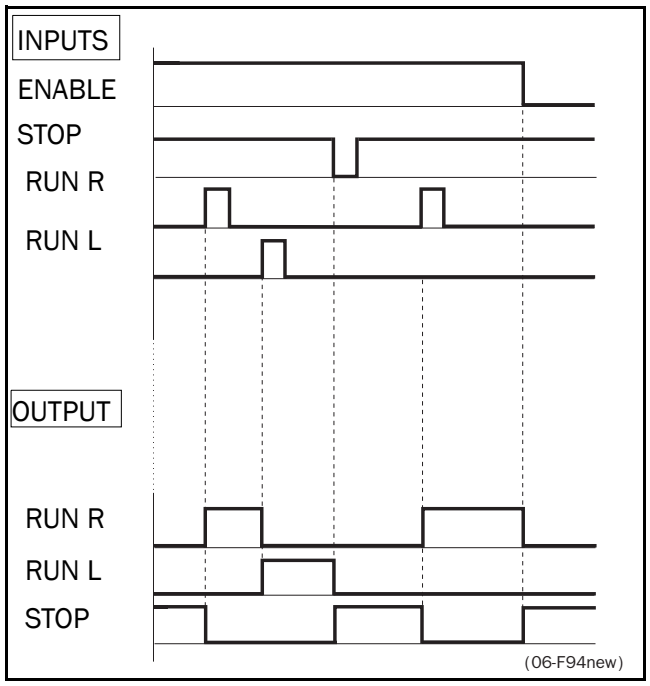


Fig. 30 Run/Stop/Enable functions Edge-controlled.

4.2.5 Reset and Autoreset operation.

If the inverter is in the Stop Mode due to a trip condition, the inverter can be reset by a pulse ("low" to "high" transition) on the Reset input (terminal 22, see § 3.7, page 18). Depending on the selected control method a restart takes place (see function Level/Edge [215] § 5.3.6, page 33):

- **Level-control**.
  If the Run inputs remain in their position the inverter 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 inverter again.

Autoreset is enabled if the Reset input is continuously active. In function Autoreset [240] (see § 5.3.26, page 36) the Autoreset functions are programmed.

NOTE! If the control commands are programmed for Keyboard control, Autoreset is not possible.

4.2.6 Speed Direction and Rotation.

The Speed Direction can be controlled by:
- RunR/RunL commands on the Control Panel.
- RunR/RunL commands on the terminals 1-22.
- Bipolar reference signal on AnIn1 or AnIn2. Both the Right and Left inputs must be high.
- Via the serial interface options.
- The Parameter Sets

The function Rotation [214] (§ 5.3.5, page 33) and Speed Direction [324] (§ 5.4.18, page 42) set the limitations and priorities to the Speed Direction of the inverter.

- **Overall limitation with function Rotation [214].**
  This function sets the overall Speed Direction that can be limited to either Left or Right direction. This limit is prior to all other selections. E.g.: if the rotation is limited to Right, a Run-Left command will be ignored. Also bipolar analogue inputs signals are ignored.
- **Setting per Parameter Set with function Speed Direct [324].**
  This function sets the Speed Direction for the Parameter Set concerned to either Right, Left or Right + Left.

4.3 Use of the Parameter Sets

With the 4 Parameter Sets various control possibilities can be made with respect to quickly changing the inverter's behaviour. It is possible to adapt the inverter online to altered machine behaviour. The way the Parameter Sets are implemented and controlled gives an enormous flexibility to the overall possibilities with regard to settings like Speed, Torque, Acc/Dec times, PID control, etc. 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. Because each Parameter Set contains more than 30 different functions (parameters), a great many different configurations and combinations can be made. Fig. 31 shows the way the Parameter Sets are activated via the digital inputs DigIn 3 and DigIn 4.

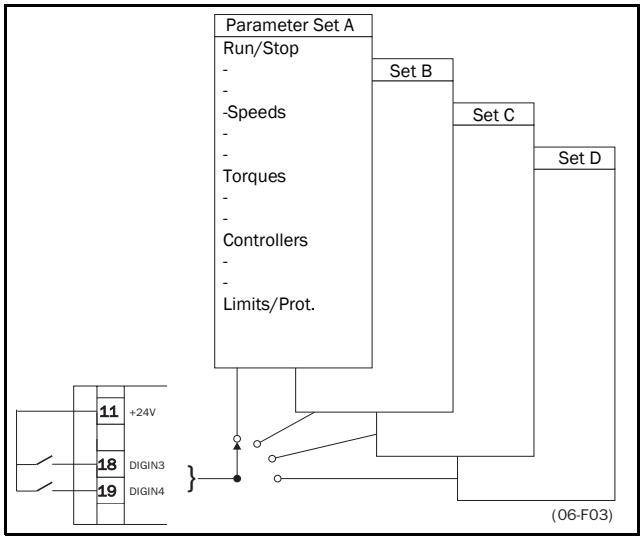


Fig. 31 Selecting the Parameter Sets.

The Parameter Set selection is done with function Select Set [234] (See § 5.3.20, page 35). Here the Parameter Sets can be selected via the Control Panel, DigIn 3+4, via DigIn 3 only or via serial communication. With function Copy Set [233] (see § 5.3.19, page 35) it is easy to copy the complete content of a single Parameter Set to another Parameter Set. If the Parameter Sets are selected via DigIn 3 and DigIn 4 they are activated according to Table 12.

Table 12 Parameter Set

Parameter Set	DigIn 3	DigIn 4
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 online, also during Run.

NOTE! The default Parameter Set is Parameter Set A.

With these settings a lot of possibilities are available. Some ideas are given here:

- **Multi speed selection.**
  Within a single Parameter Set the 7 preset speeds are selectable via the digital inputs. In combination with the Parameter Sets, 16 preset speeds can be selected using all 4 digital inputs DigIn1 and 2 for selecting preset speed within one Parameter Set and DigIn 3 and DigIn 4 for selecting the Parameter Sets.
- **Bottling machine with 3 different products.**
  Use 3 Parameter Sets for 3 different Jog Speeds, when the machine needs to be set up. The 4th Parameter Set can be used for "normal" analogue speed control when the machine is running in 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. For each gauge of thread it is important that acceleration, deceleration times, Max Speed and Max Torque are adapted to each thread gauge. For each thread size a different Parameter Set can be used.

Table 13 shows the functions (parameters) that can be set in each Parameter Set. The number behind each function is the window number.

Table 13 Parameter Set functions

Run/Stop[310]	
Acceleration time	[311]
Acc ramp type	[312]
Deceleration time	[313]
Dec ramp type	[314]
Start Mode	[315]
Stop Mode	[316]
Brake release time	[317]
Brake engage time	[318]
Wait before brake time	[319]
Vector brake	[31A]
Q-Stop time	[31B]
Spinstart	[31C]
Speed [320]	
Minimum Speed	[321]
Maximum Speed	[322]
Minimum Speed Mode	[323]
Speed Direction	[324]
Mot Pot function	[325]
Preset Speed 1	[326]
Preset Speed 2	[327]
Preset Speed 3	[328]
Preset Speed 4	[329]
Preset Speed 5	[32A]
Preset Speed 6	[32B]
Preset Speed 7	[32C]
Skip Speed 1 Low	[32D]
Skip Speed 1 High	[32E]
Skip Speed 2 Low	[32F]
Skip Speed 2 High	[32G]
Jog Speed	[32H]
Start Speed	[321]
Torque [330]	
Maximum Torque	[331]
Minimum Torque	[332]
Controllers [340]	
Speed PI Auto tune	[341]
Speed P Gain	[342]
Speed I Gain	[343]
Flux Optimization	[344]
PID Controller	[345]
PID P Gain	[346]
PID I Time	[347]
PID D Time	[348]
Limits/Protections [350]	
Low Volt Override	[351]
Rotor locked	[352]
Motor lost	[353]
Motor I^2t Type	[354]
Motor I^2t Current	[355]

4.4 Use of the Control Panel Memory

The Control Panel (CP) has two memory banks called Mem1 and Mem2. Normally all the settings, which are made or changed, will be stored at power down in an Eeprom on the controlboard of the inverter.

The memory banks in the CP are used to copy the settings of an individual inverter via the CP to other inverters. The CP must be disconnected from the original inverter (source) and than be connected to the target inverter. This can best be done with the option HCP or ECP (see § 7.2, page 74)

The memory banks can also be used as a temporary "Storage" for a specific inverter setup.

The settings can be copied in two different levels:

- **All Settings**
  The copy and load commands copy or load all settings within the entire Setup Menu, so also Motor Data, Utilities etc. This is done with the functions Copy To CP [236] and CP>Settings [239]. See § 5.3.22, page 35 and § 5.3.25, page 36.
- **Parameter Sets Only**
  With the function CP>All Sets [237] only the contents of submenu Parameter Sets [300] are loaded. With the function CP>Act Set [238] only the contents of the active Parameter Set is loaded. See § 5.3.24, page 36 and § 5.4, page 38.

Fig. 32 and Fig. 33 show the options for copying and locating the settings to and from the memories.

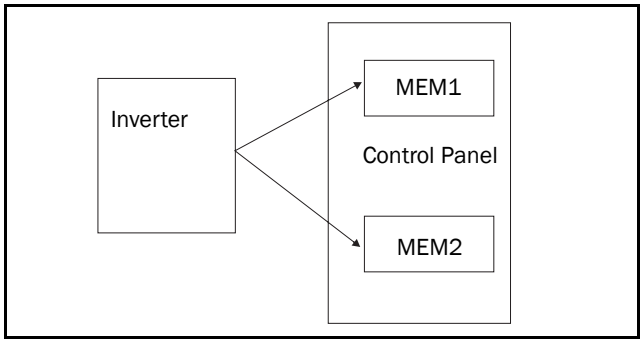


Fig. 32 Copy: - Complete Set-up

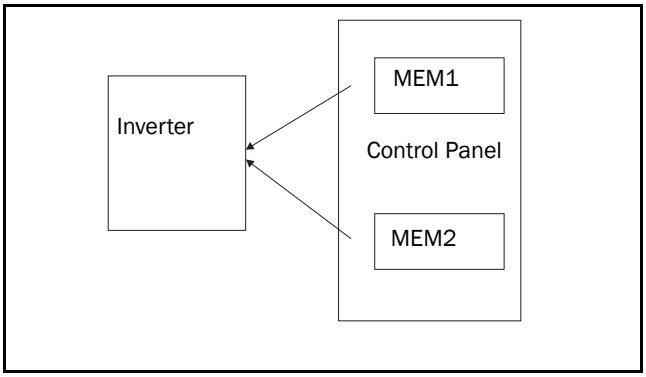


Fig. 33 Load: - Complete Set-up
- All Parameter Sets
- Active Parameter Set

NOTE! Functions with an asterisk * are also changeable during Run Mode.

5.1 Resolutions of settings

The resolutions for all range settings as described in this chapter are 3 significant digits, except for speed which is 4 significant digits. Exception are stated. Table 14 shows the resolutions for 3 and 4 significant digits.

Table 14 Resolutions of settings

3 Digit	Res.	4 Digit	Res.
0.01-9.99	0.01	0.001-9.999	0.001
10.0-99.9	0.1	10.00-99.99	0.01
100-999	1	100.0-999.9	0.1
1000-9990	10	1000-9999	1
10000-99900	100	10000-99990	10

5.2 Start window [100]

This window is displayed at every power-up and is normally displayed during operation. As default it displays the actual speed and torque.

Other read-outs are programmable with the function 1st Line [110] and 2nd Line [120].

The display function sets the content of the Start window [100].

In Fig. 34 it is shows that the display value 1st line [110] is on the upper row and display value 2nd line [120] is on the lower row.

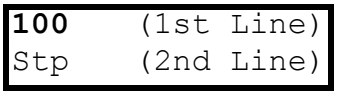


Fig. 34 Display functions.

5.2.1 1st Line [110]

Sets the content of the first line in the Start Window [100].

	110 1st Line Stp Speed *
Default:	Speed
Selection:	Speed, Torque % and Nm, Shaft Power, El Power, Current, Voltage, Frequency, DC Voltage, Temperature, FI Status, Process Speed
Speed	See window 610 § 5.7.1, page 58
Torque % Nm	See window 620 § 5.7.2, page 58
Shaft Power	See window 630 § 5.7.3, page 58
El Power	See window 640 § 5.7.4, page 58
Current	See window 650 § 5.7.5, page 58
Voltage	See window 660 § 5.7.6, page 58
Frequency	See window 670 § 5.7.7, page 58
DC Voltage	See window 680 § 5.7.8, page 58
Temperature	See window 690 § 5.7.9, page 58
FI Status	See window 6A0 § 5.7.10, page 58
Process Speed	See window 6G0 § 5.7.18, page 60

5.2.2 2nd Line [120]

Same function as 1st Line [110].

	120 2nd Line Stp Torque *
Default:	Torque % and Nm
Selection:	Speed, Torque (% and Nm), Shaft Power, El Power, Current, Voltage, Frequency, DC Voltage, Temperature, FI Status, Process Speed

5.3 Main set-up [200]

Main menu with the most important settings to get the inverter operational, e.g. motor data, drive data, utilities and options.

5.3.1 Operation [210]

Submenu to set the Drive Mode, Reference Control, Run/Stop Control.

5.3.2 Drive Mode [211]

Setting of the inverter Drive Mode. This selection also sets all the reference signals and read-outs depending on the selected mode. (See § 2.6, page 11).

- rpm for Speed Mode, actual Shaft Speed.
- Nm for Torque Mode, actual Torque.
- Hz for V/Hz Mode, output frequency in rpm.

211 Drive Mode Stp **Speed**	
Default:	Speed
Selection:	Speed, Torque, V/Hz
Speed	All control loops are related to speed control. Torque limits can still be set.
Torque	All control loops are related to Torque control. Speed limit can be set.
V/Hz	All control loops are related to frequency control. In this Mode multi-motor applications are possible. **NOTE! All the functions and window read-outs with regard to speed and rpm (e.g. Max Speed = 1500rpm, Min Speed=0rpm, etc) remain speed and rpm, although they represent the output frequency.**

5.3.3 Reference control [212]

Selection of the source of the reference signal.

212 Ref Control Stp **Remote**	
Default:	Remote
Selection:	Remote, Keyboard, Comm, Rem/DigIn 1, Comm/DigIn 1, Comm/Rem DI1, Option
Remote	The reference signal comes from the analogue inputs of the terminals 1-22 (see § 5.5.2, page 49).
Keyboard	Reference is set with the + and - keys on the Control Panel. Can only be done in window Set/View Ref [500], (see § 5.6, page 57). Now the + and - keys will set the reference value.
Comm	The reference is set via the serial communication (RS 485, fieldbus, see § 5.3.30, page 37)

212 Ref Control Stp **Remote**	
Rem/ DigIn 1	The reference signal is selectable using DigIn 1. See Fig. 35. DigIn1=High:Ref via Keys DigIn1=Low:Ref via Remote
Comm/ DigIn 1	The reference signal is selectable with DigIn 1. See Fig. 36 DigIn1=High:Ref via Keys DigIn1=Low:Ref via Communication
Comm/ Rem DI1	The reference signal is selectable using DigIn 1. DigIn1=High: Ref via Remote DigIn1=Low:Ref via Communication
Option	The reference signal is set via the option connector, depending on the option used (only visible if option is connected). See Chapter 7. page 73.

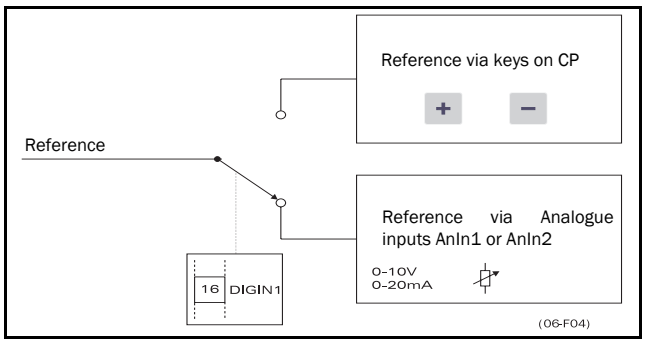


Fig. 35 Reference Control = Rem/DigIn 1.

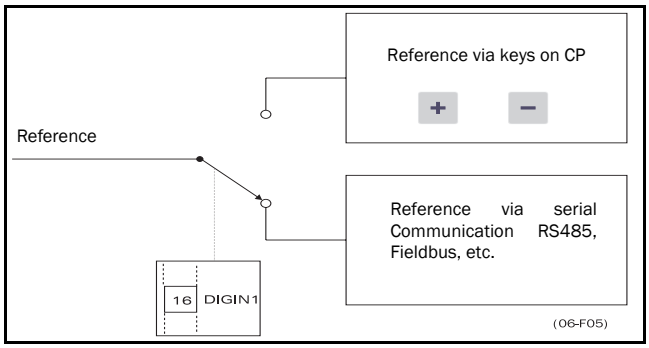


Fig. 36 Reference Control =Comm/DigIn 1.

NOTE! The programmable input DigIn 1 will not be programmable from the I/O menu [400] when "Rem/DigIn 1" Or "Comm/DigIn 1" has been selected. (See § 5.5, page 49).

NOTE! The functions "Rem/DigIn 1" and "Comm/DigIn 1" can be used to make a local/remote control. See also § 5.3.4, page 32 and § 5.5.2, page 49.

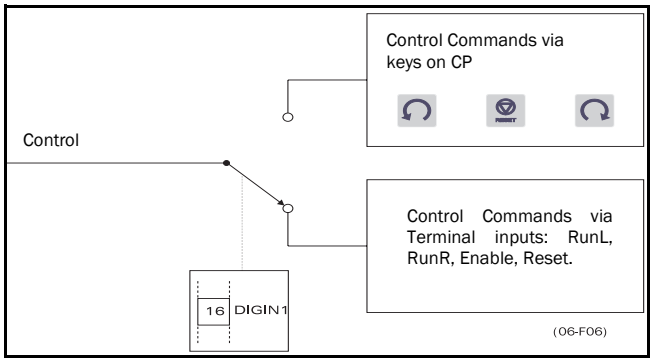


Fig. 37 Run/stp Control = Rem/DigIn 1.

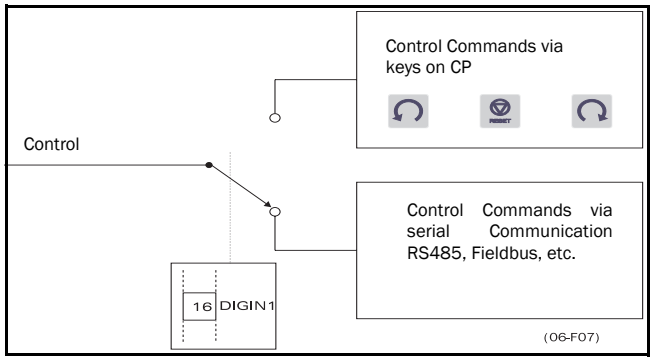


Fig. 38 Run/Stp Control =Comm/DigIn 1.

NOTE! If the reference is switched from Remote to Control Panel, the reference value is also taken over by the new reference.

5.3.4 Run/Stop/Reset control [213]

Selection of the source for run, stop and reset commands. See § 4.2, page 26 for the functional description.

	213 Run/Stp Ctrl Stp **Remote**
Default:	Remote
Selection	Remote, Keyboard, Comm, Rem/DigIn 1, Comm/DigIn 1, Comm/Rem DI1, Option
Remote	The commands come from the inputs of the terminals 1-22
Keyboard	The commands come from the command keys of the Control Panel. See § 4.1.4, page 23.
Comm	The commands come from the serial communication (RS 485, fieldbus, see § 5.3.30, page 37).
Rem/DigIn 1	With DigIn1 the commands are selectable between remote and the keyboard. See Fig. 36. DigIn1=High:Control via Keys DigIn1=Low:Control via Remote
Comm/ DigIn 1	With DigIn1 the commands are selectable between comm and the keyboard. See Fig. 37. DigIn1=High:Control via Keys DigIn1=Low:Control via Comm.
Comm/Rem DI1	The reference signal is selectable using DigIn 1. DigIn1=High: Ref via Remote DigIn1=Low:Ref via Communication
Option	The commands are set via the option connector, depending on the option used (only visible if option is connected). See Chapter 7. page 73.

NOTE! The programmable input DigIn 1 will not be programmable from the I/O menu [400] when "Rem/DigIn 1" or "Comm/DigIn 1" has been selected. (see § 5.5.13, page 53).

NOTE! The functions "Rem/DigIn 1" and "Comm/DigIn 1" can be used to make a local/remote control. (see § 5.3.3, page 31).

5.3.5 Rotation [214]

Sets the general rotation for the motor. See also § 4.2.6, page 28.

	214 Rotation Stp **R+L**
Default:	R + L
Selection:	R+L, R, L
R+L	Both speed directions allowed.
R	Speed direction is limited to right direction (clockwise). The input and key RunL are disabled. Bipolar analogue inputs/ outputs are not possible.
L	Speed direction is limited to left direction (counter-clockwise). The input and key RunR are disabled. Bipolar analogue inputs/outputs are not possible.

NOTE! If the functions "R" or "L" are selected the following windows are not visible:

Speed Direct [324]
AnIn 1 Bipol [415]
AnIn 2 Bipol [41A]

5.3.6 Level/Edge control [215]

Sets the way of input control for the inputs RunR and RunL and Enable. See also § 4.2, page 26 for more information.

	215 Level/Edge Stp **Level**
Default:	Level
Selection	Level, Edge
Level	The inputs are activated or deactivated by a continues high or low signal.
Edge	The inputs are activated or deactivated by a "low" to "high" transition.

5.3.7 Motor data [220]

Submenus to set the motor data and to perform the identification run. Input of name plate data to adapt the inverter to the connected motor. Items can only be changed when the motor is stopped, otherwise read only. The motor data are not affected by the Load Default command (see § 5.3.21, page 35).

NOTE! The default settings are for a standard 4-pole motor according to the nominal power of the inverter.

5.3.8 Motor power [221]

Setting of the nominal motor power.

	221 Motor Power Stp (P_{NOM}) **kW**
Default:	P_{nom} (see note)
Range:	1W-1.5 x P_{nom}
Resolution:	2 digits if <100

P_{nom} is the nominal inverter power.

5.3.9 Motor voltage [222]

Setting of the nominal motor voltage.

	222 Motor Volts Stp U_{NOM} **VAC**
Default:	U_{NOM} (see note)
Range:	100 - 700V
Resolution:	1V

5.3.10 Motor frequency [223]

Setting of the nominal motor frequency.

	223 Motor Freq Stp **50Hz**
Default:	50Hz
Range:	50 -300Hz
Resolution	1Hz

5.3.11 Motor current [224]

Setting of the nominal motor current.

	224 Motor Curr Stp (I_{NOM}) **A**
Default:	I_{NOM} (see note)
Range:	25 - 150% x I_{NOM}

I_{nom} is the nominal inverter current.

WARNING! Do not connect motors smaller than 25% of the nominal power of the inverter. This may disrupt the control of the motor.

Do not use motors smaller than 25% of the nominal inverter power. In that case use a smaller inverter.

WARNING! Even with the minimum limit set in window [221] the motor control can by disrupted if a smaller motor is still connected.

5.3.12 Motor Speed [225]

Setting of the nominal Motor Speed.

	225 Motor Speed Stp (n_{MOT}) **rpm**

Default:	n_{MOT}(see note)
Range:	400 -18000 rpm
Resolution:	1 rpm

5.3.13 Motor cos PHI [226]

Setting of the nominal Motor cosphi (power factor).

	226 Motor Cosphi Stp
Default:	(see note)
Range:	0.50 - 1.00

5.3.14 Motor ventilation [227]

Setting the type of motor ventilation. Affects the characteristics of the I^2t motor protection.

	227 Motor Vent Stp **Self**
Default:	Self
Selection:	Self, Forced, None
Self	Normal I^2t overload curve
Forced	Expanded I^2t overload curve
None	Limited I^2t overload curve

Fig. 39 shows the characteristics with respect to Nominal Current and Speed.

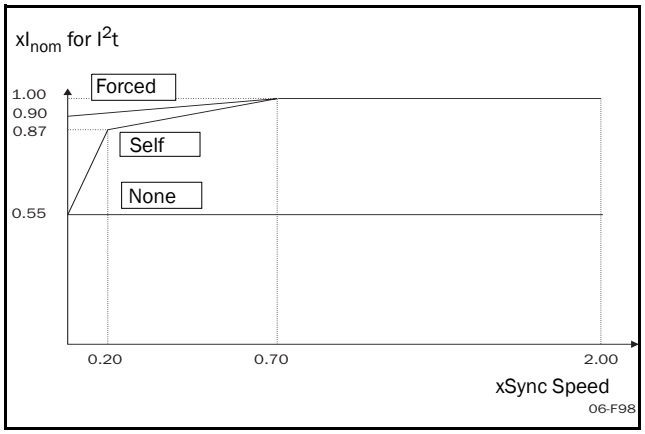


Fig. 39 I^2t curves

5.3.15 Motor identification run [228]

Fine tuning of motor parameters. During the test run the display shows "Test Run" blinking. To activate the Motor ID run, select either "Short" or "Extended", make the Enable input HIGH and press RunL or RunR on the CP. If 214 Rotation is set to L or R, the Motor ID run follows this. The ID run can be aborted by giving a Stop command via the CP or Enable input. The parameter will automatically return to OFF when the test is completed. The message "Test Run OK!" is displayed. Before the inverter can be operated normally again, the Enable input must have been low or press the STOP/RESET key on the control panel.

	228 Motor ID-run Stp **Off**
Default:	Off
Selection:	Off, Short, Extended
Off	Not active
Short	Parameters are measured with injected DC-currents. No rotation of the shaft will occur.
Extended	Additional measurements, not possible to perform with DC-currents, are done directly after a short ID run. The shaft will rotate and must be disconnected from the load.

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

NOTE! To run the inverter it is not mandatory to perform the ID RUN, but the performance will not be optimal.

NOTE! If the ID Run is aborted or not completed the message "Interrupted!" will be displayed. To start again the Enable input must be low again. The previous data are not changed in this case. Check that the MOTOR DATA are correct.

5.3.16 Utility [230]

Submenu to set common inverter settings like display language, locking Control Panel, loading defaults, copying and selecting Parameter Sets, copying settings between inverters.

5.3.17 Language [231]

Selection of the language of the LCD Display. The language selection is not affected by the Load Default command (see § 5.3.21, page 35).

	231 Language Stp English *
Default:	English
Selection:	English, Deutsch, Svenska, Nederlands, Français

5.3.18 Keyboard (un)lock [232]

If the keyboard is not locked (default) than the selection "Lock Code ?" will appear. If the keyboard is already locked, then the selection "Unlock Code ?" will appear. The keyboard can be locked with a password to prevent unauthorised personnel from changing parameters. When the keyboard is locked, parameters can be viewed but not changed. The reference value can be changed, the inverter can be started, stopped and reversed if these functions are set to be controlled from the keyboard. The code = 291.

	232 Lock Code? Stp 0 *
Default:	0
Range:	0 - 9999

NOTE! The message "CP locked!" will appear for as long as the "+" or "-" keys are pressed if an attempt to change a parameter is made while the system is locked. The value in 232 will revert to "0" after "Enter" is pressed.

5.3.19 Copy Set [233]

Copies the content of a Parameter Set into another Parameter Set. A Parameter Set consists of all parameters in the submenu Parameter Sets [300], see § 4.3, page 28.

	233 Copy Set Stp A>B *
Default:	A>B
Selection:	A>B, A>C, A>D, B>A, B>C, B>D, C>A, C>B, C>D, D>A, D>B, D>C

5.3.20 Select set no. [234]

Select a Parameter Set. A Parameter Set consists of all parameters in the submenu Parameter Sets [300]. Every function in the submenu Parameter Sets has an indication A, B, C or D depending on the active Parameter Set. Parameter Sets can be selected from the keyboard or via the programmable digital inputs 3 and/or 4. Parameter Sets can be changed during run. See § 4.3, page 28 for further explanation.

	234 Select Set Stp A
Default:	A
Selection:	A, B, C, D, DigIn 3, DigIn 3+4, Comm
A, B, C, D	Fixed selection of one of the 4 Parameter Sets A, B, C or D
DigIn 3	Selection of Parameter Set A or B with input DigIn 3. See § 4.3, page 28 for the selection table.
DigIn 3+4	Selection of Parameter Set A, B, C or D with input DigIn 3 and DigIn 4. See § 4.3, page 28 for the selection table.
Comm	Selection of the Parameter Set via serial communication. (RS 485, fieldbus, see § 5.3.30, page 37)

The active set can be viewed with function 6A0 FI status. (See § 5.7.10, page 58).

NOTE! The programmable input DigIn 3 or DigIn 4 will not be programmable from the I/O menu when DigIn 3 or DigIn 4 has been selected.

NOTE! A filter (50ms) will prevent contact bounces etc. from activating the wrong set when DigIn 3 or DigIn 4 is selected.

5.3.21 Default values [235]

Load default values on 3 different levels (factory settings).

	235 Load Default Stp A
Default:	A (the active Parameter Set)
Selection:	A, B, C, D, All, Factory
A, B, C, D	Only the selected Parameter Set will be reverted to its default settings.
All	All 4 Parameter Sets (the complete menu [300]) will be reverted to the default settings.
Factory	All 4 Parameter Sets and the menu´s [100], [200] (except [220] and [231]), [300], [400] and [800] will be reverted to the default settings.

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

NOTE! The message "Sure?" when selecting "Factory" must be confirmed by "Yes".

5.3.22 Copy all settings to Control Panel [236]

All the settings (the complete Setup Menu) are copied into the Control Panel. Two separate memory banks

Mem1 to Mem2 are available in the CP. In one Control Panel 2 complete sets of inverter settings can be stored, to be loaded into other inverters. (See also § 4.4, page 29).

	236 Copy to CP Stp CP MEMORY 1
Default:	CP MEMORY 1
Selection:	CP MEMORY 1 - CP MEMORY 2

5.3.23 Load Parameter Sets from Control Panel[237]

All 4 Parameter Sets sets from the Control Panel are loaded. Parameter Sets from the source inverter are copied to all Parameter Sets in the target inverter, i.e. A to A, B to B, C to C and D to D. (See § 4.4, page 29).

	237 CP>All Sets Stp CP MEMORY 1
Default:	CP MEMORY 1
Selection:	CP MEMORY 1 - CP MEMORY 2

5.3.24 Load the active Parameter Set from Control Panel [238]

Only the active Parameter Set is loaded from the Control Panel.

Example:
If the active Parameter Set in the target inverter is "B", then Parameter Set "B" from the selected memory bank will be loaded.

	238 CP>Act Set Stp CP MEMORY 1
Default:	CP MEMORY 1
Selection:	CP MEMORY 1-CP MEMORY 2

5.3.25 Load all settings from Control Panel [239]

All the settings from the Control Panel are loaded. The complete setup (including Motor Data) of the source inverter is copied to the target inverter. (See § 4.4, page 29).

	239 CP>Settings Stp CP MEMORY 1
Default:	CP MEMORY 1
Selection:	CP MEMORY 1-CP MEMORY 2

If MEMORY is empty, message "Failed" appears.

5.3.26 Autoreset [240]

The Autoreset must be enabled first by making the Autoreset input continuously high. See § 4.2.5, page 27. With function Number of trips [241] the Autoreset is activated. Select from window [242] to [24D] the relevant Trip conditions for the Autoreset.

5.3.27 Number of Trips [241]

Any number set above 0 activates the Autoreset. This means that after a trip, the inverter 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. The Autoreset counter is subtracted by one every 10 minutes.

If the maximum number of Trips has been reached, the trip message hour counter is marked with an "A". See also § 5.8, page 61 and § 6.2, page 70. If the Autoreset is full then the inverter must be resetted by switching off the power.

Example:
- Autoreset = 5
- Within 10 minutes 6 trips occur
- At the 6th Trip there is no Autoreset, because the Autoreset Trip Log contains already 5 trips.
- To reset, switch the power supply off/on.

	241 No of Trips Stp 0 *
Default:	0 (no Autoreset)
Range:	0 - 10 attempts

NOTE! An Autoreset is delayed by the remaining ramp time.

NOTE! Undervoltage Trips are not counted.

5.3.28 Selection of Autoreset trips

The windows [242] to [24D] select for each individual trip the Autoreset function. As default no trips are selected. Selection is On or Off.

Window	Default
242 Overtemp	Off
243 Overcurrent	Off
244 Overvolt D	Off
245 Overvolt G	Off
246 Overvolt L	Off
247 Motor Temp	Off
248 Ext Trip	Off
249 Motor Lost	Off
24A Alarm	Off
24B Locked Rotor	Off
24C Power Fault	Off

5.3.29 Option: Encoder [250]

Settings of the encoder option. See § 7.7, page 76.

NOTE! This submenu is only visible if an Encoder Card is fitted.

5.3.30 Option: Serial communication [260]

Settings of the optional serial input. See the Serial Communication instruction manual for further information.

	261 Baudrate Stp 38400 *
Default:	9600
Range:	9600 fixed

	262 Address Stp 1 *
Default:	1
Range:	1-247
Set this value to 1 in fieldbus mode. In RS232 mode, any value in the range 1-247 can be used.	

	263 Interrupt Stp Trip *
Default:	Trip
Selection:	Trip, Warning, Off
Trip	If there is no communication for longer than 15 seconds the inverter trips on “Comm Error”, see Chapter 6. page 69.
Warning	If there is no communication for longer than 15 seconds the inverter will give a warning. See Chapter 6. page 69.
Off	No interrupt safe guard active.

5.3.31 Option: PTC [270]

Settings of the optional PTC card. See also § 7.5, page 75.

NOTE! This submenu is only visible if the PTC card, Encoder Card or CRIO is connected to the inverter.

5.3.32 Option CRIO card [280]

Settings of the optional CRIO card (Crane Remote Input/Output card). See also § 7.6, page 76 and the Crane option instruction manual.

NOTE! This submenu is only visible if the CRIO card is connected to the inverter.

5.4 Parameter Sets [300]

The parameters in this main menu are regarded as a Parameter Set. These parameters are mainly of the type which are often adjusted obtain optimum machine performance. Up to four sets (A, B, C and D) can be stored. They can be selected (also during run) via the keyboard, the terminals (DigIn 3 and 4) or via the serial communications. The name of the active set is indicated by a letter in front of each parameter value. It can also be read in the FI Status [6A0] (see § 5.7.10, page 58). See for further explanation § 4.3, page 28.

5.4.1 Run/Stop [310]

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

5.4.2 Acceleration time [311]

The acceleration time is defined as the time it takes to go from 0rpm to motor synchronous speed.

NOTE! If the Acc Time is too short, the motor is accelerated according to the Torque Limit. The actual Acceleration Time may be higher than set.

	311 Acc Time Stp **A: 2.00s** *
Default:	2.00s (10.0s for size 4 and up)
Range:	0.00 - 3600s

Shows the relation between Synchronous/Max Speed and the Acceleration Time. The same is valid for the Deceleration Time.

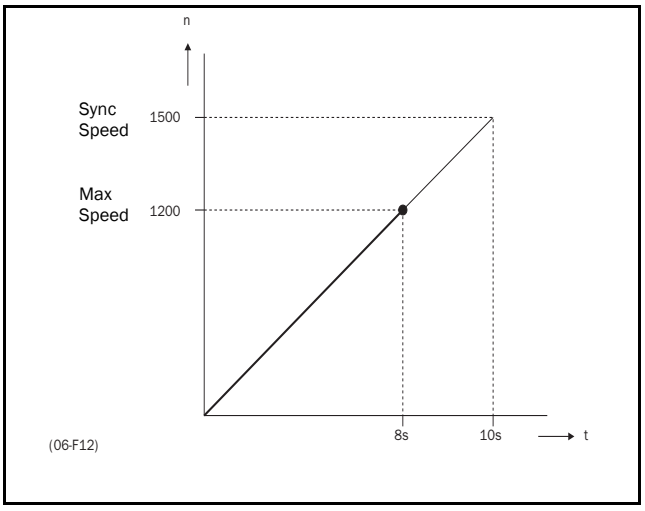


Fig. 40 Acceleration time and maximum speed.

Fig. 41 shows the settings of the Acceleration and Deceleration Times with respect to the Synchronous Speed.

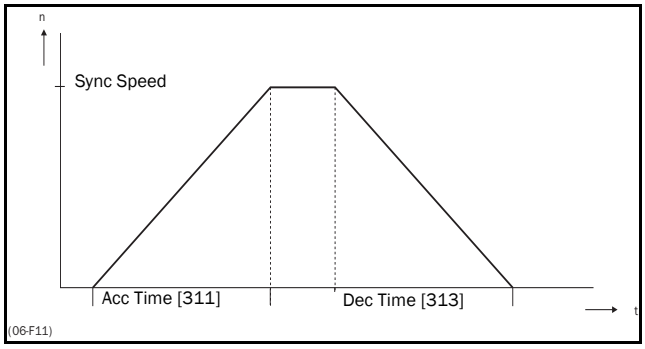


Fig. 41 Acceleration and deceleration times.

5.4.3 Acceleration ramp type [312]

Sets the type of acceleration ramp. See Fig. 42.

	312 Acc Rmp Type Stp **A: Linear** *
Default:	Linear
Selection:	Linear, S-Curve
Linear	Linear acceleration ramp
S-Curve	S-shape acceleration ramp

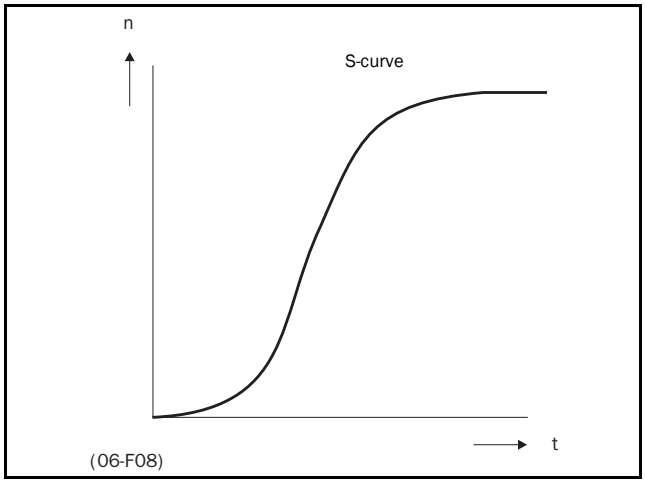


Fig. 42 S-curve acceleration ramp.

5.4.4 Deceleration time [313]

The deceleration time is defined as the time it takes to go from motor synchronous speed to 0rpm.

	313 Dec Time Stp **A: 2.00s** *
Default:	2.00s (10.0s for size 4 and up)
Range:	0.00 - 3600s

NOTE! If the Dec Time is too short and the generator energy cannot be dissipated in a brake resistor or via vector braking, the motor is decelerated according to the overvoltage limit. The actual deceleration time may be higher than set.

5.4.5 Deceleration ramp type [314]

Sets the type of acceleration ramp. Fig. 43.

	314 Dec Rmp Type Stp A: Linear *
Default:	Linear
Selection:	Linear, S-Curve
Linear	Linear deceleration ramp
S-Curve	S-shape deceleration ramp

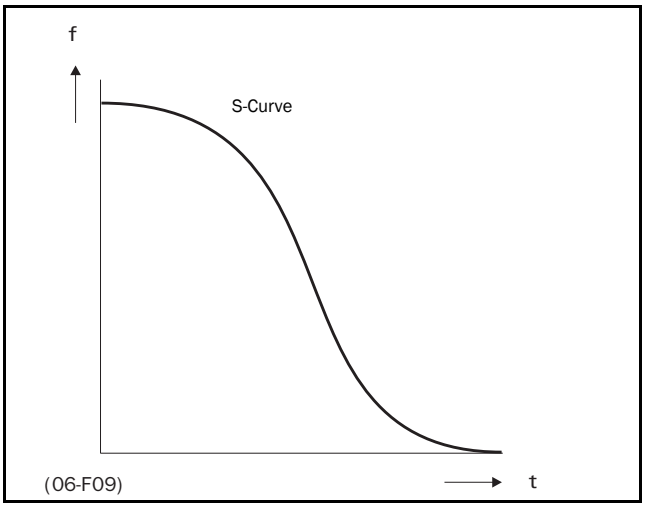


Fig. 43 S-curve deceleration ramp.

NOTE! Windows [311] to [314] are only visible if Drive Mode = Speed or V/Hz (see § 5.3.2, page 31).

5.4.6 Start Mode [315]

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

	315 Start Mode Stp A: Normal DC *
Default:	Normal DC
Selection:	Normal DC, Fast
Normal DC	Allows the motor to start with max. torque without tripping on overcurrent. After a Run command the motor will be magnetised first and the stator resistance is measured. It takes about 500 ms (depending on the motor time constant and the size of the motor it can take maximum 1.3 s) before the motor starts to rotate. This will provide better control of the motor when starting.
Fast	The motor flux increases gradually. The motor starts rotating immediately after the Run command is given.

5.4.7 Stop Mode [316]

Sets the way of stopping the motor when a STOP command is given.

	316 Stop Mode Stp A: Decel *
Default:	Decel
Selection:	Decel, Coast
Decel	The motor decelerates to zero speed according to the set deceleration time.
Coast	The motor freewheels naturally to zero speed.

5.4.8 Brake release time [317]

This Brake Release Time compensates the time it takes to release a mechanical brake. Only valid when Start Mode = Normal DC (see § 5.4.6, page 39).

	317 Brk Release Stp A: 0.00s *
Default:	0.00s
Range:	0.00 - 3.00s

Fig. 43 shows the relation between the 4 Brake functions.
- Brake Release Time [317]
- Brake Engage Time [318]
- Brake Wait Time [319]
- Start Speed [32I]

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 [32I] (see § 5.4.26, page 45).

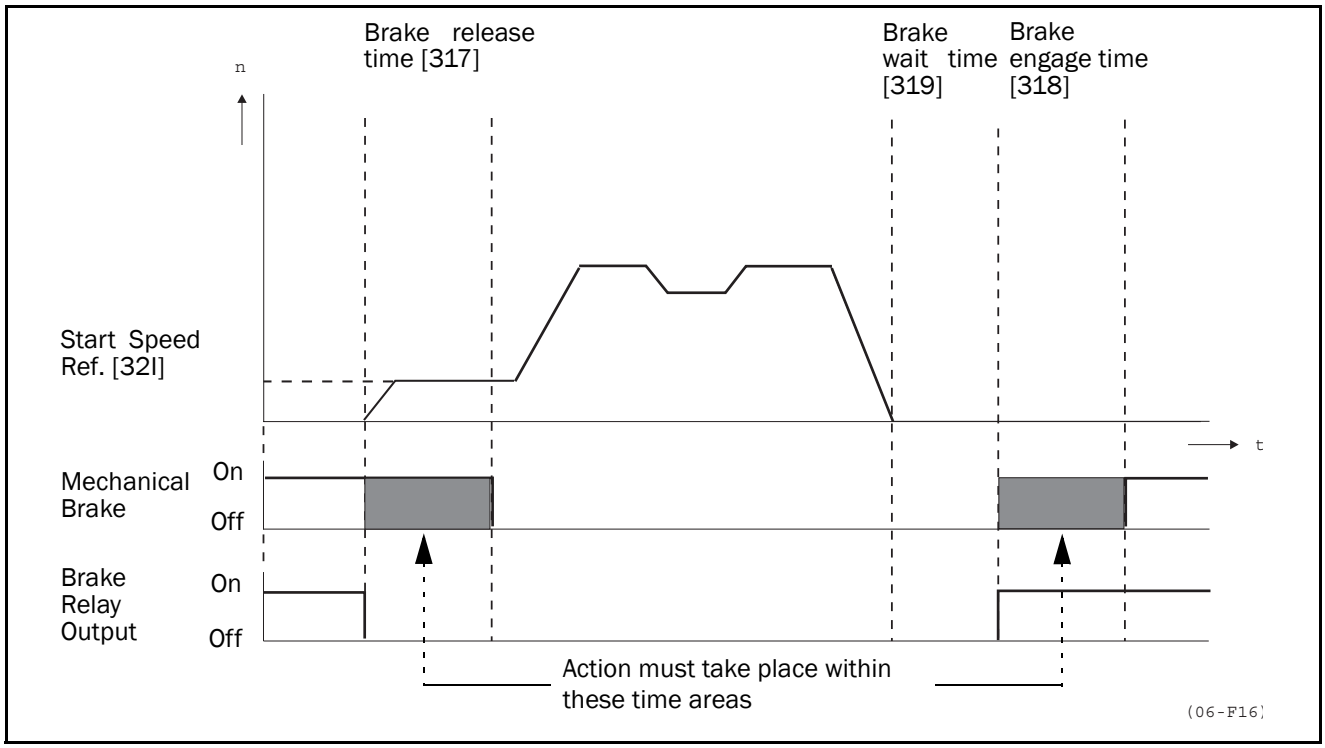


Fig. 44 Brake Output functions.

NOTE! Although this function is designed to operate a mechanical brake via the digital outputs or relays (set to Brake functions, controlling a mechanical brake. See § 5.5.29, page 56). It can also be used without a mechanical brake and hold the load in a fixed position.

5.4.9 Brake Engage Time [318]

The Brake Engage Time is the time to hold the load while the mechanical brake engages. Also used to get a firm stop when transmissions, etc. cause "whiplash" effects. Compensates the time it takes to engage a mechanical brake.

318 Brk Engage Stp **A:** **0.00s** *	
Default:	0.00s
Range:	0.00 - 3.00s

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. See § 5.5.29, page 56), it can also be used without a mechanical brake and hold the load in a fixed position.

5.4.10 Wait before Brake Time [319]

The Brake Wait Time is the time to hold the load, in order to be able to speed up immediately, or to stop and engage the brake.

319 Brk Wait Stp **A:** **0.00s** *	
Default:	0.00s
Range:	0.00 - 30.0s

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. See § 5.5.29, page 56), it can also be used without a mechanical brake and hold the load in a fixed position.

5.4.11 Vector Brake [31A]

Braking by dissipating energy in the rotor.

31A Vector Brake Stp **A:** **Off** *	
Default:	Off
Selection:	Off, On
Off	Vector brake switched off. Inverter brakes normal with voltage limit on the DC-link.
On	Maximum inverter current (I_{CL}) is available for braking. See § 8.2, page 78 and Table 27.

5.4.12 Quick Stop Time [31B]

The Q-Stop Time is a fast deceleration time to Zero Speed. It is activated by one of the programmable inputs DigIn 1, 2, 3, or 4. See § 5.5.13, page 53.

	31B Q-Stop Time Stp **A:** **0.00s** *
Default:	0.00s
Range:	0.00-300s

Fig. 45 shows how the Q-Stop time overrules the set deceleration time. The Q-Stop Time Ramp type is the same as the selected Decel Ramp Type (see § 5.4.5, page 39). If the Q-Stop Time is activated the inverter will ramp down to Zero Speed. The inverter will not go into Stop Mode.

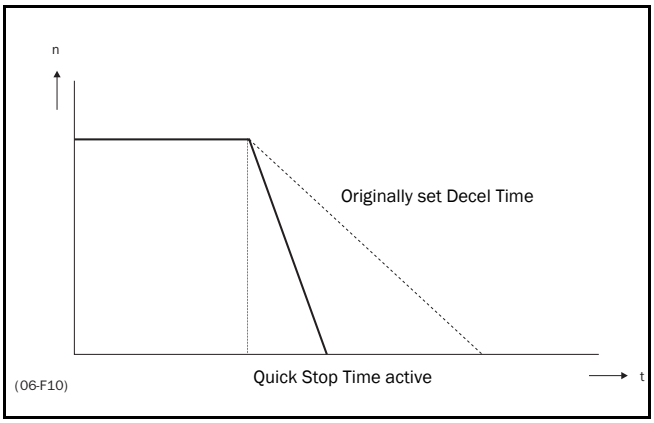


Fig. 45 Quick Stop Time.

NOTE! This window is only visible if parameter Drive [211] Drive Mode = Speed or V/Hz (see § 5.3.2, page 31).

5.4.13 Spinstart [31C]

The Spinstart will start a motor which is already running, without tripping or generating high current peaks. With the Spinstart=On the actual starting of the motor is delayed depending on motor size, running conditions of the motor before the Spinstart, inertia of the application etc.

	31C Spinstart Stp **A:** **Off** *
Default:	Off
Selection:	Off, On
Off	No Spinstart. If the motor is already running the inverter can trip or will start with high current.
On	Spinstart will allow to start a running motor without tripping or high inrush currents.

5.4.14 Speeds [320]

Submenu with all settings regarding to speeds, as Min/ Max Speed, Jog Speed, Preset Speeds, Skip Speeds.

5.4.15 Minimum Speed [321]

Sets the Minimum Speed. See the function Min Spd Mode § 5.4.17, page 42 for the behaviour at Minimum Speed.

	321 Min Speed Stp **A:** **0rpm** *
Default:	0 rpm
Range:	0 - Max Speed

NOTE! This window is NOT visible if Drive Mode = Torque (see § 5.3.2, page 31) or if Bipolar reference control is used (see § 5.5.11, page 52).

5.4.16 Maximum Speed [322]

Sets the maximum speed at 10V/20mA, unless a user defined characteristic of the analogue input is programmed (see § 5.5.4, page 49, § 5.5.5, page 50, § 5.5.9, page 52 and § 5.5.10, page 52). The synchronous speed is determined by the parameter Motor Speed [225] (see § 5.3.12, page 33).

Example:
If parameter Motor Speed [225]= 1460 rpm, the inverter calculates the synchronous speed to 1500rpm (4-pole motor). The default setting of Maximum Speed is then 1500rpm.
See also Fig. 46.

	322 Max Speed Stp **A:**Syncspd**rpm** *
Default:	Sync. speed
Range:	Min Speed - 2x Sync Speed

NOTE! It is no possible to set the Maximum Speed lower than the Minimum Speed.

5.4.17 Min Speed Mode [323]

To select the behaviour of the inverter at minimum speed.

	323 Min Spd Mode Stp **A: Scale** *
Default:	Scale
Range:	Scale, Limit, Stop
Scale	Minimum Speed = Zero reference. See Fig. 46.
Limit	Minimum Speed = Zero reference, but with a dead band according to Fig. 47.
Stop	The inverter will ramp to Zero Speed when the speed reference is lower than the minimum speed. If the reference signal comes back it will ramp up again. See Fig. 48.

NOTE! This window is NOT visible if Drive Mode = Torque (see § 5.3.2, page 31) or if Bipolar reference control is used (see § 5.5.6, page 50).

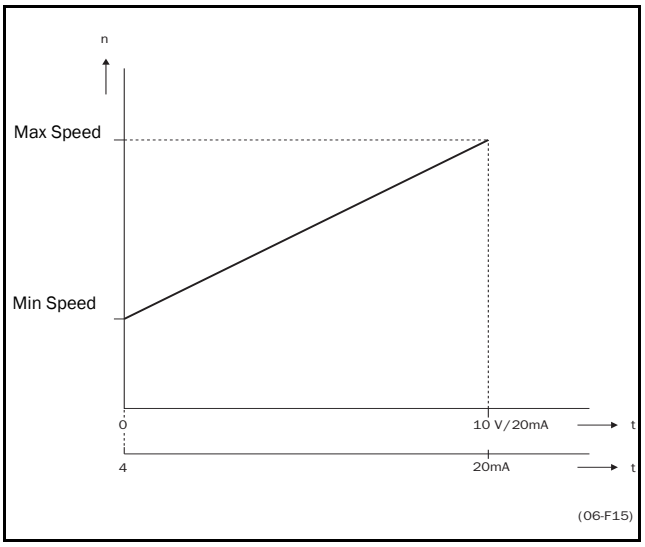


Fig. 46 Min Speed Mode = Scale.

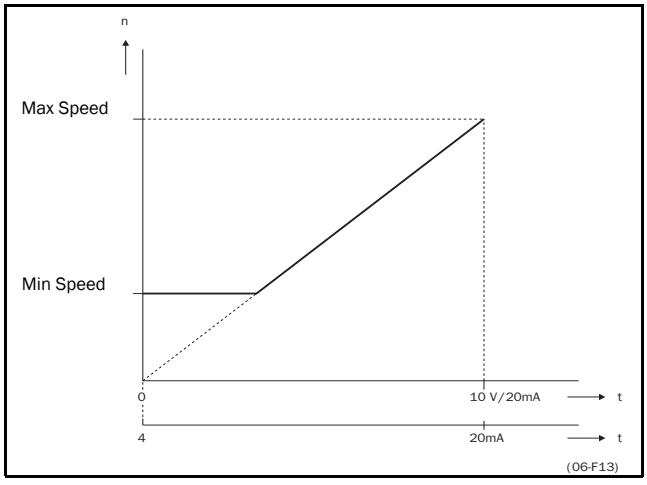


Fig. 47 Min Speed Mode = Limit.

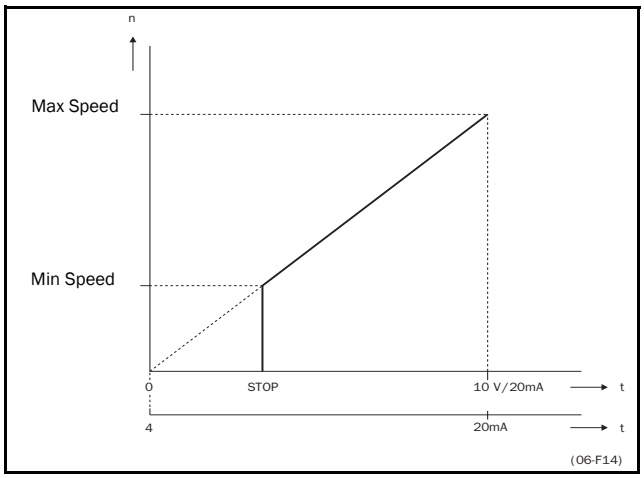


Fig. 48 Min Speed Mode = Stop.

5.4.18 Speed Direction [324]

Sets the rotation for the active Parameter Set. See § 4.2.6, page 28.

	324 Speed Direct Stp **A: R+L** *
Default:	R+L
Range:	R+L, R, L
R+L	Both speed Directions allowed.
R	Speed direction is set to right direction (clockwise). The input and key RunR and RunL will act as a general Run command. Bipolar analogue inputs/outputs are considered as unipolar inputs/outputs.
L	Speed direction is set to left direction (counter-clockwise). The input and key RunR and RunL will act as a general Run command. Bipolar analogue inputs/outputs are considered as unipolar inputs/outputs.

NOTE! This window is only visible if Rotation=R+L (see § 5.3.5, page 33).

5.4.19 Motor Potentiometer [325]

Sets the properties of the Motor Potentiometer function. See the parameter DigIn1 [421] § 5.5.13, page 53 for the selection of the Motor Potentiometer function.

	325 Motorpot Stp **A: Non Vola** *
Default:	Non Vola
Selection:	Non Vola, Volatile

Non vola	Non Volatile. After a stop, trip or power down of the inverter the active output speed at the moment of the stop will be memorized. After a new start command the output speed will resume to this saved value.
Volatile	After a stop, trip or power down, the inverter will start always from zero speed (or minimum speed, if selected).

5.4.20 Preset Speed 1 [326] to Preset Speed 7 [32C]

Preset Speeds are activated by the digital inputs DigIn1-DigIn4, see § 5.5.13, page 53 - § 5.5.16, page 54. 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 16 preset speeds are possible. (see § 4.3, page 28).

	326 Preset Spd 1 Stp **A:** **0rpm** *
Default:	0 rpm
Range:	0 - Max Speed

The same settings are valid for the windows:
[327 Preset Speed 2], with default 250 rpm
[328 Preset Speed 3], with default 500 rpm
[329 Preset Speed 4], with default 750 rpm
[32A Preset Speed 5], with default 1000 rpm
[32B Preset Speed 6], with default 1250 rpm
[32C Preset Speed 7], with default 1500 rpm
The selection of the presets is according to Table 15.

Table 15 Preset

Preset Ref 4	Preset Ref 2	Preset Ref 1	Output Speed
0	0	0	Analogue reference as programmed
0	0	1[1)]	Preset Speed 1
0	1[1)]	0	Preset Speed 2
0	1	1	Preset Speed 3
1[1)]	0	0	Preset Speed 4
1	0	1	Preset Speed 5
1	1	0	Preset Speed 6
1	1	1	Preset Speed 7

[1)] = selected if only the Preset Ref. 1, 2 or 4 is active
1 = active input
0 = non active input

Preset Speed have priority over the analogue inputs.

NOTE! If only preset ref 4 is active, than the Preset Speed 4 can be selected. If Preset Ref 2 and 4 are active, then the Preset Speeds 2, 4 and 6 can be selected.

NOTE! This window is only visible if DRIVE Mode = Speed or V/Hz (see § 5.3.2, page 31).

5.4.21 Skip Speed 1 Low [32D]

Within the range Skip Speed high to low the Shaft Speed cannot be constant to avoid mechanical resonance in the drive system.

When Skip Speed Low ≤ Ref Speed ≤ Skip Speed High, then Shaft Speed=Skip Speed HI during dec and Shaft Speed=Skip Speed LO during acc. Fig. 49 shows the function of Skip Speed Hi and Low.

	32D Skipspd 1 LO Stp A: 0rpm *
Default:	0 rpm
Range:	0 - 2x Sync. Speed

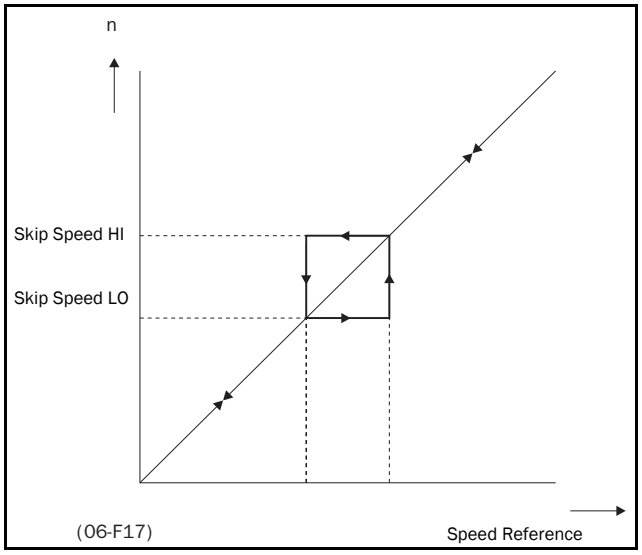


Fig. 49 Skip Speed.

NOTE! The 2 Skip Speed ranges may be overlapped.

NOTE! This window is only visible if Drive Mode = Speed or V/Hz (see § 5.3.2, page 31).

5.4.22 Skip Speed 1 High[32E]

See § 5.4.21, page 44.

	32E Skipspd 1 HI Stp A: 0rpm *
Default:	0 rpm
Range:	0 - 2x Sync. Speed

5.4.23 Skip Speed 2 Low [32F]

See § 5.4.21, page 44.

	32F Skipspd 2 LO Stp A: 0rpm *
Default:	0 rpm
Range:	0 - 2x Sync. Speed

5.4.24 Skip Speed 2 High [32G]

See § 5.4.21, page 44.

	32G Skipspd 2 HI Stp A: 0rpm *
Default:	0 rpm
Range:	0 - 2x Sync. Speed

5.4.25 Jog Speed [32H]

The Jog Speed command is activated by one of the digital inputs DigIn1-DigIn4, see § 5.5.13, page 53 - § 5.5.16, page 54. The digital input must be set to the function Jog.

The Jog command will automatically give a run command as long as the Jog command is active. The rotation is determined by the polarity of the set Jog Speed.

Example:

If Jog Speed = -30, this will give Run Left command at 30 rpm regardless of RunL or RunR commands. Fig. 50 shows the function of the Jog command.

	32H Jogspeed Stp A: 50rpm *
Default:	50 rpm
Range:	-2x Sync. Speed 0 - +2x Sync. Speed

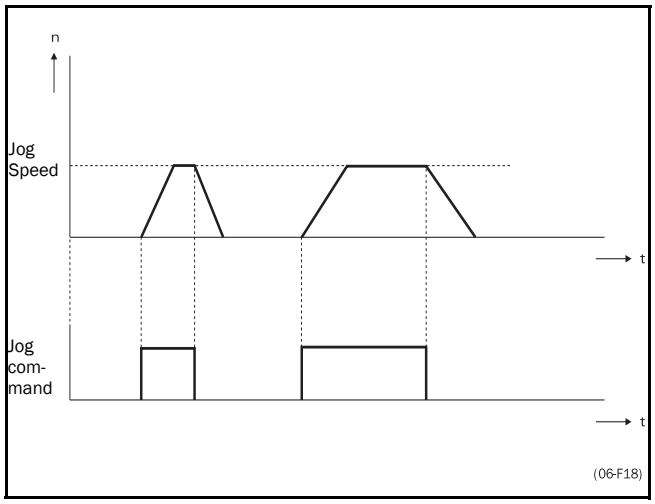


Fig. 50 Jog command.

NOTE! This window is only visible if Drive Mode = Speed or V/Hz (see § 5.3.2, page 31).

5.4.26 Start Speed [32I]

The Start Speed only operates with the brake function: Brake Release [317], see § 5.4.8, page 39. The Start 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.

	32I Start Speed Stp **A:** **10rpm** *
Default:	10 rpm
Range:	- 2x Sync. Speed -0 - +2x Sync. Speed

5.4.27 Speed priority

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

Table 16 Speed priority

Jog Mode	Preset Speeds	Motor Pot	Ref. Signal
Option cards			
On	On/Off	On/Off	Jog Speed
Off	On	On/Off	Preset Speed
Off	Off	On	Motor pot Commands
Off	Off	Off	AnIn1, AnIn2

5.4.28 Torque [330]

Submenu with all settings regarding to torque.

5.4.29 Maximum Torque [331]

Sets the maximum torque.

$$T_{MOT} = \frac{P_{MOT} x 60}{n_{MOT} x 2\Pi}$$

	331 Max Torque Stp **A:** **150%** *
Default:	150%
Range:	0 – 180% x I_{nom}/I_{mot} (VFB) 0 – 150% x I_{nom}/I_{mot} (VFX)

NOTE! 100% Torque means: T= T_{MOT}. Maximum depends on setting of Motor Current and inverter max current (see § 5.3.11, page 33), but absolute maximum adjustment is 400%

NOTE! The power loss in the motor will increase by the square of the torque when operating above 100%. 400% torque will result in 1600% power loss, which very quickly will increase the motor temperature.

5.4.30 Minimum Torque [332]

Sets the minimum torque. In some applications the minimum torque can not be set to 0%. This can result in an OVERSPEED trip. See Chapter 6. page 69.

	332 Min Torque Stp **A:** **15%** *
Default:	15%
Range:	0 - 400%

5.4.31 Controllers [340]

Submenu with all the setting regarding to the internal PI and external PID controller and the Flux optimization function.

5.4.32 Speed PI Autotune [341]

The inverter has an internal speed controller, which is used to keep the Shaft Speed equal to set reference speed. This internal speed controller works without an external feedback.

With the parameters Speed P Gain [342] (§ 5.4.33, page 46) and Speed I Time [343] (§ 5.4.34) the controller can be optimised manually.

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 motorload connected and the motor running. "Spd PI Auto" will be blinking in the display during the autotune operation. When the test is successfully concluded, the display will show "Spd PI OK!" for 3s. The Speed P Gain must be manually tuned for 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.

	341 Spd PI Auto Stp **A:** **Off** *
Default:	Off
Selection:	Off, On

NOTE! Run the Auto Tune at speed lower than 80% of the nominal motor speed.

NOTE! The setting will automatically return to Off when the auto tuning is finished.

NOTE! This window is only visible if Drive Mode = Speed or V/Hz (see § 5.3.2, page 31).

5.4.33 Speed P Gain [342]

To adjust the P Gain of the internal Speed Controller, see the parameter Speed PI Auto Tune [341] § 5.4.32, page 45.

	342 Speed P Gain Stp **A:** *
Default:	See note
Selection:	0.0 - 30.0

5.4.34 Speed I Time [343]

To adjust the time of the internal Speed Controller see parameter Speed PI Auto Tune [341] § 5.4.33.

	343 Speed I Time Stp **A:** *
Default:	See note
Range:	0.01 - 10.00 s

NOTE! The default settings are for a standard 4-pole motor according to the nominal power of the inverter.

5.4.35 Flux optimization [344]

Flux Optimization reduces the energy consumption and the motor noise, at low or no load conditions.

	344 Flux Optimiz Stp **A:** **Off** *
Default:	Off
Selection:	Off, On

NOTE! This window is only visible if Drive Mode = Speed (see § 5.3.2, page 31).

5.4.36 PID Controller [345]

The PID controller is used to control an external process via a feedback signal. In Speed Mode, the controller will act on the speed loop. In Torque Mode, the controller will act directly on the Torque Loop. The reference value can be set via analogue input AnIn1, at the Control Panel [500], or via serial communication. The feedback signal should be connected to analogue input AnIn2, which is locked to the setting "PID control" when the PID Controller is selected to "On" (or "Invert").

	345 PID Control Stp **A:** **Off** *
Default:	Off
Selection:	Off, On, Invert
Off	PID control deactivated.
On	The speed (or torque) increases when the feedback value decreases. PID settings according to windows [345] to [348] (see § 5.4.36, page 46 to § 5.4.39, page 47).
Invert	The speed (or torque) decreases when the feedback value decreases. PID settings according to windows [345] to [348] (see § 5.4.36, page 46 to § 5.4.39, page 47).

NOTE! If the PID Control = On or Invert, the input AnIn2 is automatically set as feedback input. The reference value is according to setting of window [212]. Other settings for AnIn1 and AnIn2 will be neglected.

5.4.37 PID P Gain [346]

Setting the P Gain for the PID controller. See also § 5.4.36, page 46.

	346 PID P Gain Stp **A:** **1.0** *
Default:	1.0
Selection:	0.0 - 30.0

NOTE! This window is not visible if the PID Controller = Off.

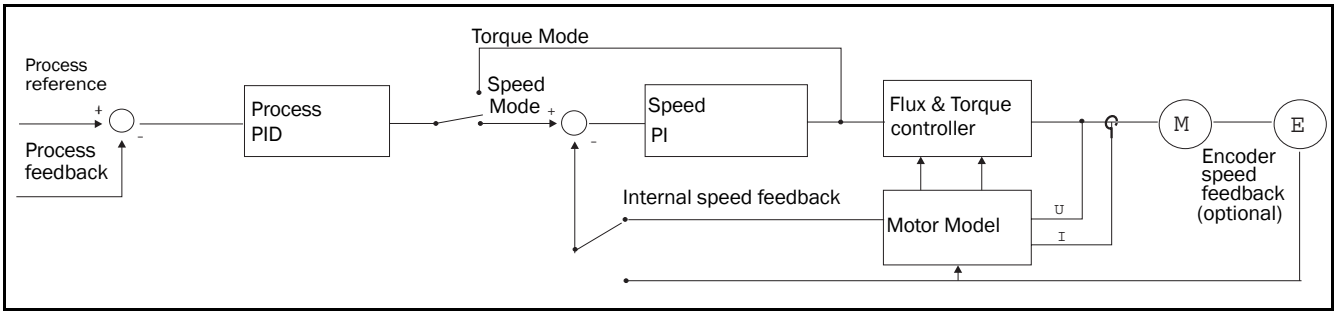


Fig. 51 Closed loop PID control.

5.4.38 PID I Time [347]

Setting the integration time for the PID controller. See § 5.4.36, page 46.

	347 PID I Time Stp A: 1.00s *
Default:	1.00 s
Selection:	0.01 - 300 s

NOTE! This window is not visible if the PID Controller = Off.

5.4.39 PID D Time [348]

Setting the differentitation time for the PID controller. See also § 5.4.36, page 46.

	348 PID D Time Stp A: 0.00s *
Default:	0.00 s
Selection:	0.00 - 30 s

NOTE! This window is not visible if the PID Controller = Off.

5.4.40 Limits/protections [350]

Submenu with all the settings regarding protection functions and limiting values for the inverter and the motor.

5.4.41 Low Voltage Override [351]

If a dip on the mains supply occurs, the inverter will automatically ramp down the speed until the voltage rises again. The rotating energy in the motor/load will keep the DC-link voltage level at the override level, as long as it can or until the motor stops. This is dependent on the inertia of the motor/load combination and the load of the motor at the time the dip occurs, Fig. 52.

	351 Low Volt OR Stp A: Off *
Default:	Off
Selection:	Off, On
Off	Normal operation, at a voltage dip the low voltage trip will protect.
On	At mains DIP, inverter ramps down until voltage rises.

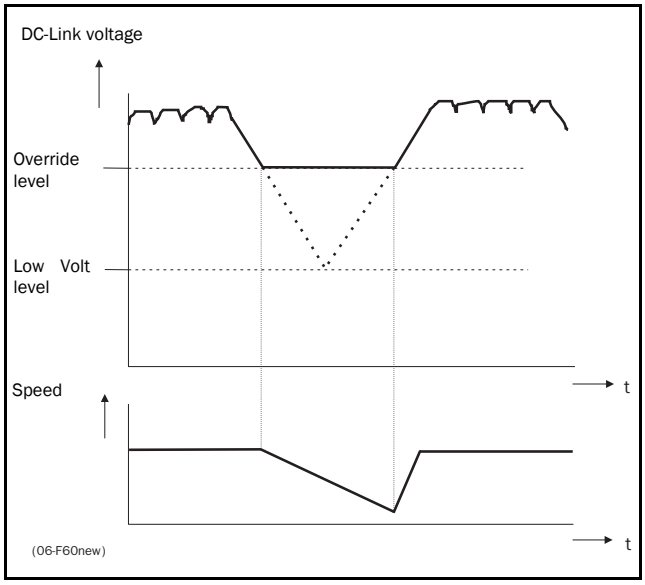


Fig. 52 Low Voltage Override.

NOTE! During the Low voltage override the LED trip/limits blinks.

5.4.42 Rotor locked[352]

Detects a locked rotor. This is when the Torque Limit has been active at zero speed for more than 5 seconds.

	352 Rotor locked Stp A: Off *
Default:	Off
Selection:	Off, On
Off	No detection
On	Inverter will trip when locked rotor is detected. Trip message “Locked Rotor”. See also Chapter 6. page 69.

5.4.43 Motor lost [353]

Detects a disconnected motor, or phase loss at the motor (1, 2 or 3 phases).

	353 Motor lost Stp A: Resume *
Default:	Off
Selection:	Resume, Trip, Off
Off	Function switched off to be used if no motor or very small motor connected.
Resume	Operation is resumed when the motor is reconnected.
Trip	Inverter will trip when the motor is disconnected. Trip message “Motor Lost”. See also Chapter 6. page 69.

5.4.44 Motor I^2t Type [354]

Select the behaviour of the I^2t protection. The I^2t trip time is calculated with the formula:

$t=120 \times 0.44/((I_{out}/I_{I2t[355]})^2-1)s$.

	354 Mot I²t Type Stp **Trip** *
Default:	Trip
Selection:	Off, Trip, Limit
Off	I^2t motor protection is not active. The I^2t protection of the inverter remains always active, even if the motor I^2t is set to Off. The inverter I^2t protection has a fixed I^2t current level of 150% I_{NOM}.
Trip	When the I^2t time is exceeded, the inverter will trip on "Overcurrent". See also Chapter 6. page 69.
Limit	When the I^2t time is exceeded, the inverters lowers the Current Limit level (CL) to the same value as the I^2t current level in window [355].

If limit is at maximum the inverter will trip at "I^2t", see Chapter 6. page 69. Fig. 53 gives an example if the Rated Motor Current is 50% and 100% of the nominal inverter current.

5.4.45 Motor I^2t Current [355]

Sets the current limit for the motor I^2t calculation. This level is independent from the torque limit. A smaller motor can still use the overcurrent capacity (torque) of a bigger inverter, at a lower I^2t level.

	355 Mot I²t I Stp (I_{MOT})**A** *
Default:	I_{MOT}
Range:	0.1A – 1.5 x I_{mot}

NOTE! This window is not visible when Motor I^2T Type = Off (see § 5.4.44, page 47).

5.4.46 Overvoltage control[356]

Used to switch off the overvoltage controller in case braking by brake chopper and resistor only is required.

	356 Overvoltage Stp **ON** *
Default:	On
Selection:	On, Off

NOTE! During the limit the LED trip/limits is blinking.

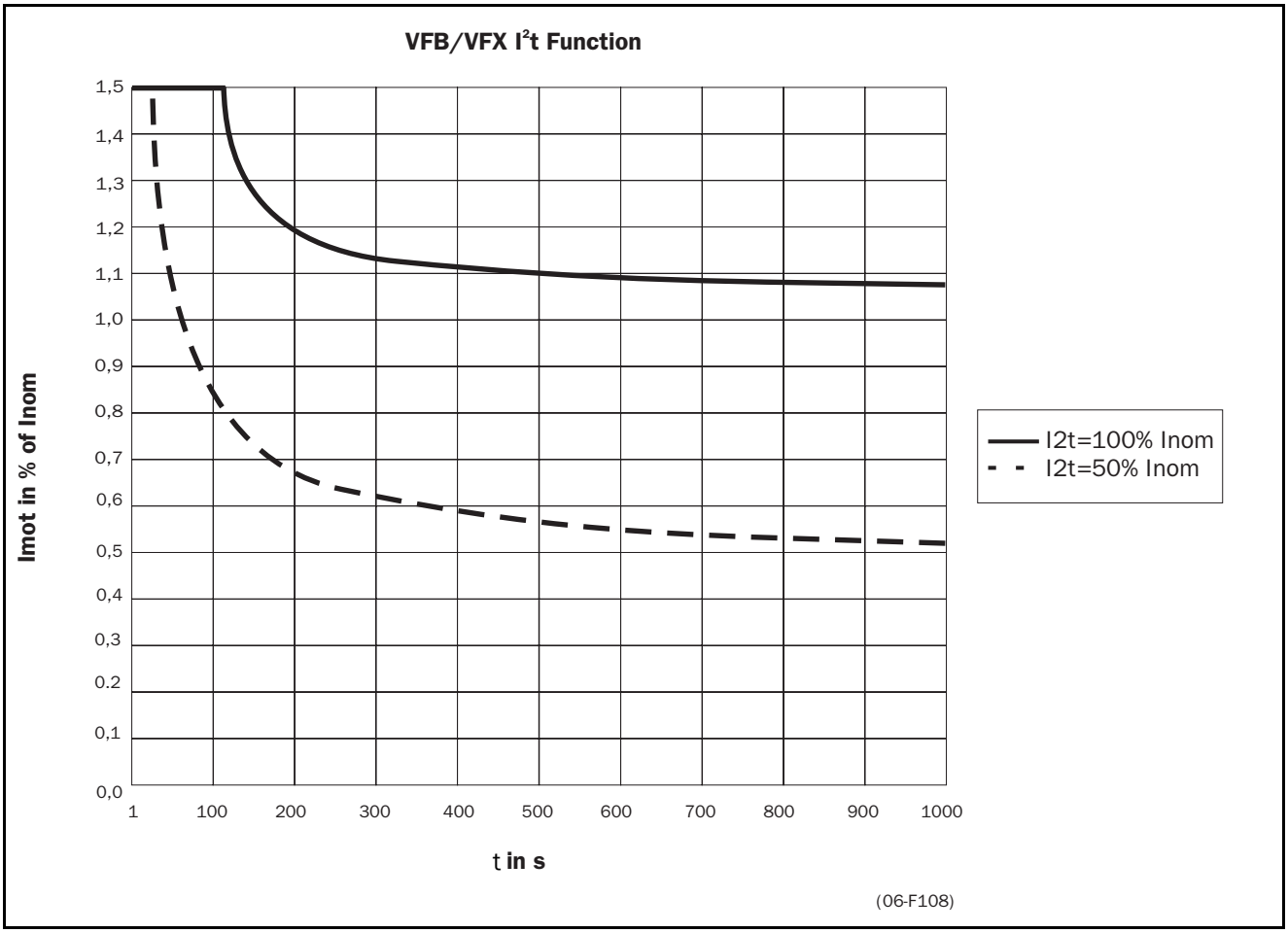


Fig. 53 I^2t function

5.5 I/O [400]

Main menu with all the settings of the standard inputs and outputs of the inverter.

5.5.1 Analogue Inputs [410]

Submenu with all settings regarding the analogue inputs.

5.5.2 AnIn1 Function [411]

Setting the function for Analogue input 1.

	411 AnIn 1 Funct Stp **Speed**
Default:	Speed
Selection:	Off, Speed, Torque
Off	Input is not active
Speed	Reference value is set for Speed Control
Torque	Reference value is set for Torque Control

NOTE! Selection of Speed or Torque is only possible when PID Controller = Off (see par. § 5.4.36, page 46. If PID Controller = on the message "PID Controller" is displayed here. If the reference signal comes from an option card, then the message "Option" is displayed here. Depends on reference by selection.

NOTE! The windows 412, 413, 414 and 415 are not visible if AnIn1 Func=Off.

Special functions:

- **Adding AnIn1 and AnIn2.**
  If AnIn1 and AnIn2 are both set to the same function the values of the inputs are added.
- **Local /Remote control.**
  If a digital input (see § 5.5.13, page 53) is set to the function "AnIn Select", This digital input can be used to switch between AnIn1 and AnIn2.

NOTE! If a digital input e.g. DigIn1=AnIn Select, then the analogue inputs are not added.

Example:

- AnIn 1 is set for speed control and 0-10V (local potentiometer).
- AnIn 2 is set for speed control and 4-20mA (remote control system)
- DigIn1 = AnIn Select

Now with DigIn1 the reference signal can be switched between AnIn1 (potentiometer local) and AnIn2 (current control -remote).

NOTE! See also function Reference Control [212] § 5.3.3, page 31 for other possibilities with Local/Remote control of the reference signal.

5.5.3 AnIn 1 Set-up [412]

Preset scaling and offset of the input configuration. The input is bipolar. This means that a negative reference signal will give a reversal of the speed direction of the motor.

	412 AnIn 1 Setup Stp **0-10V/0-20mA**
Default:	0-10V/0-20mA
Selection:	0-10V/0-20mA, 2-10V/4-20mA, User defined
0-10V/ 0-20mA	Normal full scale configuration of the input. See Fig. 54.
2 - 10V/ 4 - 20mA	The input has a fixed offset=20% and Gain=1.25 (Live Zero). See Fig. 55.
User defined	The input can be set to a user defined offset and scaling. Now the functions AnIn 1 Offset [413] and AnIn 1 Gain [414] will appear to set the user defined configuration of the input. (Windows [417] and [418] for AnIn 2). Output=(Input - Offset) x Gain **NOTE! If an Offset is selected, then a Bipolar input is not possible.**

5.5.4 AnIn 1 Offset [413]

	413 AnIn 1 Offst Stp **0%**
Default:	0%
Range:	-100% to +100%

Adds or subtracts an offset to the value of AnIn1. See Fig. 56.

NOTE! This window is only visible if the function AnIn 1 Setup = User Defined [412].

See also; § 5.5.3, page 49
AnIn 2 [416]
§ 5.5.7, page 52
and Rotation = R+L
§ 5.3.5, page 33.

NOTE! If an Offset or Minimum Speed is selected, then a Bipolar input is not possible.

5.5.5 AnIn 1 Gain [414]

	414 AnIn 1 Gain Stp 1.00 *
Default:	1.00
Range:	-8.00 to +8.00

Multiplies AnIn1 with the Gain, see Fig. 57.

NOTE! This window is only visible if the function AnIn1 Setup = User Defined [412], see § 5.5.3, page 49 and § 5.5.7, page 52.

Special function: Inverted reference signal
If the Offset is -100% and the Gain is -1.00 the input will act as inverted reference input, see Fig. 58.

5.5.6 AnIn 1 Bipolar [415]

	415 AnIn 1 Bipol Stp Off *
Default:	Off
Selection:	Off, On
Off	The input is unipolar and can be used for voltage (0-10VDC) and current control (0-20mA)
On	The input is bipolar. The polarity of the reference signal (-10V – +10V or -20mA – +20mA) determines the Speed direction. Both input RunR and RunL must be active to operate the bipolar function on the analog input.

NOTE! This window is not visible if Rotation [214] is set to a fixed direction. (See § 5.3.5, page 33).

NOTE! If an Offset or Minimum Speed is selected, then a Bipolar input is not possible.

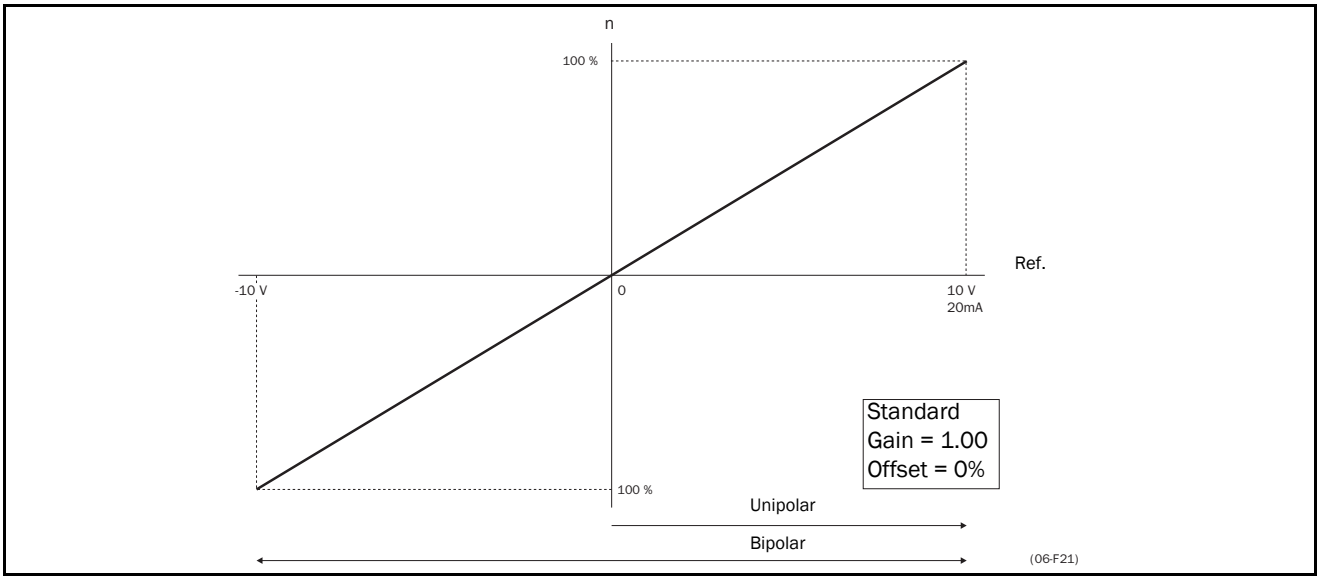


Fig. 54 Normal full-scale configuration.

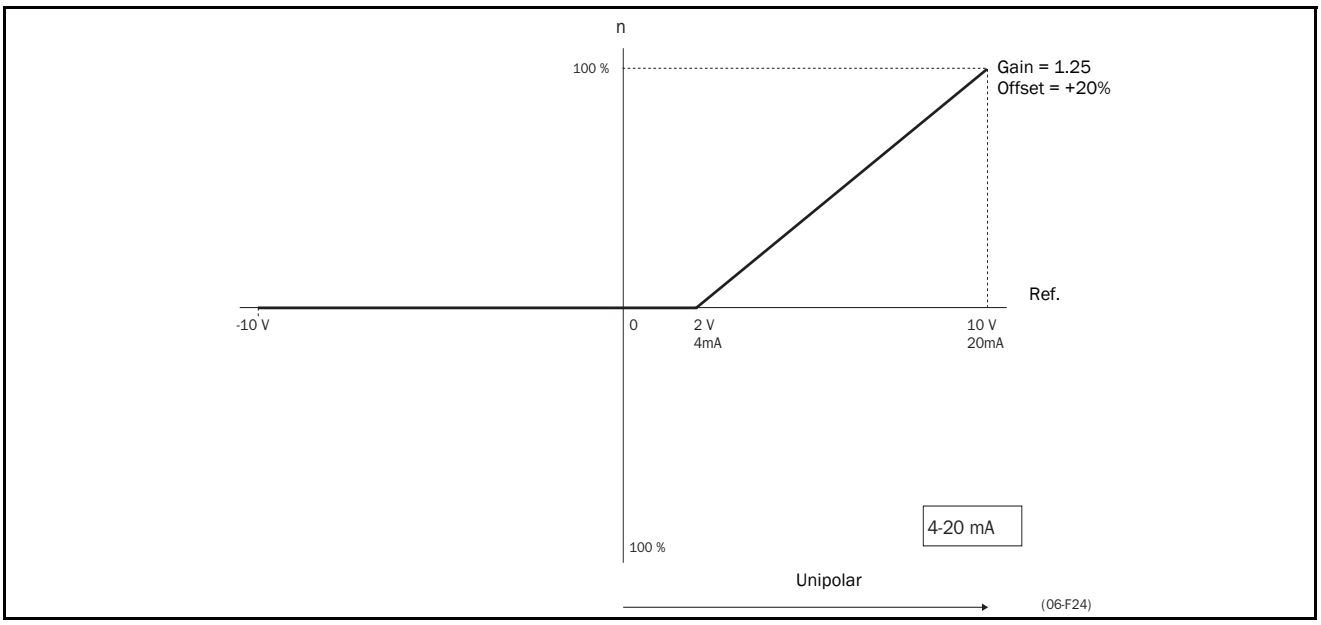


Fig. 55 Gain=1.25 Offset 20% (Live Zero 4-20mA).

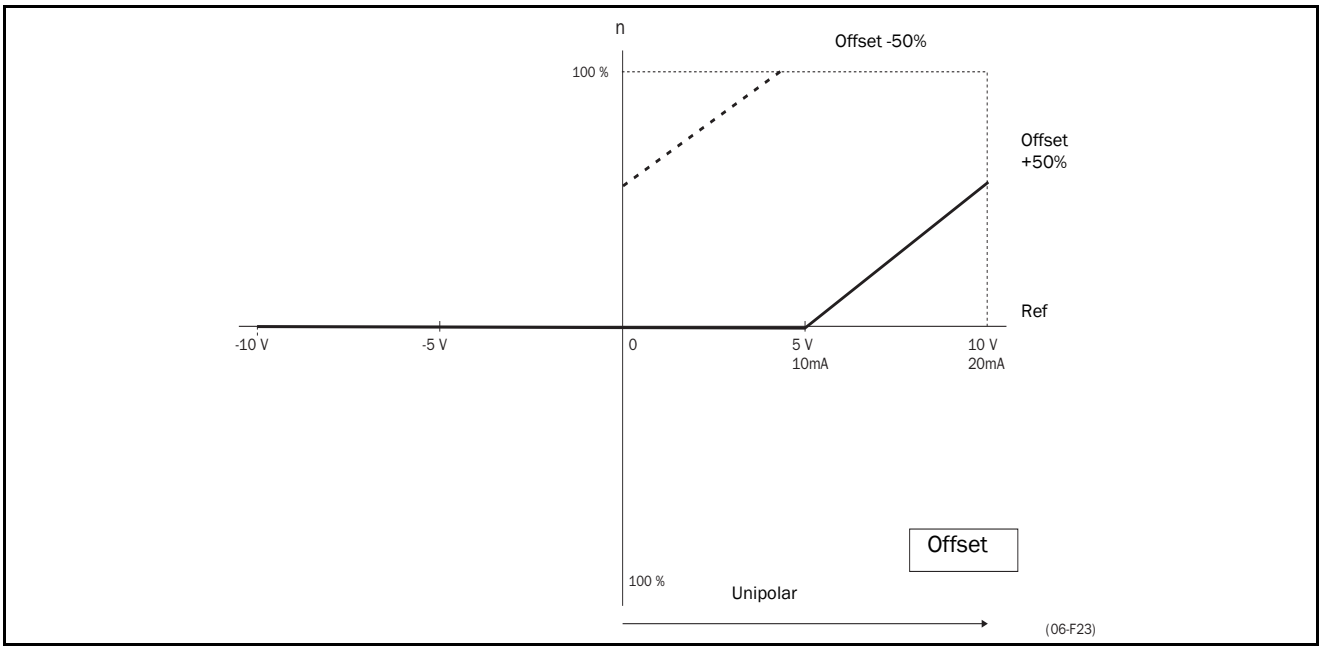


Fig. 56 Function of the Offset setting.

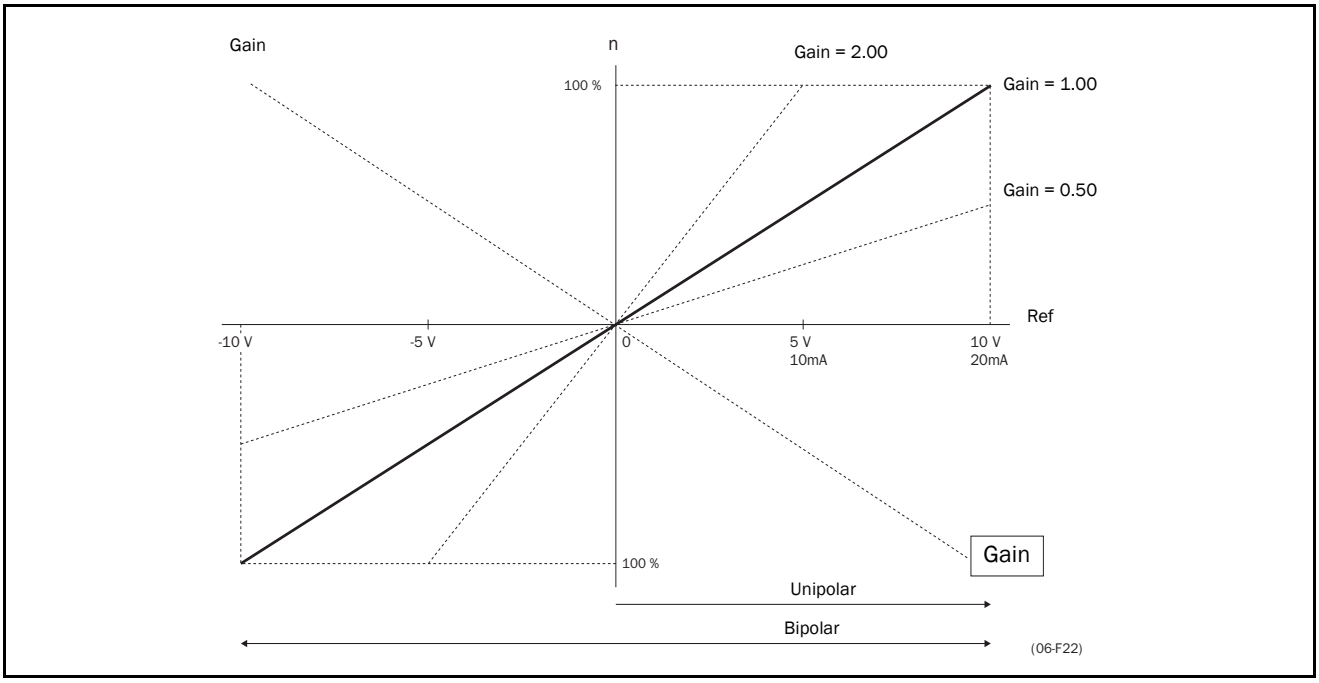


Fig. 57 Function of the Gain setting.

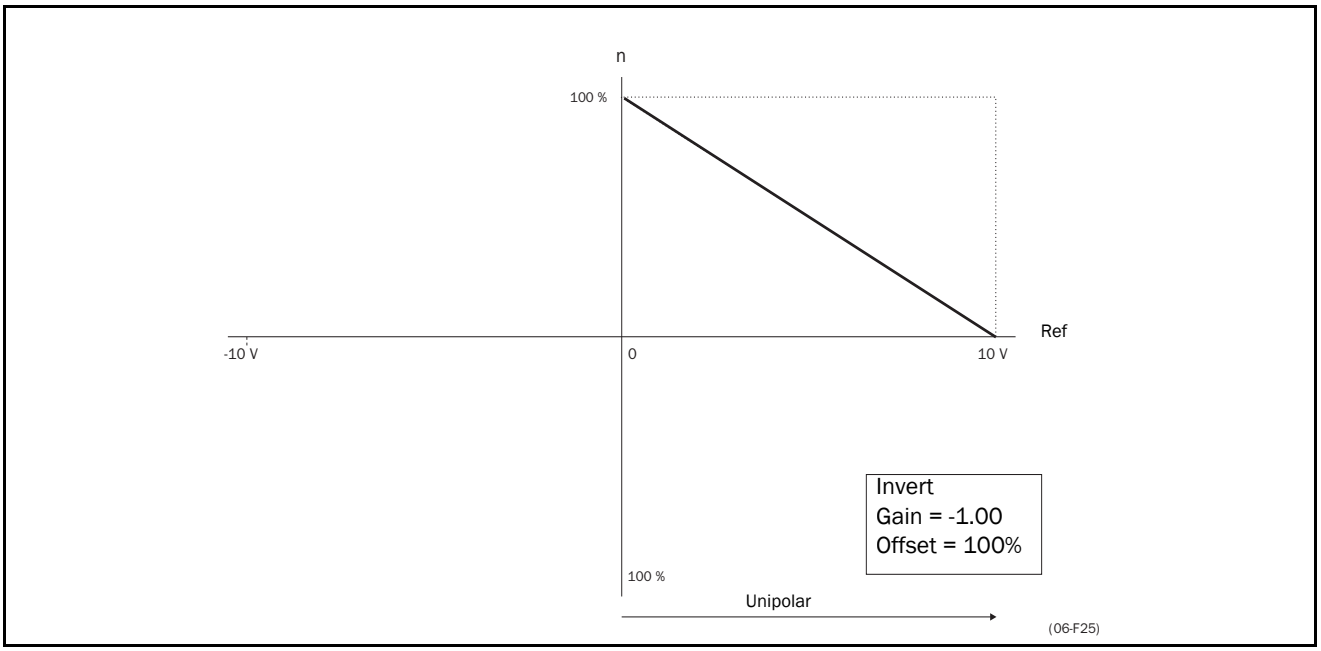


Fig. 58 Inverted reference

5.5.7 AnIn2 Function [416]

Setting the function for Analogue Input 2.

Same function as AnIn 1 Func [411] see § 5.5.2, page 49.

	416 AnIn 2 Funct Stp **Off**
Default:	Off
Selection:	Off, Speed, Torque

5.5.8 AnIn 2 Set-up [417]

Same functions as AnIn 1 Setup [412] see § 5.5.3, page 49.

	417 AnIn 2 Setup Stp **0-10V/0-20mA**
Default:	0-10V/0-20mA
Selection:	0-10V/0-20mA, 2-10V, 4-20mA, user defined

5.5.9 AnIn 2 Offset [418]

Same function as AnIn 1 Offset [413] see § 5.5.4, page 49.

	418 AnIn 2 Offst Stp **0%**
Default:	0%
Range:	-100% to +100%

5.5.10 AnIn 2 Gain [419]

Same functions as AnIn 1 Gain [414] see § 5.5.5, page 50.

	419 AnIn 2 Gain Stp **1.00**
Default:	1.00
Range:	-8.00 to +8.00

5.5.11 AnIn 2 Bipolar [41A]

Same function as AnIn1 Bipol [415] (see § 5.5.6, page 50).

	41A AnIn 2 Bipol Stp **Off**
Default:	Off
Selection:	Off, On

5.5.12 Digital Inputs [420]

Submenu with all the settings regarding the digital inputs.

5.5.13 DigIn 1 [421]

To select the function of the digital input. In total there are 4 digital inputs. If the same function is programmed for more than one input that function will be activated according to 'OR' logic.

	421 DigIn 1 Stp **Off**
Default:	Off
Selection:	Off, Lim Switch+, Lim Switch-, Ext. Trip, Stop, AnIn Sel, Pres Ref 1, Pres Ref 2, Pres Ref 4, Quick Stop, Jog, Mot Pot up, Mot Pot down, Mains Off
Off	The input is not active.
Lim Switch+ Active low	Inverter ramps to stop and prevents rotation in "R" direction (clockwise), when the signal is low!
Lim Switch - Active low	Inverter ramps to stop and prevents rotation in "L" direction (counterclockwise) when the signal is low!
Ext. Trip Active low	The input is used as external trip input (active low). The inverter will react as being tripped, so coasts to stop. Trip message "External trip" is displayed. See Chapter 6. page 69.
STOP	Stop Command according to the selected Stop Mode in window [316], § 5.4.7, page 39. See § 4.2, page 26 for detailed information.
AnIn Select	Selects AnIn 2 or AnIn 1 if they have the same function. Can be used for Local/ Remote Control, § 5.5.2, page 49. Low: AnIn 1 active, High: AnIn 2 active.
Preset Ref 1	To select the Preset Speed Reference. See § 5.4.20, page 43.
Preset Ref 2	To select the Preset Speed Reference. See § 5.4.20, page 43.
Preset Ref 4	To select the Preset Speed Reference. See § 5.4.20, page 43.
Quick Stop	To activate the Quick Stop function. See § 5.4.12, page 41.
Jog	To activate the Jog function. Gives a Run command with the set Jog Speed and direction, § 5.4.25, page 44.
MotPot Up	Increases the internal reference value according to the set acceleration time with a minimum of 16 seconds. Has the same function as a "real" motor potentiometer. See Fig. 59.
MotPot Down	Decreases the internal reference value according to the set deceleration time with a minimum of 16s, see MotPot Up.
Mains Off	Active when mains contactor is off.

NOTE! The External Trip is active low. Be aware that if there is nothing connected to the input, the inverter will trip at "External trip" immediately.

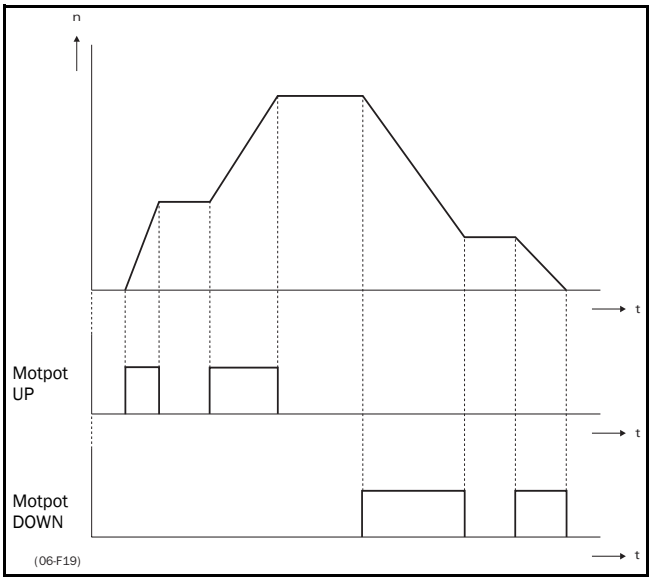


Fig. 59 MotPot function.

The MotPot function is volatile, this means that the reference value is 0rpm after a power down, stop or trip, see § 5.4.19, page 42.

The Motpot command has priority over the analogue inputs. If an analogue reference is active and at the same time the Motpot UP/DOWN is activated, the reference will increase/decrease from that point on. The analogue reference is not in use when the Motpot function is active.

NOTE! If either the function Reference Control [212] (§ 5.3.3, page 31) or Run/Stop Control [213] (§ 5.3.4, page 32) are set to Rem/DigIn1 or Comm/DigIn 1, the digital input cannot be programmed. The following messages are displayed: "Ref by key", "Run by key" or "Rf+Rn=key"

5.5.14 DigIn 2 [422]

Same function as DigIn 1 [421]. See § 5.5.13, page 53.

	422 DigIn 2 Stp **Off**
Default:	Off
Selection:	Off, Lim Switch+, Lim Switch-, Ext. Trip, Stop, AnIn 2 Sel, Pres Ref 1, Pres Ref 2, Pres Ref 4, Quick Stop, Jog, Mot Pot Up, Mot Pot Down, Mains Off

NOTE! If the function Select set no [234] (§ 5.3.20, page 35) is set DigIn 3+4, the digital input cannot be programmed. The message "PS Selected" is displayed.

5.5.15 DigIn 3 [423]

Same function as DigIn 1 [421]. See § 5.5.13, page 53.

	423 DigIn 3 Stp **Off**
Default:	Off
Selection:	Off, Lim Switch+, Lim Switch-, Ext. Trip, Stop, AnIn 2 Sel, Pres Ref 1, Pres Ref 2, Pres Ref 4, Quick Stop, Jog, Mot Pot Up, Mot Pot Down, Mains Off

NOTE! If the function Select set no [234] (§ 5.3.20, page 35) is set to DigIn3 or DigIn 3+4 the digital input cannot be programmed. The message "PS Selected"is displayed.

5.5.16 DigIn 4 [424]

Same function as DigIn 1 [421]. See § 5.5.13, page 53.

	424 DigIn 4 Stp **Off**
Default:	Off
Selection:	Off, Lim Switch+, Lim Switch-, Ext. Trip, Stop, AnIn 2 Sel, Pres Ref 1, Pres Ref 2, Pres Ref 4, Quick Stop, Jog, Mot Pot Up, Mot Pot Down, Mains Off

NOTE! If the function Select set no [234] (§ 5.3.20, page 35) is set DigIn 3+4, the digital input cannot be programmed. The message "PS Selected" is displayed.

5.5.17 Analogue Outputs [430]

Submenu with all settings regarding the analogue outputs.

5.5.18 AnOut 1 function [431]

Sets the function for the optional Analogue Output 1. See also Fig. 54 - Fig. 58.

	431 AnOut1 Funct Stp **Speed** *
Default:	Speed
Selection:	Torque, Speed, Shaft power, Frequency, Current, El power, Outp Voltage
Torque	-400 to +400% of T_{NOM}
Speed	-Max Speed to +Max Speed
Shaft power	-400 to +400% of P_{nmot}
Frequency	-200 to +200% of f_{MOT}
Current	0 - 400% of I_{MOT}
El power	-400 to +400% of P_{nmot}
Output Voltage	0 - 100% of Max. Output Voltage (= Mains)

NOTE! The output can only be bipolar if set at voltage: 0 ±10VDC. The output is unipolar if set at current: 0-20mA. See § 5.5.22, page 55.

5.5.19 AnOut 1 Setup [432]

Preset scaling and offset of the output configuration.

	432 AnOut1 Setup Stp **0-10V/0-20mA** *
Default:	0-10V/0-20mA
Selection:	0-10V/0-20mA, 2-10V/4-20mA, user defined
0-10V/ 0-20mA	Normal full scale configuration of the output
2-10V/ 4-20mA	The output has a fixed 20% offset (Live Zero config.) and 0.8 x Gain. See Fig. 60.
User defined	The output can be set to a user de-fined offset and scaling. Now the functions AnOut1 Offset [423] and AnOut1 Gain [424] will appear to set the user defined configuration of the output (windows [428] and [429] for AnOut2)

NOTE! See function AnIn 1 OFFSET [413] § 5.5.4 and AnInI 1 Gain [414] § 5.5.5 for the explanation of the setting of the user defined Offset and Gain with respect to all the analogue inputs and outputs.

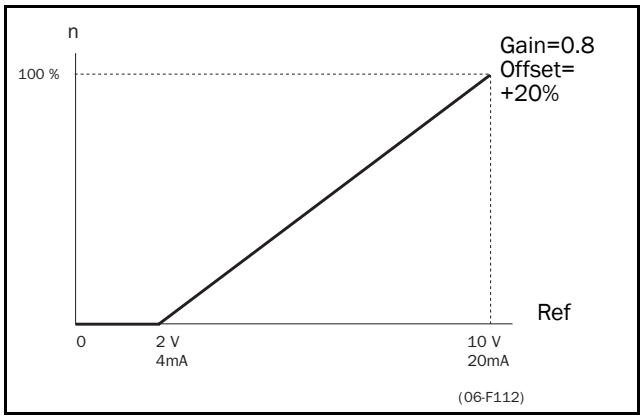


Fig. 60 AnOut 4-20mA.

5.5.20 AnOut 1 Offset [433]

Adds or subtracts an offset to the value of AnOut 1.

	433 AnOut1 Offst Stp **0%** *
Default:	0%
Range:	-100% to +100%

NOTE! This window is only visible if the function AnOut1 Setup = User Defined [432] see § 5.5.19, page 54.

5.5.21 AnOut 1 Gain [434]

Multiplies a gain level to the value of AnOut 1.

The Gain on an Analogue output works inverted compared with the input. See Fig. 60 and Fig. 61. See also Fig. 55.

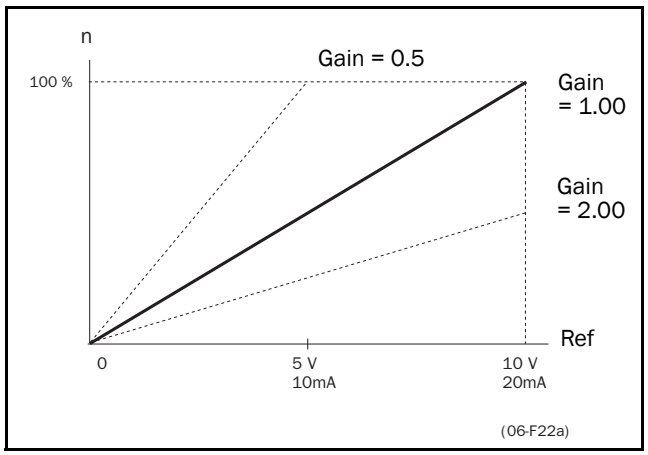


Fig. 61 Function of the Gain setting on the Analogue output.

	434 AnOut1 Gain Stp **1.00** *
Default:	1.00
Range:	-8.00 to +8.00

NOTE! This window is only visible if the function AnOut1 Setup = User Defined [432]. See § 5.5.19, page 54.

5.5.22 AnOut 1 Bipolar [435]

Sets the output for bipolar use.

	435 AnOut1 Bipol Stp **Off** *
Default:	Off
Selection:	Off, On
Off	The output is unipolar and can be used for voltage (0-10VDC) and current control (0-20mA)
On	The output is bipolar, but can only be used as a voltage output (-10 - 0 ± 10VDC)

5.5.23 AnOut 2 function [436]

Sets the function for Analogue Output 2.

	436 AnOut2 Funct Stp **Torque** *
Default:	Torque
Selection:	Torque, Speed, Shaft power, Frequency, Current, El power, Outp Voltage
Torque	-400 to +400% of T_{NOM}
Speed	-Max Speed to +Max Speed
Shaft power	-400 to +400% of P_{NMOT}
Frequency	-200 to +200% of f_{MOT}
Current	0 - 400% of I_{MOT}
El power	-400 to +400% of P_{NMOT}
Output Voltage	0 - 100% of Max. Output Voltage (= Mains)

NOTE! The output can only be bipolar if set at voltage: -10 - 0 ±10VDC. The output is unipolar if set at current: 0-20mA. See also § 5.5.11, page 52.

5.5.24 AnOut 2 Set-up [437]

Same function as AnOut1 Setup [432]. See § 5.5.19, page 54.

5.5.25 AnOut 2 Offset [438]

Same function as AnOut1 Offset [433]. See § 5.5.20, page 54.

5.5.26 AnOut 2 Gain [439]

Same function as AnOut1 Gain [434]. See § 5.5.21, page 55.

5.5.27 AnOut 2 Bipolar [43A]

Same function as AnOut1 Bipolar [435]. See § 5.5.22, page 55.

5.5.28 Digital Outputs [440]

Submenu with all the settings regarding the digital outputs.

5.5.29 DigOut 1 Function [441]

Sets the function of the digital output 1.

NOTE! The definitions as described here are valid for the active output condition.

	441 DigOut 1 Stp **Run** *
Default:	Run
Selection:	Run, Stop, Acc/Dec, At Speed, At Max Speed, Trip, Limit, Warning, Ready, T=T Lim, I>I_{nom}, Brake, SgnI<Offset, Alarm, Pre-alarm, Max Alarm, Max Pre-alarm, Min Alarm, Min Pre-alarm, LY, !LY, LZ, !LZ, CA 1, !A1k CA 2, !A2, CD 1, !D1, CD 2, !D2, Operation
Run	The inverter output is active.
Stop	The inverter output is not active.
Acc/Dec	The speed is increasing or decreasing.
At Speed	The Output Speed = Reference Speed. Hysteresis 1%
At Max Speed	The speed is limited by the Maximum Speed, see § 5.4.16, page 41. Hysteresis 1%
No Trip	No Trip condition active, see Chapter 6. page 69.
Trip	A Trip condition is active, see Chapter 6. page 69.
Autorst Trip	Autoreset trip condition active, see § 6.2.4, page 70.
Limit	A Limit condition is active, see Chapter 6. page 69.
Warning	A warning condition is active, see Chapter 6. page 69.
Ready	The inverter is ready for operation. This means that the inverter is powered up and healthy.
T= T_{lim}	The Torque is limited by the Torque Limit function. See Torque Limit [351] § 5.4.41, page 47.
I>I_{nom}	The Output current is higher than the rated inverter current.
Brake	The output is used to control a mechanical brake. The control of the brake is set by the functions: - § 5.4.8, page 39 - § 5.4.9, page 40 - § 5.4.10, page 40
SgnI< Offset	One of the AnIn input signals is lower than 75% of the offset level.
Alarm	The Max or Min Alarm Level has been reached. See § 5.9, page 61.
Pre-Alarm	The Max or Min Pre-alarm Level has been reached. See § 5.9, page 61.
Max Alarm	The Max Alarm level has been reached. See § 5.9, page 61.
Max Pre-Alrm	The Max Pre-alarm level has been reached. See § 5.9, page 61.
Min Alarm	The Min Alarm Level has been reached. See § 5.9, page 61.
Min Pre-Alrm	The Min Pre-alarm Level has been reached. See § 5.9, page 61.
LY	Logic output Y. See § 5.9.11, page 65
!LY	Logic output Y inverted. See § 5.9.11, page 65
LZ	Logic output Z. See § 5.9.11, page 65
!LZ	Logic output Zinverted. See § 5.9.11, page 65
CA 1	Analogue comparator 1 output, see § 5.9.11, page 65
!A1	Analogue comp 1 inverted output, see § 5.9.11, page 65
CA 2	Analogue comparator 2 output, see § 5.9.11, page 65
!A2	Analogue comp 2 inverted output, see § 5.9.11, page 65
CD 1	Digital comparator 1 output, see § 5.9.11, page 65
!D1	Digital comp 1 inverted output, see § 5.9.11, page 65
CD 2	Digital comparator 2 output, see § 5.9.11, page 65
!D2	Digital comp 2 inverted output, see § 5.9.11, page 65
Operation	Inverter in operation with motor.

5.5.30 DigOut 2 Function [442]

Sets the function of the digital output 2. Same function as DigOut1 [441] (§ 5.5.29, page 56).

	442 DigOut 2 Stp **Brake** *
Default:	Brake
Selection:	Run, Stop, Acc/Dec, At Speed, At Max Speed, Trip, Limit, Warning, Ready, T=T Lim, I>I_{nom}, Brake, SgnI<Offset, Alarm, Pre-alarm, Max Alarm, Max Pre-alarm, Min Alarm, Min Pre-alarm, LY, !LY, LZ, !LZ, CA 1, !A1k CA 2, !A2, CD 1, !D1, CD 2, !D2, Operation

5.5.31 Relays [450]
Submenu with all the settings for the relay outputs.

5.5.32 Relay 1 Function [451]
Sets the function of the relay output 1.
Same function as DigOut 1 [441] § 5.5.29, page 56.

	451 Relay 1 Func Stp **Ready** *
Default:	Ready
Selection:	Run, Stop, Acc/Dec, At Speed, At Max Speed, Trip, Limit, Warning, Ready, T=T Lim, I>I_{nom}, Brake, SgnI<Offset, Alarm, Pre-alarm, Max Alarm, Max Pre-alarm, Min Alarm, Min Pre-alarm, LY, !LY, LZ, !LZ, CA 1, !A1k CA 2, !A2, CD 1, !D1, CD 2, !D2, Operation

5.5.33 Relay 2 Function [452]
Sets the function of the relay output 2.
Same function as DigOut 1 [441] § 5.5.29, page 56.

	452 Relay 2 Func Stp **Trip** *
Default:	Trip
Selection:	Run, Stop, Acc/Dec, At Speed, At Max Speed, Trip, Limit, Warning, Ready, T=T Lim, I>I_{nom}, Brake, SgnI<Offset, Alarm, Pre-alarm, Max Alarm, Max Pre-alarm, Min Alarm, Min Pre-alarm, LY, !LY, LZ, !LZ, CA 1, !A1k CA 2, !A2, CD 1, !D1, CD 2, !D2, Operation

5.6 Set/View reference value [500]
Main menu to view or set the reference value. The read-out depends on the selected drive and controller mode:

Table 17 Set/view reference value

DRIVE Mode	Read-out:	Resolution (see § 5.1, page 30):
Speed Mode	rpm	4 digit
Torque Mode	Nm	3 digit
PID Controller	%	3 digit

View reference value
As default the window 500 is in view operation. Depending on the drive Mode as indicated in Table 17, relevant value of the active reference signal is displayed.

Set reference value
If the function Reference Control [212] (§ 5.3.3, page 31) is programmed: Ref Control = Keyboard, then the reference value must be set in window 500 with the + and - keys on the control panel. Window 500 displays on-line the actual reference value according to the Mode Settings in Table 17.

5.7 View operation [600]

Main menu for viewing all actual operational data, like speed, torque, power, etc.

5.7.1 Speed [610]

Displays the actual Shaft Speed.

	610 Speed Stp rpm
Unit:	rpm
Resolution:	1 rpm

5.7.2 Torque [620]

Displays the actual Shaft Torque.

	620 Torque Stp %Nm
Unit:	Nm and %
Resolution:	0.1 Nm and 1%

5.7.3 Shaft power [630]

Displays the actual Shaft Power.

	630 Shaft Power Stp kW
Unit:	(k)W
Resolution:	1W

5.7.4 Electrical power [640]

Displays the actual Electrical Output Power.

	640 El Power Stp kW
Unit:	(k)W
Resolution:	1W

5.7.5 Current [650]

Displays the actual Output Current.

	650 Current Stp A
Unit:	A
Resolution:	0.1 A

5.7.6 Voltage [660]

Displays the actual Output Voltage.

	660 Voltage Stp V
Unit:	V
Resolution:	1V

5.7.7 Frequency [670]

Displays the actual Output Frequency.

	670 Frequency Stp Hz
Unit:	Hz
Resolution:	0.1Hz

5.7.8 VDC-Link voltage [680]

Displays the actual DC-link Voltage.

	680 DC Voltage Stp V
Unit:	V
Resolution:	1V

5.7.9 Heatsink temperature [690]

Displays the actual Heat Sink Temperature.

	690 Temperature Stp °C
Unit:	°C
Resolution:	1°C

5.7.10 FI status [6A0]

Indicates the overall status of the frequency inverter. See Fig. 62.

6A0 FI Status
Stp 1/222/333/44

Fig. 62 Drive status.

Table 18 FI status

Display position	status	value
1	Parameter Set	A,B,C,D
222	Source of reference value	-Key (keyboard) -Rem (remote) -Com (Serial comm.) -Opt (option)
333	Source of Run/Stop/Reset command	-Key (keyboard) -Rem (remote) -Com (Serial comm.) -Opt (option)
44	Limit functions	-TL (Torque Limit) -SL (Speed Limit) -CL (Current Limit) -VL (Voltage 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.

5.7.11 Digital input status [6B0]
Indicates the status of the Digital inputs. See Fig. 63.

The first row indicates the digital inputs.
- L Run Left input (RUN L)
- R Run Right input (RUN R)
- E Enable input
- R Reset input
- 1 DigIn 1
- 2 DigIn 2
- 3 DigIn 3
- 4 DigIn 4

Reading downwards from the first row to the second row the status of the associated input is shown:

- H High
- L Low

So the example in Fig. 63 indicates that the RunR, Enable and DigIn 2 are active at this moment.

```
6B0 DI: LRER 1234
Run     HLHL LHLL
```

Fig. 63 Digital input status example.

5.7.12 Analogue input status [6C0]
Indicates the status of the Analogue inputs. Fig. 64.

```
6CO AI: 1       2
Stp    -100%  65%
```

Fig. 64 Analogue input status

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. 64 indicates that both the Analogue inputs are active.

5.7.13 Run time [6D0]
Displays the total time that the inverter has been in the Run Mode.

	6DO Run Time Stp h:m
Unit:	h: m (hours: minutes)
Range:	0h: 0m - 65535h: 59m

5.7.14 Reset Run time [6D1]
To reset the Run Time counter, see function Run [6D0] § 5.7.13, page 59.

	6D1 Reset Run Tm Stp No
Default:	No
Selection:	No, Yes

NOTE! After the reset the setting automatically reverts to "No".

5.7.15 Mains time [6E0]
Displays the total time that the inverter has been connected to the mains supply. This timer cannot be reset.

	6EO Mains Time Stp h:m
Unit:	h: m (hours: minutes)
Range:	0h: 0m - 65535h: 59m

NOTE! At 65535 h: 59 m the counter stops. It will not revert to 0h: 0m.

5.7.16 Energy [6F0]

Displays the total energy consumption since the last Reset Energy [6F1] has taken place (see § 5.7.17, page 60).

	6F0 Energy Stp **kWh**
Unit:	kWh
Range:	0.0 - 999999.9kWh

5.7.17 Reset Energy [6F1]

To reset the kWh counter see § 5.7.16, page 60.

	6F1 Reset Energy Stp **No**
Default:	No
Selection:	No, Yes

NOTE! After reset the setting automatically goes back to "No".

5.7.18 Process Speed [6G0]

The Process Speed is a display function which can be programmed according to several quantities and units with regard to the speed, which is programmed with the functions Set Process Unit [6G1] and Set Process Scale [6G2] in this menu.

6G0 Process Spd Stp

5.7.19 Set Process Unit [6G1]

Selection of the process unit with regard to the speed.

	6G1 Set Prc Unit Stp None
Default:	None
Selection:	None, rpm, %, m/s, /min., /hr
None	No unit selected
rpm	Revolutions per minute
m/s	Meter per second
%	Percentage of Maximum Speed
/min	Per minute
/hr	Per hour

5.7.20 Set Process Scale [6G2]

Scales the process value with reference to the Motor Shaft Speed.

Example:

A conveyor belt has at 1200 rpm a velocity of 3.6m/s. Set the Process Unit = m/s. The process scale is 3.6:1200=0.003. So if the Process Scale = 0.003, then the read-out at 1200 rpm will be 3.6m/s.

NOTE! Resolution is 4 significant digits (see § 5.1, page 30).

	6G2 Set Prc Scal Stp **1.000** *
Default:	1.000
Range:	0.000 - 10.000

5.7.21 Warning [6H0]

Display the actual or last warning condition. A warning occurs if the inverter 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 (see § 4.1.2, page 23).

6H0 Warning Stp warn.msg

The active warning message is displayed here. See § 6.1, page 69.

If no warning is active the message "No Warning" is displayed.

5.8 View trip log [700]

Main menu for viewing all the logged trip data. In total the inverter 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 [6D0] counter.

5.8.1 Trip 1 [710] to trip 10 [7A0]

The trip message can be any message as described in § 6.2, page 70.

	7x0 Trip message Stp **h:m**
Unit:	h: m (hours: minutes)
Range:	0h: 0m - 65355h: 59m

730 OVERCURRENT
Stp **1396h: 13m**

Fig. 65 Trip 3

Example:
Fig. 65 shows the third trip memory window 730: Overcurrent trip occurred after 1396 hours and 13 minutes in Run time.

5.8.2 Reset trip log [7B0]

To reset the content of the 10 trip memories. See § 5.8.1, page 61.

	7B0 Reset Trip Stp No
Default:	No
Selection:	No, Yes

NOTE! After the reset the setting goes automatically back to "NO". The message "OK" is displayed for 2 sec.

5.9 Monitor [800]

Main menu for setting the Monitor functions.

5.9.1 Alarm functions [810]

The monitor functions enable the inverter to be used as a Load monitor. Load monitors are used to protect machines against mechanical overload. E.g. jamming of a conveyer belt, screw conveyer, belt failure on a fan, dry running on a pump. The load is measured in the inverter by the calculated motor torque. There is an Overload alarm (Max Alarm and Max Pre-Alarm) and an Underload (Min Alarm and Min Pre-Alarm).
The Max- and Min-alarm act as a trip condition. The pre-alarms act as a warning condition. All the Alarms can be monitored on the Digital or Relay outputs. See § 5.5.29, page 56.
See: § 6.1, page 69,
§ 5.7.21, page 60 and Table 21.

The Autoset function determines automatically during running the 4 alarm levels: Maximum alarm, Max. Pre-Alarm, Min. Alarm and Min. Pre-alarm.
Fig. 66 gives an example of the monitor functions.

5.9.2 Alarm Select[811]

Selects the types of alarms that are active.

	811 Alarm Select Stp **Off** *
Default:	Off
Selection:	Off, Max, Min, Min+Max
Off	No alarm functions active. **NOTE! The windows [812-819] are not visible**
Min	Min Alarm active. The alarm output functions as an Underload alarm. **NOTE! The windows [816-817] are not visible**
Max	Max Alarm active. The alarm output functions as an Overload alarm. **NOTE! The windows [818-819] are not visible**
Max+Min	Both Max and MIN alarm are active. The alarm outputs function as overload and underload alarms.

5.9.3 Ramp Alarm [812]

Selects that the (pre)alarm signals are inhibited during acceleration/deceleration of the motor to avoid false alarms.

	812 Ramp Alarm Stp Off *
Default:	Off
Selection:	Off, On
On	(Pre) alarms active during acceleration/deceleration.
Off	(Pre) alarms are inhibited during acceleration/deceleration.

5.9.4 Alarm start delay [813]

Sets the delay time after RUN command after which the alarm may be given.

- If Ramp Enable=On (see § 5.9.3, page 62) The start delay begins after a RUN command. -
- If Ramp Enable=Off (see par.5.8.2) The start delay begins after the acceleration ramp.

	813 Start Delay Stp 2s *
Default:	0
Range:	0-3600s

5.9.5 Alarm response delay [814]

Sets the delay time between the first occurrence of an alarm condition and after which the alarm is given.

	814 Response Dly Stp 0.1s *
Default:	0.1s
Range:	0-90s

5.9.6 Auto set function[815]

Sets the actual torque level at 100% and automatically the accompanying alarm levels.

	815 Auto Set Stp No *
Default:	No
Selection:	No, Yes

The set levels for the (pre)alarms are:

Overload	Max Alarm	$1.15xT_{ACTUAL}$
	Max pre-alarm	$1.10xT_{ACTUAL}$
Underload	Min pre-alarm	$0.90xT_{ACTUAL}$
	Min alarm	$0.85xT_{ACTUAL}$

After execution the message "Autoset OK!" is displayed for 1s and the selection reverts to "No".

5.9.7 Max Alarm level (Overload) [816]

Sets the Max Alarm level (Overload).

	816 Max Alarm Stp 150% *
Default:	150%
Range:	0-400%

The alarm level is given in % of the nominal torque T_{NOM}. Normal setting: 150%. The Alarm is activated if the set value has been reached.

5.9.8 Max Pre-alarm level (Overload) [817]

Sets the Max Pre-alarm level (Overload).

	817 Max Pre-Alrm Stp 110% *
Default:	110%
Range:	0-400%

The Pre-alarm level is given in % of the nominal torque T_{NOM}. Normal setting: 110%. The Pre-Alarm is activated if the set value has been reached.

5.9.9 Min Alarm level (Underload) [818]

Sets the Max Alarm level (Underload).

	818 Min Alarm Stp 0% *
Default:	0%
Range:	0-400%

The alarm level is given in % of the nominal torque T_{NOM}. Normal setting: 0%. The Alarm is activated if the set value has been reached.

5.9.10 Min Pre-alarm level (Underload) [819]

Sets the Min Pre-alarm level (Underload).

	819 Min Pre-Alrm Stp 90% *
Default:	90%
Range:	0-400%

The alarm level is given in % of the nominal torque T_{NOM}. Normal setting: 90%. The Pre-alarm is activated if the set value has been reached.

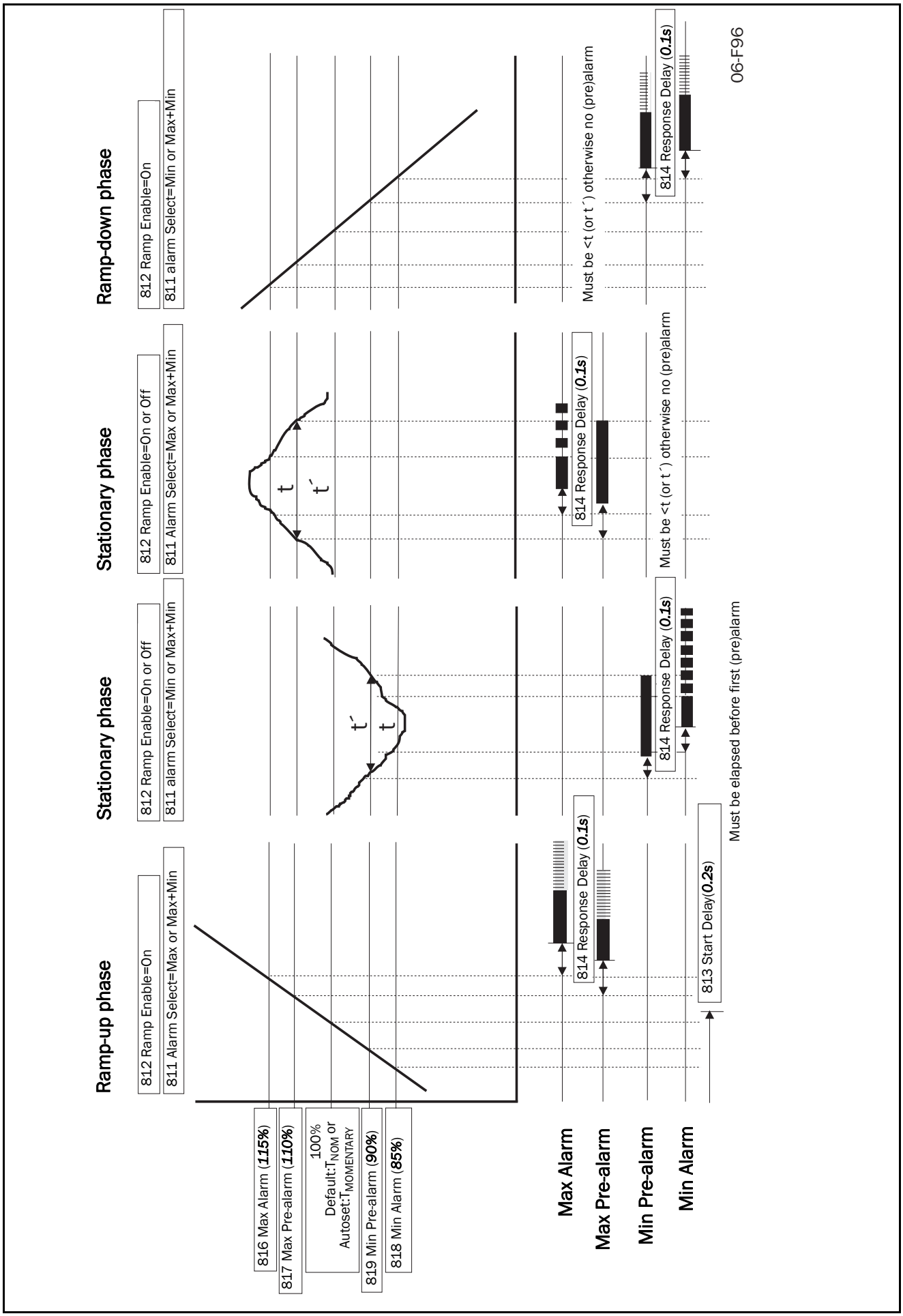


Fig. 66 Alarm functions

5.9.11 Comparators [820]

There are 2 analogue comparators that compare any available analogue value (including the analogue reference inputs) with an adjustable constant.

There are 2 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. See par 5.5.28 page 52.

5.9.12 Analogue Comparator 1 value [821]

Selection of the analogue value for Analogue Comparator 1 (CA1).

Analogue comparator 1 compares the in window [821] selectable analogue value with the in window [822] adjustable constant. When the value exceeds the constant, the output signal CA1 becomes High and !A1 Low, see Fig. 67.
The output signal can be programmed to the digital or relay outputs. See par 5.5.28 page 52.

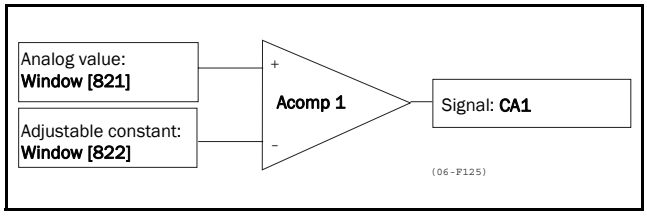


Fig. 67 Analogue Comparator

	821 CA1 Value Stp Speed *
Default:	Speed
Selection:	Speed, Torque, Shaft Power, El Power, Current, Outp. Voltage, Frequency, DC Voltage, Temperature, Energy, Run Time, Mains Time, AnIn 1, AnIn 2
Speed	rpm
Torque	%
Shaft Power	kW
El Power	kW
Current	A
Voltage	V
Frequency	Hz
DC Voltage	VDC
Temperature	°C
Energy	kWh
Run Time	h
Mains Time	h
AnIn1	%
AnIn2	%

5.9.13 Analogue Comparator 1 constant [822]

Selects the analogue comparator constant level according to the selected value in window [821].
The default value is always 0.

	822 CA1 Constant Stp 300rpm *
Default:	300 rpm
Selection:	Selection is made automatically according to window [821].
Speed	2 x Max speed in rpm
Torque	0-400% T_{nom}
Shaft Power	0-400% P_{nom} in kW
El Power	0-400% P_{nom} in kW
Current	0-400% I_{nom} in A
Voltage	0-Mains in V
Frequency	0 - 400Hz
DC Voltage	0-1250 VDC
Temperature	0-100°C
Energy	0-1,000,000kWh
Run Time	0-65535hr
Mains Time	0-65535hr
AnIn1	0-100%
AnIn2	0-100%

5.9.14 Analogue Comparator 2 value [823]

Function is identical to Analogue Comparator 1 Value, see § 5.9.12, page 65.

	823 CA2 Value Stp Torque *
Default:	Torque
Selection:	Speed, Torque, Shaft Power, El Power, Current, Outp. Voltage, Frequency, DC Voltage, Temperature, Energy, Run Time, Mains Time, AnIn 1, AnIn 2

5.9.15 Analogue Comparator 2 constant [824]

Function is identical to Analogue Comparator 1 level see § 5.9.13, page 65.

	824 CA2 Constant Stp 20% *
Default:	20%
Selection:	Selection is made automatically according to window [823].

5.9.16 Digital Comparator 1 [825]

Selection of the input signal for Digital Comparator 1 (CD1).

This output signal CD1 becomes High if the selected input signal is active. See Fig. 68.

The output signal can be programmed to the digital or relay outputs. See par 5.5.28 page 52.

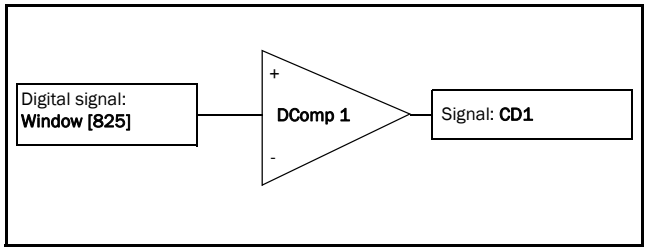


Fig. 68 Digital comparator

	825 CD1 Stp Run *
Default:	Run
Selection:	DigIn 1, DigIn 2, DigIn 3, DigIn 4, DigIn 5, DigIn 6, DigIn 7, DigIn 8, Acc, Dec, I2t, Run, Stop, Trip, Max Alarm, Min Alarm, V-Limit, AtMaxSpeed, C-Limit, T-Limit, Overtemp, Overvolt G, Overvolt D, Overcurrent, Low Voltage, Max Pre-Alarm, Min Pre-Alarm
DigIn 1	Digital input 1
DigIn 2	Digital input 2
DigIn 3	Digital input 3
DigIn 4	Digital input 4
DigIn 5	Digital input 5 (Extended I/O option)
DigIn 6	Digital input 6 (Extended I/O option)
DigIn 7	Digital input 7 (Extended I/O option)
DigIn 8	Digital input 8 (Extended I/O option)
Acc	Acceleration status
Dec	Deceleration status
I^2t	I^2t overload status
Run	Run status
Stop	Stop status
Trip	Trip status
Max Alarm	Max Alarm status
Min Alarm	Min Alarm status
V-Limit	Voltage Limit
AtMaxSpeed	Speed limit
C-Limit	Current limit
T-Limit	Torque limit
Overtemp	Over temperature warning
Overvolt G	Over voltage Generating warning
Overvolt D	Over voltage Decelerating warning
Overcurrent	Over current warning
Low Voltage	Low Voltage warning
Max Pre-Alarm	Max Pre-Alarm warning
Min Pre-Alarm	Min Pre-Alarm warning

5.9.17 Digital Comparator 2 [826]

Function is identical to Digital Comparator 1 see § 5.9.16, page 66. Selection of the input signal for Digital Comparator 2 (CD2).

	826 CD 2 Stp DigIn 1 *
Default:	DigIn 1
Selection:	DigIn 1, DigIn 2, DigIn 3, DigIn 4, DigIn 5, DigIn 6, DigIn 7, DigIn 8, Acc, Dec, I2t, Run, Stop, Trip, Max Alarm, Min Alarm, V-Limit, F-Limit, C-Limit, T-Limit, Overtemp, Overvolt G, Overvolt D, Overcurrent, Low Voltage, Max Pre-Alarm, Min Pre-Alarm

5.9.18 Logic Output Y [830]

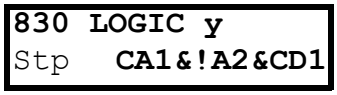
By means of an expression editor, the comparator signals can be logically combined into the Logic Y function.
The expression editor has the following features:

- Up to 3 comparator outputs can be used:
  CA1, CA2, CD1 or CD2.
- The comparator outputs can be inverted:
  !A1, !A2, !D1 or !D2.
- The following logical operators are available:
  "+" : OR operator
  "&" : AND operator
  "^" : EXOR operator
  Expressions according to the following truth table can be made:

Table 19 Truth table for the logical operators

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. See par 5.5.28 page 52.



The expression must be programmed by means of the menu's 831 to 835.

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>10 Hz
The comparator !A2 is set for
load <20%
The comparator CD1 is set for:
Run active
The 3 comparators are all AND-ed, given the "broken belt detection".
In window 830, the in windows 831-835 entered expression for Logic Y is visible.
Set window 831 to **CA1**.
Set window 832 to **&**.
Set window 833 to **!A2**.
Set window 834 to **&**.
Set window 835 to **CD1**.

Window 830 now holds the expression for Logic Y:
CA1&!A2&CD1
which is to be read as (CA1&!A2)&CD1.

NOTE! Set window 834 to "." to finish the expression when only two comparators are required for Logic Y.

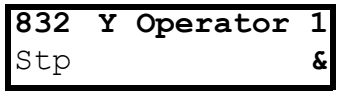
5.9.19 Y Comp 1 [831]

Selects the first comparator for the Logic Y function.

Default:	CA!
Selection:	CA1, !A1, CA2, !A2, CD1, !D1, CD2, !D2

5.9.20 Y Operator 1 [832]

Select the first operator for the Logic Y function.



Default:	&
Selection:	&, +, ^ &=AND, +=OR, ^=EXOR

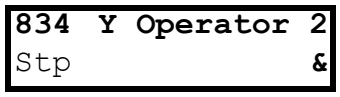
5.9.21 Y Comp 2 [833]

Selects the second comparator for the Logic Y function.

Default:	!A1
Selection:	CA1, !A1, CA2, !A2, CD1, !D1, CD2, !D2

5.9.22 Y Operator 2 [834]

Select the second operator for the Logic Y function.



Default:	&
Selection:	&, +, ^,· &=AND, +=OR, ^=EXOR When · (dot) is selected, the Logic Y expression is finished (in case only two comparators are tied together).

5.9.23 Y Comp 3 [835]

Selects the thrid comparator for the Logic Y function.

Default:	CD1
Selection:	CA1, !A1, CA2, !A2, CD1, !D1, CD2, !D2

5.9.24 Logic function Z [840]

```
840 LOGIC Z
Stp   CA1&!A2&CD1
```

The expression must be programmed by means of the menu's 841 to 845.

5.9.25 Z Comp 1 [841]

Selects the first comparator for the Logic Z function.

	841 Z Comp 1 Stp CA1 *
Default:	CA!
Selection:	CA1, !A1, CA2, !A2, CD1, !D1, CD2, !D2

5.9.26 Z Operator 1 [842]

Select the first operator for the Logic Z function.

	842 Z Operator 1 Stp & *
Default:	&
Selection:	&, +, ^ &=AND, +=OR, ^=EXOR

5.9.27 Z Comp 2 [843]

Selects the second comparator for the Logic Z function.

	843 Z Comp 2 Stp !A1 *
Default:	!A!
Selection:	CA1, !A1, CA2, !A2, CD1, !D1, CD2, !D2

5.9.28 Z Operator 2 [844]

Select the second operator for the Logic Z function.

	844 Z Operator 2 Stp & *
Default:	&
Selection:	&, +, ^, · &=AND, +=OR, ^=EXOR When · (dot) is selected, the Logic Z expression is finished (in case only two comparators are tied together).

5.9.29 Z Comp 3 [845]

Selects the third comparator for the Logic Z function.

	845 Z Comp 3 Stp CD1 *
Default:	CD1
Selection:	CA1, !A1, CA2, !A2, CD1, !D1, CD2, !D2

5.10 View system data [900]

Main menu for viewing all the inverter system data.

5.10.1 Type [910]

Shows the inverter type according to the type number. See § 1.5, page 8.

The other options are indicated on the type plate of the inverter. See Fig. 69.

```
910 FI Type
Stp      VFX-074
```

Fig. 69 Example Type

Example:
-VFX40-074 VFX 400 volt, 37 kW, 74A

5.10.2 Software [920]

Shows the software version number of the inverter. Fig. 70 gives an example of the version number.

```
920 Software
Stp         V1.00
```

Fig. 70 Example software version

NOTE! It is important that the software version displayed in window [920] 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 inverter.

6.1 Trips, warnings and limits

In order to protect the inverter the principal operating variables are continuously monitored by the DSPs. If one of these variables exceeds the safety limit an error message is displayed. In order to avoid any possible 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 inverter.

"Trip"
- the inverter stops immediately, the motor coasts naturally to standstill.
- the trip relay or output is active (if selected)
- the trip LED is on
- the accompanying trip message is displayed in the LCD display
- the "TRP" status indication in the LCD-display is on (area C of the LCD display, § 4.1.1, page 22)

Apart from the TRIP indicators there are 2 more indicators to show that the inverter is in an "abnormal" situation. These indicators can be programmed to operate a relay or output (see § 5.5.32, page 57).

"Limits"
- the inverter is limiting torque and/or speed to avoid a trip.
- the Limit relay or output (if selected) is active
- the trip LED is blinking
- one of the Limit status indication in the LCD display is on (area C of the LCD display, see § 4.1.1, page 22)

"Warning"
- the inverter is close to a trip limit.
- the Warning relay or output (if selected) is active
- the trip LED is blinking
- the warning message is displayed in window [6FO]

Table 20 Trips, warnings and limits.

Trip	Selection	Trip (Instant)	Limit	Warning
Rotor locked	Off On	- X	- X	- X
Motor lost	Resume Trip	- X	X -	X -
Motor I^2t	Off Trip Limit	- X -	- - X	- X X
Low volt override	On Off	- -	X -	X -
Low voltage	-		-	X
Overvoltage Line	-	X	-	X
Overvoltage Gen/Dec	-	X	-	-
Overcurrent	-	X	-	-
Power Fault		X	-	-
Overtemperature	-	X	-	X
External trip	-	X	-	-
Motor temperature (PTC)	Off Trip	- X	- -	- X
Alarm Max Alarm Min		X X	- -	- -
Pre-alarm Max Pre-alarm Min		- -	- -	X X

NOTE! The trip indications rotor locked, motor I^2t, low voltage override can be set individually please see § 5.4.40, page 47.

NOTE! The trip indication "Motor temperature" is only active if the option card Encoder PTC, RIO or CRIO is built in. See Chapter 7. page 73.

6.2 Trip conditions, causes and remedy

The table in this paragraph must be considered as a basic help to find the cause of a failure in the system and to find a way to solve a problem. A frequency inverter is mostly just a small part of a complete drive system. Sometimes it is difficult to determine the cause of the failure, although the frequency inverter 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 there are any questions.

The inverter is designed in such way that it tries to avoid trips by limiting torque, overvolt etc.

Failures occurring while 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 the environment of the system (e.g. wear).

Failures that occur regularly for no obvious reasons, can be caused in general by Electro Magnetic Interference. Be sure that the installation fulfils the demands for installation according to the EMC directives. See Chapter 3. page 12.

Sometimes the so-called "Trial and error" method is a quicker way to determine the cause of the failure. This method can be done at any level, from changing settings and functions to disconnecting single control cables or exchanging the complete inverters.

The Trip Log (see § 5.8, page 61) can be useful to determine whether certain trips occur at certain moments. The Trip Log also records the time of the trip related to the run time counter.

DANGER! If it is necessary to open the inverter 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 following safety instructions as well as the safety instructions on page 2.

6.2.1 Technically qualified personnel

Installation, commissioning, demounting, making measurements, etc., of or at the frequency inverter may only be carried out by personnel technically qualified for the task.

6.2.2 Opening the frequency inverter

DANGER! Always switch the mains voltage off if it is necessary to open the inverter and wait at least 5 minutes to allow the buffer capacitors to discharge.

If the frequency inverter must be opened, for example to make connections or change the positions of the jumpers, always switch off the mains voltage and wait at least 5 minutes to allow the buffer capacitors to discharge. The connections for the control signals and the jumpers are isolated from the mains voltage. Always take adequate precautions before opening the frequency inverter.

6.2.3 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 first be disconnected from the frequency inverter. Wait at least 5 minutes before continuing.

6.2.4 Autoreset Trip

If the maximum number of Trips during Autoreset has been reached, the trip message hour counter is marked with a "A". (See § 5.8.1, page 61 and § 5.3.26, page 36).

Fig. 71 Autoreset trip

Fig. 71 shows the 3rd trip memory window 730: Overvoltage G trip after the maximum Autoreset attempts taken place after 345 hours and 45 minutes of run time.

Table 21 Trip condition

Trip Condition	Possible Cause	Remedy
Low voltage (warning only) "LV"	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 inverter. - Try to use other mains supply lines if dip is caused by other machinery - Use the function low voltage override [352] see § 5.4.42, page 47
Overvoltage L(ine) "OVL"	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.
Overvoltage G(enerator) "OVG" Overvoltage D(eceleration) "OVD"	Too high DC Link voltage; - Too short deceleration time with respect to motor/machine inertia. - Too small brake resistor, mal-functioning 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)
Overcurrent "OC"	Motor current exceeds the Peak motor current (I_{TRIP}) - 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 - Saturation of current measurement circuit	- 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 cables connections
	I^2t value is exceeded. - Overload on the motor according to the programmed I^2t settings. See § 5.4.45, page 48 and § 5.3.14, page 34.	- Check on mechanical overload on the motor or the machinery (bearings, gearboxes, chains, belts, etc.) - Change the Motor I^2t Current setting see § 5.4.45, page 48 - Check the Motor Vent setting. See § 5.3.14, page 34.
Power fault	- Overload condition in the DC-link - Desaturation of IGBT's - Peak voltage on DC-link - Hard short-circuit between phases or phase to earth - Earth fault Overload condition in the DC-link	- Check on bad motor cable connections - Check on bad earth cable connection - Check on water or moisture in the motor housing and cables connections - Check that rating plate data of the motor is correctly entered and make an ID run - See overvoltage trips
Overtemperature "OT"	Heat sink temperature exceeds VFB 85°C (warning at 80°C) VFX 80°C (warning at 75°C) - Too high ambient temperature of the inverter - Insufficient cooling - Too high current - Blocked or stuffed fans	- Check the cooling of the inverter cabinet. See also § 8.5, page 80. - Check the functionality of the built-in fans. The fans must switch on automatically if the heat sink temperature exceeds 60°C - Check inverter and motor rating - Clean fans

Table 21 Trip condition

Trip Condition	Possible Cause	Remedy
Motor lost	Phase loss or too great an 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. See § 5.4.43, page 47
External trip	External input (DigIn 1-4) active - active low function on the input.	- Check the equipment that initiates the external input - Check the programming of the digital inputs DigIn 1-4 (see § 5.5.13, page 53)
Overspeed	Motor speed exceeds maximum speed - Speed at speed Auto Tune too high - Minimum torque too low - Too small motor - Wrong motor data	- Lower speed at Auto Tune. See § 5.4.32, page 45. - Increase min torque. See § 5.4.30, page 45. - Increase motor size - Check motor data. See § 5.3.7, page 33.
Internal trip	Error in the micro processor system	- If trip remains, contact your supplier.
Rotor locked	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. See § 5.4.42, page 47.
Motor temperature	Motor thermistor exceeds maximum level **NOTE! Only valid if the optional PTC input is used. See § 7.5, page 75.**	- 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.
Max Alarm	Max alarm level (overload) has been reached. See § 5.9, page 61.	- Check the load condition of the machine - Check the monitor setting in § 5.9, page 61.
Min Alarm	Min alarm level (underload) has been reached. See § 5.9, page 61.	- Check the load condition of the machine - Check the monitor setting in § 5.9, page 61.

6.3 Maintenance

The frequency inverter is designed to require no servicing or maintenance. There are however some points which must be checked regularly.

All inverters have built in fans which are automatically switched on if the heat sink temperature reaches 45°C for VFB and 60°C for VFX. This means that the fans are only running if the inverter is running and loaded. The design of the heat sinks is such that the fan is not blowing the cooling air through the interior of the inverter, but only across the outer surface of the heat sink. However, running fans will always attract dust. Depending on the environment the fan and the heat sink will collect dust. Check this and clean the heat sink and the fans when necessary.

If inverters are built in cabinets, also check and clean the dust filters of the cabinet regularly.

Check external wiring, connections and control signals. Tighten terminal screws if necessary.

7. OPTIONS

The standard available options are described here briefly. Some of the options have their own instruction or installation manual. For more information please contact your supplier.

7.1 Protection class IP23 and IP54

The inverter model 210 to 749 (VFX) are available in protection class IP23 and inverter model 018 to 749 are available in class IP54, according to the standards IEC 529.

The table below shows the versions with respect to the standard version IP20.

See Chapter 8. page 77 for the dimensions and weights.

Table 22 Options

Type 400V/ 500V	IP20	IP23	IP54
VFB**-004 VFB**-006 VFB**-008 VFB**-010 VFB**-012 VFB**-016	Standard unit	Not available	Not available
VFX**-018 VFX**-026 VFX**-031 VFX**-037	Not available	Not available	Standard unit
VFX**-046 VFX**-060 VFX40-073	Standard unit	Not available	Standard unit, same size as IP 20
VFX**-061 VFX**-074 VFX**-090	Standard unit	Not available	Standard unit, same size as IP 20
VFX**-109 VFX**-146 VFX40-175	Standard unit	Not available	Single unit, same size as IP 20
VFX50-175 VFX**-210 VFX**-250 VFX**-300 VFX**-374	Standard unit	Please, contact your supplier	Please, contact your supplier
VFX**-500 VFX**-600 VFX**-749	2 Single units size 5, delivered with the required electrical connection material for parallel connection	Please, contact your supplier	Please, contact your supplier

7.2 External Control Panel (ECP)

The external Control Panel can be used to be built into any cabinet door or panel. The inverter must be ordered without the built-in Control Panel. The Control Panel can also be used to read data from one inverter and copy it to an other inverter. See Chapter 5.3.16 page 34.

The option comes complete with the required connection material and installation instructions.

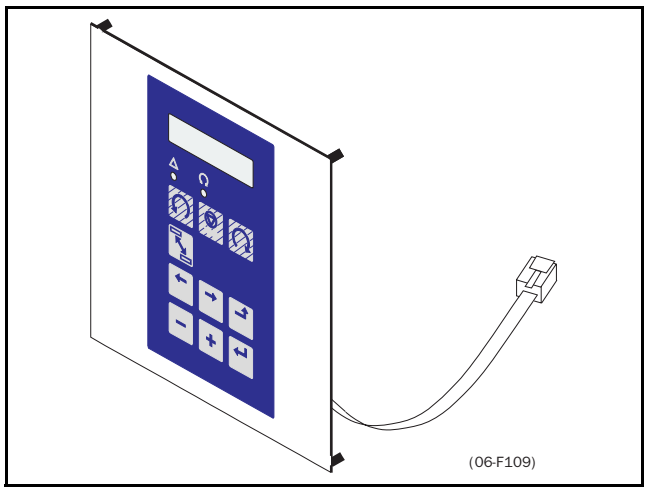


Fig. 72 ECP

7.3 Handheld Control Panel

The Handheld Control Panel can be used as an external handheld remote control. The inverter must be ordered without the built-in Control Panel. The Handheld Control Panel can also be used to read data from one inverter and copy it to an other inverter. See § 5.3.16, page 34.

The option comes complete with the required connection material and installation instructions.

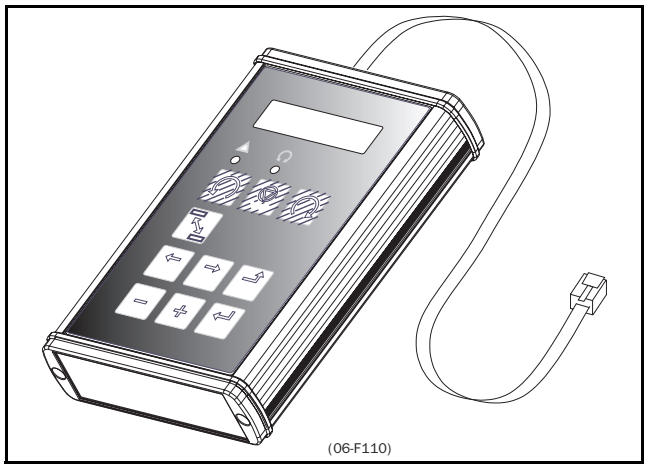


Fig. 73 HCP

7.4 Brake chopper

All inverter sizes can be fitted with an optional built-in brake chopper. The brake resistor must be mounted outside the inverter. The choice of the resistor depends on the application, switch-on duration and duty-cycle.

WARNING! The table gives the minimum values of the brake resistors. Do not use resistors lower than this value. The inverter can trip or even be damaged due to high brake currents.

Table 23 Brake resistor 400V type

400V Type	P in kW	R in Ohm
VFB40-004	1.5	47
VFB40-006	2.2	47
VFB40-008	3	47
VFB40-010	4	47
VFB40-012	5.5	47
VFB40-016	7.5	47
VFX40-018	7.5	22
VFX40-026	11	22
VFX40-031	15	22
VFX40-037	18.5	22
VFX40-046	22	9.7
VFX40-060/-061	30	9.7/7.43
VFX40-073/-074	37	9.7/6.1
VFX40-090	45	5.0
VFX40-109	55	4.2
VFX40-146	75	3.1
VFX40-175	90	2.6
VFX40-210	110	2.16
VFX40-250	132	1.81
VFX40-300	160	1.51
VFX40-374	200	1.21
VFX40-500	250	2x 1.81
VFX40-600	315	2x 1.51
VFX40-749	400	2x 1.21

Table 24 Brake resistor 500V type

500V Type	P in kW	R in Ohm
VFX50-018	11	27
VFX50-026	15	27
VFX50-031	18.5	27
VFX50-037	22	27
VFX50-046	30	12.5
VFX50-060/-061	37	12.5/9.6
VFX50-074	45	7.9
VFX50-090	55	6.5
VFX50-109	75	5.4
VFX50-146	90	4.0
VFX50-175	110	3.33
VFX50-210	132	2.78
VFX50-250	160	2.33
VFX50-300	200	1.94
VFX50-374	250	1.56
VFX50-500	315	2x 2.33
VFX50-600	400	2x 1.94
VFX50-749	500	2x 1.56

See also Chapter 3.3 page 13.

NOTE! Although the inverter will detect a failure in the brake electronics it is strongly recommended to use resistors with a thermal overload which will cut off the power at overload.

The brake chopper option is built-in by the manufacturer and must be specified when the inverter is ordered.

7.5 PTC card

The PTC option card is used to connect directly thermistors (PTCs) according to DIN 44081/44082. Specifications of the input (see § 5.3.31, page 37):

Table 25 PTC card

Assumed thermistor network	1, 3 or 6 thermistors in series
Sense voltage	2.0V ±10%
Short circuit current limit	1.0 mA ±10%
No trip to trip threshold	2825 Ω ±10%
Switch back threshold	1500 Ω ±10%

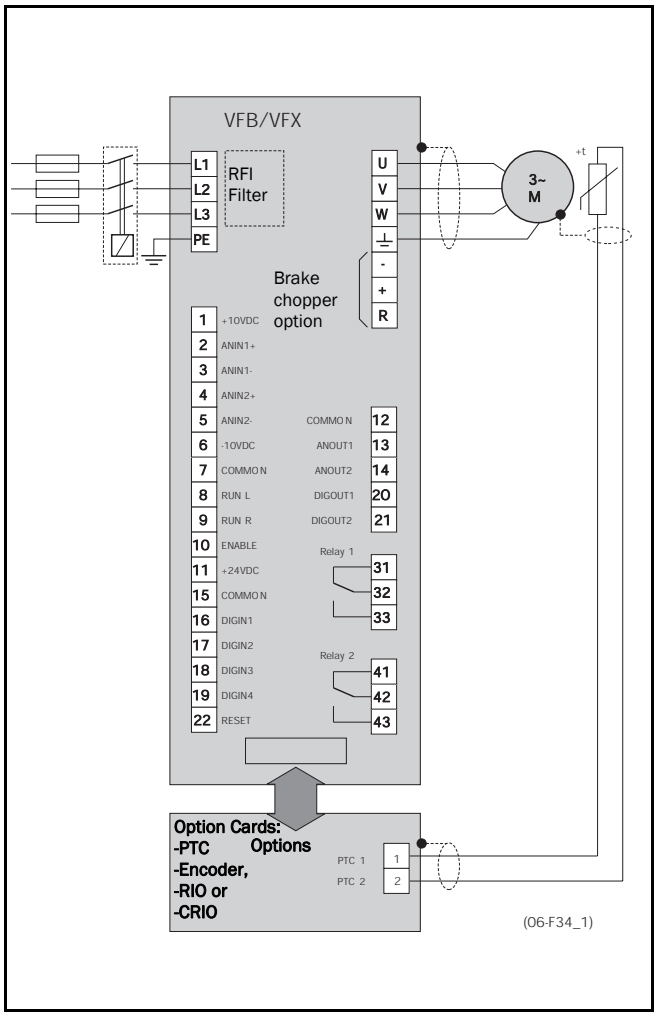


Fig. 74 Connection of the motor thermistor (PTC).

Fig. 74 shows the connection of the thermistor directly to the inverter.
The PTC input is incorporated on the options cards and may be activated via the Setup Menu:

- PTC card
- Encoder card
- CRIO card

See § 7.7, page 76 when the PTC function on the Encoder Card is used.

7.6 CRIO card

The CRIO Card (Crane Remote I/O) is designed specially for use with cranes. It has several inputs and outputs which confirm to control systems used with cranes. See also § 5.3.32, page 37.

7.7 Encoder card

The Encoder Card is used to connect an encoder to the inverter for more accurate speed control. The card can handle the most common encoder signals. See also § 5.3.29, page 37. The Encoder Card incorporates also the PTC input see § 5.3.31, page 37. Fig. 75 shows the connection of the Encoder card. It can be activated via the Setup Menu.

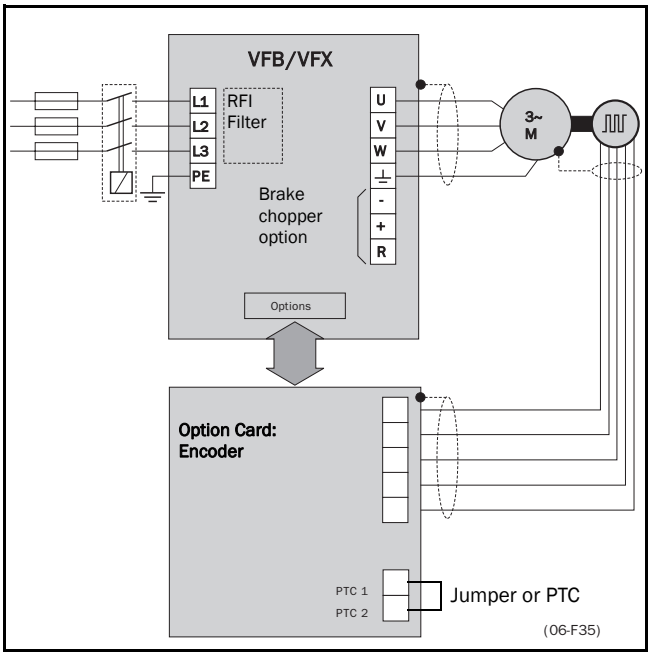


Fig. 75 ENCODER card connection.

To detect the Encoder Card or PTC Card, different DC-Voltages on the Ext. Trip input to the Control board are used. This DC-Voltage is present when the PTC resistance is low or the PTC input is shorted and thus the inverter is not tripped.

If the inverter is switched on when tripped on MOTOR TEMP (PTC input is open or sees high resistance), window 250 is invisible, but window 270 remains visible. It is then necessary to first remove the trip cause by letting the motor cool down. Window 250 and its submenu's automatically reappear with their prevailing settings when the trip condition is over.

NOTE! If the PTC-input is not used, always connect a jumper. This is also the delivery condition.

7.8 Serial communication, fieldbus

There are several option card for serial communication depending on the bus system. See Fig. 76 for the connection of the serial link.

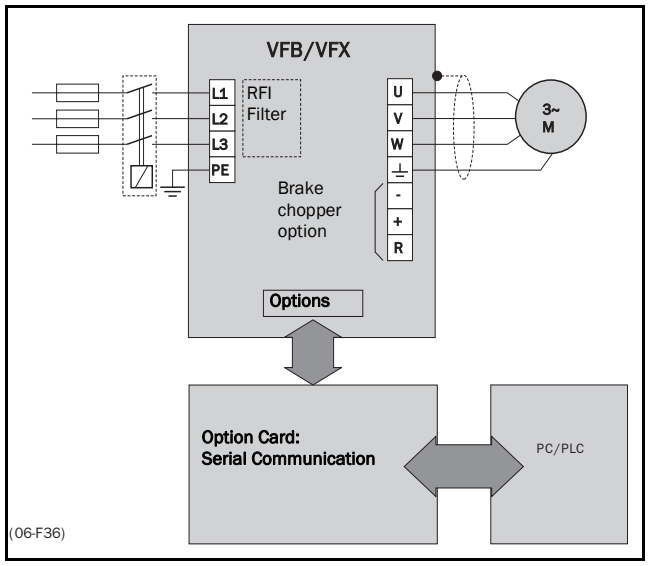


Fig. 76 Connection of a serial link.

Option cards for several bus systems are available: RS485, Profibus etc. See § 5.3.30, page 37.

8. TECHNICAL DATA

8.1 General electrical specifications

Table 26 General electrical specifications

General

Mains voltage:	400-415V +10%/-15% (VFB/VFX40) 480-525V +10%/-15% (VFX50)
Mains frequency:	50/60Hz
Input power factor:	0.95
Output voltage:	0- Mains supply voltage:
Output frequency:	0-300Hz
Output switching frequency:	3,0 kHz (1.5kHz for model 210 and bigger)
Efficiency at nominal load:	97% for model 004 to 016 98% for model 018 to 037 97.5% for model 046 to 073 98% for model 074 to 749

Control signal inputs:
Analogue (differential)

Analogue Voltage/current:	0- ±10V or 20mA via jumper
Max. input voltage:	±30V
Input impedance:	21kΩ (voltage) 250Ω (current)
Resolution:	10 bits
Hardware accuracy:	0.5% typ + 1 ½ LSB fsd
Non-linearity	1½LSB

Digital:

Input voltage:	High>7VDC Low<4VDC
Max. input voltage:	+30VDC
Input impedance:	<14VDC: 5kΩ ≥14VDC: 3kΩ
Signal delay:	≤8ms

Control signal outputs
Analogue

Output voltage/current:	±10V/+20mA via jumper
Max. output voltage:	±15V
Short-circuit current (∞):	±15mA (voltage) +140mA (current)
Output impedance:	10Ω (voltage)
Resolution:	8 bits + 10 bit AnOut 1
Hardware accuracy:	1.9% typ fsd (voltage) 2.4%typ fsd (current)
Offset:	3LSB
Non-linearity:	2LSB

Digital

Output voltage:	High>20VDC @50mA >23VDC open Low<1VDC @50mA
Shortcircuit current(∞):	100mA max (together with +24VDC)

Relays

Contacts	2A/250V~/AC1

References

+10VDC -10VDC +24VDC	+10VDC @10mA Shortcircuit current +30mA max -10mA @-10VDC Short-circuit current -30mA max +24VDC Short-circuit current +100mA max (together with Digital Outputs)

8.2 Electrical specifications related to type

Table 27 Electrical specifications related to type

Housing	400V Type	Nominal power (400V) P_{NOM} [kW]	500V type	Nominal power (500V) P_{NOM} [kW]	Nominal output current I_{NOM} [A,RMS]	Max Current 60 $I_{max,}$ [A,RMS]	Nominal input current I_{IN} [A,RMS]
B1	VFB40-004	1.5	-------	-	4	6	4.5
	VFB40-006	2.2	-------	-	6	9	6.8
	VFB40-008	3	-------	-	7.5	11	8.5
	VFB40-010	4	-------	-	9.5	14	10.5
	VFB40-012	5.5	-------	-	12	18	13.3
	VFB40-016	7.5	-------	-	16	24	17.8
S2	VFX40-018	7.5	VFX50-018	11	18	27	16
	VFX40-026	11	VFX50-026	15	26	39	23
	VFX40-031	15	VFX50-031	18.5	31	46	28
	VFX40-037	18.5	VFX50-037	22	37	55	35
X2	VFX40-046	22	VFX50-046	30	46	69	44
	VFX40-060	30	VFX50-060	37	61	92	58
	VFX40-073	37	-------	-	74	111	70
X3	VFX40-061	30	VFX50-061	37	61	92	58
	VFX40-074	37	VFX50-074	45	74	111	70
	VFX40-090	45	VFX50-090	55	90	135	86
X4	VFX40-109	55	VFX50-109	75	109	164	104
	VFX40-146	75	VFX50-146	90	146	220	139
	VFX40-175	90	----------	-----	175	260	166
X5	----------	--------	VFX50-175	110	175	263	166
	VFX40-210	110	VFX50-210	132	210	315	200
	VFX40-250	132	VFX50-250	160	250	375	238
	VFX40-300	160	VFX50-300	200	300	450	285
	VFX40-374	200	VFX50-374	250	375	560	356
X10	VFX40-500	250	VFX50-500	315	500	750	475
	VFX40-600	315	VFX50-600	400	600	900	570
	VFX40-749	400	VFX50-749	500	750	1125	721

8.3 Derating at higher temperature

The Table 30 shows the derating possibilities if a higher ambient temperature is necessary. For example: If a VFX 40-026 has a maximum ambient temperature of 50°C, there is no derating necessary. But with a size 2 VFX40-046 derating of 25% (10 x 2,5%) it is necessary to operate at an ambient temperature of 50°C.

Table 28 Ambient temperature and derating

Housing	Type 400/500V	IP20/IP23		IP54	
		Max temp.	Derating possible	Max temp.	Derating possible
B1	VFB40-004 VFB40-006 VFB40-008 VFB40-010 VFB40-012 VFB40-016	40°C	Yes, -2.5%/°C to max +10°C	------ ------ ------ ------ ------ ------	------ ------ ------ ------ ------ ------
S2	VFX**-018 VFX**-026 VFX**-031 VFX**-037			40°C 40°C 40°C 40°C	Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C
X2	VFX**-046 VFX**-060 VFX40-073	40°C 40°C 40°C	Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C	35°C 35°C 35°C	Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C
X3	VFX**-061 VFX**-074 VFX**-090	50°C 40°C 40°C	No Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C	45°C 35°C 35°C	No Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C
X4	VFX**-109 VFX**-146 VFX40-175	50°C 40°C 40°C	No Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C	45°C 35°C -----	No Yes, -2.5%/°C to max +10°C ------
X5	VFX50-175 VFX**-210 VFX**-250 VFX**-300 VFX**-374	--------- 50°C 40°C 40°C 40°C	------ No Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C	45°C 45°C 35°C 35°C 35°C	No No Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C
X10	VFX**-500 VFX**-600 VFX**-749	40°C 40°C	Yes, -2.5%/°C to max +10°C	35°C 35°C	Yes, -2.5%/°C to max +10°C

8.4 Mechanical specifications

The table below gives an overview of the dimensions and weights. The model 500 to 749 consist of 2 parallel inverters built in a standard cabinet.

Table 29 Mechanical specifications

Housing	VFB/VFX model	Dim. HxWxD [mm] IP20	Dim. HxWxD [mm] IP23/ IP54	Weight IP20 [kg]	Weight IP23/ IP54 [kg]
B1	004 to 016	360 x 126 x 260	--------	7.0	-------
S2	018 to 037		470(530) x 176 x 272		19 (IP54)
X2	046 to 073	530(590) x 220 x 270	530(590) x 220 x 270	26	26
X3	061 to 090	650(750) x 340 x 295	650(750) x 340 x 295	55	55
X4	109 to 40-175	800(900) x 450 x 330	800(900) x 450 x 330	85	85
X5	50-175 to 374	1100(1145) x 500 x 420	*	160	*
X10	500 to 749	1100(1145) x 1050 x 420	*	320	*

* Contact you supplier

8.5 Environmental conditions

Table 30 Environmental conditions

Normal operation	
Temperature:	See table, page 79
Atmospheric pressure:	86 - 106 kPa
Relative humidity, non condensing:	0 - 90%
Storage	
Temperature:	-20 - +60 °C
Atmospheric pressure:	86 - 106 kPa
Relative humidity, non condensing:	0 - 90%

8.6 Fuses, cable cross-sections and glands

Use mains fuses of the type gL/gG conforming to IEC269 or installation cut-outs with similar characteristics. PG glands will be replaces with metric glands according to EN50262. Check the equipment first before installing the glands. In due time only metric glands will be used.

NOTE! Cable cross-section is dependent on the application and must be determined in accordance with local regulations.

NOTE! The dimensions of the power terminals used in the model 500 to 749 and up can differ depending on customer specification. Please check the enclosed project documentation for detailed information.

Table 31 Fuses, cable cross-sections and glands

Housing	Type 400V/500V	Maximum value fuse [A]	Maximum cable cross-section connector [mm^2]		Clamping range glands [mm] (PG and metric)		
			Solid	Flexible	Mains cable	Motor cable	
						IP 20/23	IP54
B1	VFB40-004 VFB40-006 VFB40-008 VFB40-010 VFB40-012 VFB40-016	6 10 10 16 16 20	4 4 4 10 10 10	2.5 2.5 2.5 6 6 6	------ ------ ------ ------ ------ ------	------ ------ ------ ------ ------ ------	------ ------ ------ ------ ------ ------
S2	VFX**-018 VFX**-026 VFX**-031 VFX**-037	20 25 35 50	16 16 16 16	10 10 10 10	Ø32 (cable entry)		Ø32 (cable entry)
X2	VFX**-046 VFX**-060 VFX40-073	50 80 80	25 50	16 35	PG29 (14-25) M40 (19-28)	PG29 (23-31) M40 (27-34)	PG29 (18-25) M40 (27-34)
X3	VFX**-061 VFX**-074 VFX**-090	80 80 100	50	35	PG42 (28-38) M50 (27-35)	PG42 (34-50) M50 (35-43)	PG42 (32-38) M50 (35-43)
X4	VFX**-109 VFX**-146 VFX40-175	125 160 200	95 95 95		PG48 (34-44) M63 (34-45)	PG48 (39-50) M63 (40-47.5)	PG48 (37-44) M63 (40-47.5)
X5	VFX50-175 VFX**-210 VFX**-250 VFX**-300 VFX**-374	200 250 315 400 500	150		------	------	------
X10	VFX**-500 VFX**-600 VFX**-749	See note	See note		------ ------	------ ------	------ ------
					PG11 (4-10) M20 (8-12)	PG11 (11-15) M20 (8-12)	PG11 (5-10) M20 (8-12)

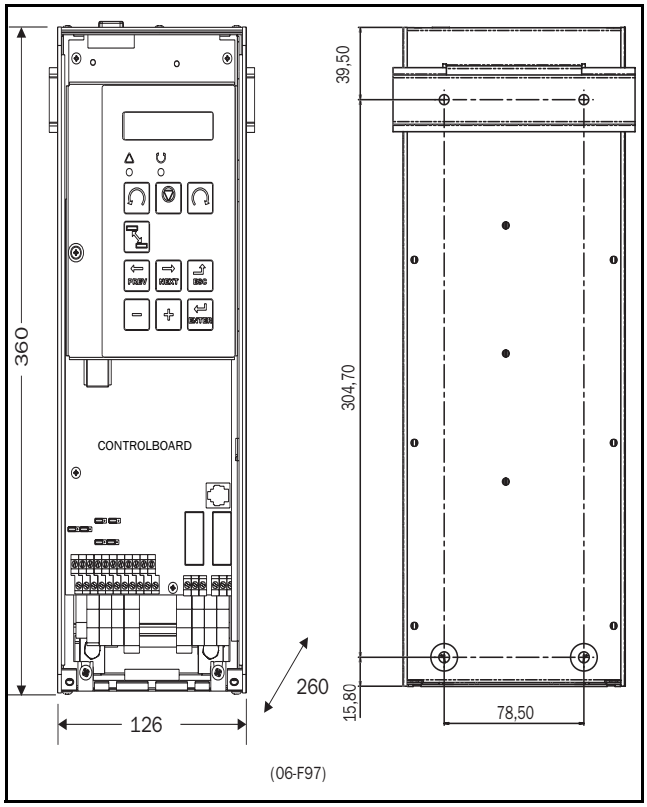


Fig. 77 VFB model 004 to 016 (B1)

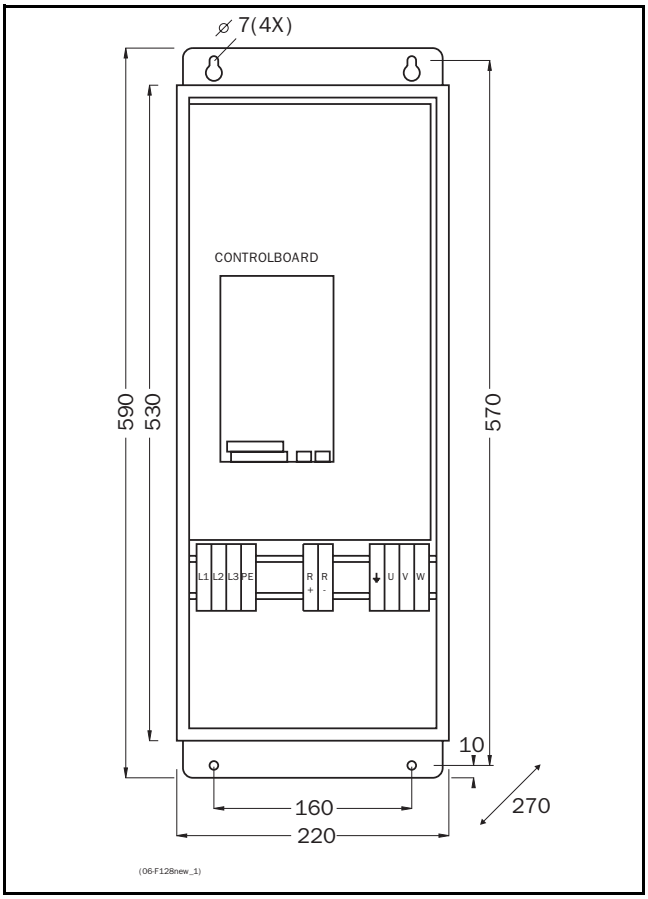


Fig. 79 VFX model 046 to 060 and 073 (X2)

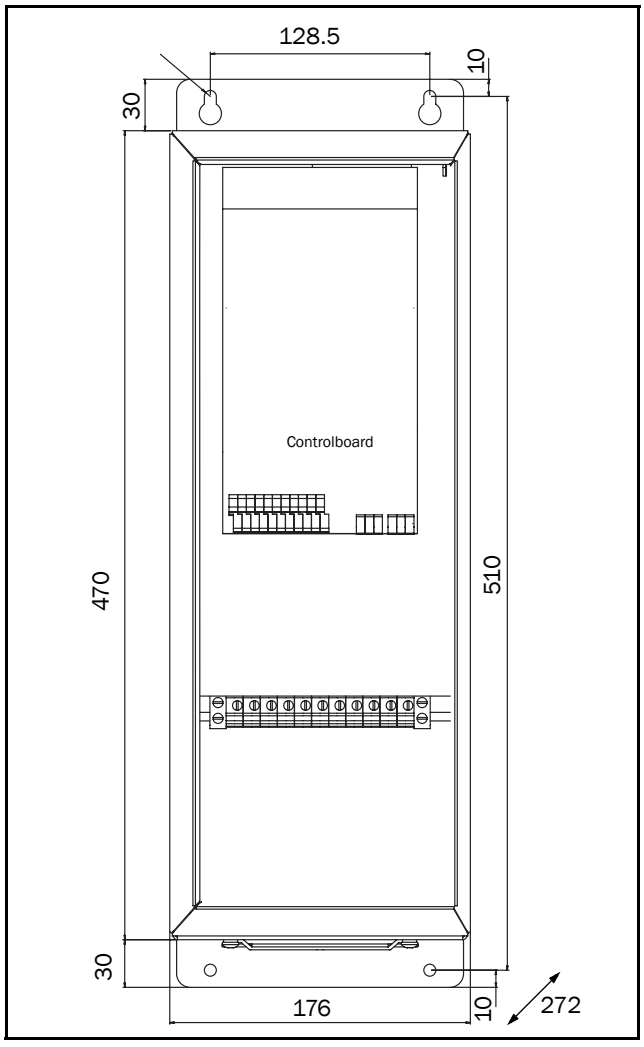


Fig. 78 VFX model 018 to 037 (S2)

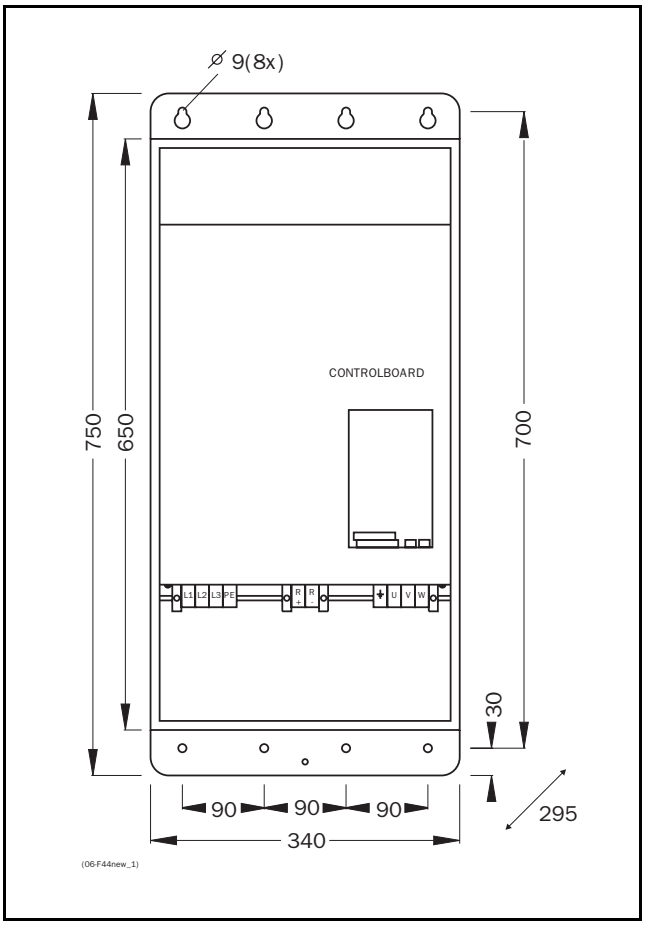


Fig. 80 VFX model 061, 074 and 090 (X3)

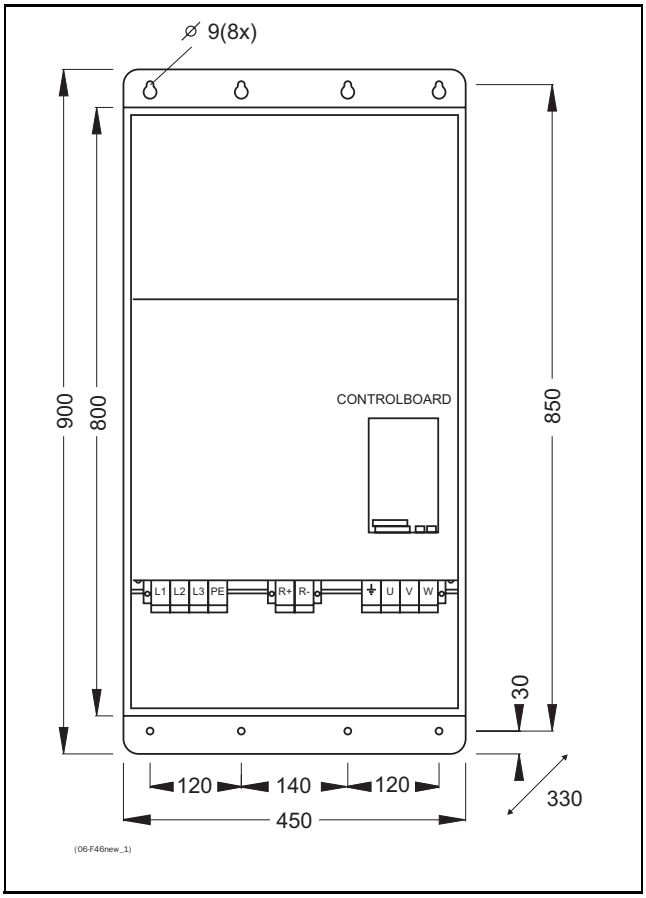


Fig. 81 VFX model 109 to 40-175 (X4)

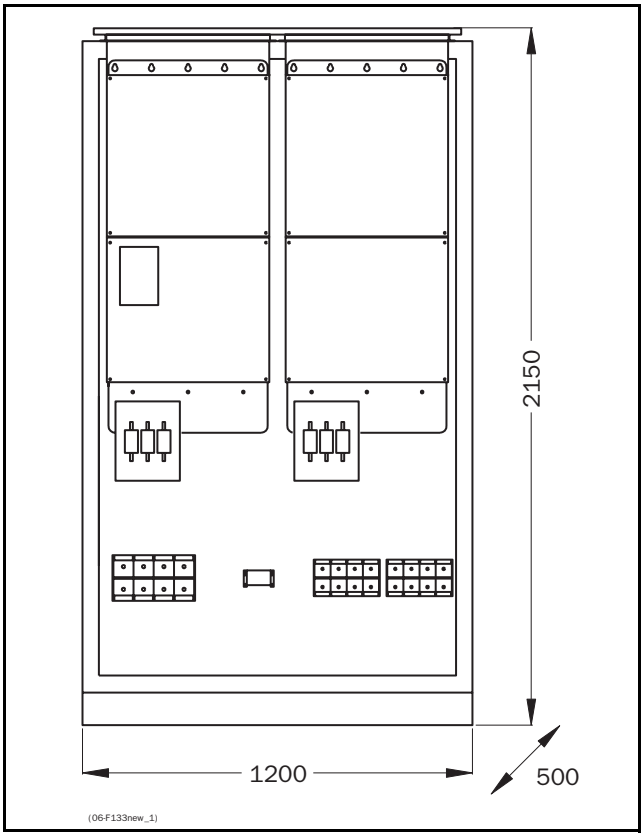


Fig. 83 VFX model 500 to 749 (X10)

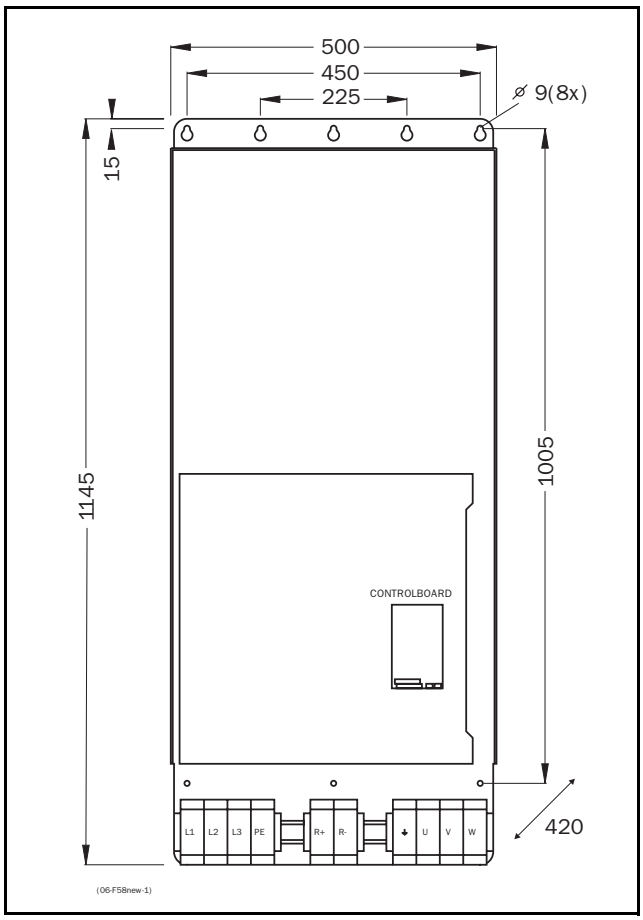


Fig. 82 VFX model 50-175 to 374 (X5)

9. SETUP MENU LIST

- Functions with * can be changed during RUN
- Default setting with thick outline are depending on Power Board ID and/or Motor Data settings
- If no value as default is filled in, this means it is a View function and can be filled in later for diagnoses purposes.

				DEFAULT	CUSTOM
100	Start window				
	110	1st Line		Speed	
	120	2nd Line		Torque	
200	Main set-up				
	210	Operation			
		211	Drive Mode	Speed	
		212	Reference Control	Remote	
		213	Run/Stop Control	Remote	
		214	Rotation	R+L	
		215	Level/Edge	Level	
	220	Motor Data			
		221	Motor power	P_{NOM}(kW)	
		222	Motor voltage	U_{nom}VAC	
		223	Motor Frequency	50Hz	
		224	Motor Current	(I_{NOM})A	
		225	Motor Speed	(n_{MOT}) rpm	
		226	Motor Cosphi	Depends on P_{nom}	
		227	Motor Ventilation	Self	
		228	Motor ID run	Off	
	230	Utility			
		231	*Language	English	
		232	*Keyboard (un)lock	0	
		233	*Copy set	A>B	
		234	*Select Set No.	A	
		235	Load Default	Active Set A-D	
		236	*Copy all settings to CP	CP MEM1	
		237	Load parameter sets from CP	CP MEM1	
		238	Load active parameter set from CP	CP MEM1	
		239	Load all settings from CP	CP MEM1	
	240	Autoreset			
		241	Numbers of Trips	0	
		242	Overtemp	off	
		243	Overcurrent	off	
		244	Overvolt D	off	
		245	Overvolt G	off	
		246	Overvolt L	off	
		247	Motor Temp	off	
		248	Ext. Trip	off	
		249	Motor Lost	off	
		24A	Alarm	off	
		24B	Locked Rotor	off	
		24C	Power Fault	off	
		24D	Comm. error	off	
	260	Option: Serial Comm.			
		261	Baudrate	9600	
		262	Address	1	
		263	Interrupt	Trip	
300	Parameter Sets				
	310	Run/Stop			
		311	*Acceleration time	2s	
		312	*Acc. ramp type	Linear	
		313	*Deceleration time	2s	
		314	*Dec. ramp type	Linear	
		315	*Start Mode	Normal(DC)	
		316	*Stop Mode	Decel	
		317	*Brake release time	0.00s	
		318	*Brake engage time	0.00s	
		319	*Wait before brake time	0.00s	
		31A	*Vector brake	Off	
		31B	*Q-Stop time	0.00s	
		31C	Spin Start	off	
	320	Speeds			
		321	*Minimum Speed	0rpm	
		322	*Maximum Speed	(SyncSpd) rpm	
		323	*Minimum Speed Mode	Scale	
		324	Speed direct	R+L	
		325	Motor Pot.	Non vola	
		326	*Preset Speed 1	0rpm	
		327	*Preset Speed 2	250rpm	
		328	*Preset Speed 3	500rpm	
		329	*Preset Speed 4	750rpm	
		32A	*Preset Speed 5	1000rpm	
		32B	*Preset Speed 6	1250rpm	
		32C	*Preset Speed 7	1500rpm	
		32D	*Skip Speed 1 Low	0rpm	
		32E	*Skip Speed 1 High	0rpm	
		32F	*Skip Speed 2 Low	0rpm	
		32G	*Skip Speed 2 High	0rpm	
		32H	*Jog Speed	50rpm	
		32I	Start Speed	50rpm	
	330	Torques			
		331	*Maximum Torque	150%	
		332	*Minimum Torque	15%	

			DEFAULT	CUSTOM
340	Controllers			
	341	*Speed PI Auto Tune	Off	
	342	*Speed P Gain	5.0x	
	343	*Speed I Time	Depends on P_{NOM}	
	344	*Flux Optimization	Off	
	345	*PID Controller	Off	
	346	*PID P Gain	1.0x	
	347	*PID I Time	1.00s	
	348	*PID D Time	0.00s	
350	Limits/Protections			
	351	*Low Volt Override	Off	
	352	*Rotor locked	Off	
	353	*Motor lost	Resume	
	354	*Motor I^2t Type	Trip	
	355	*Motor I^2t Current	I_{nom}(A)	
400	I/O			
410	Analogue Inputs			
	411	AnIn1 Function	Speed	
	412	AnIn1 Setup	0-10V/ 0-20mA	
	413	AnIn1 Offset	0%	
	414	AnIn1 Gain	1.00	
	415	AnIn1 Bipol	Off	
	416	AnIn2 Function	Off	
	417	AnIn2 Setup	0-10V/ 0-20mA	
	418	AnIn2 Offset	0%	
	419	AnIn2 Gain	1.00	
	41A	AnIn2 Bipol	Off	
420	Digital Inputs			
	421	Digital Input 1	Off	
	422	Digital input 2	Off	
	423	Digital input 3	Off	
	424	Digital input 4	Off	
430	Analogue Outputs			
	431	*AnOut1 Function	Speed	
	432	*AnOut1 Setup	0-10V/ 0-20mA	
	433	*AnOut1 Offset	0%	
	434	*AnOut1 Gain	1.00	
	435	*AnOut1 Bipolar	Off	
	436	*AnOut2 Function	Torque	
	437	*AnOut2 Setup	0-10V/ 0-20mA	
	438	*AnOut2 Offset	0%	
	439	*AnOut2 Gain	1.00	
	43A	*AnOut2 Bipolar	Off	
440	Digital Outputs			
	441	*Digital Output1 Function	Run	
	442	*Digital Output2 Function	Brake	

				DEFAULT	CUSTOM
450	Relays				
	451	*Relay 1 Function	Ready		
	452	*Relay 2 Function	Trip		
500	Set/View reference value				
600	View operation				
	610	Speed		.....rpm	
	620	Torque		.....%Nm	
	630	Shaft power		.....kW	
	640	Electrical power		.....kW	
	650	Current		.....ARMS	
	660	Voltage		.....VAC	
	670	Frequency		.....Hz	
	680	DC-Link Voltage		.....VDC	
	690	Temperature		.....°C	
	6A0	FI status		.....	
	6B0	Digital input status		.....	
	6C0	Analogue input status		.....	
	6D0	Run Time		.....h:..m	
	6D1	Reset Run Time		No	
	6E0	Mains Time		.....h:.....m	
	6F0	Energy		.....kW	
	6FI	Reset Energy		No	
	6G0	Process Speed		.....	
	6G1	*Set Process Unit		None	
	6G2	*Set Process Scale		1.000	
	6H0	Warning		.....	
700	View Trip Log				
	710	Trip 1		.....h:..m	
	720	Trip 2		.....h:...m	
	730	Trip 3		.....h:..m	
	740	Trip 4		.....h:..m	
	750	Trip 5		.....h:..m	
	760	Trip 6		.....h:..m	
	770	Trip 7		.....h:..m	
	780	Trip 8		.....h:..m	
	790	Trip 9		.....h:..m	
	7A0	Trip 10		.....h:..m	
	7B0	Reset Trip		No	
800	Monitor				
	810	Alarm Function			
	811	*Alarm Select	Off		
	812	*Ramp Enable	Off		
	813	*Start Delay	2s		
	814	*Response Delay	0.1s		
	815	*Auto Set	No		
	816	*Max Alarm	150%		
	817	*Max Pre-Alarm	110%		
	818	*Min Alarm	0%		
	819	*Min Pre-Alarm	90%		

				DEFAULT	CUSTOM
	820	Comparators			
		821	*CA1 Value	Speed	
		822	*CA1 Constant	300rpm	
		823	*CA2 Value	Torque	
		824	*CA2 Constant	20%	
		825	*CD1	Run	
		826	*CD2	DigIn1	
	830	Logic Y		CA1&!A2&!CD1	
		831	*Y Comp 1	CA1	
		832	*Y Operator 1	&	
		833	*Y Comp 2	!A2	
		834	*Y Operator 2	&	
		835	*Y Comp 3	CD1	
	840	Logic Z		CA1&!A2&CD1	
		841	*Z Comp 1	CA1	
		842	*Z Operator 1	&	
		843	*Z Comp 2	!A2	
		844	*Z Operator 2	&	
		845	*Z Comp 3	CD1	
900	View system data				
	910	FI Type			.....
	920	Software			.....

10. PARAMETER SET LIST

Table 32 Parameter Set List

				Default	A	B	C	D
300	Parameter Sets							
	310	Run/Stop						
		311	*Acceleration time	2s				
		312	*Acc. ramp type	Linear				
		313	*Deceleration time	2s				
		314	*Dec. ramp type	Linear				
		315	*Start Mode	Normal(DC)				
		316	*Stop Mode	Decel				
		317	*Brake release time	0.00s				
		318	*Brake engage time	0.00s				
		319	*Wait before brake time	0.00s				
		31A	*Vector brake	Off				
		31B	*Q-Stop time	0.00s				
		31C	Spin Start	off				
	320	Speeds						
		321	*Minimum Speed	0rpm				
		322	*Maximum Speed	(SyncSpd) rpm				
		323	*Minimum Speed Mode	Scale				
		324	Speed direct	R+L				
		325	Motor Pot.	Non vola				
		326	*Preset Speed 1	0rpm				
		327	*Preset Speed 2	250rpm				
		328	*Preset Speed 3	500rpm				
		329	*Preset Speed 4	750rpm				
		32A	*Preset Speed 5	1000rpm				
		32B	*Preset Speed 6	1250rpm				
		32C	*Preset Speed 7	1500rpm				
		32D	*Skip Speed 1 Low	0rpm				
		32E	*Skip Speed 1 High	0rpm				
		32F	*Skip Speed 2 Low	0rpm				
		32G	*Skip Speed 2 High	0rpm				
		32H	*Jog Speed	50rpm				
		32I	Start Speed	10rpm				
	330	Torques						
		331	*Maximum Torque	150%				
		332	*Minimum Torque	15%				
	340	Controllers						
		341	*Speed PI Auto Tune	Off				
		342	*Speed P Gain	5.0x				
		343	*Speed I Time	0.10s				
		344	*Flux Optimization	Off				
		345	*PID Controller	Off				
		346	*PID P Gain	1.0x				
		347	*PID I Time	1.00s				
		348	*PID D Time	0.00s				
	350	Limits/Protections						
		351	*Low Volt Override	Off				
		352	*Rotor locked	Off				
		353	*Motor lost	Resume				
		354	*Motor I^2t Type	Trip				
		355	*Motor I^2t Current	I_{nom}(A)				

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