Valid for the following inverter Models:
FDU40-003 to FDU40-1k1
FDU50-018 to FDU50-1k1
FDU69-120 to FDU69-1k1
Software version: 3.XX

FLOWDRIVE™ FDU

INSTRUCTION MANUAL - English

Document number: 01-2232-01
Edition: r6
Date of release: 2006-01-15

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 67.

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 main voltage, do not touch the control board when the inverter is switched on.

Precautions to be taken with a connected motor
If work must be carried out on a connected motor or on the driven machine, the mains voltage must always be disconnected from the frequency inverter first. 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 absolutely necessary to follow the installation instructions. See § 3.4, page 12.

Mains voltage selection
The frequency inverter is suitable for use with the main voltages listed in § 8.1, page 75. 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 have been 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 has 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 68.

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.

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1. GENERAL INFORMATION

1.1 Introduction

The frequency inverter is intended for controlling pump and fan loads with quadratic characteristics and many other applications which require low dynamic performance. The inverter is equipped with a sophisticated vector modulator which uses a modern DSP (Digital Signals Processor). The modulation principle is based on the so-called V/Hz method. Various features and option cards make the inverter flexible to operate in many different applications.

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:
FDU40-003 to FDU40-1k1
FDU50-018 to FDU50-1k1
FDU69-120 to FDU69-1k1

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.

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 Declaration, 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 67.

- 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 11 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 21 explains the operation of the frequency inverter.
- Chapter 5. page 29 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 68 gives information about troubleshooting, fault finding and diagnoses.
- Chapter 7. page 72 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 75 lists all technical data concerning the complete power range.
- Chapter 9. page 83 and chapter 10. page 85 are lists to fill in the customer settings for all parameters.

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 78. 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.

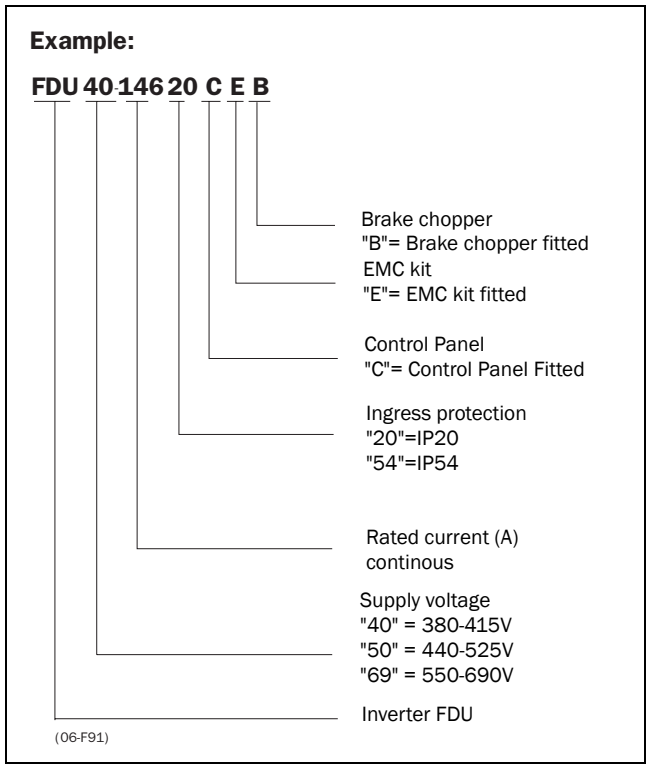


Fig. 1 Type number

1.6 Standards

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

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 establisments.
The FDU frequency inverter complies with the product standard EN 61800-3 including amendment A11 (Any kind of metal screened cable may be used). The standard FDU frequency inverter 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 cuase radio interference in which case the user may be requierd to take adequate measures.

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 frequency 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**

1.7 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 default settings for I/O, etc. For other I/O settings, controller functions, etc., please refer to chapter 5. page 29.

2.1 Making the first start

- Check that the mains and motor wiring are correct according to chapter 3. page 11.
- The motor data (taken from the motor name plate) should be entered in menu 220, see § 5.3.9, page 33.
- To run the motor, there must be a reference value and a start command present. See also Fig. 2.
- The default for a frequency reference value is input AnIn1 on terminal 2, 0-10VDC. Connect a potentiometer or a 0-10V variable signal between inputs 2 and 7 (a +10V reference for the potentiometer is available on terminal 1).
- The reference value coming into the inverter can be viewed in window 500, see § 5.6, page 56.
- The run command (RunR) is given by making input terminal 8 high, i.e. a closed contact between terminals 8 and 11.
- Set the reference value to a low value (about 10% of nominal frequency) 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 56.
- 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 29.

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 30) and the Run/Stop control in window [213] (§ 5.3.4, page 31) to "Keyboard".
- The reference value is entered directly in window [500] see § 5.6, page 56.
- 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 with a 2 kΩ potentiometer. A Run command can be given on inputs (DigIn1) to start the inverter. The potentiometer will work as a Frequency Reference (default).

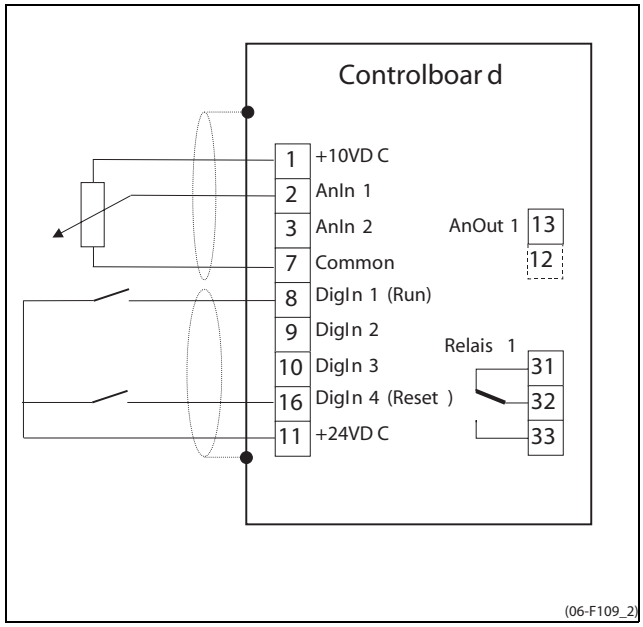


Fig. 2 Minimum control wiring.

WARNING! Always switch off the mains vol-tage 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.

NOTE! The models 500 – 1k1 (cabinets) inverters are mainly built to customer specification, detailed connection information comes with the enclosed project documentation of these inverters.

3.1 Mounting and cooling

The inverter must be mounted vertically against a flat surface. Use the template to mark out the position of the fixing holes.

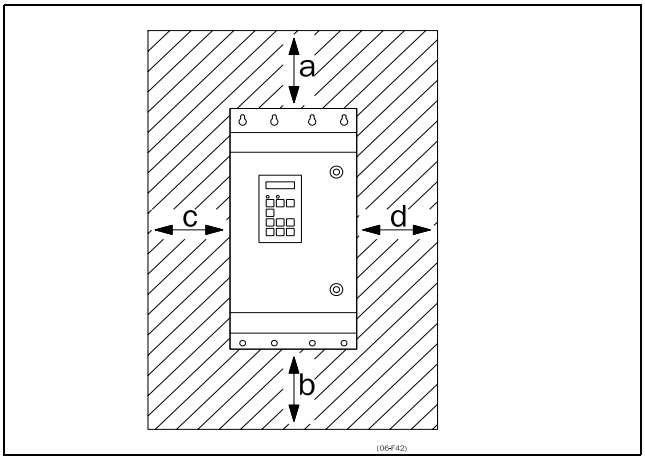


Fig. 3 Frequency inverter mounting model 003 to 375

Fig. 3 show the minimum free space required around the inverter of the model 003 to 375 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

		003-013	018-037	046-375
FDU-FDU	a	200 mm	200 mm	200 mm
	b	200 mm	200 mm	200 mm
	c	30 mm	0 mm	30 mm
	d	30 mm	0 mm	30 mm
FDU-wall	a	100 mm	100 mm	100 mm
	b	100 mm	100 mm	100 mm
	c	30 mm	0 mm	30 mm
	d	30 mm	0 mm	30 mm

FDU model 003 to 375
Fig. 75, page 67 - Fig. 87, page 82 give the size and fixing sizes of the inverters. For the other models up to model 375 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

FDU Model	Flow rate [m^3/hour]
003 – 013	40
018 – 037	150
046 – 073	165
074 – 108	510
109 – 175	800
210 – 375	975

3.3 Mains and motor connections

Fig. 4 shows the positions of the mains connectors and the motor connectors. The FDU model 003 to 175 can be opened with the supplied key. The front panel is hinged on one side. The FDU model 210 to 1k1 can be opened by removing the front plate completely.

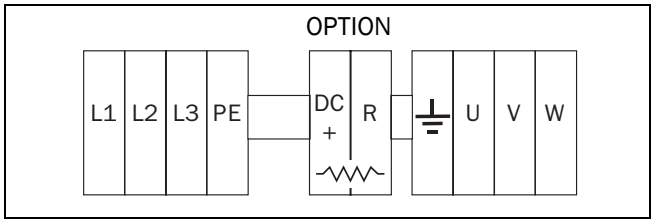


Fig. 4 Mains and motor connections for model 003 to 013 and 046 to1k1.

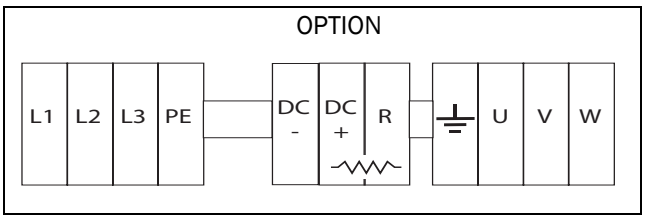


Fig. 5 Mains and motor connections for model 018 to 037

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.

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 manual. 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 has been 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. 6 and Fig. 7.

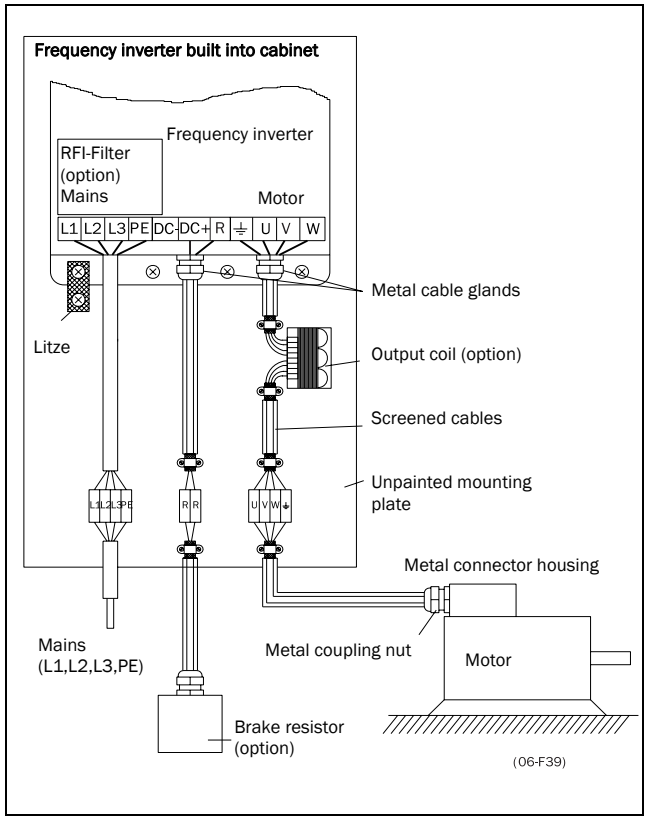


Fig. 6 Frequency inverter in a cabinet on a mounting plate.

Fig. 6 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.

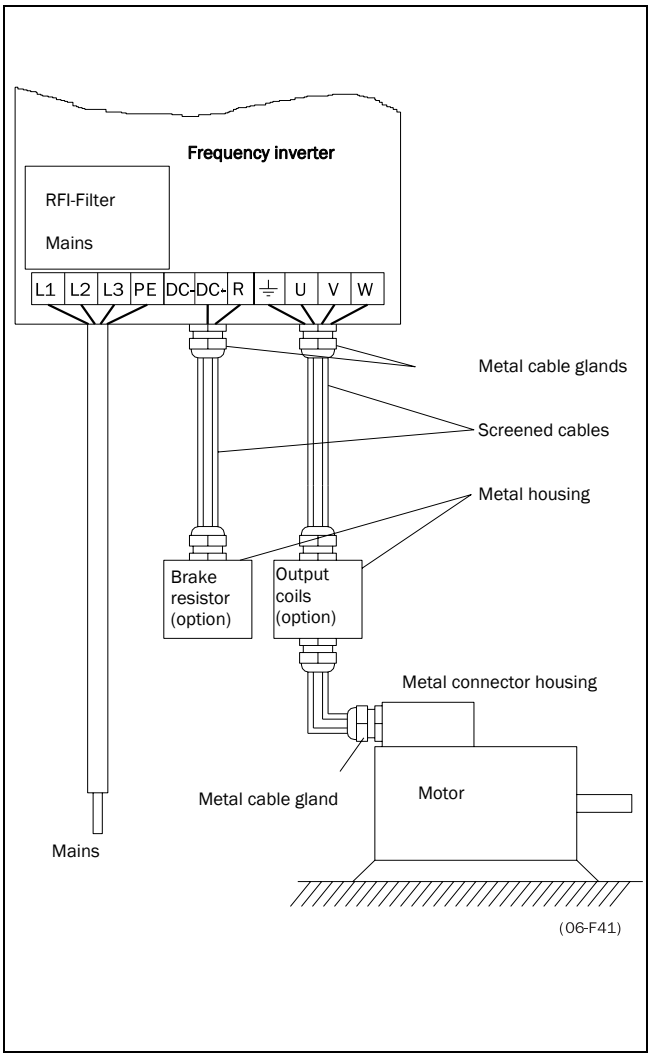


Fig. 7 Frequency inverter as stand alone.

Fig. 7 shows an example when there is no metal mounting plate used (e.g.: if IP54 inverters are used). It is important to keep the "circuit" closed, by using metal housing and cable glands.

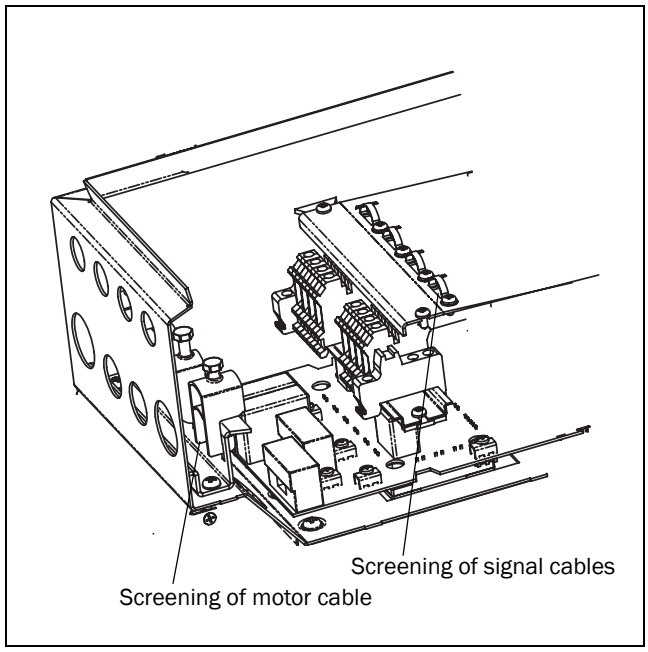


Fig. 8 Screening of cables with size S2

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 the model 500 to 1k1 (IP23/IP54) and up are mounted in a standard cabinet. The internal wiring complies with the EMC standard. Fig. 9 shows an example of a large size inverter built in a cabinet.

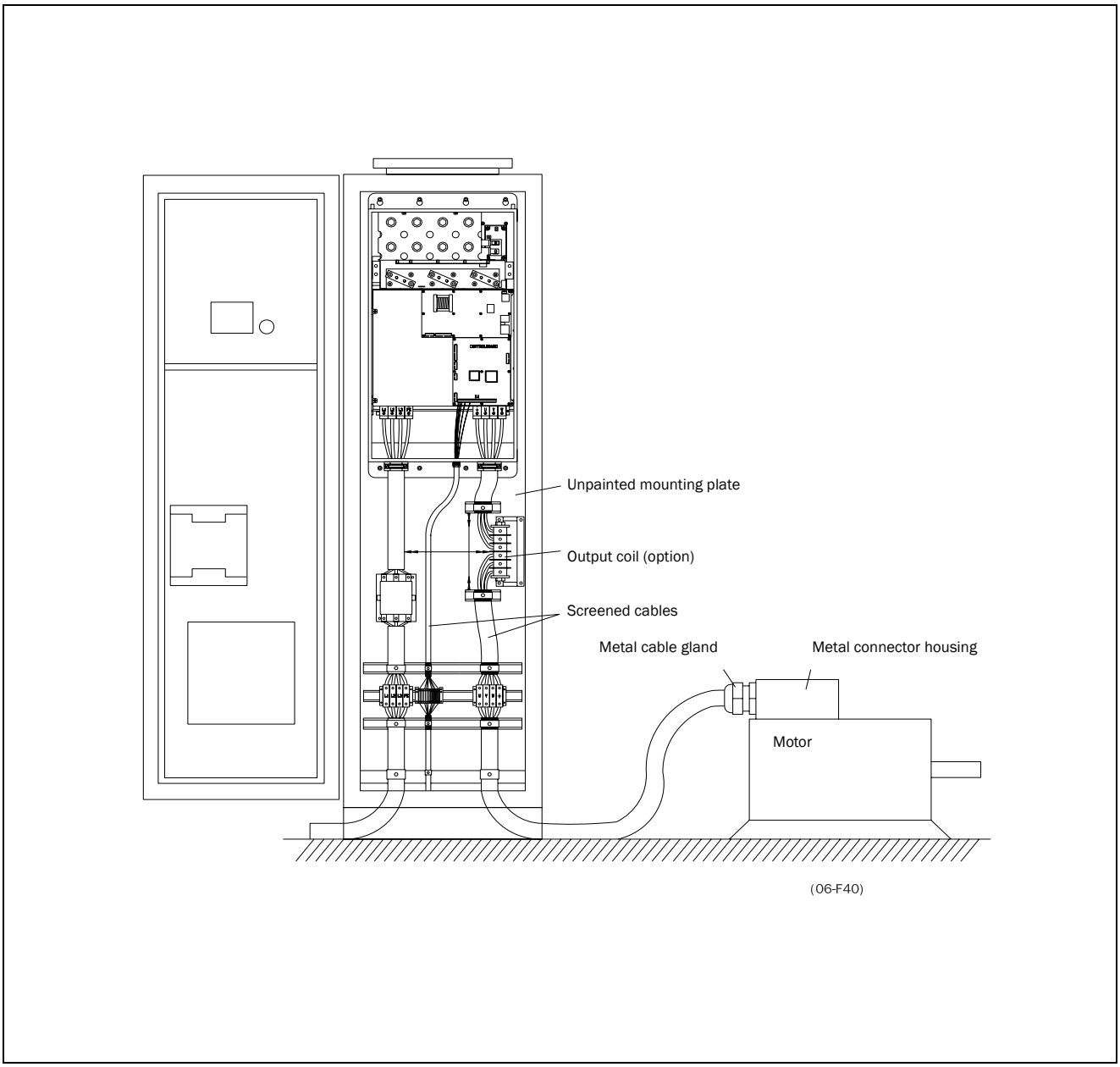


Fig. 9 Big size inverter in cabinet.

3.5 Stripping lengths for cables

Fig. 10 indicates the recommended stripping lengths for motor and power supply cables.

Table 5 Stripping lengths for mains and motor cables

Model	Mains cable		Motor cable		
	a (mm)	b (mm)	c (mm)	d (mm)	e (mm)
003 – 013	60	8	60	8	31
018 – 037	115	12	115	12	32
046 – 073	130	11	130	11	34
074 – 108	160	16	160	16	41
109 – 146	170	24	170	24	46
175	170	33	170	33	46
210 – 375	–	40	–	40	–

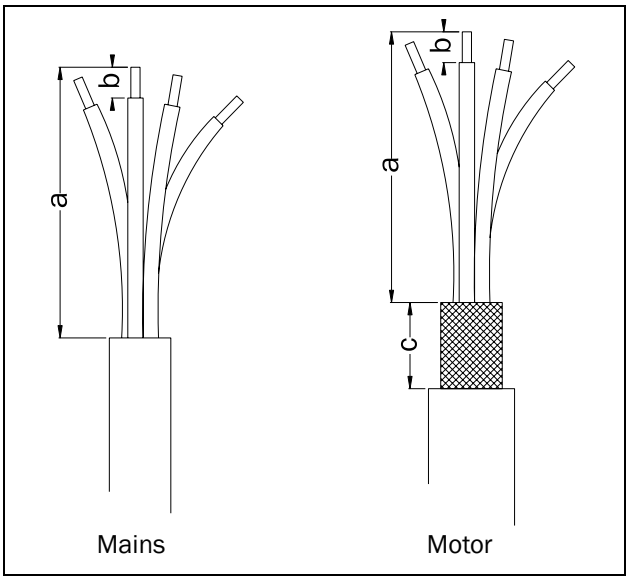


Fig. 10 Stripping lengths for cables - FDU.

3.6 Control board

Fig. 11 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 capa-citors 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.

Standard control board

- 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 output
- Terminal 41-43 Relay output
- X4 connector: Communication connector. Only used if communication options like RS485, fieldbus etc. are built in.
- X5, X5a connector: Option connector, only used if options are built in.
- X8 connector: Control Panel connection.

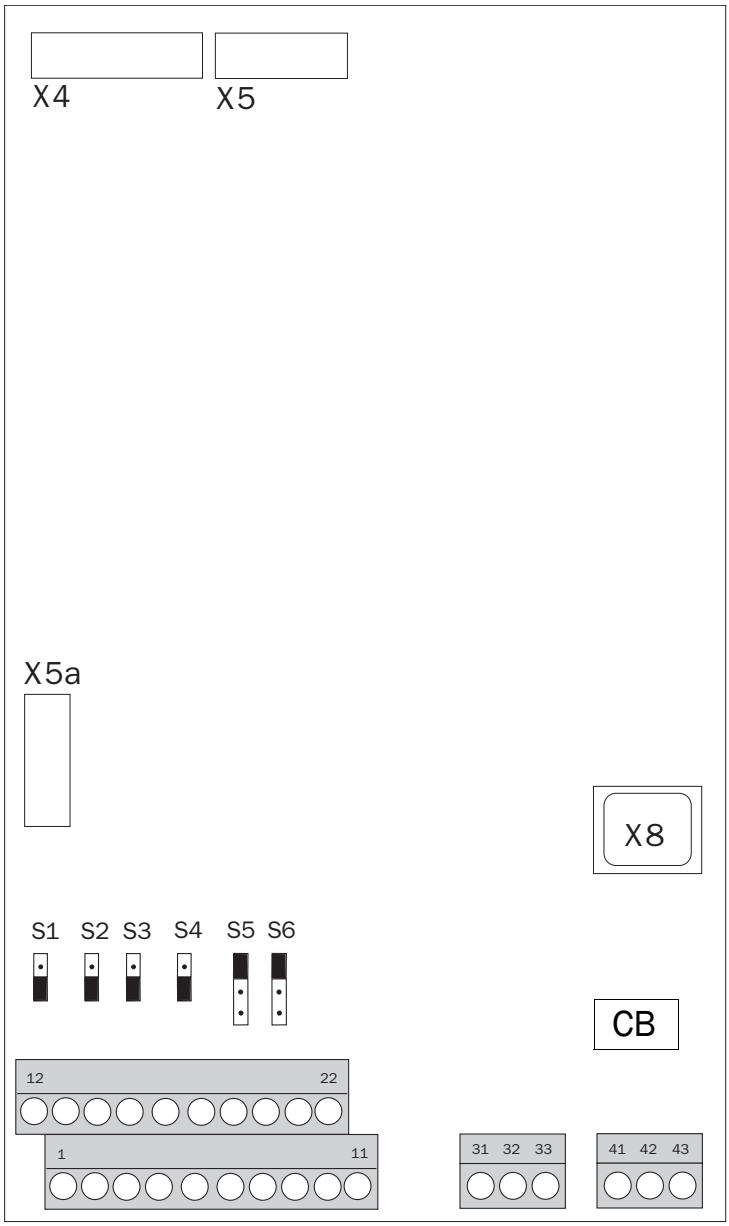


Fig. 11 Control board layout

3.7 Control signals connections, default settings

The connections for the control signals are accessible after opening the front panel. See Fig. 79-Fig. 86.
The Standard control signal connections are suitable for stranded flexible wire up to 1.5 mm^2 and for solid wire up to 2.5 mm^2.

NOTE! The function of the inputs and outputs described in Table 6 are the default settings. Please refer to chapter 5. page 29 for the other functions of each in and output.

NOTE! The maximum total combined current 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	Frequency reference, positive signal	0 -10VDC or 0/4 - 20mA	analogue input
3	AnIn 2	Off positive signal	0 -10VDC or 0/4 - 20mA	analogue input
4	PTC +	PTC motor thermistor input	According to DIN44081/ 44082	analogue input
5	PTC -			
6	-10V	-10VDC Supply voltage	-10VDC, max 10mA	output
7	Common	Signal ground	0V	output
8	DigIn 1	Run; rotation according to window [324] (default: right)	0-8/24VDC	digital input
9	DigIn 2	Off	0-8/24VDC	digital input
10	DigIn 3	Off	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 - 200% f_{MOT}	0 ±10VDC or 0/4 - +20mA	analogue output
14	AnOut 2	0 - 200% I_{MOT}	0 ±10VDC or 0/4 - +20mA	analogue output
15	Common	Signal ground	0V	output
16	DigIn 4	RESET	0-8/24VDC	digital input
17	DigIn 5	Off	0-8/24VDC	digital input
18	DigIn 6	Off	0-8/24VDC	digital input
19	DigIn 7	Off	0-8/24VDC	digital input
20	DigOut 1	Run, active if motor runs	24VDC, 100mA, see note	digital output
21	DigOut 2	NOTRIP, no Trip active	24VDC, 100mA, see note	digital output
22	DigIn 8	Off	0-8/24VDC	digital input
Terminal				
31	N/C 1	Relay 1 output Trip, active when the inverter is in a TRIP condition	potential free change over 2A/250VAC/AC1	relay output
32	COM 1			
33	N/O 1			
Temrinal				
41	N/C 2	Relay 2 Output Ready, active when the inverter is ready to start	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 Directives 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 occasionally 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 (0-250VAC) 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 12.

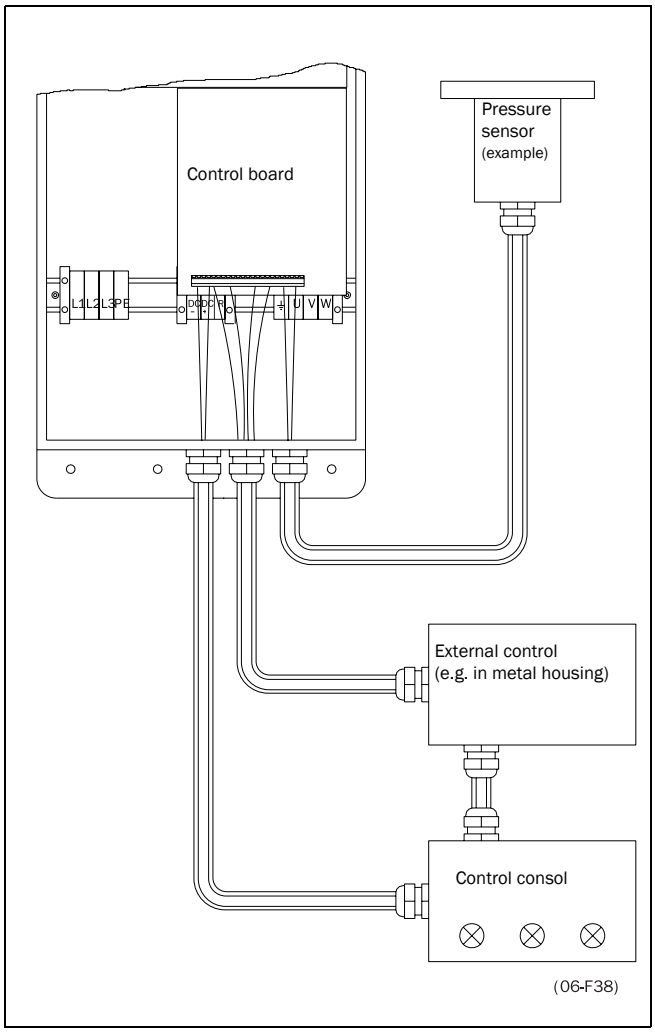


Fig. 12 Electro Magnetic (EM) screening of control signal cables.

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

If long control cables are used, the wavelength (¼λ) 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. 12.

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

3.8.3 Current control (0-20mA)

A current signal like 0-20mA is less sensitive to disturbances than a 0-10V signal, because it has a low impedance (250Ω) compared with a voltage signal (20kΩ). It is therefore strongly advised to use current controlled signals if the cables are longer than a few meters.

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 18. 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. 13 gives an overall view of a connection example of the inverter.

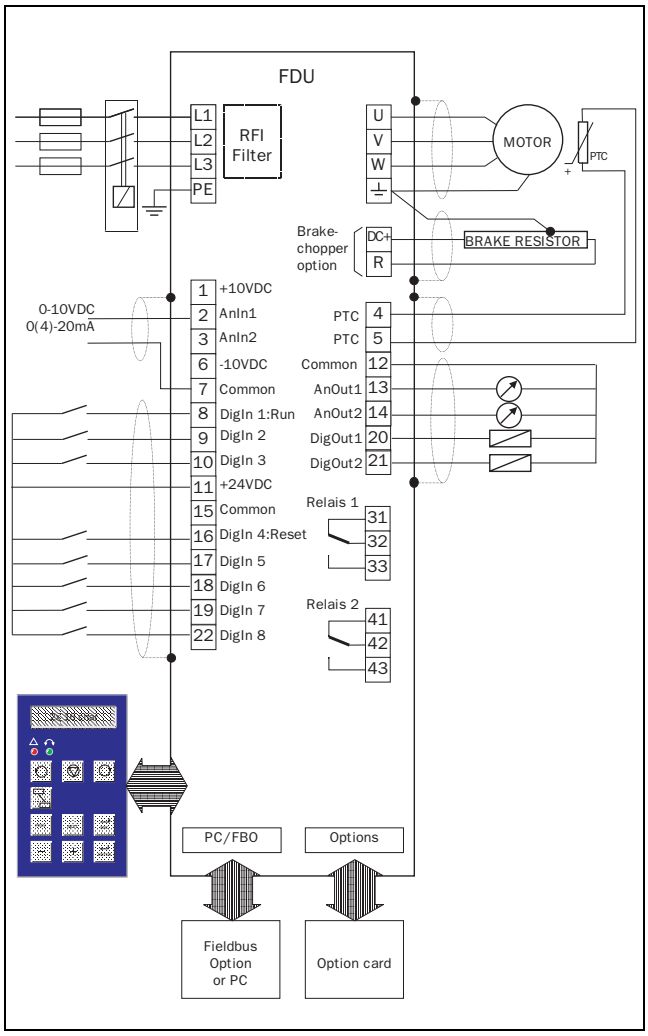


Fig. 13 Connection example.

3.10 Connection options

The option cards are connected by the optional connectors X4, X5 or X5a on the control board see Fig. 11, page 16 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 18. See also chapter 7. page 72.

3.11 Inputs/outputs configuration with the jumpers

The jumpers S1 to S4 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. See Fig. 14 for location of the Jumpers (S5 and S6 for future use).

Table 7 Jumper settings

Input/Output	Type	Jumper
AnOut1	0-10V (default)	S1
	0-20mA	S1
AnOut2	0 -10V(default)	S2
	0-20mA	S2
AnIn1	0 -10V (default)	S3
	0-20mA	S3
AnIn2	0 -10V (default)	S4
	0-20mA	S4
PTC	PTC (default)	S5 S6
	No function	S5 S6
	No function	S5 S6

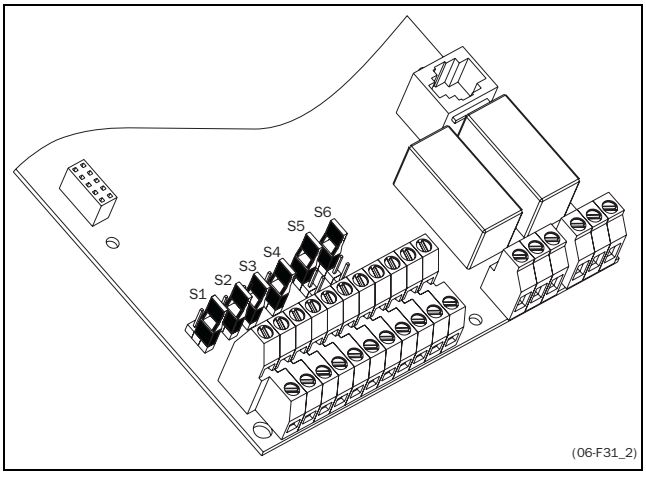


Fig. 14 Location of connectors and jumpers.

3.12 Long motor cables

If the connection to the motor is longer than 100 m (40 m for model 003-013), 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 Motors in parallel

Paralleling motors is possible as long as the total current does not exceed the nominal value of the inverter. The following has to be taken into account with regard to the values of motor data (see also § 5.3.9, page 33)

Window 211 Motor Power: must be added.
Window 222 Motor Voltage: must be equal.
Window 223 Motor Frequency: must be equal.
Window 224 Motor Current: must be added.
Window 225 Motor Speed: must be averaged.
Window 226 Motor Cos PHI: must be averaged.

3.15 Use of a thermal overload and thermistors

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

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

Motor thermistors offer better thermal protection for the motor. Depending on the type of motor thermistor fitted the PTC input (see § 5.3.31, page 36) 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, I^2t type [354] § 5.4.40, page 47 and I^2t current [355] § 5.4.41, page 48.

3.16 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.

3.17 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
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_{CL}	120% I_{NOM}, 60s	A, RMS
I_{TRIP}	Peak motor current 280% 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 29). Depending on the size of the inverter this will take a few seconds.

The default Start Window will appear as follows:

```
100                0Hz
Stp              0.0A
```

4.1 Operating the control panel

Fig. 15 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 on the Blank Control Panel. See also § 4.1.2, page 22 and § 7.2, page 73.

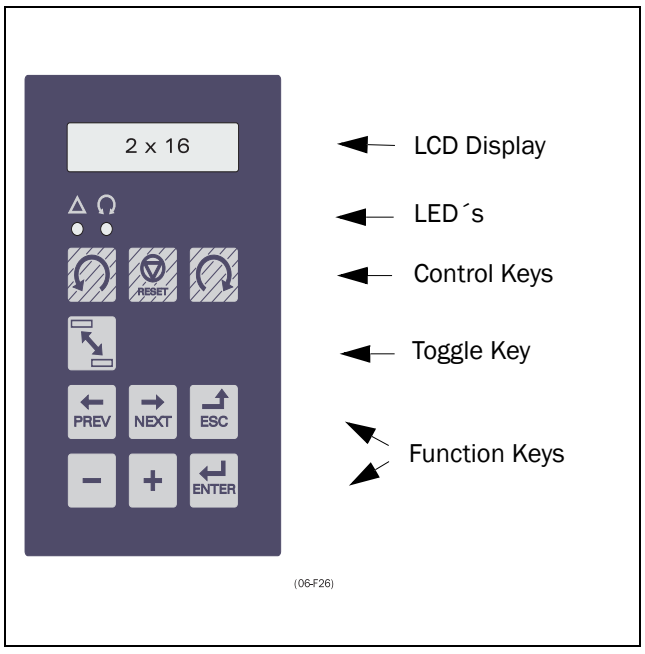


Fig. 15 Control Panel.

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:

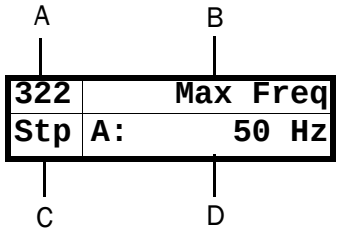


Fig. 16 The Display

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 § 5.2)
Run : Motor runs
Trp : Tripped
Stp : Motor is stopped
VL : Voltage limit
FL : Frequency 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)
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. 17 Example upper level menu (Main Menu)

```
320 Frequencies
Stp
```

Fig. 18 Example mid level menu (Submenu tens)

```
321 Min Freq
Stp A          0Hz
```

Fig. 19 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:

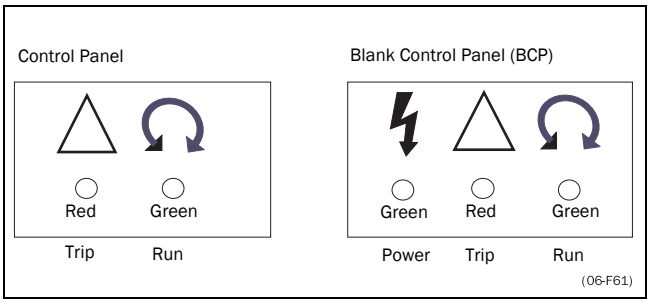


Fig. 20 LED indications

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 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.

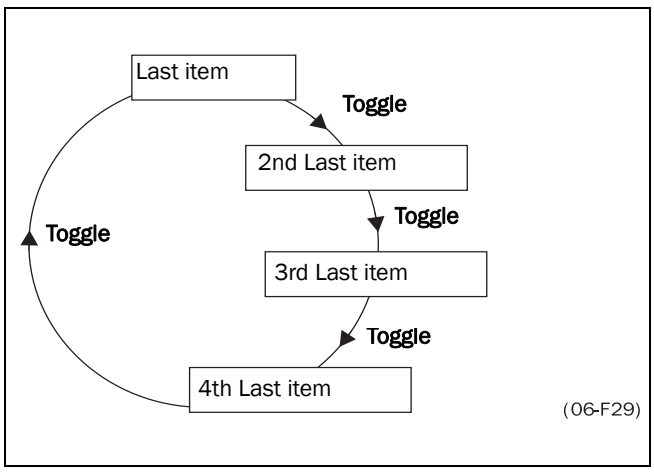


Fig. 21 Toggle memory

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. If the Enable function is programmed on one of digital inputs (see § 5.5.11, page 51) this input must be active to allow Run/Stop commands from the Control Panel.

Table 10 Control keys

	RUN L:	gives a start with rotation left
RESET	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) simultaneously.

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	ENTER key:	- to step to a lower menu level - to confirm a changed setting
ESC	ESCAPE key:	- to step to a higher menu level - to ignore a changed setting, without confirming
PREV	PREVIOUS key:	- to step to a previous menu window within the same level
NEXT	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 Frequencies [320]).

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

Example 1:

Submenu Frequencies [320] counts from 321 to 32H.

Example 2:

Main menu View Operation [600] counts from 610 to 6F0.

Fig. 22 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 frequency and current as default. Programmable for many other read-outs

200 MAIN SETUP

Main 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, frequency setting, torque limitation, 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. 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 frequency, load, 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, comparator functions.

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 83) and in chapter 5. page 29.

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.

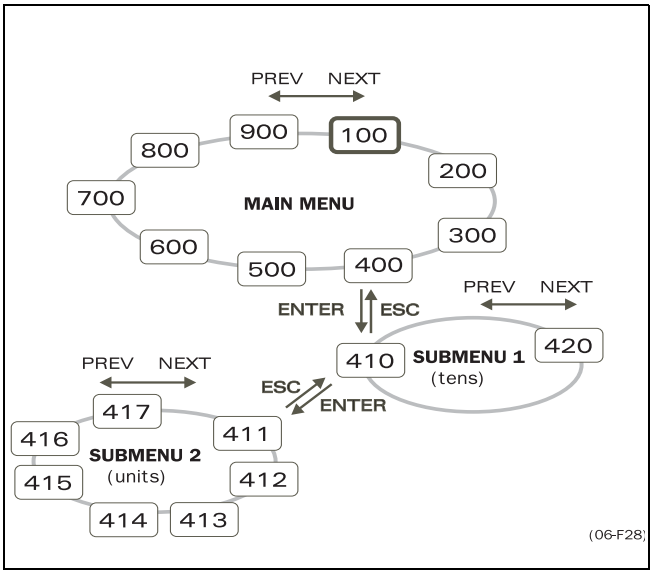


Fig. 22 Menu structure.

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.

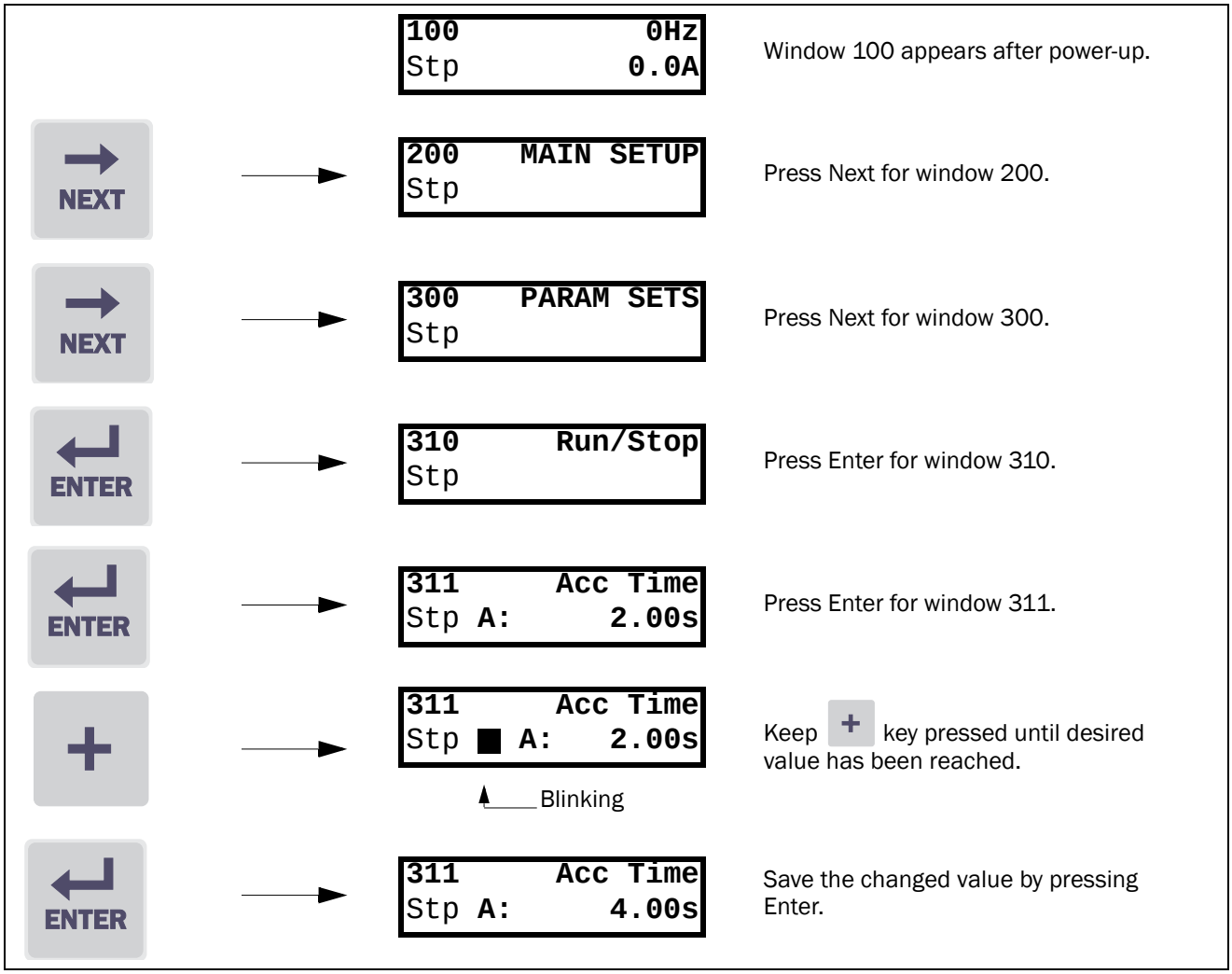


Fig. 23 Programming example

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 the function Run/Stp Ctrl [213] this can be selected for keyboard or serial communication control, see § 5.3.4, page 31.

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. 24. In this example the inverter is started and stopped with DigIn 1 and a reset after trip can be given with DigIn 4.

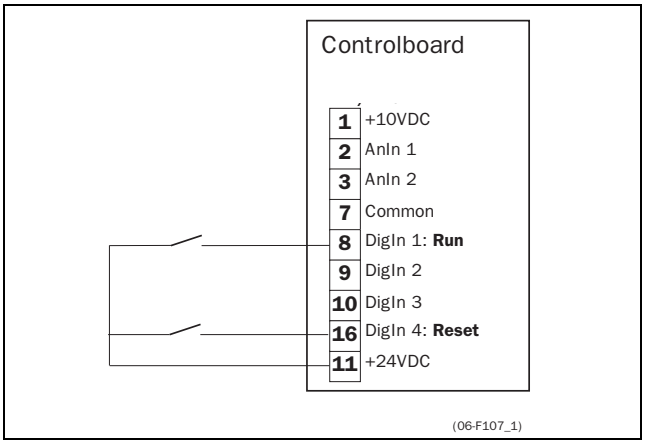


Fig. 24 Default setting Run/Reset commands.

The inputs are default set for level-control (see § 5.3.6, page 32). The input DigIn 1 is programmed for the Run command (see § 5.5.11, page 51). The rotation is determined by the rotation set according to the active Parameter Set.

4.2.2 Enable and Stop functions.

Both functions can be used separately or simultaneously. The choice of which function is to be used depends on the application and the control mode of the inputs (Level/Edge [215], see § 5.3.6, page 32).

NOTE! In the Edge mode, at least one digital input must be programmed to "stop", 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.

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

Stop

If the input is made active (LO) then the inverter will stop according to the selected stop mode set in window [31A] (see § 5.4.11, page 41).
Fig. 25 shows the function of the Enable and the Stop input and the Stop Mode=Decel[31A].
To run the input must be HI.

NOTE! The Stop Mode=Coast [31A] will give the same behaviour as the Enable input.

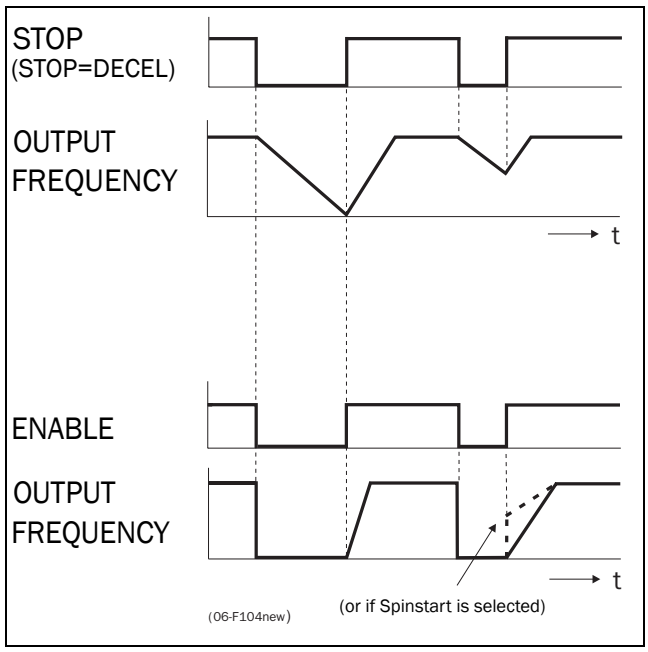


Fig. 25 Functionality of the Stop and Enable input

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 32). 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 selecting as shown in Fig. 26.

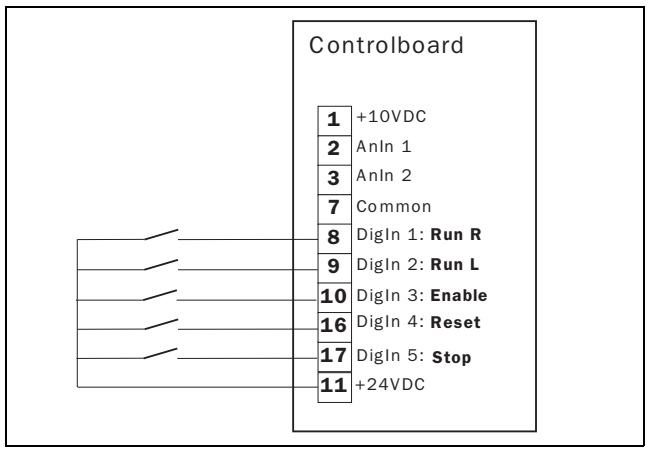


Fig. 26 Wiring example Run/Stop/Enable/Reset inputs.

The Enable input must be continuously active in order to accept any run-right or run-left command. If both RunR and RunL inputs are active, then the inverter stops according to the selected Stop Mode. Fig. 27 gives an example of a possible sequence.

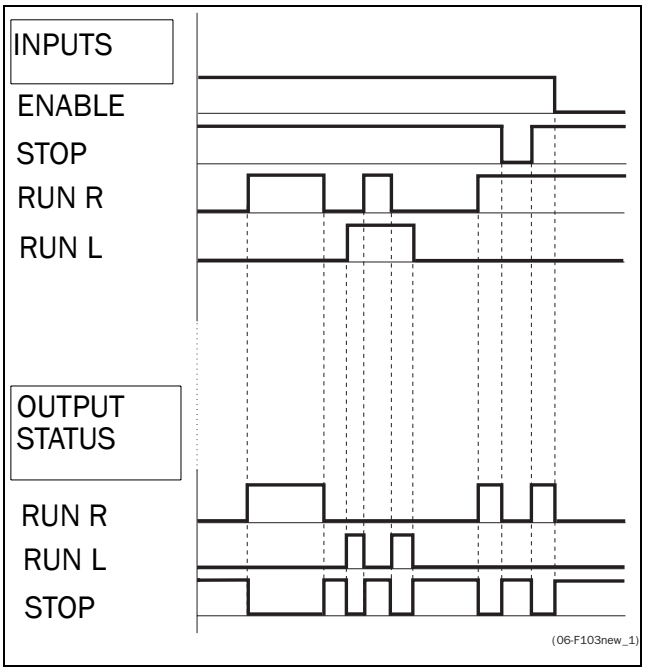


Fig. 27 Input and output status for level control.

4.2.4 Run Inputs Edge-controlled

Window 215 Level/Edge must be set to Edge to activate edge control (§ 5.3.6, page 32) 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.

See Fig. 26. The Enable and Stop input must be active continuously in order to accept any run-right or run-left command. The last edge (RunR or RunL) is valid. Fig. 28 gives an example of a possible sequence.

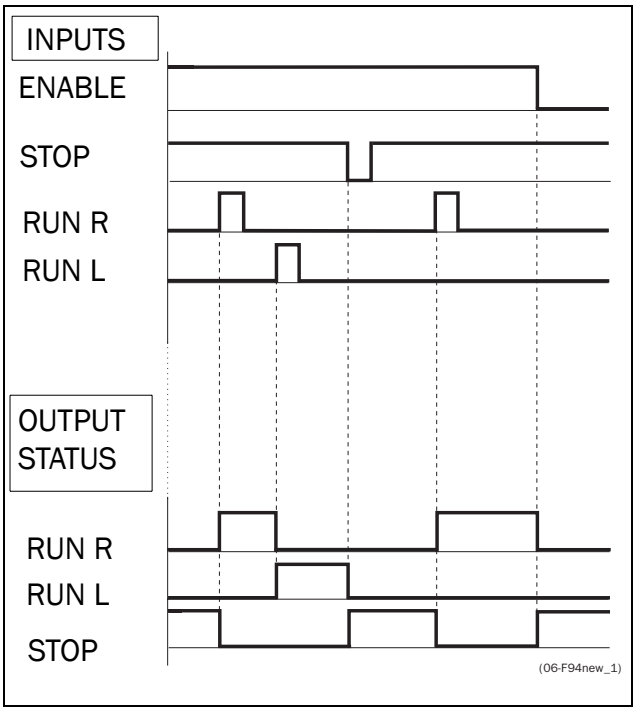


Fig. 28 Input and output status for edge control.

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, default on DigIn 4. Depending on the selected control method a restart takes place (see function Level/Edge [215] § 5.3.6, page 32):

- **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 § 5.3.27, page 35) the Autoreset functions are programmed.

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

4.2.6 Frequency Direction and Rotation.

The Frequency Direction can be controlled by:

- RunR/RunL commands on the Control Panel.
- RunR/RunL commands on the terminal strip (terminal 1-22).
- Via the serial interface options.
- The Parameter Sets

The function Rotation [214] (§ 5.3.5, page 32) and Direction [324] (§ 5.4.17, page 43) set the limitations and priorities to the Frequency Direction of the inverter.

- **Overall limitation with function Rotation [214].**
  This function limits the overall Frequency Direction to either Left or Right direction or allows both directions. This limit is prior to all other selections. E.g.: if the rotation is limited to Right, a Run-Left command will be ignored.
- **Selection per Parameter Set with function Direction [324].**
  This function sets the Frequency Direction for the external RUN command (set to a Digital Input) in each Parameter Set. The RunL and RunR commands will always overrule this setting.

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 Frequency, Max 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. 29 shows the way the Parameter Sets are activated via the digital inputs DigIn 3 and DigIn 4.

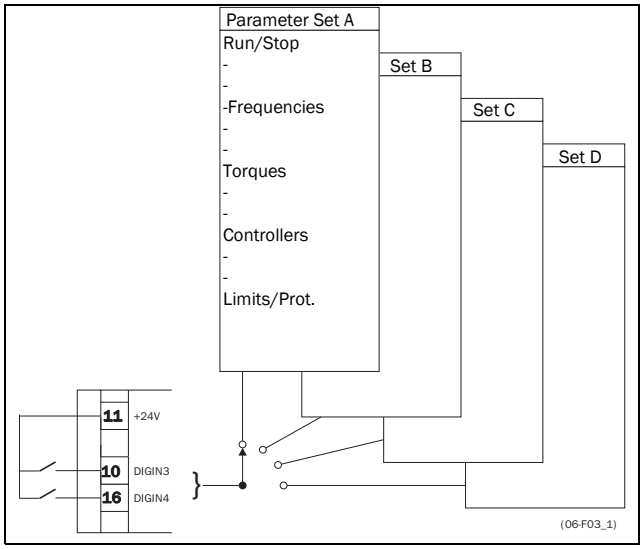


Fig. 29 Selecting the Parameter Sets.

The Parameter Set selection is done with function Select Set [234] (See § 5.3.21, page 34). 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 § 5.3.20, page 34) it is easy to copy the complete contents 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 on-line, 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 frequency selection.**
  Within a single Parameter Set the 7 preset frequency are selectable via the digital inputs. In combination with the Parameter Sets, 28 preset frequencies can be selected using all 4 digital inputs DigIn1 and 2 for selecting preset frequency 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 frequencies, when the machine needs to be set up. The 4th Parameter Set can be used for "normal" analogue frequency 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 Frequency 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 MotPot	[312]
Acc time> Min Freq	[313]
Acc ramp type	[314]
Deceleration time	[315]
Dec MotPot	[316]
Dec time < Min Freq	[317]
Dec ramp type	[318]
Start Mode	[319]
Stop Mode	[31A]
Spinstart	[31B]
Frequency [320]	
Minimum Frequency	[321]
Maximum Frequency	[322]
Minimum Frequency Mode	[323]
Direction	[324]
Mot Pot function	[325]
Preset Frequency 1	[326]
Preset Frequency 2	[327]
Preset Frequency 3	[328]
Preset Frequency 4	[329]
Preset Frequency 5	[32A]
Preset Frequency 6	[32B]
Preset Frequency 7	[32C]
Skip Frequency 1 Low	[32D]
Skip Frequency 1 High	[32E]
Skip Frequency 2 Low	[32F]
Skip Frequency 2 High	[32G]
Jog Frequency	[32H]
Torque [330]	
Torque Limit	[331]
Maximum Torque	[332]
Controllers [340]	
Flux Optimization	[341]
Sound Char	[342]
PID Controller	[343]
PID P Gain	[344]
PID I Time	[345]
PID D Time	[346]
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 ECP (External Control Panel, see § 7.2, page 73).

The memory banks can also be used as an 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 § 5.3.23, page 35 and § 5.3.26, page 35.
- **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 § 5.3.25, page 35 and § 5.4, page 40.

Fig. 30 and Fig. 31 show the options for copying and locating the settings to and from the memories.

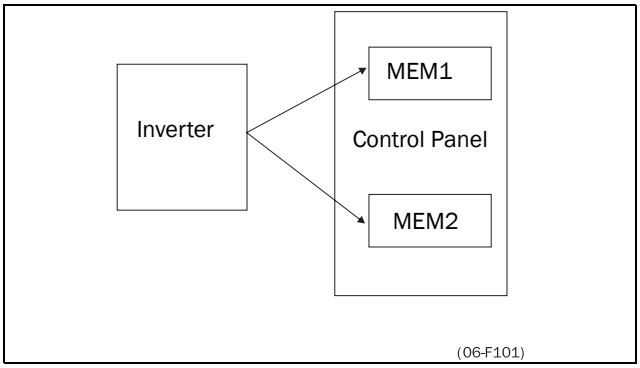


Fig. 30 Copy: - Complete Set-up

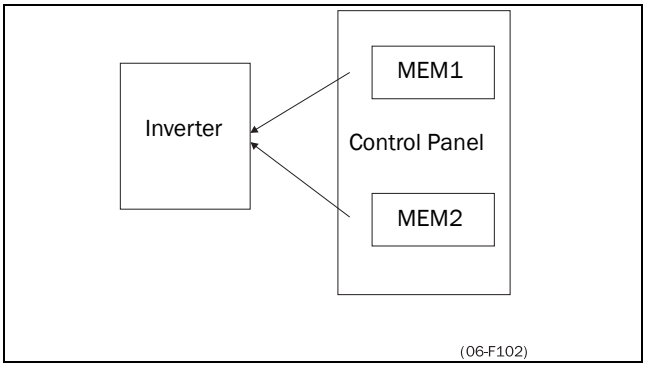


Fig. 31 Load: - Complete Set-up
- All Parameter Sets
- Active Parameter Set

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

5.1 Resolution of settings

The resolution for all range settings as described in this chapter are 3 significant digits. Exceptions are stated. Table 15 shows the resolutions for 3 and 4 significant digits.

Table 14 Resolutions of settings

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

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 frequency 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. 32 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.

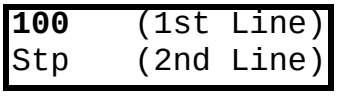


Fig. 32 Display functions.

5.2.1 1st Line [110]

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

	110 1st Line Stp Frequency *
Default:	Frequency
Selection:	Frequency, Load, El Power, Current, Output Voltage, DC Voltage, Temperature, FI Status, Process Speed
Frequency	See window 610 § 5.7.1, page 56
Load	See window 620 § 5.7.2, page 56
El Power	See window 630 § 5.7.3, page 56
Current	See window 640 § 5.7.4, page 56
Output Voltage	See window 650 § 5.7.5, page 56
DC Voltage	See window 660 § 5.7.6, page 57
Temperature	See window 670 § 5.7.7, page 57
FI Status	See window 680 § 5.7.8, page 57
Process Speed	See window 6E0 § 5.7.16, page 58

5.2.2 2nd Line [120]

Same function as 1st Line [110].

	120 2nd Line Stp Current *
Default:	Current
Selection:	Frequency, Load, El Power, Current, Output Voltage, 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 V/Hz mode, Reference Control, Run/Stop Control.

5.3.2 V/Hz Curve [211]

Setting of the V/Hz curve. Fig. 33 shows the difference between to 2 selections.

	211 V/Hz curve Stp **Linear** *
Default:	Linear
Selection:	Linear, Square
Linear	The V/Hz ratio is constant over the whole frequency range, giving the nominal magnetic field to the motor. The inverter is able to give nominal field over the full frequency range 0 to 50Hz. The 50Hz is automatically set by the motor data (see § 5.3.10, page 33). This curve is suitable for all applications.
Square	The square curve lowers the V/Hz ratio in the lower load area and thus the magnetic field in the motor. This reduces the motor losses and the extra modulation noise of the motor. This curve is suitable for applications with a quadratic load curve. In general these are centrifugal pumps and fans.

NOTE! Be sure the application is designed to be used at a low V/Hz ratio. If not the inverter can trip on Overload or Overcurrent trips due to low voltage on the motor. (See chapter 6. page 68).

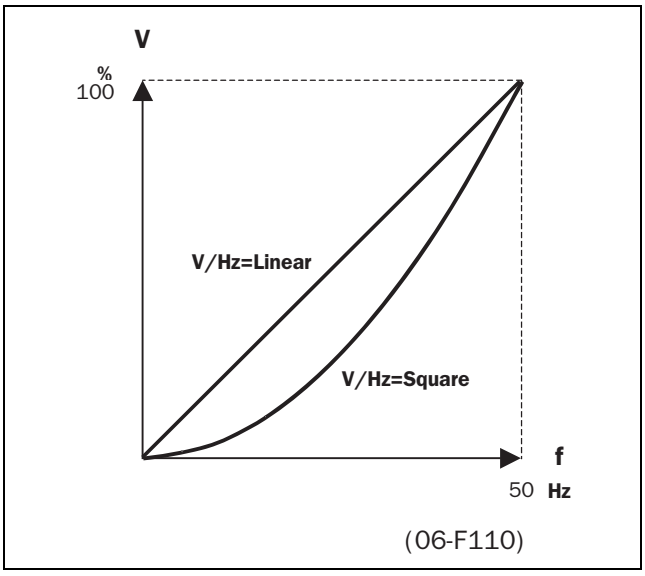


Fig. 33 V/Hz curves

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 2, Comm/DigIn 2, Comm/RemDI2, Option
Remote	The reference signal comes from the analogue inputs of the terminal strip (terminal 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 56). 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 36)
Rem/ DigIn 2	The reference signal is selectable using DigIn 2. See Fig. 34. DigIn2=High:Ref via Keys DigIn2=Low:Ref via Remote
Comm/ DigIn 2	The reference signal is selectable with DigIn 2. See Fig. 35 DigIn2=High:Ref via Keys DigIn2=Low:Ref via Communication
Comm/ Rem DI2	The reference signal is selectable with DigIn 2. DigIn2=High:Ref via Remote DigIn2=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 72.

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

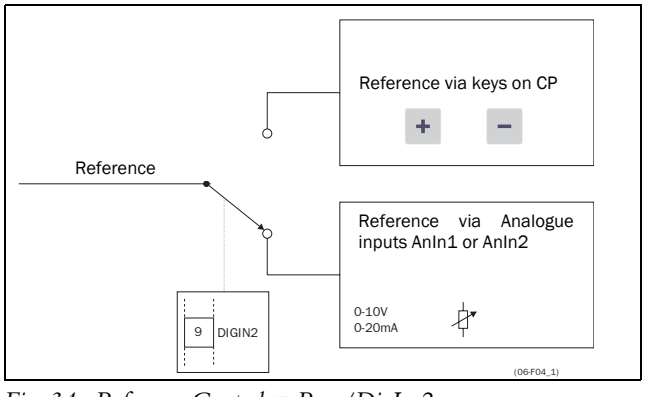


Fig. 34 Reference Control = Rem/DigIn 2.

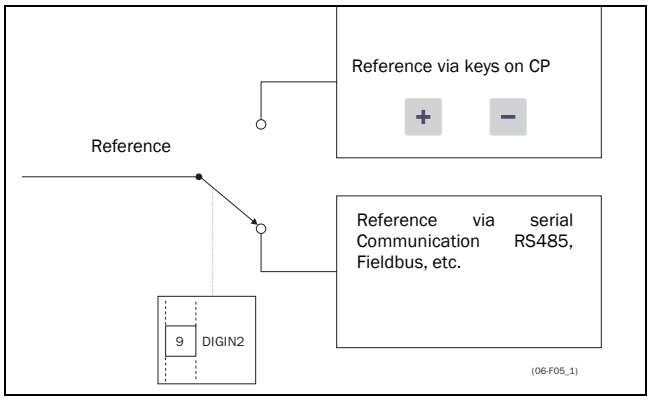


Fig. 35 Reference Control =Comm/DigIn 2.

NOTE! The programmable input DigIn 2 will not be programmable from the I/O menu [400] when "Rem/DigIn 2" Or "Comm/DigIn 2" has been selected. (See § 5.5, page 49).

NOTE! The functions "Rem/DigIn 2" and "Comm/DigIn 2" can be used to make a local/remote control. See also § 5.3.4, page 31 and § 5.5.2, page 49.

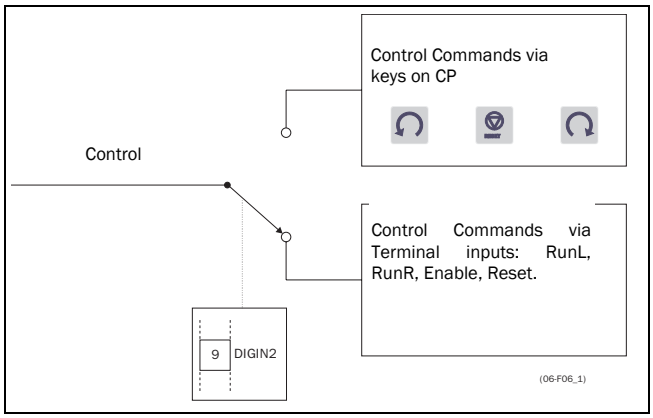


Fig. 36 Run/stp Control = Rem/DigIn 2.

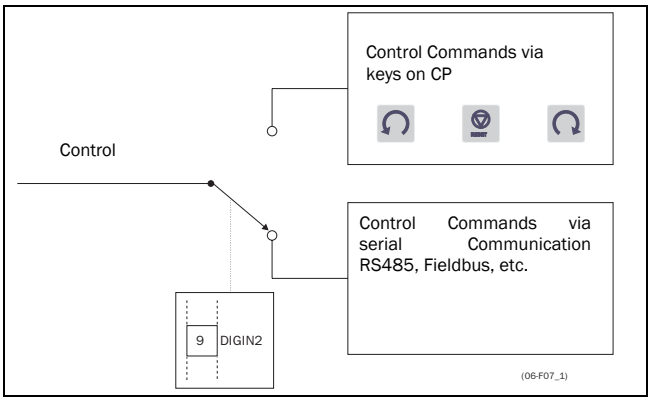


Fig. 37 Run/Stp Control =Comm/DigIn 2.

5.3.4 Run/Stop/Reset control [213]

Selection of the source for run, stop and reset commands. See § 4.2, page 25 for the functional description.

	213 Run/Stp Ctrl Stp **Remote**
Default:	Remote
Selection	Remote, Keyboard, Comm, Rem/DigIn 2, Comm/DigIn 2, Comm/RemDI2, Option
Remote	The commands come from the inputs of the terminal strip (terminal 1-22)
Keyboard	The commands come from the command keys of the Control Panel. See § 4.1.4, page 22.
Comm	The commands come from the serial communication (RS 485, Fieldbus, see § 5.3.30, page 36).
Rem/ DigIn 2	With DigIn2 the commands are selectable between remote and the keyboard. See Fig. 36. DigIn2=High:Control via Keys DigIn2=Low:Control via Remote
Comm/ DigIn 2	With DigIn2 the commands are selectable between comm and the keyboard. See Fig. 37. DigIn2=High: Control via Keys DigIn2=Low: Control via serial communication
Comm/ Rem DI2	With DigIn2 the commands are selectable between comm and remote. DigIn2=High: Control via Remote DigIn2=Low: Control via serial 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 72.

NOTE! The programmable input DigIn 2 will not be programmable from the I/O menu [400] when "Rem/DigIn 2" or "Comm/DigIn 2" has been selected. (see § 5.5.11, page 51).

NOTE! The functions "Rem/DigIn 2" and "Comm/DigIn 2" can be used to make a local/remote control (see § 5.3.3, page 30).

5.3.5 Rotation [214]

Sets the general rotation for the motor. See also § 4.2.6, page 27.

	214 Rotation Stp R+L
Default:	R + L
Selection:	R+L, R, L
R+L	Both frequency directions allowed.
R	Frequency direction is limited to right direction (clockwise). The input and key RunL are disabled.
L	Frequency direction is limited to left direction (counter-clockwise). The input and key RunR are disabled.

NOTE! If the functions "R" or "L" are selected the window Direction [324] invisible.

5.3.6 Level/Edge control [215]

Sets the way of input control for the inputs RunR and RunL. See also § 4.2, page 25 for the functional description.

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

5.3.7 IxR Compensation [216]

Compensates the voltage drop over the stator resistance of the motor by increasing the output voltage at constant frequency. IxR Compensation is most important at low frequencies and is used to obtain a higher starting torque. The maximum voltage increase is 25% of the nominal output voltage. See Fig. 38.

The IxR Compensation can be used in combination with Linear V/Hz curve as well as with Square V/Hz curves although the combination with Square V/Hz curves has little use. See Fig. 39.

	216 IxR Comp Stp 0.0% *
Default:	0.0%
Range:	0-25% x U_{NOM}
Resolution	0.1%

NOTE! A too high level of IxR Compensation could cause saturation of the windings in the motor. This can cause a "Power Fault" trip. The effect of IxR Compensation is stronger with higher power motors.

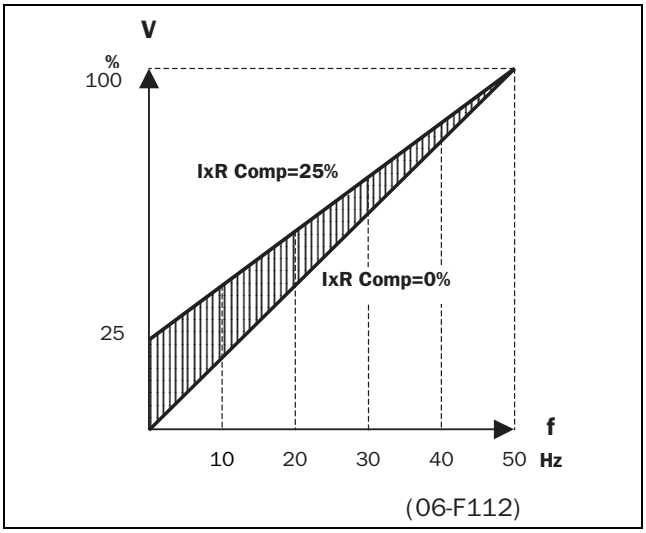


Fig. 38 IxR Comp at Linear V/Hz curve

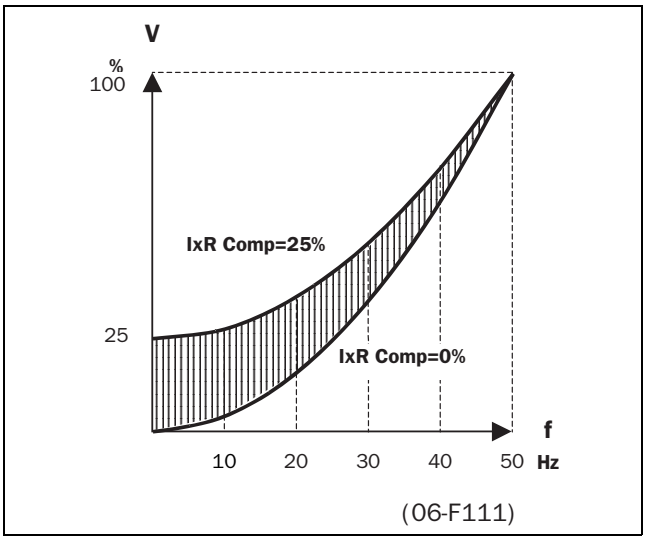


Fig. 39 IxR Comp at Square V/Hz curve

5.3.8 Mains [217]

To select 230V mains voltage input for the inverter.

NOTE! Only to be selected if 230V main supply is used. This window is only visible in FDU 40 inverters.

	217 Mains Stp 400V
Default:	400V
Selection:	230V, 400V

5.3.9 Motor data [220]

Submenus to set the motor data. 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 (§ 5.3.22, page 35).

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

5.3.10 Motor power [221]

Setting of the nominal motor power

	221 Motor Power Stp (P$_{NOM}$)kW
Default:	P$_{nom}$ (see note§ 5.3.9, page 33)
Range:	1W-120% x P$_{nom}$
Resolution	2 significant digits for values <100

P$_{nom}$ is the nominal inverter power.

5.3.11 Motor voltage [222]

Setting of the nominal motor voltage.

	222 Motor Volts Stp U$_{NOM}$VAC
Default:	400V for FDU40 500V for FDU50 690V for FDU69
Range:	100-800V
Resolution	1V

5.3.12 Motor frequency [223]

Setting of the nominal motor frequency.

	223 Motor Freq Stp 50Hz
Default:	50Hz
Range:	24-400Hz
Resolution	1Hz

5.3.13 Motor current [224]

Setting of the nominal motor current.

	224 Motor Curr Stp (I$_{NOM}$)A
Default:	I$_{NOM}$ (see note§ 5.3.9, page 33)
Range:	25 - 120% x I$_{NOM}$

I$_{nom}$ is the nominal inverter current.

5.3.14 Motor Speed [225]

Setting of the nominal Motor Speed.

	225 Motor Speed Stp (n$_{MOT}$)rpm
Default:	n$_{MOT}$(see note§ 5.3.9, page 33)
Range:	400 -24000 rpm
Resolution	1 rpm

5.3.15 Motor cos PHI [226]

Setting of the nominal Motor cosphi (power factor).

	226 Motor Cosphi Stp
Default:	(see note§ 5.3.9, page 33)
Range:	0.50 - 1.00

5.3.16 Actual pole number [229]

If the motor speed is set to a value which complies to a pole number > 12 a new window [229] appears automatically. In this window the actual pole number can be set. Due to little margins in the pole number calculation it could be possible that the inverter calculates a wrong pole number if this is not set.

	229 Poles Stp
Default:	no default value
Range:	14-144

5.3.17 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.

5.3.18 Language [231]

Selection of the language of the LCD Display. The language selection is not affected by the Load Default command (see § 5.3.22, page 35)

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

5.3.19 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.

5.3.20 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 27.

	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

5.3.21 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 27 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 27 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 27 for the selection table.
Comm	Selection of the Parameter Set via serial communication. (RS 485, fieldbus, see § 5.3.30, page 36)

The active set can be viewed with function 680 FI status. (See § 5.7.8, page 57).

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.

5.3.22 Default values [235]

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

235 Load Default Stp A	
Default:	A
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".

5.3.23 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 28).

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

5.3.24 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 28).

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

5.3.25 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

5.3.26 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 28).

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

5.3.27 Autoreset [240]

The Autoreset must be enabled first by making the Autoreset input continuously high. See § 4.2.5, page 26. With function Number of trips [241] the Autoreset is activated. Select from window [242] to [24E] the relevant Trip condition for the Autoreset.

5.3.28 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 60 and § 6.2, page 69. If the Autoreset is full then the inverter must be reset by a normal Reset.

Example:

- Autoreset = 5
- Within 10 minutes 6 trips occur
- At the 6th Trip there is no Autoreset, because the Autoreset Trip Log contains 5 trips already.
- To reset, apply a normal reset: input High to Low and High again to maintain the Autoreset function. The counter is reset.

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

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

5.3.29 Selection of Autoreset trips

The windows [242] to [24E] 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
24D Undervoltage	Off
24E Comm Error	Off

5.3.30 Option: Serial communication [250]

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

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

252 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.	

253 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 68.
Warning	If there is no communication for longer than 15 seconds the inverter will give a warning. See chapter 6. page 68.
Off	No interrupt safe guard active.

5.3.31 PTC [260]

Settings of the PTC input. Fig. 40 shows the connection of the PTC input. The motor thermistors (PTC) must comply to DIN 44081/44082. The specification of the input:

Table 15 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%

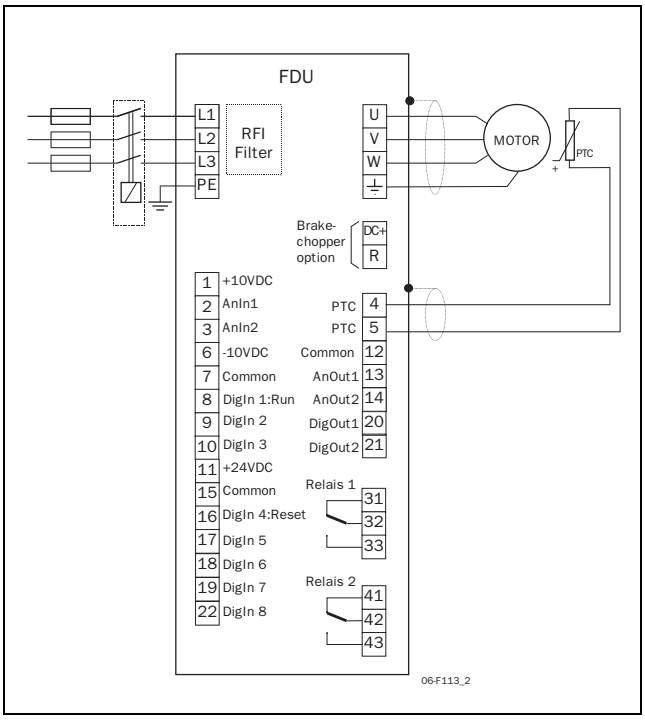


Fig. 40 Connection of the motor thermistor (PTC).

5.3.32 PTC [261]

To enable or disable the PTC input.

	261 PTC Stp Off *
Default:	Off
Selection:	Off, On
Off	PTC input disabled
On	PTC input enabled

NOTE! The jumpers S5 and S6 must be in the position according to Table 7.

5.3.33 Macros [270]

Macro's pre set a selected number of windows, so only small adjustment are needed to set up the inverter for a particular application. The Macro's will mainly pre set Input and Output selections. After selecting a Macro all Windows still can be changed.

NOTE! When a macro is selected, only the used parameters are changed. Previous settings, manually or via macro´s, are not changed. The description of the macro´s in this user manual is based on the default settings of the inverter.

5.3.34 Select Macro [271]

When the selecting a Macro, the message "Sure?" must be confirmed by "Yes" to activate the selected Macro.

	271 Select macro Stp Loc/Rem Ana *
Default:	Loc/Rem/Ana
Selection:	Loc/Rem Ana, Loc/Rem Comm, PID, Preset, MotPot, Pump/Fan

Loc/Rem Ana

Local/Remote control with analogue signal:
- DigIn 2 selects between:
  - Run/Stop control via the Control Panel
  - Remote Run/Stop control.
- DigIn 3 selects between:
  - Analogue Input 1 (4-20mA)
  - Analogue input 2 (0-10V)

By operating DigIn2 and 3 simultaneously, a switch-over is made between:

Local (both HI) Run/Stop/Reset via Control Panel
Reference via AnIn2 (0-10V for potentiometer)

or

Remote (both LO) Run/Stop/Reset via User Interface
Reference via AnIn1 (4-20mA)

The following settings are made:

Table 16 Macro Loc/Rem Ana

Window	Selection/Range
212 Ref Control	Remote
213 Run/Stop Control	Rem/DigIn 2
411 AnIn 1 Funct	Frequency
412 AnIn 1 Setup	2-10V/4-20mA
415 AnIn 2 Funct	Frequency
416 AnIn 2 Setup	0-10V/0-20mA
423 DigIn 3	AnIn Select

NOTE! Jumper S3 must be set for "current". See § 3.10, page 19. See Fig. 41 for a connection example.

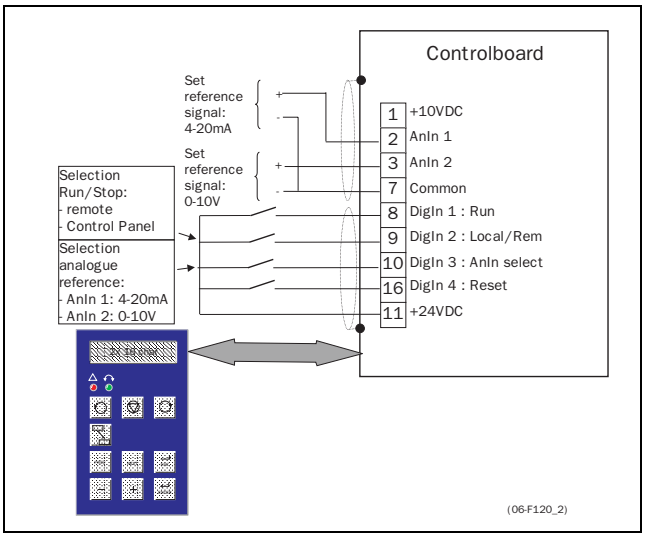


Fig. 41 Local / Remote Ana macro

Loc/Rem Comm

Local/Remote control with serial communication.:

NOTE! A serial communication option must be connected and set:

- DigIn 2 selects between:
  - Run/Stop control with reference (+,- keys) both via the Control Panel
  - Remote Run/Stop control with remote analogue reference via the serial option.

The following settings are made:

Table 17 Macro Loc/Rem Comm

Window	Selection/Range
212 Ref Control	Comm/DigIn 2
213 Run/Stop Control	Comm/DigIn 2
411 AnIn1 Funct	Off
415 AnIn2 Funct	Frequency
416 AnIn2 Setup	0-10V/0-20mA

See Fig. 42 for a connection example.

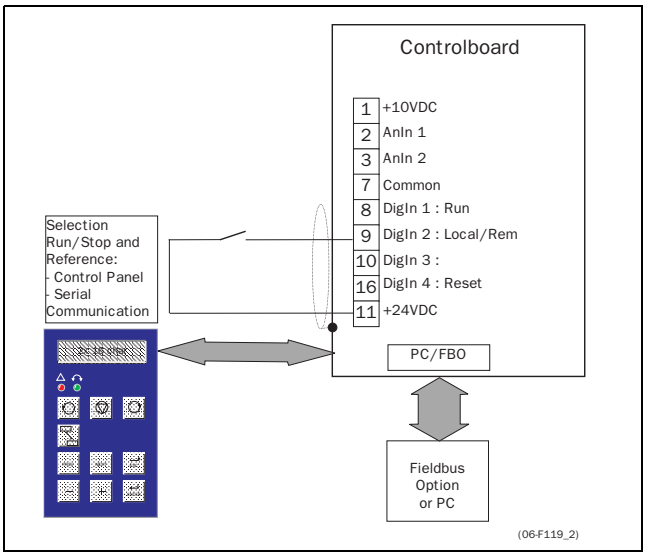


Fig. 42 Local/Remote Comm macro

PID

Setup for PID operation:

- Analogue reference is on AnIn 1(0-10V)
- Feedback reference is on AnIn 2 (0-10V)
- Run /Stop control is remote.

The following settings are made:

Table 18 Macro PID

Window	Selection/Range
212 Ref Control	Remote
213 Run/Stop Control	Remote
343 PID Control	On
411 AnIn 1 Funct	PID control
412 AnIn1 Setup	0-10V/0-20mA
416 AnIn2 Setup	0-10V/0-20mA

See Fig. 43 for a connection example.

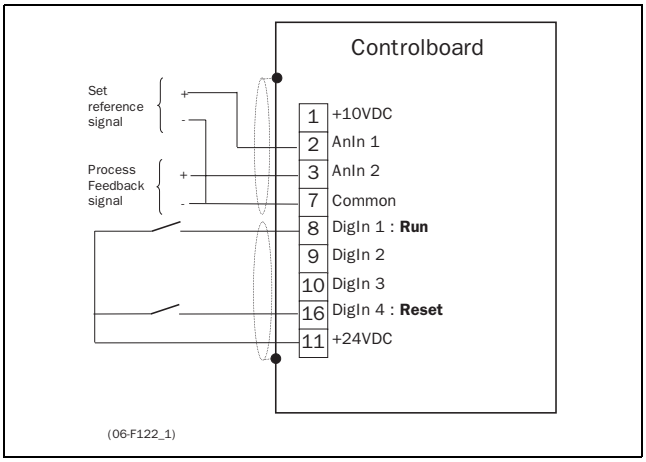


Fig. 43 PID Macro

Preset Frequency

Selecting 3 preset frequencies with digital inputs DigIn 2 and DigIn 3.:

- DigIn 2 and 3 selects the preset frequencies according to the truth table:

DigIn 3	DigIn 2	Preset
LO	LO	No preset
LO	HI	Preset 1
HI	LO	Preset 2
HI	HI	Preset 3

The following settings are made:

Table 19 Macro Preset Frequency

Window	Selection/Range
212 Ref Control	Remote
213 Run/Stop Control	Remote
411 AnIn 1 Funct	Off
422 DigIn 2	Pres Ref 1
423 DigIn 3	Pres Ref 2

See Fig. 44 for a connection example.

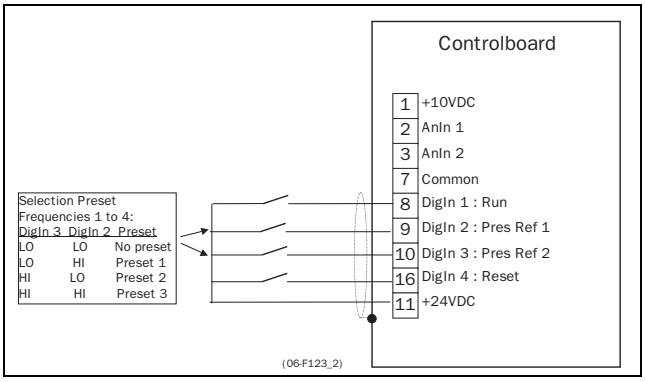


Fig. 44 Preset Frequency

MotPot

Local/Remote control with the Motor Potentiometer function:

- DigIn 2 selects between:
  - Run/Stop control with Analogue reference (+,- keys) both via the Control Panel.
  - Remote Run/Stop control with remote reference MotPot function on DigIn 5 and DigIn 6.

The following settings are made:

Table 20 Macro MotPot

Window	Selection/Range
212 Ref Control	Rem/DigIn 2
213 Run/Stop Control	Rem/DigIn 2
425 DigIn 5	MotPot Up
426 DigIn 6	MotPot Down

See Fig. 45 for a connection example.

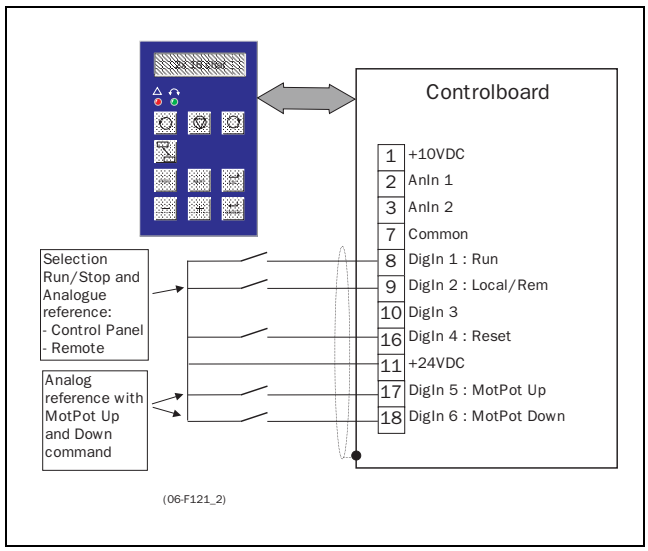


Fig. 45 MotPot macro

Pump/Fan

Applying this macro will set the most important Pump control functions according to the table below:

Table 21 Macro Pump/Fan

Window	Selection/Range
212 Ref Control	Remote
213 Run/Stop Control	Remote
214 Rotation	R
281 Pump control	On
343 PID Control	On (for all four parameter sets)
411 AnIn 1 Function	Frequency If the window 343 is On, “PID Control” is displayed
412 AnIn 1 Setup	0-10V/0-20mA
416 AnIn 2 Setup	0-10V/0-20mA

See the Pump Option instruction manual for more information about using the Macro function.

5.3.35 Pump Control [280]

Settings for the Pump Control option. See and the Pump Control instruction manual.

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 to 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 § 5.7.8, page 57). See for further explanation § 4.3, page 27.

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 nominal motor frequency.

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:	0.50 - 3600s

Fig. 46 shows the relationship between nominal motor frequency/Max Frequency and the Acceleration Time. The same is valid for the Deceleration Time.

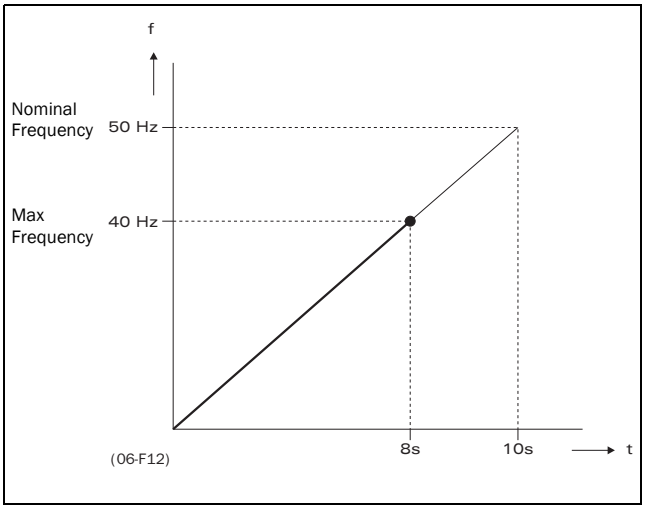


Fig. 46 Acceleration time and maximum frequency.

Fig. 47 shows the settings of the Acceleration and Deceleration Times with respect to the nominal motor frequency.

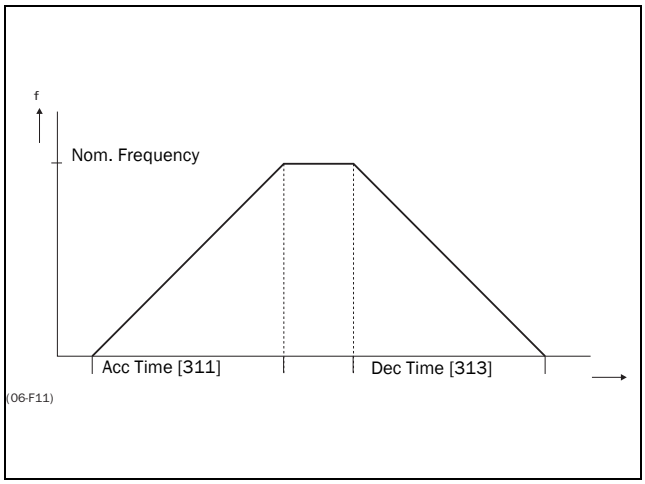


Fig. 47 Acceleration and deceleration times.

5.4.3 Acceleration time for MotPot [312]

If the MotPot function is selected, this is the acceleration time for the MotPot Up command. See § 5.5.11, page 51.

	312 Acc MotPot Stp **16.00s** *
Default:	16.00
Range:	0.50-3600s

5.4.4 Acceleration time to Min. Frequency [313]

If a Minimum frequency is programmed this is acceleration time from 0Hz to the Minimum Frequency at a Run command.

	313 Acc>Min Freq Stp **2.00s** *
Default:	2.00s (10.0s for size 4 and up)
Range:	0.50-3600s

5.4.5 Acceleration ramp type [314]

Sets the type of all the acceleration ramps. See Fig. 48.

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

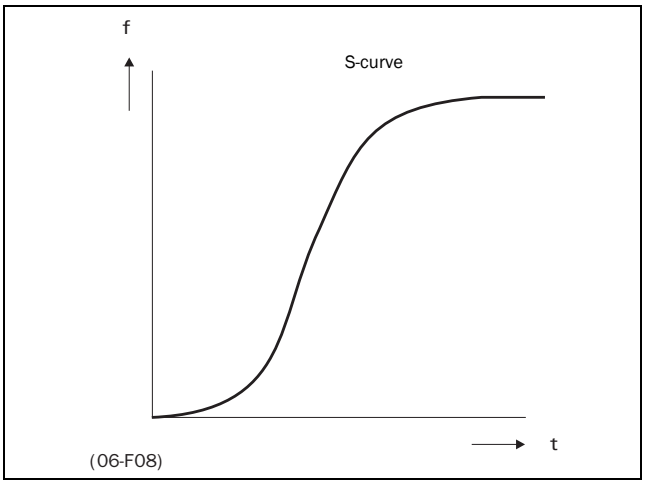


Fig. 48 S-curve acceleration ramp.

5.4.6 Deceleration time [315]

The deceleration time is defined as the time it takes to go from nominal motor frequency to 0Hz.

	315 Dec Time Stp **A: 2.00s** *
Default:	2.00s (10.0s for size 4 and up)
Range:	0.50 - 3600s

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

5.4.7 Deceleration time for MotPot [316]

If the MotPot function is selected, this is the deceleration time for the MotPot Down command. See § 5.5.11, page 51.

	316 Dec MotPot Stp **16.00s** *
Default:	16.00s
Range:	0.50-3600s

5.4.8 Deceleration time to Min. Frequency [317]

If a Minimum frequency is programmed this is deceleration time from the Minimum Frequency to 0Hz at a Stop command.

	317 Dec<Min Freq Stp **2.00s** *
Default:	2.00s (10.0s for size 4 and up)
Range:	0.50-3600s

5.4.9 Deceleration ramp type [318]

Sets the type of all the acceleration ramps Fig. 49.

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

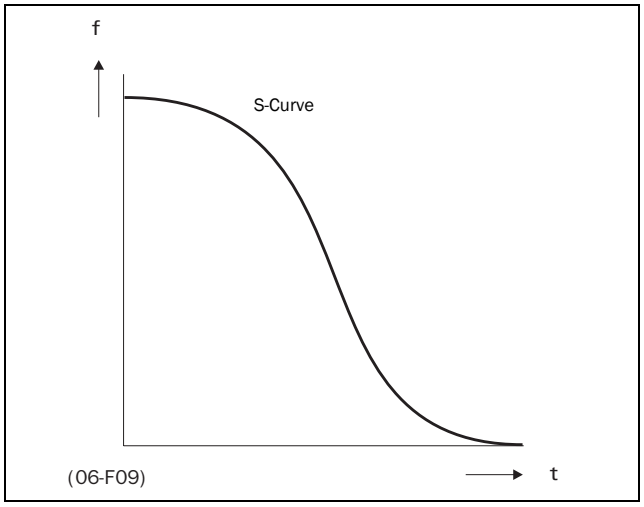


Fig. 49 S-curve deceleration ramp.

5.4.10 Start Mode [319]

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

	319 Start Mode Stp **A: Fast** *
Default:	Fast
Selection:	Fast (fixed setting)
Fast	The motor flux increases gradually. The motor starts rotating immediately after the Run command is given.

5.4.11 Stop Mode [31A]

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

	31A Stop Mode Stp **A: Decel** *
Default:	Decel
Selection:	Decel, Coast
Decel	The motor decelerates to 0Hz according to the set deceleration time.
Coast	The motor freewheels naturally to 0Hz.

5.4.12 Spinstart [31B]

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

	31B 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.

5.4.13 Frequencies [320]

Submenu with all settings regarding to frequencies, as Min/Max frequencies, Jog frequencies, Preset frequencies, Skip frequencies.

5.4.14 Minimum Frequency [321]

Sets the Minimum Frequency. See the function Min Frq Mode § 5.4.16, page 42 for the behaviour at Minimum Frequency. The Minimum Frequency will operate as an absolute lower limit.

	321 Min Freq Stp **A:** **0Hz** *
Default:	0 Hz
Range:	0 - Max Frequency

NOTE! The Jog function and the Preset Frequencies ignore the Minimum Frequency setting. See also § 5.4.25, page 45, § 5.5.11, page 51 and § 5.4.19, page 43.

5.4.15 Maximum Frequency [322]

Sets the maximum frequency at 10V/20mA, unless a user defined characteristic of the analogue input is programmed (see § 5.5.4, page 50, § 5.5.5, page 50, § 5.5.8, page 51 and § 5.5.9, page 51). The nominal motor frequency is determined by the parameter Motor frequency [225] (see § 5.3.14, page 33). The Maximum Frequency will operate as an absolute maximum limit.

	322 Max Freq Stp **A:** **f_{MOT}Hz** *
Default:	f_{MOT}
Range:	Min Freq - 2x f_{MOT}

NOTE! It is not possible to set the Max frequency lower than the Minimum frequency.

5.4.16 Min Freq Mode [323]

To select the behaviour of the inverter at minimum frequency.

	323 Min Frq Mode Stp **A:** **Scale** *
Default:	Scale
Range:	Scale, Limit, Stop
Scale	Minimum Frequency = Zero reference. See Fig. 50.
Limit	Minimum Frequency = Zero reference, but with a dead band according to Fig. 51.
Stop	The inverter will ramp to zero frequency when the frequency reference is lower than the minimum frequency. If the reference signal comes back it will ramp up again. See Fig. 52.

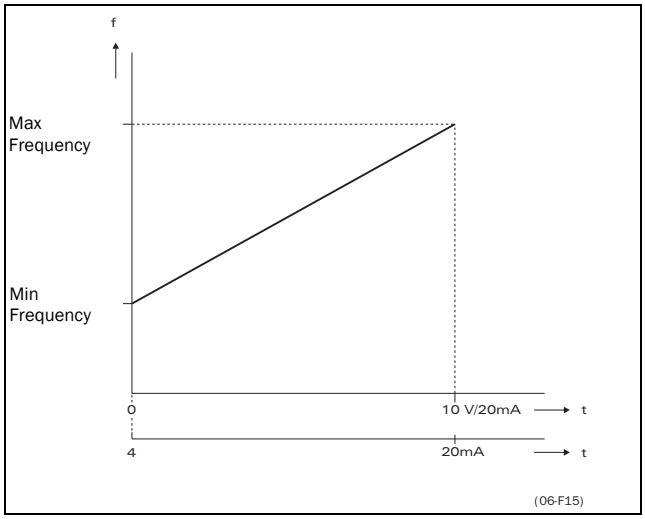


Fig. 50 Min Frq Mode = Scale.

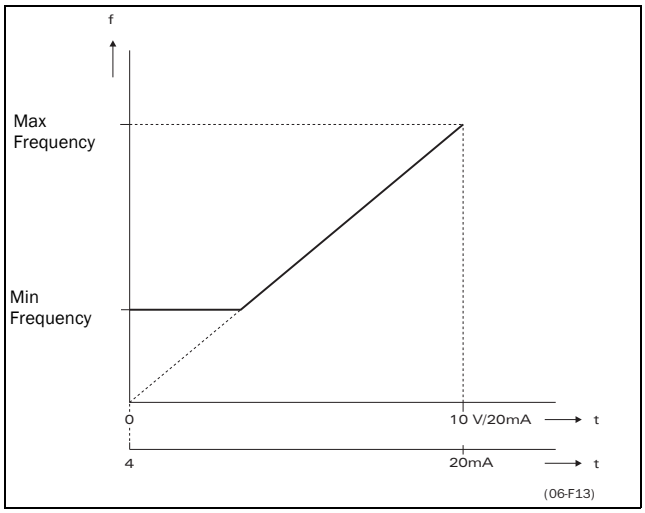


Fig. 51 Min Frq Mode = Limit.

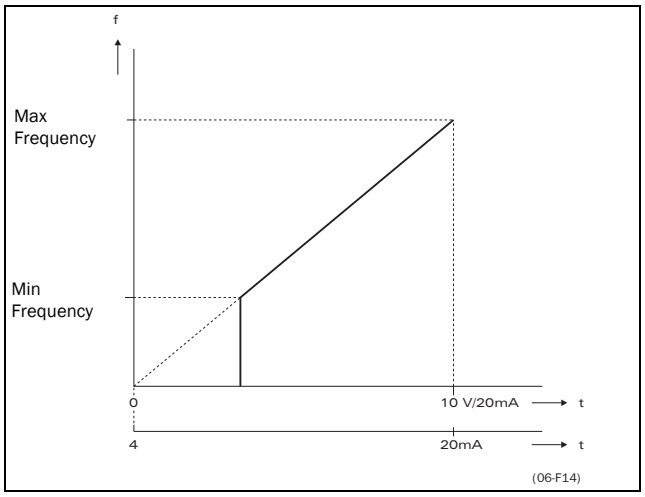


Fig. 52 Min Frq Mode = Stop.

5.4.17 Frequency Direction [324]

Sets the rotation for the active Parameter Set. See § 4.2.6, page 27.

	324 Direction Stp **A:** **R**
Default:	R
Range:	R, L
R	Direction is set to right direction (clockwise).
L	Direction is set to left direction (counter-clockwise).

NOTE! This window is only visible if Rotation=R+L (see § 5.3.5, page 32).

This function is only useful when a RUN command is set to one of the Digital inputs. The RunL and RunR commands will always overrule this setting.

5.4.18 Motor Potentiometer [325]

Sets the properties of the Motor Potentiometer function. See the parameter DigIn1 [421] § 5.5.11, page 51 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 frequency at the moment of the stop will be memorized. After a new start command the output frequency will resume to this saved value.
Volatile	After a stop, trip or power down, the inverter will start always from zero frequency (or minimum frequency, if selected).

5.4.19 Preset Frequency 1 [326] to Preset Frequency 7 [32C]

Preset Frequencies are activated by the digital inputs, see § 5.5.11, page 51 - § 5.5.14, page 52. 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 frequencies can be activated per Parameter Set. Using all the Parameter Sets, up to 28 preset frequencies are possible. (see § 4.3, page 27).

	326 Preset Frq 1 Stp **A:** **10Hz** *
Default:	10Hz
Range:	0 - Max Frequency

The same settings are valid for the windows:
[327 Preset Freq 2], with default 20Hz
[328 Preset Freq 3], with default 30Hz
[329 Preset Freq 4], with default 35Hz
[32A Preset Freq 5], with default 40Hz
[32B Preset Freq 6], with default 45Hz
[32C Preset Freq 7], with default 50Hz
The selection of the presets is according to Table 22.

Table 22 Preset

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

1)= selected if only one Preset Ref is active
1 = active input
0 = non active input

Preset Frequencies have priority over the analogue inputs.

NOTE! If only preset Ref 4 is active, then the Preset Freq 4 can be selected. If Preset Ref 2 and 4 are active, then the Preset Frequencies 2, 4 and 6 can be selected.

5.4.20 Skip Frequency 1 Low [32D]

Within the range Skip Freq high to low the output frequency cannot be constant to avoid mechanical resonance in the drive system.

When Skip Frequency Low ≤ Ref Frequency ≤ Skip Frequency High, then Output Frequency=Skip Frequency HI during dec and Output Frequency=Skip Frequency LO during acc. Fig. 53 shows the function of Skip Frequency Hi and Low.

Between Skip Frequency HI and LO, the frequency changes with the set acceleration and deceleration times.

	32D Skipfrq 1 LO Stp **A: 0.0Hz** *
Default:	0.0 Hz
Range:	0 - f_{MAX}

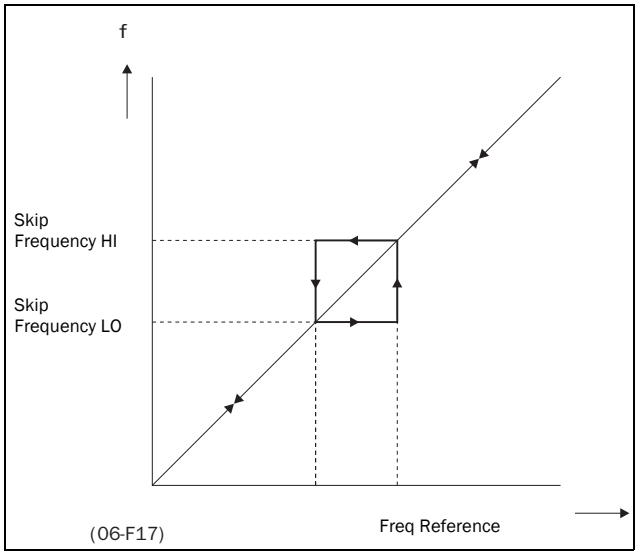


Fig. 53 Skip Frequency.

NOTE! The 2 Skip Frequency ranges may be overlapped.

5.4.21 Skip Frequency 1 High[32E]

See § 5.4.20, page 44.

	32E Skipfrq 1 HI Stp **A: 0.0Hz** *
Default:	0.0 Hz
Range:	0 - f_{MAX}

5.4.22 Skip Frequency 2 Low [32F]

See § 5.4.20, page 44.

	32F Skipfrq 2 LO Stp **A: 0.0Hz** *
Default:	0.0 Hz
Range:	0 - f_{MAX}

5.4.23 Skip Frequency 2 High [32G]

See § 5.4.20, page 44.

	32G Skipfrq 2 HI Stp **A: 0.0Hz** *
Default:	0.0 Hz
Range:	0 - f_{MAX}

5.4.24 Jog Frequency [32H]

The Jog Frequency command is activated by one of the digital inputs, see § 5.5.11, page 51 - § 5.5.14, page 52. 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 Frequency.

Example:

If Jog Frequency = -10, this will give Run Left command at 10 Hz regardless of RunL or RunR commands. Fig. 54 shows the function of the Jog command.

	32H Jogfrequency Stp **A: 2.0Hz** *
Default:	2.0 Hz
Range:	0 - ±2x f_{MOT}

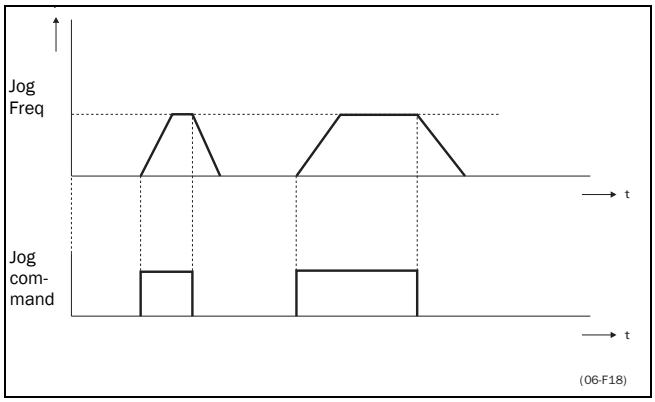


Fig. 54 Jog command.

5.4.25 Frequency priority

The active frequency 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 frequency reference.

Table 23 Frequency priority

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

5.4.26 Torque [330]

Submenu with all settings regarding to torque.

5.4.27 Torque Limit [331]

Enables the Torque limit control loop.

	331 Torque Limit Stp **A: Off** *
Default:	Off, (window 332 invisible)
Range:	Off, on

5.4.28 Maximum Torque [332]

Sets the maximum torque. This Maximum Torque operates as an upper torque limit. A Frequency Reference is always necessary to run the motor.

$$T_{MOT}(Nm) = \frac{P_{MOT}(w)x60}{n_{MOT}(rpm)x2\Pi}$$

	332 Max Torque Stp **A: 120%** *
Default:	120%
Range:	0 - 200%

NOTE! 100% Torque means: I_{NOM}= I_{MOT}. Maximum depends on setting of Motor Current and inverter max current (see § 5.3.13, page 33), but absolute maximum adjustment is 200%

5.4.29 Controllers [340]

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

5.4.30 Flux optimization [341]

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

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

The Flux Optimization automatically decreases the V/Hz ratio, depending on the actual load of the motor. Fig. 55 shows the area within the Flux Optimization is active.

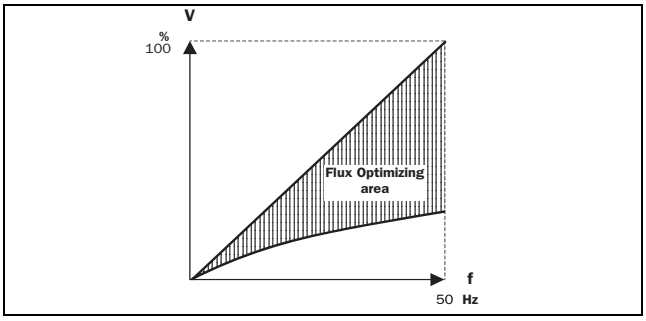


Fig. 55 Flux Optimizing

NOTE! The Flux Optimizing is NOT active when [211] V/Hz Curve=Square, see § 5.3.2, page 30.

5.4.31 Sound Characteristic [342]

Sets the sound characteristic of the inverter output stage by changing the switching frequency and/or pattern.

	342 Sound Char Stp **A: F** *
Default:	F
Selection:	E, F, G, H
E	Switching frequency 1,5Khz
F	Switching frequency 3 Khz
G	Switching frequency 6 Khz
H	Switching frequency 6 Khz, random modulation. (±750Hz)

NOTE! At switching frequencies>1,5Khz derating may become necessary. For size 5 and up, the switching frequency is always 1.5 kHz.

5.4.32 PID Controller [343]

The PID controller is used to control an external process via a feedback signal. The reference value can be set via analogue input AnIn1, at the Control Panel [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").

	343 PID Control Stp A: Off *
Default:	Off
Selection:	Off, On, Invert
Off	PID control deactivated.
On	The frequency increases when the feedback value decreases. PID settings according to windows [345] to [348] (see § 5.4.32, page 46 to § 5.4.35, page 46).
Invert	The frequency decreases when the feedback value decreases. PID settings according to windows [345] to [348] (see § 5.4.32, page 46 to § 5.4.35, page 46).

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 function settings for AnIn1 and AnIn2 will be neglected.

5.4.33 PID P Gain [344]

Setting the P Gain for the PID controller. See also § 5.4.32, page 46.

	344 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

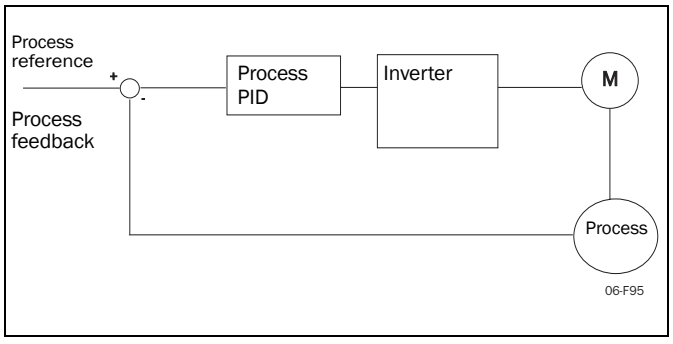


Fig. 56 Closed loop PID control.

5.4.34 PID I Time [345]

Setting the integration time for the PID controller. See § 5.4.32, page 46.

	345 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.

5.4.35 PID D Time [346]

Setting the differentiation time for the PID controller. See also § 5.4.32, page 46.

	346 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.

5.4.36 Limits/protections [350]

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

5.4.37 Low Voltage Override [351]

If a dip on the mains supply occurs, the inverter will automatically ramp down the frequency 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. 57.

	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.

The override level depends on the inverter type:
- FDU40:450VDC
- FDU50:520VDC
- FDU69:650VDC

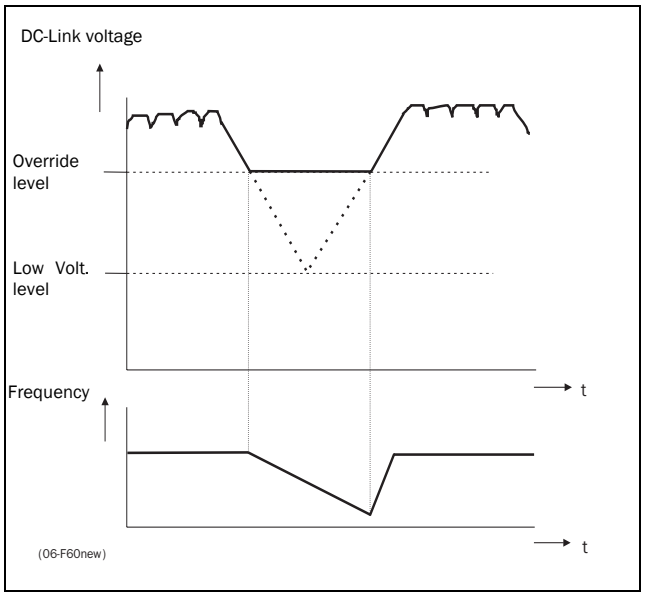


Fig. 57 Low Voltage Override.

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

5.4.38 Rotor locked[352]

Detects a locked rotor. This is when the Torque Limit has been active at very low frequency 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 68.

5.4.39 Motor lost [353]

Detects a disconnected motor, or phase loss at the motor (1, 2 or 3 phases) after 5 seconds.

	353 Motor lost Stp **A: Off** *
Default:	Off
Selection:	Off, Resume, Trip
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 68.

5.4.40 Motor I^2t Type [354]

Select the behaviour of the I^2t protection. The I^2t trip time is calculated with the formula:
$t=60 \times 0.44/((I_{out}/I_{I2t[355]})^2-1)s$.

	354 Mot I^2t 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 110% I_{NOM}.
Trip	When the I^2t time is exceeded, the inverter will trip on "Overload". See also chapter 6. page 68.
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].

Fig. 58 gives an example if the rated motor current is 50% and 100% of the nominal inverter current. If the limit is at maximum the inverter will trip at "I^2t", see chapter 6. page 68.

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

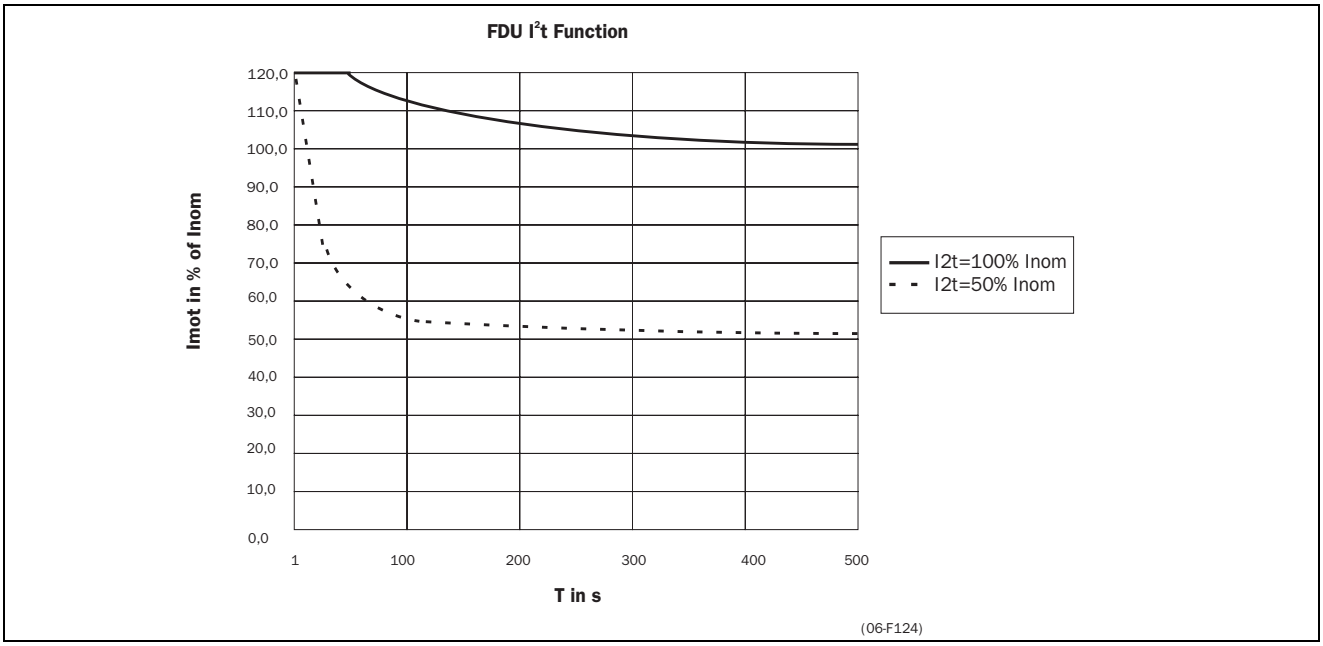


Fig. 58 I^2t function

5.4.41 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_NOM)A *
Default:	I_{NOM}
Range:	1.1 x I_{NOM} of the inverter

NOTE! This window is not visible when Motor I^2T Type = Off (see § 5.4.40, page 47)

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 **Frequency**	
Default:	Frequency
Selection:	Off, Frequency, Torque
Off	Input is not active
Frequency	Reference value is set for Frequency Control. 100%=F_{MAX}
Torque	The input acts as an upper torque limit. The Maximum Torque is set in window Max Torque [332], see § 5.4.27, page 45. 100%=T_{MAX}

NOTE! 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 selection.

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

Special functions:

- **Adding AnIn1 and AnIn2.**
  If AnIn1 and AnIn2 are both set the values of the inputs are added.
- **Local /Remote control.**
  If a digital input (see § 5.5.11, page 51) 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. DigIn3=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)
- DigIn 3 = AnIn Select

Now with DigIn 3 the reference signal can be switched between AnIn 1 (potentiometer local) and AnIn 2 (current control remote).

NOTE! See also function Reference Control [212] § 5.3.3, page 30 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 unipolar.

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. 59.
2 - 10V/ 4 - 20mA	The input has a fixed offset=20% and Gain=1.25 (Live Zero). See Fig. 60.
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

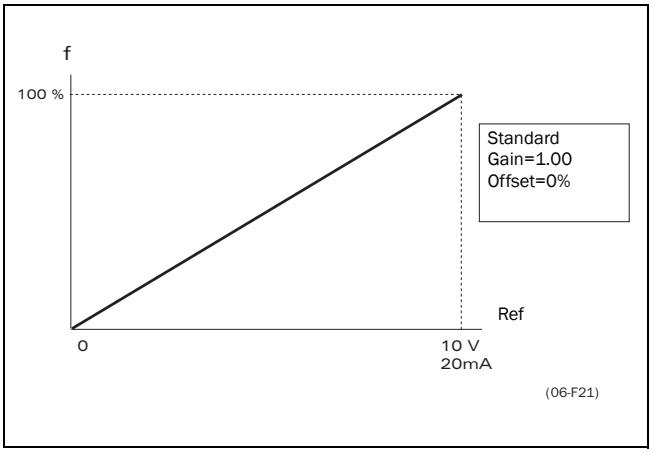


Fig. 59 Normal full-scale configuration.

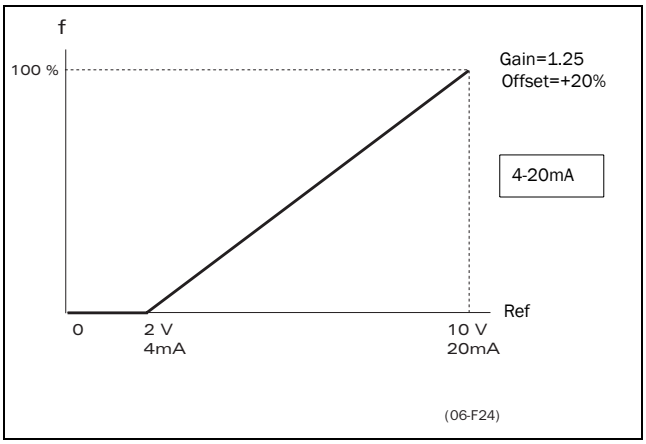


Fig. 60 2-10V/4-20mA (Live Zero).

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. 61.

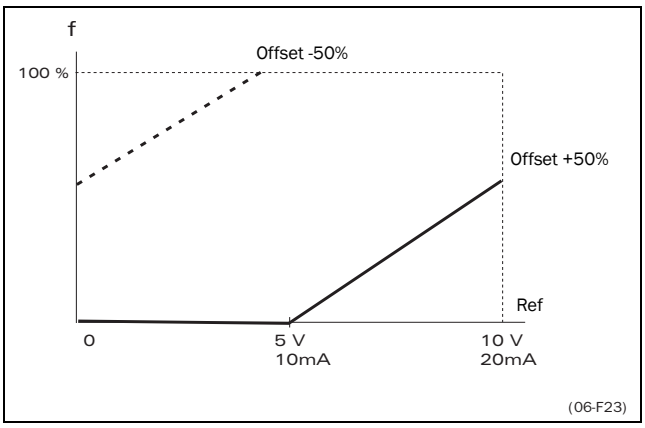


Fig. 61 Function of the AnIn Offset setting.

NOTE! This window is only visible if the function AnIn 1 Setup = User Defined [412].
See also; AnIn 2 [416] § 5.5.6, page 50 and Rotation = R+L § 5.3.5, page 32.

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. 62.

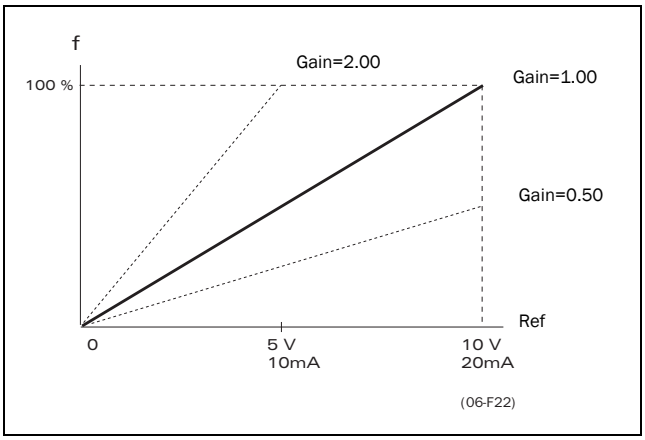


Fig. 62 Function of the AnIn Gain setting.

NOTE! This window is only visible if the function AnIn1 Setup = User Defined [412], see § 5.5.3, page 49 and § 5.5.6, page 50.

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. 63.

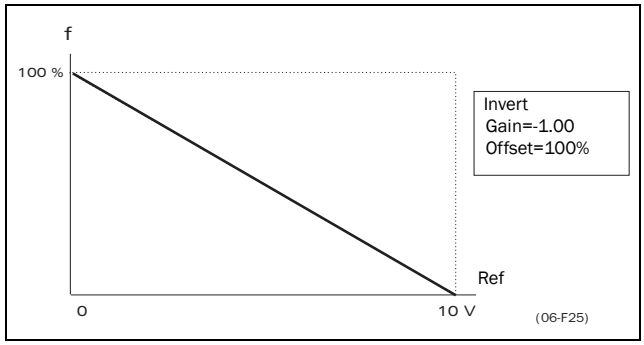


Fig. 63 Inverted reference

5.5.6 AnIn2 Function [415]
Setting the function for Analogue Input 2.

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

	415 AnIn 2 Funct Stp **Off**
Default:	Off
Selection:	Off, Frequency, Torque
Off	See § 5.5.2, page 49
Frequency	See § 5.5.2, page 49
Torque	See § 5.5.2, page 49

5.5.7 AnIn 2 Set-up [416]
Same functions as AnIn 1 Setup [412] see § 5.5.3, page 49.

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

5.5.8 AnIn 2 Offset [417]

Same function as AnIn 1 Offset [413] see § 5.5.4, page 50.

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

5.5.9 AnIn 2 Gain [418]

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

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

5.5.10 Digital Inputs [420]

Submenu with all the settings regarding the digital inputs.

5.5.11 DigIn 1 [421]

To select the function of the digital input.
On the standard controlboard there are 8 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 Run
Default:	Run
Selection:	Off, Ext trip, Stop, Enable, RunR, RunL, Run, Reset, AnIn Select, Pres Ref1, Pres Ref2, Pres Ref4, MotPot Up, MotPot Down, Deact MotPot, Jog, Drive1 feedb, Drive2 feedb, Mains Off, Deact Pump
Off	The input is not active.
Ext. Trip	**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.**
Stop	Stop command according to the selected Stop mode in window [31A] § 5.4.11, page 41, see § 4.2, page 25. **NOTE! The Stop command is active low.**
Enable	Enable command. General start condition to run the inverter. If made low during running the output of the inverter is cut off immediately, causing the motor to coast to zero speed, see § 4.2, page 25 for detailed information. **NOTE! If none of the DigIns are programmed to "Enable", the internal Enable signal is active.**
RunR	Run Right command. The output of the inverter will be a clockwise rotary field, see § 4.2, page 25.
RunL	Run Left command. The output of the inverter will be a counter-clockwise rotary field, see § 4.2, page 25.
Run	Run command. The direction of the rotary field is determined by the setting of window Rotation [214] (see § 5.3.4, page 31) and window Direction [324] (see § 5.4.17, page 43), see § 4.2, page 25 for more information.
Reset	Reset command. To reset a Trip condition and to enable the Autoreset function. See § 4.2, page 25.
AnIn Select	Selects AnIn2 or 1 if they have the same function. Can be used for local/ Remote control. See § 5.5.2, page 49. Low: AnIn1 active High: AnIn2 active.
Preset Ref 1	To select the Preset Frequency Reference. See § 5.4.19, page 43.
Preset Ref 2	To select the Preset Frequency Reference. See § 5.4.19, page 43.
Preset Ref 4	To select the Preset Frequency Reference. See § 5.4.19, page 43.
MotPot Up	Increases the internal reference value acc. to the set acceleration time with a min. of 16 s. Has the same function as a "real" motor potentiometer see Fig. 64.
MotPot Down	Decreases the internal reference value according to the set deceleration time with a minimum of 16s. See MotPot Up
Deact MotPot	Deactivate the MotorPot function, analog reference value active.
Jog	To activate the Jog function. Gives a Run command with the set Jog Freq. and Direction, § 5.4.24, page 44.
Drive 1 feedb	Feedback input Drive 1 for Pump control.
Drive 2 feedb	Feedback input Drive 2 for Pump control.
Mains Off	Active when mains contactor is off.
Deact Pump	Deactivate the pump controller

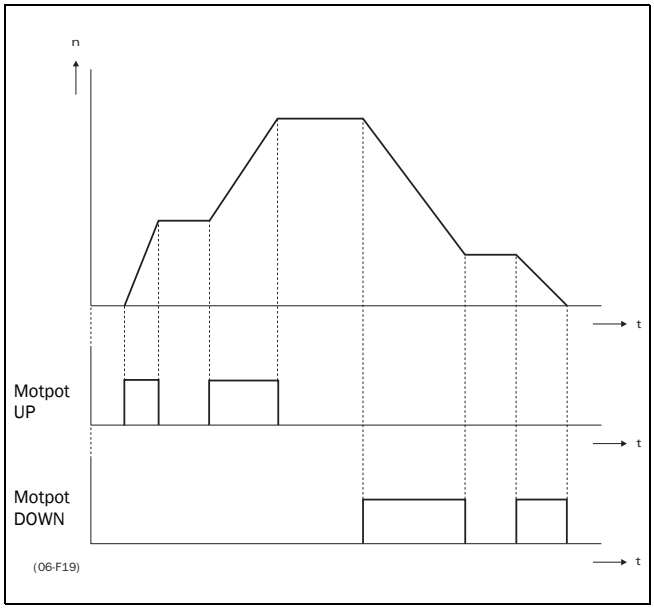


Fig. 64 MotPot function.

The MotPot function is as default volatile, this means that the reference value is 0rpm after a power down or after stop or trip, see § 5.4.18, page 43.

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.

5.5.12 DigIn 2 [422]

Same function as DigIn 1 [421]. See § 5.5.11, page 51.

	422 DigIn 2 Stp **Off**
Default:	Off
Selection:	Off, Ext trip, Stop, Enable, RunR, RunL, Run, Reset, AnIn Select, Pres Ref1, Pres Ref2, Pres Ref4, MotPot Up, MotPot Down, Deact MotPot, Jog, Drive1 feedb, Drive2 feedb, Mains Off, Deact Pump

NOTE! If either the function Reference Control [212] (§ 5.3.3, page 30) or Run/Stop Control [213] (§ 5.3.4, page 31) are set to Rem/DigIn2 or Comm/DigIn2, the digital input cannot be programmed. The following message is displayed: "Local/ Rem".

5.5.13 DigIn 3 [423]

Same function as DigIn 1 [421]. See § 5.5.11, page 51.

	423 DigIn 3 Stp **Off**
Default:	Off
Selection:	Off, Ext trip, Stop, Enable, RunR, RunL, Run, Reset, AnIn Select, Pres Ref1, Pres Ref2, Pres Ref4, MotPot Up, MotPot Down, Deact MotPot, Jog, Drive1 feedb, Drive2 feedb, Mains Off, Deact Pump

NOTE! If the function Select set no [234] (§ 5.3.21, page 34) is set to DigIn 3 or DigIn 3+4 the digital input cannot be programmed. The message "PS Selected" is displayed.

5.5.14 DigIn 4 [424]

Same function as DigIn 1 [421]. See § 5.5.11, page 51.

	424 DigIn 4 Stp **Reset**
Default:	Reset
Selection:	Off, Ext trip, Stop, Enable, RunR, RunL, Run, Reset, AnIn Select, Pres Ref1, Pres Ref2, Pres Ref4, MotPot Up, MotPot Down, Deact MotPot, Jog, Drive1 feedb, Drive2 feedb, Mains Off, Deact Pump

NOTE! If the function Select set no [234] (§ 5.3.21, page 34) is set to DigIn 3 or DigIn 3+4 the digital input cannot be programmed. The message "PS Selected" is displayed.

5.5.15 DigIn 5 [425]

Same function as DigIn 1 [421]. See § 5.5.13, page 52.

	425 DigIn 5 Stp **Off**
Default:	Off
Selection:	Off, Ext trip, Stop, Enable, RunR, RunL, Run, Reset, AnIn Select, Pres Ref1, Pres Ref2, Pres Ref4, MotPot Up, MotPot Down, Deact MotPot, Jog, Drive1 feedb, Drive2 feedb, Mains Off, Deact Pump

5.5.16 DigIn 6 [426]

Same function as DigIn 1 [421]. See § 5.5.13, page 52.

	426 DigIn 6 Stp **Off**
Default:	Off
Selection:	Off, Ext trip, Stop, Enable, RunR, RunL, Run, Reset, AnIn Select, Pres Ref1, Pres Ref2, Pres Ref4, MotPot Up, MotPot Down, Deact MotPot, Jog, Drive1 feedb, Drive2 feedb, Mains Off, Deact Pump

5.5.17 DigIn 7 [427]

Same function as DigIn 1 [421]. See § 5.5.13, page 52.

	427 DigIn 7 Stp **Off**
Default:	Off
Selection:	Off, Ext trip, Stop, Enable, RunR, RunL, Run, Reset, AnIn Select, Pres Ref1, Pres Ref2, Pres Ref4, MotPot Up, MotPot Down, Deact MotPot, Jog, Drive1 feedb, Drive2 feedb, Mains Off, Deact Pump

5.5.18 DigIn 8 [428]

Same function as DigIn 1 [421]. See § 5.5.11, page 51.

	428 DigIn 8 Stp **Off**
Default:	Off
Selection:	Off, Ext trip, Stop, Enable, RunR, RunL, Run, Reset, AnIn Select, Pres Ref1, Pres Ref2, Pres Ref4, MotPot Up, MotPot Down, Deact MotPot, Jog, Drive1 feedb, Drive2 feedb, Mains Off, Deact Pump

5.5.19 Analogue Outputs [430]

Submenu with all settings regarding the analogue outputs.

5.5.20 AnOut 1 function [431]

Sets the function for the optional Analogue Output 1. The output is unipolar.

	431 AnOut1 Funct Stp **Frequency** *
Default:	Frequency
Selection:	Frequency, Load, El power, Current, Outp Voltage, Fmin-Fmax
Frequency	0 to 200% of f_{MOT}
Load	0 to 200% of nominal inverter load
El power	0 to 200% of P_{NOM}
Current	0 to 200% of I_{NOM}
Outp Voltage	0 - 100% of Max. Output Voltage (= Mains)
Fmin-Fmax	The scale is automatically set between the minimum and the maximum frequency.

5.5.21 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 configuration) and 0.8x gain. See Fig. 65 and Fig. 66.
User defined	The output can be set to a user defined 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)

The gain on an Analogue output works inverted compared to the input. See Fig. 65, Fig. 66 and Fig. 62.

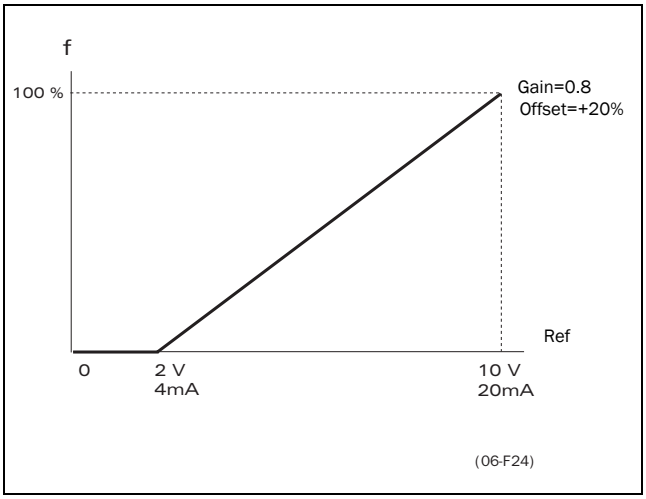


Fig. 65 AnOut 4-20mA.

5.5.22 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 § 5.5.21, page 53.

5.5.23 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. 65, Fig. 66 and Fig. 62.

	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 § 5.5.21, page 53.

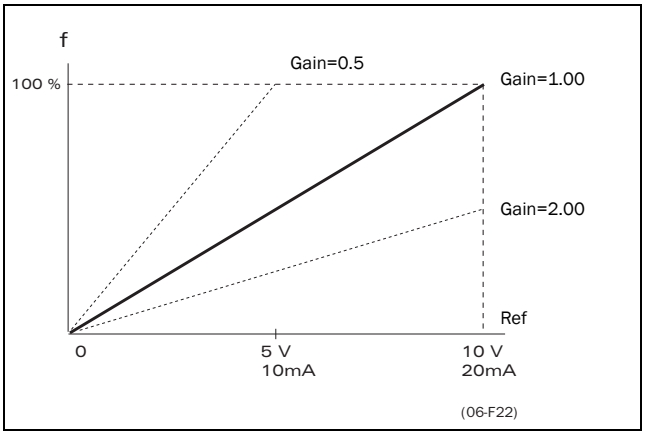


Fig. 66 AnOut Gain setting.

5.5.24 AnOut 2 function [435]

Sets the function for the Analogue Output 2.

	435 AnOut2 Funct Stp **Current** *
Default:	Current
Selection:	Frequency, Load, El power, Current, Outp Voltage
Frequency	0 to 200% of f_{MOT}
Load	0 to 200% of nominal inverter load
El power	0 to 200% of P_{NOM}
Current	0 to 200% of I_{NOM}
Outp Voltage	0 - 100% of Max. Output Voltage (= Mains)
Fmin-Fmax	The scale is automatically set between the minimum and the maximum frequency.

5.5.25 AnOut 2 Set-up [436]

Same function as AnOut1 Setup [432]. See § 5.5.21, page 53.

5.5.26 AnOut 2 Offset [437]

Same function as AnOut1 Offset [433]. See § 5.5.22, page 53.

5.5.27 AnOut 2 Gain [438]

Same function as AnOut1 Gain [434]. See § 5.5.23, page 54.

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, 0Hz, Acc/Dec, At Freq, At Max Freq, No Trip, Trip, Autorst Trip, Limit, Warning, Ready, T=T Lim, I>I_{nom}, SgnI<Offset, Alarm, Pre-alarm, Max Alarm, Max Pre-alarm, Min Alarm, Min Pre-alarm, LY, !LY, LZ, !LZ, CA1, !A1, CA2, !A2, CD1, !D1, CD2, !D2, Operation
Run	The inverter output is active.
Stop	The inverter output is not active.
0Hz	The output frequency=0+-0.1Hz when in Run condition.
Acc/Dec	The freq is increasing or decreasing.
At Freq	The Output Freq = Reference Frequency.
At Max Freq	The frequency is limited by the Maximum Freq, see § 5.4.15, page 42
No Trip	No Trip condition active, see chapter 6. page 68.
Trip	A Trip condition is active, see chapter 6. page 68.
Autorst Trip	Autoreset trip condition active, see § 6.2.4, page 69.
Limit	A Limit condition is active, see chapter 6. page 68.
Warning	A warning condition is active, see chapter 6. page 68.
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 [331] § 5.4.27, page 45.
I>I_{nom}	The Output current is higher than the rated inverter current.

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 60.
Pre-Alarm	The Max or Min Pre-alarm Level has been reached. See § 5.9, page 60.
Max Alarm	The Max Alarm level has been reached. See § 5.9, page 60.
Max Pre-Alrm	The Max Pre-alarm level has been reached. See § 5.9, page 60.
Min Alarm	The Min Alarm Level has been reached. See § 5.9, page 60.
Min Pre-Alrm	The Min Pre-alarm Level has been reached. See § 5.9, page 60.
LY	Logic output Y. See § 5.9.19, page 65
!LY	Logic output Y inverted. See § 5.9.19, page 65
LZ	Logic output Z. See § 5.9.19, page 65
!LZ	Logic output Zinverted. See § 5.9.19, page 65
CA 1	Analogue comparator 1 output, see § 5.9.12, page 64
!A1	Analogue comp 1 inverted output, see § 5.9.12, page 64
CA 2	Analogue comparator 2 output, see § 5.9.12, page 64
!A2	Analogue comp 2 inverted output, see § 5.9.12, page 64
CD 1	Digital comparator 1 output, see § 5.9.12, page 64
!D1	Digital comp 1 inverted output, see § 5.9.12, page 64
CD 2	Digital comparator 2 output, see § 5.9.12, page 64
!D2	Digital comp 2 inverted output, see § 5.9.12, page 64
Operation	Inverter in operation with motor

5.5.30 DigOut 2 Function [442]

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

Sets the function of the digital output 2. Same function as DigOut 1 [441] (§ 5.5.29, page 54).

	442 DigOut 2 Stp **No Trip** *
Default:	No trip
Selection:	Run, Stop, 0Hz, Acc/Dec, At Freq, At Max Freq, No Trip, Trip, Autorst Trip, Limit, Warning, Ready, T=T Lim, I>I_{NOM}, SgnI<Offset, Alarm, Pre-alarm, Max Alarm, Max Pre-alarm, Min Alarm, Min Pre-alarm, LY, !LY, LZ, !LZ, CA1, !A1, CA2, !A2, CD1, !D1, CD2, !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 54.

	451 Relay 1 Func Stp **Trip** *
Default:	Trip
Selection:	Run, Stop, 0Hz, Acc/Dec, At Freq, At Max Freq, No Trip, Trip, Autorst Trip, Limit, Warning, Ready, T=T Lim, I>I_{NOM}, SgnI<Offset, Alarm, Pre-alarm, Max Alarm, Max Pre-alarm, Min Alarm, Min Pre-alarm, LY, !LY, LZ, !LZ, CA1, !A1, CA2, !A2, CD1, !D1, CD2, !D2, Operation

5.5.33 Relay 2 Function [452]

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

Sets the function of the relay output 2.
Same function as DigOut 1 [441] § 5.5.29, page 54.

	452 Relay 2 Func Stp **Ready** *
Default:	Ready
Selection:	Run, Stop, 0Hz, Acc/Dec, At Freq, At Max Freq, No Trip, Trip, Autorst Trip, Limit, Warning, Ready, T=T Lim, I>I_{nom}, SgnI<Offset, Alarm, Pre-alarm, Max Alarm, Max Pre-alarm, Min Alarm, Min Pre-alarm, LY, !LY, LZ, !LZ, CA1, !A1, CA2, !A2, CD1, !D1, CD2, !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 controller mode:

Table 24 Set/view reference value

Mode	Read-out:	Resolution (see § 5.1, page 29):
Frequency Mode	Hz	3 digit
PID Controller	%	3 digit

View reference value

As default the window 500 is in view operation. The value of the active frequency reference signal is displayed.

Set reference value

If the function Reference Control [212] (§ 5.3.3, page 30) 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 24.

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 Output Frequency.

610 Frequency Stp Hz	
Unit:	Hz
Resolution:	0.1 Hz

5.7.2 Load [620]

Displays the actual Torque.

620 Load Stp %	
Unit:	%
Resolution:	1%

5.7.3 Electrical power [630]

Displays the actual Electrical Output Power.

630 El Power Stp kW	
Unit:	kW
Resolution:	1W

5.7.4 Current [640]

Displays the actual Output Current.

640 Current Stp A	
Unit:	A
Resolution:	0.1 A

5.7.5 Output Voltage [650]

Displays the actual Output Voltage.

650 Outp.Voltage Stp V	
Unit:	V
Resolution:	1V

5.7.6 DC-Link voltage [660]

Displays the actual DC-link Voltage.

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

5.7.7 Heat sink temperature [670]

Displays the actual Heat Sink Temperature.

670 Temperature Stp °C	
Unit:	°C
Resolution:	0.1°C

5.7.8 FI status [680]

Indicates the overall status of the frequency inverter. See Fig. 67.

```
680 FI Status
Stp 1/222/333/44
```

Fig. 67 Drive status.

Table 25 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) -FL (Frequency Limit) -CL (Current Limit) -VL (Voltage Limit) ----No limit active

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 terminal terminal 1-22
- TL: Torque Limit active.

5.7.9 Digital input status [690]

Indicates the status of the Digital inputs. See Fig. 68.

The first row indicates the digital inputs.

- 1 DigIn 1
- 2 DigIn 2
- 3 DigIn 3
- 4 DigIn 4
- 5 DigIn 5
- 6 DigIn 6
- 7 DigIn 7
- 8 DigIn 8

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. 68 indicates that DigIn 1, DigIn 3 and DigIn 6 are active at this moment.

```
690 DI: 1234 5678
Run     HLHL LHLL
```

Fig. 68 Digital input status example.

5.7.10 Analogue input status [6A0]

Indicates the status of the Analogue inputs. Fig. 69.

```
6A0 AI: 1      2
Stp    100%  65%
```

Fig. 69 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 100% input value
- 65% AnIn2 has a 65% input value

So the example in Fig. 69 indicates that both the Analogue inputs are active.

5.7.11 Run time [6B0]

Displays the total time that the inverter has been in the Run Mode.

6B0 Run Time Stp h: m	
Unit:	h: m (hours: minutes)
Range:	0h: 0m - 65535h: 59m

5.7.12 Reset Run time [6B1]

To reset the Run Time counter, see function Run [6D0] § 5.7.11, page 57.

	6B1 Reset Run Tm Stp No *
Default:	No
Selection:	No, Yes

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

5.7.13 Mains time [6C0]

Displays the total time that the inverter has been connected to the mains supply. This timer cannot be reset.

	6C0 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.

5.7.14 Energy [6D0]

Displays the total energy consumption since the last Reset Energy [6F1] has taken place (see § 5.7.15, page 58).

	6D0 Energy Stp kWh
Unit:	kWh
Range:	0.0 - 999999.9kWh

5.7.15 Reset Energy [6D1]

To reset the kWh counter see § 5.7.14, page 58.

	6D1 Reset Energy Stp No *
Default:	No
Selection:	No, Yes

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

5.7.16 Process Speed [6E0]

The Process Speed is a display function which can be programmed according to several quantities and units with regard to the frequency, which is programmed with the functions Set Process Unit [6E1] and Set Process Scale [6E2] in this menu.

6E0 Process Spd Stp

5.7.17 Set Process Unit [6E1]

Selection of the process unit with regard to the speed.

	6E1 Set Prc Unit Stp OFF *
Default:	OFF
Selection:	Off, %, °C, °F, bar, Pa, kPa, psi, Nm, Hz, /s, cyc/s, U/s, m/s, ft/s, m3/s, gal/s, ft3/s, kg/s, lbs/s, rpm, /min, cyc/m, U/m, m/min, ft/m, L/m, m3/m, gal/m, ft3/m, kg/m, lbs/m, /h, cyc/h, U/h, m/h, ft/h, L/h, m3/h, gal/h, ft3/h, kg/h, lbs/h, tons/h
Off	No unit selection
%	Percentage of Maximum Frequency
°C	Degree Centigrade
°F	Degree Fahrenheit
bar	bar
Pa	Pascal
kPa	Kilopascal
psi	Pounds per square inch
Nm	Torque
Hz	Frequency
/s	Per second
cyc/s	Cycles per second
U/s	Units per second
m/s	Metres per second
ft/s	Feet per second
L/s	Litres per second
m3/s	Cubic meters per second
gal/s	Gallons per second
ft3/s	Cubic feet per second
kg/s	Kilograms per second
lbs/s	Pounds per second
rpm	Revolutions per minute
/min	Per minute
cyc/min	Cycles per minute

U/min	Units per minute
m/min	Metres per minute
ft/min	Feet per minute
L/min	Litres per minute
m3/min	Cubic metres per minute
gal/min	Gallons per minute
ft3/min	Cubic feet per minute
kg/min	Kilograms per minute
lbs/min	Pounds per minute
/h	per hour
cyc/h	Cycles per hour
U/h	Units per hour
m/h	Metres per hour
ft/h	Feet per hour
L/h	Litres per min
m3/h	Cubic meters per hour
gal/h	Gallons per hour
ft3/h	Cubic feet per hour
kg/h	Kilograms per hour
lbs/h	Pounds per hour
tons/h	Tons per hour

5.7.18 Set Process Scale [6E2]

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

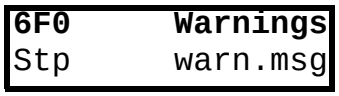
Example:

A pump has at 40Hz a flow of 3.6 litres per second. Set the Process Unit = L/s. The process scale is 3.6:40=0.09. So if the Process Scale = 0.09, then the read-out at 40Hz will be 3.6L/s.

	
Default:	1.000
Range:	0.000 - 10.000
Resolution	4 significant digits (§ 5.1, page 29)

5.7.19 Warning [6F0]

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 22).



The active warning message is displayed here. See § 6.1, page 68.

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

The following warnings are possible;

- Overtemp
- Overvolt G
- Overcurrent (I^2t)
- Low voltage
- Min Pre-Alarm
- Max Pre-Alarm
- Comm Error

See also chapter 6. page 68.

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 [6B0] counter.

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

The trip message can be any message as described in § 6.2, page 69.

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

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

Fig. 70 Trip 3

Example:
Fig. 70 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 60.

	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 can be set for a trip condition. The pre-alarms act as a warning condition. All the alarms can be monitored on the Digital or Relay outputs. See also:

- § 5.5.28, page 54,
- § 6.1, page 68,
- § 5.7.19, page 59,
- Table 28, page 70.

The Autoset function determines automatically during running the 4 alarm levels: Maximum alarm, Max. Pre-Alarm, Minimum Alarm and Min. Pre-alarm.

Fig. 71, page 63 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, Max+Min
Off	No alarm functions active. **NOTE! The windows [813-815] are not visible.**
Max	Max Alarm active. The alarm output functions as an Overload alarm. **NOTE! The windows [819-81A] are not visible.**
Min	Min Alarm active. The alarm output functions as an Underload alarm. **NOTE! The windows [817-818] are not visible.**
Max+Min	Both Max and MIN alarm are active. The alarm outputs function as overload and underload alarms.

5.9.3 Alarm Trip [812]

Selects which alarm must cause a Trip to the inverter.

	812 Alarm trip Stp Off *
Default:	Off
Selection:	Off, Min, Max, Max+Min
Off	No trip if an alarm is active. The Alarms can be monitored on the Digital or Relay outputs. See § 5.5.28, page 54.
Max	The Max alarm will trip the inverter. See also Chapter 6. page 68.
Min	The Min Alarm will Trip the inverter. See also Chapter 6. page 68.
Max+Min	Both a Min or Max Alarm will trip the inverter. See Chapter 6. page 68.

5.9.4 Ramp Alarm [813]

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

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

5.9.5 Alarm start delay [814]

Sets the delay time after a Run command, after which the alarm may be given.

- If Ramp Enable=On (see § 5.9.4, page 61). The start delay begins after a RUN command.
- If Ramp Enable=Off .The start delay begins after the acceleration ramp.

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

5.9.6 Alarm response delay [815]

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

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

5.9.7 Auto set function[816]

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

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

The set levels for the (pre)alarms are:

Overload	Max Alarm	1.15xActual Load
	Max pre-alarm	1.10xActual Load
Underload	Min pre-alarm	0.90xActual Load
	Min alarm	0.85xActual Load

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

5.9.8 Max Alarm level (Overload) [817]

Sets the Max Alarm level (Overload).

	817 Max Alarm Stp 120% *
Default:	120%
Range:	0-200%

The alarm level is given in % of the nominal load. Normal setting: 150%. The Alarm is activated if the set value has been reached.

5.9.9 Max Pre-alarm level (Overload) [818]

Sets the Max Pre-alarm level (Overload).

	818 Max Pre-Alrm Stp **110%** *
Default:	110%
Range:	0-200%

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.

5.9.10 Min Alarm level (Underload) [819]

Sets the Max Alarm level (Underload).

	819 Min Alarm Stp **0%** *
Default:	0%
Range:	0-200%

The alarm level is given in % of the nominal load. Normal setting: 0%. The Alarm is activated if the set value has been reached.

5.9.11 Min Pre-alarm level (Underload) [81A]

Sets the Min Pre-alarm level (Underload).

	81A Min Pre-Alrm Stp **90%** *
Default:	90%
Range:	0-200%

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

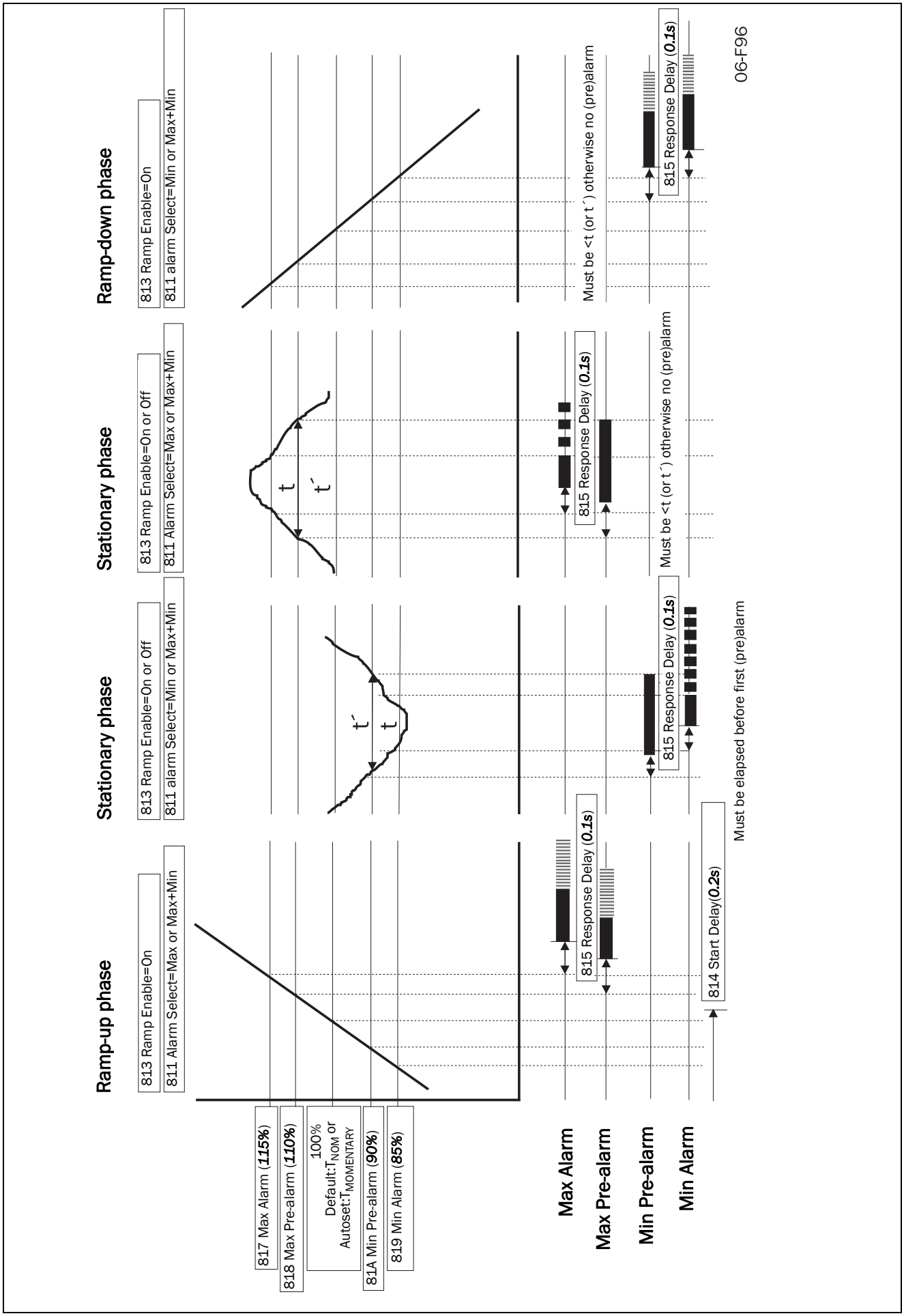


Fig. 71 Alarm functions

5.9.12 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.

5.9.13 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. 72.
The output signal can be programmed to the digital or relay outputs. See par 5.5.28 page 52.

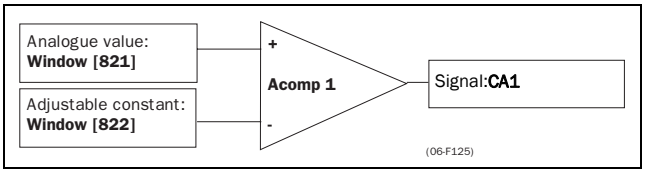


Fig. 72 Analogue Comparator

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

5.9.14 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 0Hz *
Default:	0Hz
Selection:	Selection is made automatically according to window [821].
Frequency	0 - 400Hz
Load %	0-200%
El Power	0-200%, P_{NOM} in kW
Current	0-200%, I_{NOM} in A
Voltage	0-Mains in V
DC Voltage	0-Mains. $\sqrt{2}$ in VDC DC Voltage
Temperature	0-100°C
Energy	0-1,000,000kWh
Run Time	0-65500hr
Mains Time	0-65500hr
AnIn1	0-100%
AnIn2	0-100%
Process speed	0.01 – 10.0

5.9.15 Analogue Comparator 2 value [823]

Function is identical to Analogue Comparator 1 Value, see § 5.9.13, page 64.

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

5.9.16 Analogue Comparator 2 constant [824]

Function is identical to Analogue Comparator 1 level see § 5.9.14, page 64.

	824 CA2 Constant Stp 0% *
Default:	0%
Selection:	Selection is made automatically according to window [823].

5.9.17 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. 73.

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

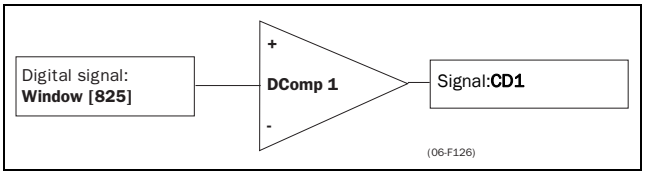


Fig. 73 Digital comparator

	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, F-Limit, 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
DigIn 6	Digital input 6
DigIn 7	Digital input 7
DigIn 8	Digital input 8
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
F-Limit	Frequency 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

5.9.18 Digital Comparator 2 [826]

Function is identical to Digital Comparator 1 see § 5.9.17, page 65. 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

5.9.19 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:

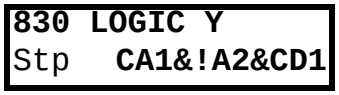
- Up to 3 comparator outputs can be used: CA1, CA2, CD1, CD2 or LZ. (or LY)
- The comparator outputs can be inverted: !A1, !A2, !D1, !D2, or !LZ. (or !LY)
- The following logical operators are available:
  "+" : OR operator
  "&" : AND operator
  "^" : EXOR operator

  Expressions according to the following truth table can be made:

Table 26 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 § 5.5.28, page 54.



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>10Hz

The comparator !A2 is set for:
- load < 20%

The comparator CD1 is set for:
- Run active

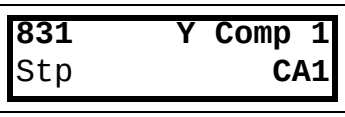
The 3 comparator are all AND-ed, given the "broken belt detection".

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

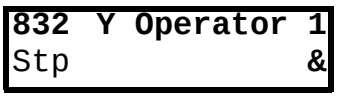
NOTE! Set window 834 to "." to finish the expression when only two comparators are required for Logic Y.

5.9.20 Y Comp 1 [831]
Selects the first comparator for the Logic Y function.



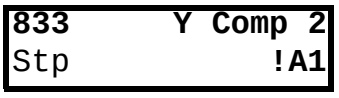
Default:	CA!
Selection:	CA1, !A1, CA2, !A2, CD1, !D1, CD2, !D2, LZ, !LZ

5.9.21 Y Operator 1 [832]
Select the first operator for the Logic Y function.



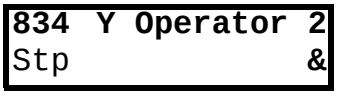
Default:	&
Selection:	&, +, ^ &=AND, +=OR, ^=EXOR

5.9.22 Y Comp 2 [833]
Selects the second comparator for the Logic Y function.



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

5.9.23 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).

5.9.24 Y Comp 3 [835]
Selects the third comparator for the Logic Y function.

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

5.9.25 Logic function Z [840]

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

5.9.26 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, LY, !LY

5.9.27 Z Operator 1 [842]
Select the first operator for the Logic Z function.

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

5.9.28 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, LY, !LY

5.9.29 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).

5.9.30 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, LY, !LY

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. 74.

```
910 FI Type
Stp     FDU40-074
```

Fig. 74 Example Type

Examples:
-FDU40-074 FDU 400 volt, 37 kW, 74A

5.10.2 Software [920]
Shows the software version number of the inverter. Fig. 75 gives an example of the version number.

```
920 Software
Stp        V 1.23
```

Fig. 75 Example software version

V 1.23 = Version of the Software

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 21)

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 digital output (see § 5.5.32, page 55).

"Limits"
- the inverter is limiting torque and/or frequency 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 21)

"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[6F0] and the lower left corner of the display.

Table 27 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
Comm Error (Interrupt [253])	Off Trip Warning	- X -	- - -	- X X
Low volt override	Off On	- -	- X	- X
Low voltage	-	X	-	X
Overvoltage Line	-	X	-	X
Overvoltage Gen/Dec	-	X	-	-
Overcurrent	-	X	-	-
Overtemperature	-	X	-	X
Power Fault	-	X	-	-
External trip	-	X	-	-
Motor temperature (PTC)	Off Trip	- X	- -	- X
Alarm Max/Alarm Min		- X	- -	- -
Pre-Alarm Max/Pre-Alarm Min		-	-	X

NOTE! The trip events Rotor locked, Motor I^2t, Low voltage override and Comm Error can be set individually please see § 5.4.36, page 46.

NOTE! The trip indication "Motor temperature" is only active if the option PTC is built in. See chapter 7. page 72.

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 a 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 11.

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 60) 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 60 and § 5.3.27, page 35).

Fig. 76 Autoreset trip

Fig. 76 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 28 Trip condition

Trip Condition	Possible Cause	Remedy
Low voltage "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 § 5.4.38, 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)
Power fault	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 - Too high IxR Compensation level	- Check the acceleration time settings and make them longer if necessary. - Check the motor load. - Check on bad motor cable connections - Check on bad earth cable connection - Check on water or moisture in the motor housing and cables connections - Lower the level of IxR Compensation [216], See § 5.3.7, page 32.
	Overload condition in the DC-link: - Hard short-circuit between phases or phase to earth - Saturation of current measurement circuiting - Earth fault - Desaturation of IGBT´s - Peak voltage on 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 - See Overvoltage trips
Overcurrent "I^2t"	I^2t value is exceeded. - Overload on the motor according to the programmed I^2t settings. See § 5.4.41, page 48.	- Check on mechanical overload on the motor or the machinery (bearings, gearboxes, chains, belts, etc.) - Change the Motor I^2t Current setting see § 5.4.41, page 48
Overtemperature "OT"	Heat sink temperature exceeds 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 78. - Check the functionality of the built-in fans. The fans must switch on auto-matically if the heat sink temperature exceeds 60°C. At power up the fans are brieftly switched on. - Check inverter and motor rating - Clean fans

Table 28 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 § 5.4.39, page 47
External Error	External input (DigIn 1-8) active: - active low function on the input.	- Check the equipment that initiates the external input - Check the programming of the digital inputs DigIn 1-8 (see § 5.5.11, page 51)
Internal trip	Error in the microprocessor 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 § 5.4.38, page 47.
Motor temperature	Motor thermistor exceeds maximum level **NOTE! Only valid if the optional PTC input is used. See § 5.3.31, page 36.**	- 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.
Comm Error (Interrupt [253])	Error on serial communication (option)	- Check cables and connection of the serial communication. - Check all settings with regard to the serial communication - Restart the equipment including the inverter
Max Alarm	Max alarm level (overload) has been reached. See § 5.9, page 60.	- Check the load condition of the machine - Check the monitor setting in § 5.9, page 60.
Min Alarm	Min alarm level (underload) has been reached. See § 5.9, page 60.	- Check the load condition of the machine - Check the monitor setting in § 5.9, page 60.

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 60°C. 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 into 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 models 210 to 1k1 are available in protection class IP23 and inverter models 003 to 1k1 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 8.6 page 79 for the dimensions and weights.

Table 29 Options

Type 400V/500V	IP20	IP23	IP54
FDU40-003 FDU40-004 FDU40-006 FDU40-008 FDU40-010 FDU40-013	Standard unit	Not available	Standard unit, same size as IP 20
FDU**-018 FDU**-026 FDU**-031 FDU**-037	Not available	Not available	Standard unit
FDU**-046 FDU**-060 FDU40-073	Standard unit	Not available	Standard unit, same size as IP 20
FDU**-074 FDU**-090 FDU40-108	Standard unit	Not available	Standard unit, same size as IP 20 Standard unit, same size as IP 20 Not available
FDU**-109 FDU**-146 FDU**-175	Standard unit	Not available	Single unit, same size as IP 20
FDU**-210 FDU**-250 FDU**-300 FDU**-375	Standard unit	Please, contact your supplier.	Please, contact your supplier
FDU**-500 FDU**-600 FDU**-750	2 Standard units size 5, delivered with the required electrical connection material for parallel connection	Please, contact your supplier	Please, contact your supplier
FDU**-900 FDU**-1k1	3 Standard 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 but Blank Control Panel instead. The Control Panel can also be used to read data from one inverter and copy it to an other inverter. See chapter 5.3.17 page 33.

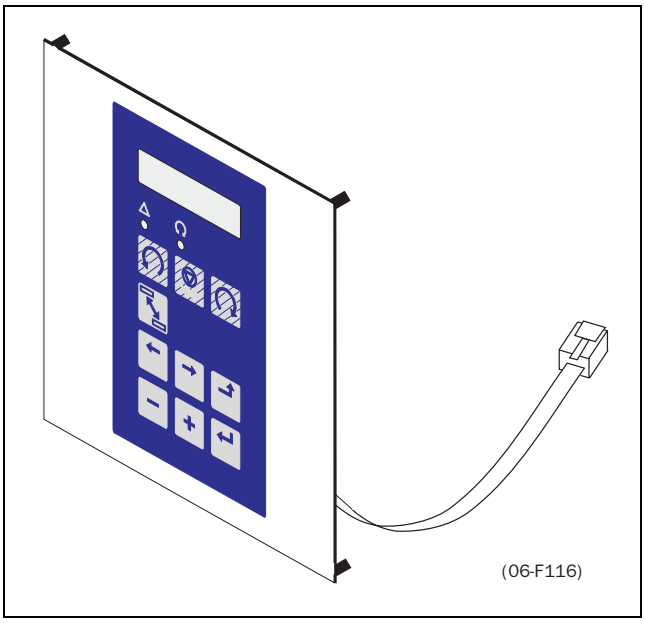


Fig. 77 ECP

7.3 Handheld Control Panel (HCP)

The Handheld Control Panel can be used as an external handheld remote control. The inverter must be ordered without the built-in Control Panel but Blank Control Panel instead. The Handheld Control Panel can also be used to read data from one inverter and copy it to an other inverter. See § 5.3.17, page 33.

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

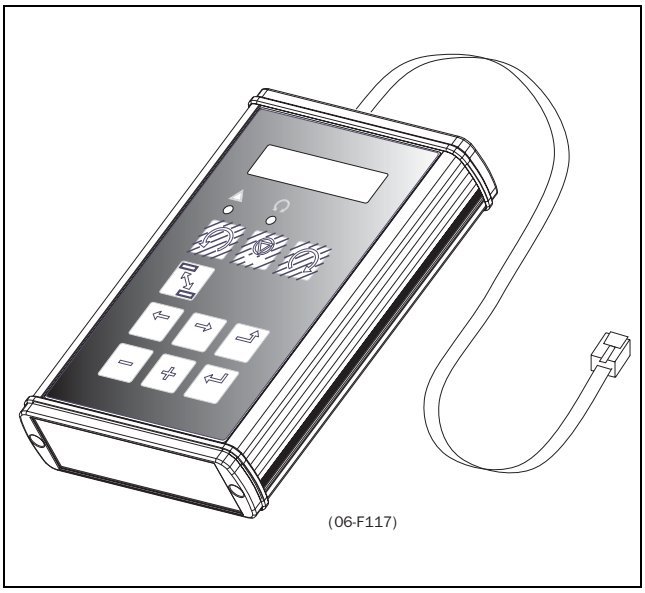


Fig. 78 HCP

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 braking currents.

Table 30 Brake resistor 400V type

400V Type	P in kW	R in Ohm
FDU40-003	0.75	227
FDU40-004	1.5	142
FDU40-006	2.2	94.4
FDU40-008	3	75.6
FDU40-010	4	59.7
FDU40-013	5.5	43.6
FDU40-018	7.5	22
FDU40-026	11	22
FDU40-031	15	22
FDU40-037	18.5	22
FDU40-046	22	19.4
FDU40-060	30	9.7
FDU40-073	37	9.7
FDU40-074	37	7.7
FDU40-090	45	6.3
FDU40-108	55	5.2
FDU40-109	55	5.2
FDU40-146	75	3.9
FDU40-175	90	3.2
FDU40-210	110	2.7
FDU40-250	132	2.27
FDU40-300	160	1.89
FDU40-375	200	1.51
FDU40-500	250	2x 2.27
FDU40-600	315	2x 1.89
FDU40-750	400	2x 1.51
FDU40-900	500	3x 1.89
FDU40-1k1	630	3x 1.51

Table 31 Brake resistors 500V types

500V Type	P in kW	R in Ohm
FDU50-018	11	27
FDU50-026	15	27
FDU50-031	18.5	27
FDU50-037	22	27
FDU50-046	30	25
FDU50-060	37	12
FDU50-074	45	9.9
FDU50-090	55	8.1
FDU50-109	75	6.7
FDU50-146	90	5.0
FDU50-175	110	4.2
FDU50-210	132	3.5
FDU50-250	160	2.92
FDU50-300	200	2.43
FDU50-375	250	1.94
FDU50-500	315	2x 2.92
FDU50-600	400	2x 2.43
FDU50-750	500	2x 1.94
FDU50-900	630	3x 2.43
FDU50-1k1	710	3x 1.94

Table 32 Brake resistors 690V types

690V Type	P in kW	R in Ohm
FDU69-120	110	7.9
FDU69-140	132	6.7
FDU69-170	160	5.5
FDU69-215	200	4.4
FDU69-270	250	3.5
FDU69-340	315	2x 5.5
FDU69-430	400	2x 4.2
FDU69-540	500	2x 3.5
FDU69-645	630	3x 4.2
FDU69-810	800	3x 3.5

See also chapter 3.3 page 12.

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 I/O Board

Extension card with 7 extra relay outputs. The I/O Board works in combination with the Pump/Fan Control, but can also be used as a separate option.

7.6 Output coils

Above about 40m length of screened motor cable for FDU40-003 to -013 and about 100m for all other FDU inverters, output coils are recommended, which are supplied separately. Because of the fast switching of the motor voltage and the capacity of the motor cable both line to line and line to earth screen, large switching currents can be generated with long lengths of motor cable. Output coils prevent the inverter from tripping and should be installed as close as possible to the inverter.

7.7 Overvoltage clamp

Together with output coils the output voltage is clamped to +100VDC above the prevailing DC-Link voltage and the slew rate is limited to 500V/µs.

7.8 Serial communication, fieldbus

There are several option card for serial communication depending on the bus system. See Fig. 79 for the connection of the serial link.

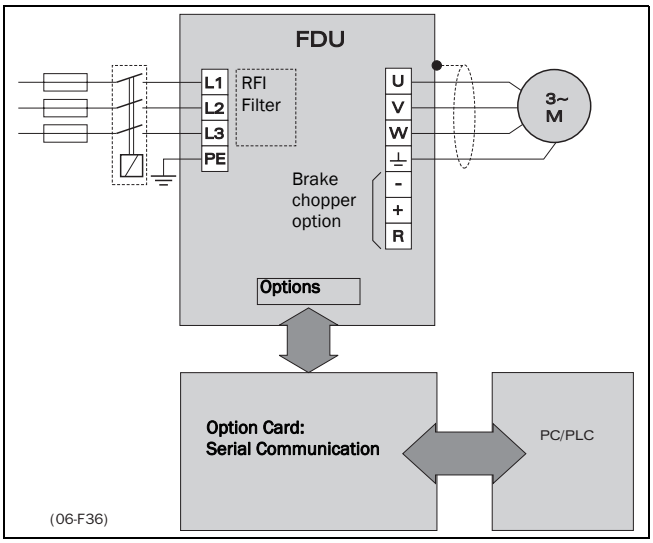


Fig. 79 Connection of a serial link.

Option cards for several bus systems are available: RS485, Profibus etc. See § 5.3.30, page 36.

8. TECHNICAL DATA

8.1 General electrical specifications

Table 33 General electrical specifications

General

Mains voltage:	380-415V +10%/-15% (FDU40) 440-525V +10/-15% (FDU50) 550-690V +10%/-15% (FDU69)
Mains frequency:	50/60Hz
Input power factor:	0.95
Output voltage:	0- Mains supply voltage:
Output frequency:	0-400Hz
Output switching frequency:	FDU40/FDU50 size 1-4: 3kHz FDU69 and size 5, 10, 15: 1.5 kHz
Efficiency at nominal load:	97% for model 003 to 013 98% for model 018 to 037 97.5% for model 046 to 073 98% for model 074 to 1k1

Control signal inputs:
Analogue (differential)

Analogue Voltage/current:	0-10V/0-20mA via jumper
Max. input voltage:	+30V
Input impedance:	20kΩ (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:	<12.8VDC: 5kΩ ≥12.8VDC: 3kΩ
Signal delay:	≤8ms

Control signal outputs
Analogue

Output voltage/current:	0-10V/0-20mA via jumper
Max. output voltage:	+15V @5mA cont.
Short-circuit current (∞):	+15mA (voltage) +140mA (current)
Output impedance:	10Ω (voltage)
Resolution:	10 bit
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 -10VDC @10mA +24VDC Short-circuit current +100mA max (together with Digital Outputs)

8.2 Electrical specifications related to type

Table 34 Electrical specifications related to type 400V/500V

Housing	Type 400V	Nominal power (400V) P_{NOM} [kW]	Type 500V	Nominal power (500V) P_{NOM} [kW]	Nominal output current I_{NOM}[A,RMS]	Current limit Icl during 60s I_{CL},[A,RMS]	Nominal input current I_{IN} [A,RMS]
X1	FDU40-003	0.75			2.5	3	2.2
	FDU40-004	1.5	-	-	4	4.8	3.5
	FDU40-006	2.2	-	-	6	7.2	5.2
	FDU40-008	3	-	-	7.5	9	6.5
	FDU40-010	4	-	-	9.5	11.4	8.2
	FDU40-013	5.5	-	-	13	15.6	11.4
S2	FDU40-018	7.5	FDU50-018	11	18	22	16
	FDU40-026	11	FDU50-026	15	26	31	23
	FDU40-031	15	FDU50-031	18.5	31	37	28
	FDU40-037	18.5	FDU50-037	22	37	44	35
X2	FDU40-046	22	FDU50-046	30	46	55	42
	FDU40-060	30	FDU50-060	37	61	73	57
	FDU40-073	37	-	-	74	89	69
X3	FDU40-074	37	FDU50-074	45	74	89	69
	FDU40-090	45	FDU50-090	55	90	108	85
	FDU40-108	55	-	-	109	131	102
X4	FDU40-109	55	FDU50-109	75	109	131	102
	FDU40-146	75	FDU50-146	90	146	175	137
	FDU40-175	90	FDU50-174	110	175	210	164
X5	FDU40-210	110	FDU50-210	132	210	252	197
	FDU40-250	132	FDU50-250	160	250	300	235
	FDU40-300	160	FDU50-300	200	300	360	282
	FDU40-375	200	FDU50-375	250	375	450	352
X10	FDU40-500	250	FDU50-500	315	500	600	470
	FDU40-600	315	FDU50-600	400	600	720	564
	FDU40-750	400	FDU50-750	500	750	900	704
X15	FDU40-900	500	FDU50-900	630	900	1080	865
	FDU40-1k1	630	FDU50-1k1	710	1125	1350	1081

Table 35 Electrical specifications related to type 690V

Housing	Type 690V	Nominal power (690V) P_{NOM} [kW]	Nominal output current I_{NOM} [A,RMS]	Current limit Icl during 60s I_{CL} [A,RMS]	Nominal input current I_{IN} [A,RMS]
X5	FDU69-120	110	121	145	116
	FDU69-140	132	144	173	138
	FDU69-170	160	173	208	166
	FDU69-215	200	217	260	208
	FDU69-270	250	274	329	263
X10	FDU69-340	315	340	408	326
	FDU69-430	400	430	516	413
	FDU69-540	500	540	648	519
X15	FDU69-645	630	645	774	619
	FDU69-810	800	810	972	778

8.3 Derating at higher temperature

The Table 39 shows the necessary derating if a higher ambient temperature is necessary. For example: If a FDU40-026 has a maximum ambient temperature of 50°C, there is no derating necessary. But with a FDU40-046 derating of 25% (10 x 2,5%) it is possible to operate at an ambient temperature of 50°C.

Table 36 Ambient temperature and derating 400-500V types

Housing	Type 400/500V	IP20		IP23/IP54	
		Max temp.	Derating: possible	Max temp.	Derating: possible
X1	FDU40-003 FDU40-004 FDU40-006 FDU40-008 FDU40-010 FDU40-013	50°C 50°C 50°C 50°C 50°C 40°C	No No No No No Yes, -2.5%/°C to max +10°C	45°C 45°C 45°C 45°C 45°C 35°C	No No No No No Yes, -2.5%/°C to max +10°C
S2	FDU**-018 FDU**-026 FDU**-031 FDU**-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	FDU**-046 FDU**-060 FDU40-073	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	FDU**-074 FDU**-090 FDU40-108	47°C 40°C 40°C	Yes, -2.5%/°C to max +3°C Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C	42°C 35°C –	Yes, -2.5%/°C to max +3°C Yes, -2.5%/°C to max +10°C –
X4	FDU**-109 FDU**-146 FDU40-175 FDU50-174	50°C 46,5°C 40°C 40°C	No Yes, -2.5%/°C to max +3.5°C Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C	45°C 41.5°C 35°C –	No Yes, -2.5%/°C to max +3.5°C Yes, -2.5%/°C to max +10°C –
X5	FDU**-210 FDU**-250 FDU**-300 FDU**-375	50°C 47°C 40°C 40°C	No Yes, -2.5%/°C to max +3°C Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C	45°C 42°C 35°C 35°C	No Yes, -2.5%/°C to max +3°C Yes, -2.5%/°C to max +10°C Yes, -2.5%/°C to max +10°C
X10	FDU**-500 FDU**-600 FDU**-750	40°C 40°C 40°C	Yes, -2.5%/°C to max +10°C	35°C 35°C 35°C	Yes, -2.5%/°C to max +10°C
X15	FDU**-900 FDU**-1k1	40°C 40°C	Yes, -2.5%/°C to max +10°C	35°C 35°C	Yes, -2.5%/°C to max +10°C

Table 37 Ambient temperature and derating 690V type

	690V type	IP20		IP23/IP54	
		Max temp.	Derating: -2.5%/°C to max +10°C	Max temp.	Derating: -2.5%/°C to max +10°C
X5	FDU69-120 FDU69-140 FDU69-170 FDU69-215 FDU69-270	35°C	Yes	35°C	Yes
X10	FDU69-340 FDU69-430 FDU69-540	35°C	Yes	35°C	Yes
X15	FDU69-645 FDU69-810	35°C	Yes	35°C	Yes

8.4 Mechanical specifications

The table below gives an overview of the dimensions and weights. The models 500 to 1k1 consist of 2 or 3 parallelled inverters built in a standard cabinet.

Table 38 Mechanical specifications

Housing	FDU model	Dim. HxWxD [mm] IP20	Dim. HxWxD [mm] IP23/IP54	Weight IP20 [kg]	Weight IP23/IP54 [kg]
X1	003 to 013	350(400)x 220 x 150	350(400)x 220 x 150	10	10
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	074 to 108	650(750) x 340 x 295	650(750) x 340 x 295	55	55
X4	109 to 175	800(900) x 450 x 330	800(900) x 450 x 330	85	85
X5	210 to 375	1100(1145) x 500 x 420	*	160	*
X10	500 to 750	1100(1145) x 1050 x 420	*	320	*
X15	900 to 1k1	1100(1145) x 1600 x 420	*	480	*

* Contact your supplier

8.5 Environmental conditions

Table 39 Environmental conditions

Normal operation	
Temperature:	0 - See table, page 77
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 replaced 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 models 500 to 1k1 can differ, depending on customer specification. Please check the enclosed project documentation for detailed information.

Table 40 Fuses, cable cross-sections and glands 400/500V types

Housing	Type 400V/500V	Maximum value fuse [A]	Max. cable cross-section connector [mm^2]		Clamping range glands [mm] (PG and metric)		
			Solid	Flexible	Mains cable (plastic)	Motor cable (metal)	
						IP 20/23	IP54
X1	FDU40-003 FDU40-004 FDU40-006 FDU40-008 FDU40-010 FDU40-013	6 6 10 10 16 16	6 6 6 6 6 6	4 4 4 4 4 4	PG 13.5(5-12) M20 (7-13)	PG 13.5(14-16.5) M20 (8.5-13)	PG 13.5(6-12) M20 (8.5-13)
S2	FDU**-018 FDU**-026 FDU**-031 FDU**-037	20 25 35 50	16 16 16 16	10 10 10 10	Ø32 (cable entry)		Ø32 (cable entry)
X2	FDU**-046 FDU**-060 FDU40-073	50 80 80	16 25 50	10 16 35	PG29 (14-25) M40 (19-28)	PG29 (23-31) M40 (27-34)	PG29 (18-25) M40 (27-34)
X3	FDU**-074 FDU**-090 FDU40-108	80 100 125	50	35	PG42 (28-38) M50 (27-35)	PG42 (34-50) M50 (35-43)	PG42 (32-38) M50 (35-43)
X4	FDU**-109 FDU**-146 FDU40-175 FDU50-175	125 160 200 200	95 95 95 95		PG48 (34-44) M63 (34-45)	PG48 (39-50) M63 (40-47.5)	PG48 (37-44) M63 (40-47.5)
X5	FDU**-210 FDU**-250 FDU**-300 FDU**-375	250 315 400 400	150 150 150 240		-	-	-
X10	FDU**-500 FDU**-600 FDU**-750	See note	See note		- -	- -	- -
X15	FDU**-900 FDU**-1k1	See note	See note		-	-	-
Control signals					PG11 (4-10) M20 (8-12)	PG11 (11-15) M20 (8-12)	PG11 (5-10) M20 (8-12)

Table 41 Fuses, cable cross-sections and glands 690V type

Housing	690V type	Maximum value fuse [A]	Maximum cable cross-section connector [mm^2]
X5	FDU69-120 FDU69-140 FDU69-170 FDU69-215 FDU69-270	125 160 200 250 300	150
X10	FDU69-340 FDU69-430 FDU69-540	See note	See note
X15	FDU69-645 FDU69-810	See note	See note

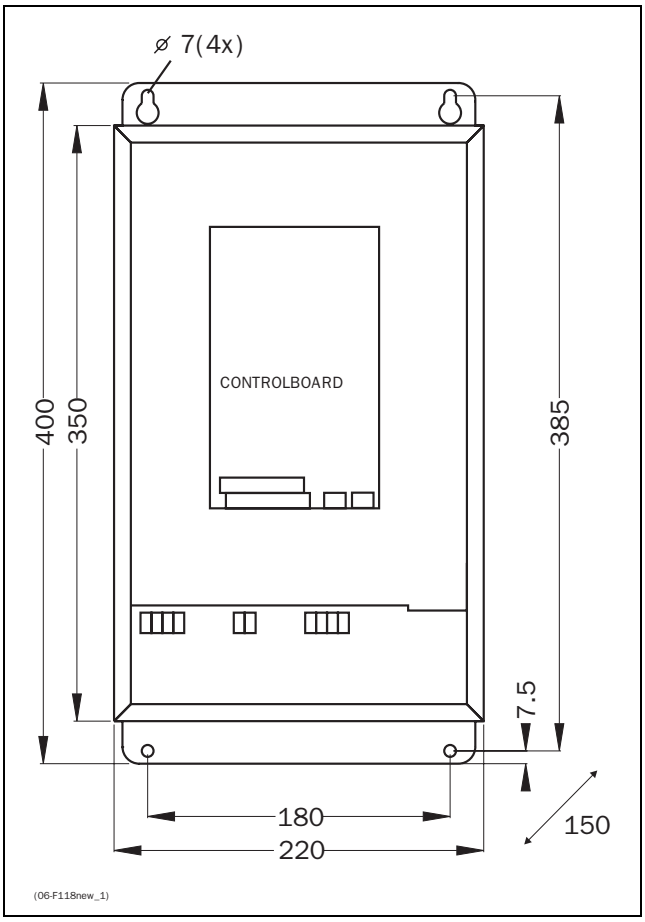


Fig. 80 FDU model 003 to 013 (X1)

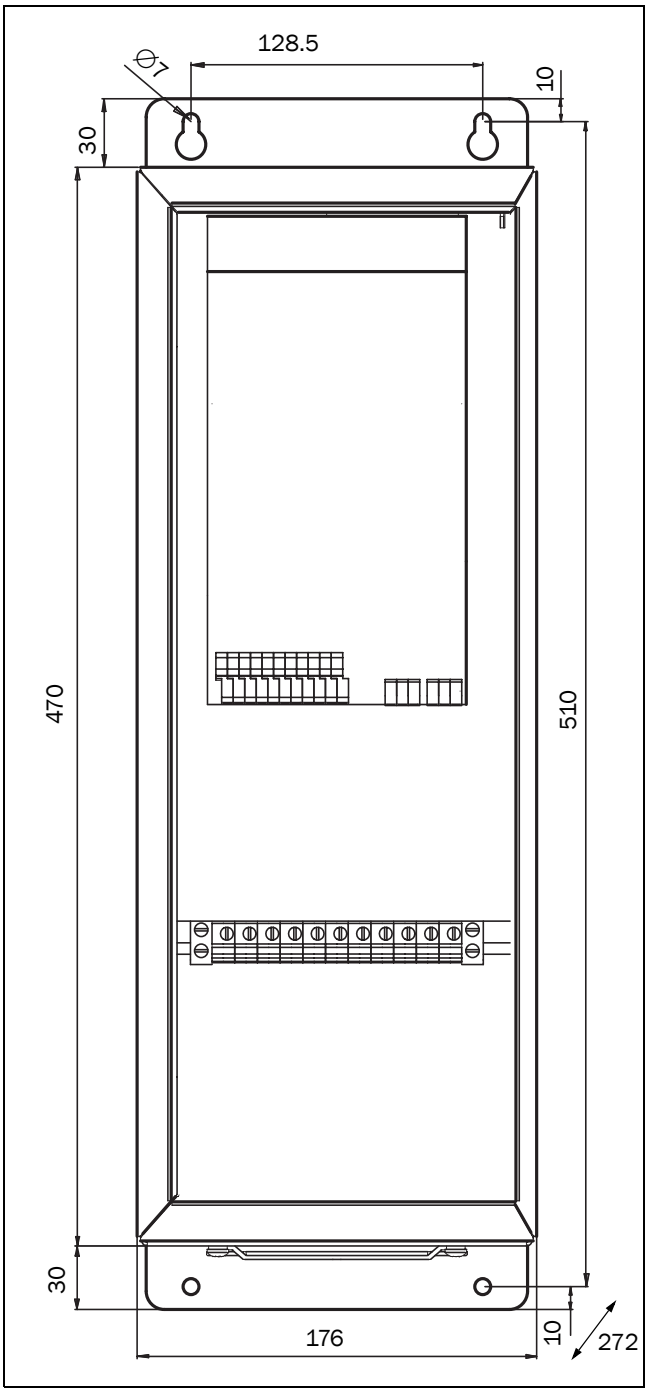


Fig. 81 FDU model 018 to 037 (S2)

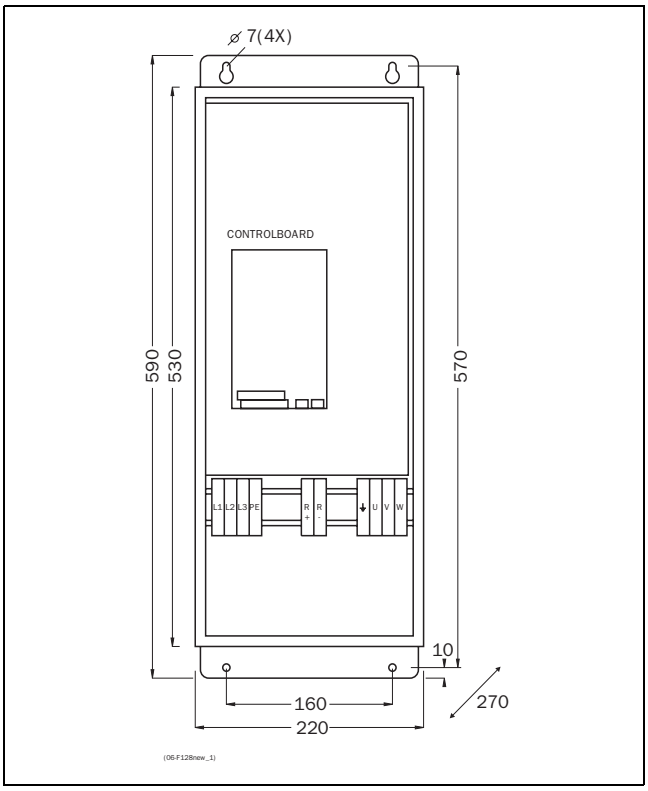


Fig. 82 FDU model 046 to 073 (X2)

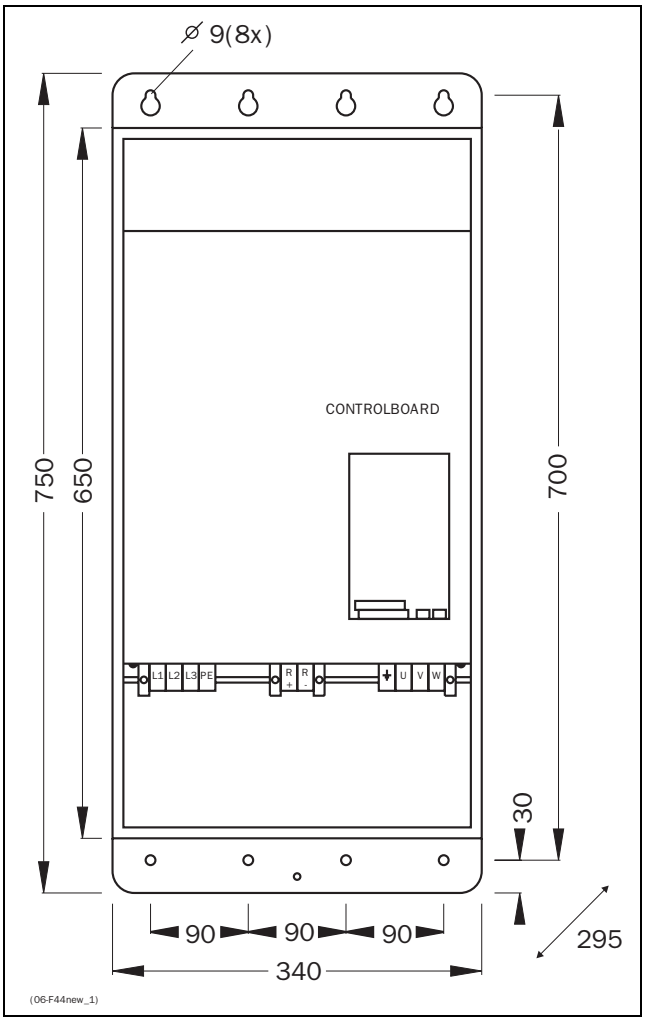


Fig. 83 FDU model 074 to 108 (X3)

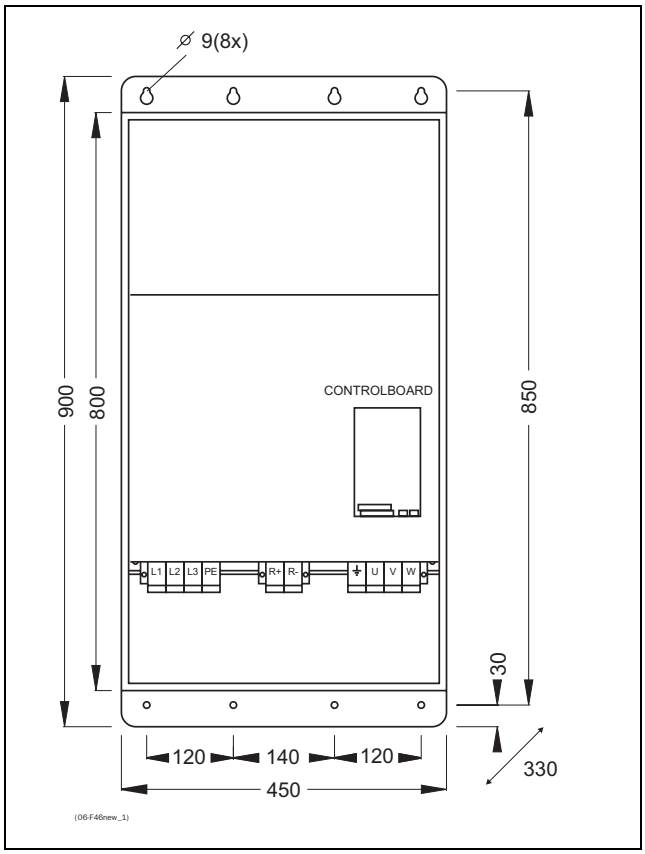


Fig. 84 FDU model 109 to 175 (X4)

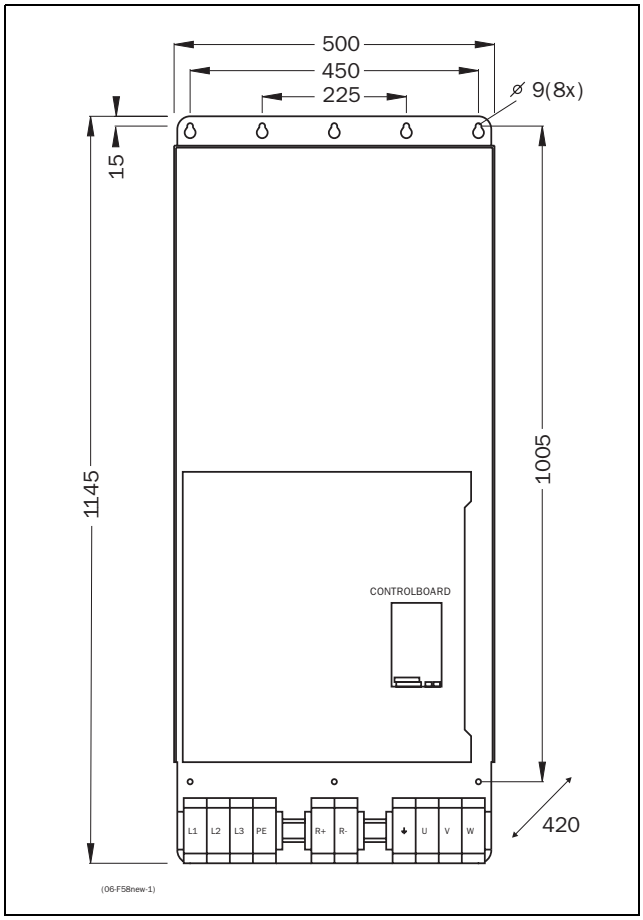


Fig. 85 FDU model 210 to 375 (X5)

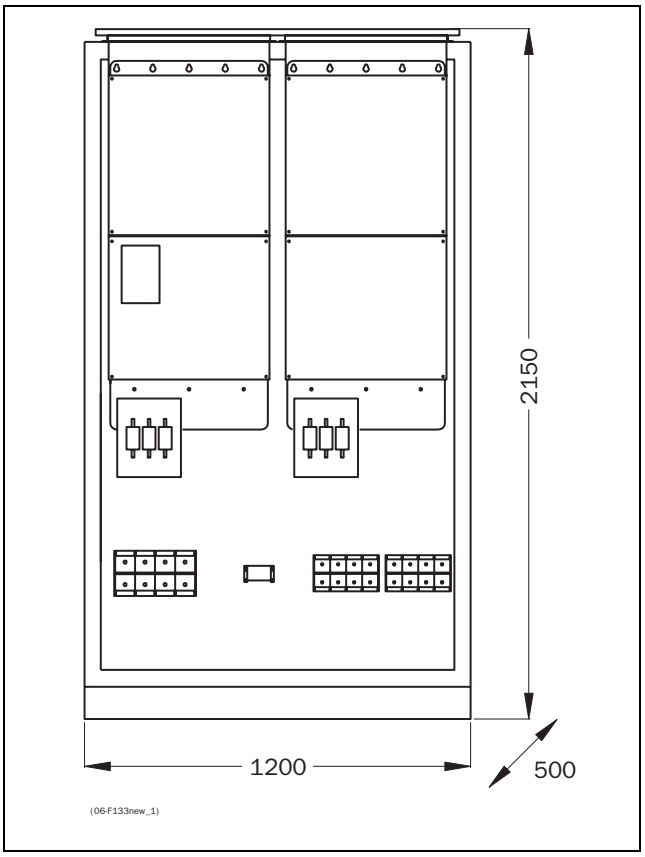


Fig. 86 FDU model 500 to 750, Example in cabinet (X10)

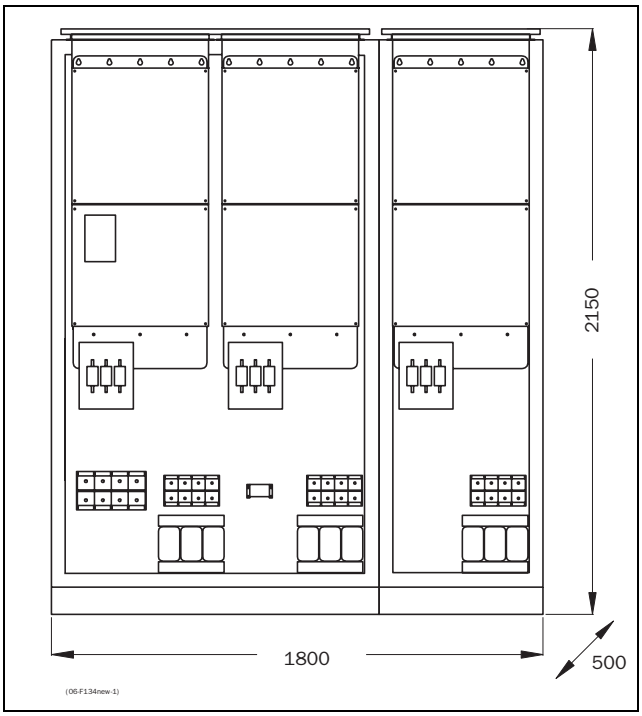


Fig. 87 FDU model 900 to 1k1, Example in cabinet (X15)

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		Frequency	
	120	*2nd Line		Current	
200	Main set-up				
	210	Operation			
		211	*V/Hz Curve	Linear	
		212	Reference Control	Remote	
		213	Run/Stop Control	Remote	
		214	Rotation	R+L	
		215	Level/Edge	Level	
		216	* IxR Comp	0%	
		217	Mains	400V	
	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}	
		229	Poles	–	
	230	Utility			
		231	Language	English	
		232	*Lock Code?	0	
		233	Copy set	A>B	
		234	*Select Set No.	A	
		235	Load Default	A	
		236	*Copy all settings to CP	CP MEM1	
		237	Load all 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	Undervoltage	Off	
		24E	Comm Error	Off	
250	Option: Serial Comm.				
		251	Baudrate	9600	
		252	Address	1	
		253	Interrupt	Trip	
260	PTC				
		261	*PTC Function	Off	
270	Macros				
		271	*Select macro	Loc/Rem Ana	
280	Pump/Fan Control				
300	Parameter Sets				
310	Run/Stop				
		311	*Acc. time	2.00s	
		312	*Acc. MotPot	16.00s	
		313	*Acc>Min Freq	2.00s	
		314	*Acc. ramp type	Linear	
		315	*Dec time	2.00s	
		316	*Dec MotPot	16.00s	
		317	*Dec<Min Freq	2.00s	
		318	*Dec Ramp Type	Linear	
		319	*Start Mode	Fast	
		31A	*Stop Mode	Decel	
		31B	*Spinstart	Off	
320	Frequencies				
		321	*Min Frequency	0Hz	
		322	*Max Frequency	f_{MOT}Hz	
		323	*Min Freq Mode	Scale	
		324	Frequency Direct	R	
		325	*Motor Pot.	Non vola	
		326	*Preset Freq 1	10Hz	
		327	*Preset Freq 2	20Hz	
		328	*Preset Freq 3	30Hz	
		329	*Preset Freq 4	35Hz	
		32A	*Preset Freq 5	40Hz	
		32B	*Preset Freq 6	45Hz	
		32C	*Preset Freq 7	50Hz	
		32D	*Skip Freq 1 Low	0Hz	
		32E	*Skip Freq 1 High	0Hz	
		32F	*Skip Freq 2 Low	0Hz	
		32G	*Skip Freq 2 High	0Hz	
		32H	*Jog Frequency	2Hz	
330	Torques				
		331	*Torque limit	Off	
		332	*Maximum Torque	120%	
340	Controllers				
		341	*Flux Optimization	Off	
		342	*Sound Char	F	
		343	*PID Control	Off	
		344	*PID P Gain	1.0	
		345	*PID i Time	1.00s	
		346	*PID D Time	0.00s	

				DEFAULT	CUSTOM
	350	Limits/Protections			
		351	*Low Volt Override	Off	
		352	*Rotor locked	Off	
		353	*Motor lost	Off	
		354	*Motor I^2t Type	Trip	
		355	*Motor I^2t I	$I_{MOT}(A)$	
400	I/O				
	410	Analogue Inputs			
		411	AnIn1 Function	Frequency	
		412	AnIn1 Setup	0-10V/ 0-20mA	
		413	*AnIn1 Offset	0%	
		414	*AnIn1 Gain	1.00	
		415	AnIn2 Function	Off	
		416	AnIn2 Setup	0-10V/ 0-20mA	
		417	*AnIn2 Offset	0%	
		418	*AnIn2 Gain	1.00	
	420	Digital Inputs			
		421	Digital Input 1	Run	
		422	Digital input 2	Off	
		423	Digital input 3	Off	
		424	Digital input 4	Reset	
		425	Digital Input 5	Off	
		426	Digital Input 6	Off	
		427	Digital Input 7	Off	
		428	Digital Input 8	Off	
	430	Analogue Outputs			
		431	*AnOut1 Function	Frequency	
		432	*AnOut1 Setup	0-10V/0-20mA	
		433	*AnOut1 Offset	0%	
		434	*AnOut1 Gain	1.00	
		435	*AnOut2 Function	Current	
		436	*AnOut2 Set-up	0-10V/0-20mA	
		437	*AnOut2 Offset	0%	
		438	*AnOut2 Gain	1.00	
	440	Digital Outputs			
		441	*DigOut1 Funct	Run	
		442	*DigOut2 Funct	No Trip	
	450	Relays			
		451	*Relay 1 Function	Trip	
		452	*Relay 2 Function	Ready	
500	Set/View reference value				
600	View operation				
	610	Frequency			.....Hz
	620	Load			.....%Nm
	630	Electrical power			.....kW
	640	Current			.....ARMS
	650	Voltage			.....VAC
	660	DC-Voltage			V
	670	Temperature			.....^oC
	680	FI-Status			.....
	690	Digital Input status			.....
	6A0	Analogue Input status			1:.....2:.....
	6B0	Run Time			h.....m.....
		6B1	*Reset Run Time	No	
	6C0	Mains Time			.....

				DEFAULT	CUSTOM
	6D0	Energy			.....kWh
		6D1	*Reset Energy	No	
	6E0	Process Frequency			h:....m.....
		6E1	*Set Prc Unit	Off	
		6E2	*Set Prc Scale	1.000	
	6F0	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	*Alarm Trip	Off	
		813	*Ramp Alarm	Off	
		814	*Start Delay	2s	
		815	*Response Delay	0.1s	
		816	*Auto Set	No	
		817	*Max Alarm	120%	
		818	*Max Pre-Alarm	110%	
		819	*Min Alarm	0%	
		81A	*Min Pre-Alarm	90%	
	820	Comparators			
		821	*CA 1 Value	Frequency	
		822	*CA 1 Constant	10Hz	
		823	*CA 2 Value	Load	
		824	*CA 2 Constant	20%	
		825	*CD 1	Run	
		826	*CD 2	DigIn 1	
	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 42 Parameter Set List

				Default	A	B	C	D
300	Parameter Sets							
	310	Run/Stop						
		311	*Acc. time	2.00s				
		312	*Acc. MotPot	16.00s				
		313	*Acc>Min Freq	2.00s				
		314	*Acc. ramp type	Linear				
		315	*Dec time	2.00s				
		316	*Dec MotPot	16.00s				
		317	*Dec<Min Freq	2.00s				
		318	*Dec Ramp Type	Linear				
		319	*Start Mode	Fast				
		31A	*Stop Mode	Decel				
		31B	*Spinstart	Off				
	320	Frequency						
		321	*Min Frequency	0Hz				
		322	*Max Frequency	f_{MOT}Hz				
		323	*Min Freq Mode	Scale				
		324	Frequency Direct	R				
		325	*Motor Pot.	Non vola				
		326	*Preset Freq 1	10Hz				
		327	*Preset Freq 2	20Hz				
		328	*Preset Freq 3	30Hz				
		329	*Preset Freq 4	35Hz				
		32A	*Preset Freq 5	40Hz				
		32B	*Preset Freq 6	45Hz				
		32C	*Preset Freq 7	50Hz				
		32D	*Skip Freq 1 Low	0Hz				
		32E	*Skip Freq 1 High	0Hz				
		32F	*Skip Freq 2 Low	0Hz				
		32G	*Skip Freq 2 High	0Hz				
		32H	*Jog Frequency	2Hz				
	330	Torques						
		331	*Torque Limit	Off				
		332	*Maximum Torque	120%				
	340	Controllers						
		341	*Flux Optimization	Off				
		342	*Sound Char	F				
		343	*PID Control	Off				
		344	*PID P Gain	1.0				
		345	*PID I Time	1.00s				
		346	*PID i Time	1.00s				
		347	*PID D Time	0.00s				
		348	*Flux Optimization	Off				
	350	Limits/Protections						
		351	*Low Volt Override	Off				
		352	*Rotor locked	Off				
		353	*Motor lost	Off				
		354	*Motor I^2t Type	Trip				
		355	*Motor I^2t I	I_{MOT}(A)				

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