GE Consumer & Industrial
Electrical Distribution

AF-650 GP™
General Purpose Drive
(230V to 50HP, 460/575V to 100HP)

Operating Instructions

imagination at work

Contents

1. How to Read these Operating Instructions

1.1.1. How to Read these Operating Instructions

AF-650 GP is designed to provide high shaft performance on electrical motors. Please read this manual carefully for proper use. Incorrect handling of the frequency converter may cause improper operation of the frequency converter or related equipment, shorten lifetime or cause other troubles.

These Operating Instructions will help you get started, install, program, and troubleshoot your AF-650 GP.
. AF-650 GP is a high performance frequency converter for asynchronous as well as permanent motors and handles various kinds of motor control principles such as volts/hertz, advanced vector control, sensorless vector, and full flux vector control..
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Chapter 1, **How to Read these Operating Instructions**, introduces the manual and informs you about the approvals, symbols, and abbreviations used in this literature.

Chapter 2, **Safety Instructions and General Warnings**, entails instructions on how to handle the AF-650 GP correctly.

Chapter 3, **How to Install**, guides you through mechanical and technical installation.

Chapter 4, **How to Program**, shows you how to operate and program the AF-650 GP via the Keypad.

Chapter 5, **General Specifications**, contains technical data about AF-650 GP.

Chapter 6, **Troubleshooting**, assists you in solving problems that may occur when using AF-650 GP.

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Available Literature for AF-650 GP

- The AF-650 GP Design Guide entails all technical information about the drive design and applications including encoder, resolver and relay options.
- The AF-650 GP Profibus Operating Instructions provide the information required for controlling, monitoring and programming the drive via a Profibus fieldbus.
- The AF-650 GP DeviceNet Operating Instructions provide the information required for controlling, monitoring and programming the drive via a DeviceNet fieldbus.
- The AF-650 GP DCT 10 Operating Instructions provide information for installation and use of the software on a PC.
- The AF-650 GP IP21 / Nema 1 kit Instruction provides information for installing the IP21 / Nema 1 field installed option kits..
- The AF-650 GP 24 V DC Backup Instruction provides information for installing the 24 V DC Backup option.

GE technical literature is also available online at www.geelectrical/drives.

1.1.2. Approvals

1.1.3. Symbols

Symbols used in this Operating Instructions.

NB!
Indicates something to be noted by the reader.

Indicates a general warning.

Indicates a high-voltage warning.

*	Indicates default setting

1.1.4. Abbreviations

Alternating current	AC
American wire gauge	AWG
Ampere/AMP	A
Current limit	I_{LIM}
Degrees Celsius	°C
Direct current	DC
Drive Control Tool	DCT
Drive Dependent	D-TYPE
Electro Magnetic Compatibility	EMC
Electronic Thermal Overload	Elec. OL
Gram	g
Hertz	Hz
Kilohertz	kHz
Meter	m
Millihenry Inductance	mH
Milliampere	mA
Millisecond	ms
Minute	min
Nanofarad	nF
Newton Meters	Nm
Nominal motor current	$I_{M,N}$
Nominal motor frequency	$f_{M,N}$
Nominal motor power	$P_{M,N}$
Nominal motor voltage	$U_{M,N}$
Parameter	par.
Protective Extra Low Voltage	PELV
Printed Circuit Board	PCB
Rated Inverter Output Current	I_{INV}
Revolutions Per Minute	RPM
Regenerative terminals	Regen
Second	s
Synchronous Motor Speed	n_s
Torque limit	T_{LIM}
Volts	V

2

2. Safety Instructions and General Warning

Equipment containing electrical components may not be disposed of together with domestic waste.
It must be separately collected with electrical and electronic waste according to local and currently valid legislation.

The DC link capacitors remain charged after power has been disconnected. To avoid electrical shock hazard, disconnect the frequency converter from mains before carrying out maintenance. When using a PM-motor, make sure it is disconnected. Before doing service on the frequency converter wait at least the amount of time indicated below:

380 - 500 V	0.25 - 7.5 kW	4 minutes
	11 - 75 kW	15 minutes
	90 - 200 kW	20 minutes
	250 - 800 kW	40 minutes
525 - 690 V	37 - 315 kW	20 minutes
	355 - 1000 kW	30 minutes

AF-650 GP

Operating Instructions

Software version: 4.9x

These Operating Instructions can be used for all AF-650 GP frequency converters with software version 4.9x.
The software version number can be seen from par. ID-43 Software *Version*.

2.1.1. High Voltage

The voltage of the frequency converter is dangerous whenever the frequency converter is connected to mains. Incorrect installation or operation of the motor or frequency converter may cause damage to the equipment, serious personal injury or death. The instructions in this manual must consequently be observed, as well as applicable local and national rules and safety regulations.

Installation in high altitudes

380 - 500 V: At altitudes above 3 km, please contact GE regarding PELV.

525 - 690 V: At altitudes above 2 km, please contact GE regarding PELV.

The voltage of the frequency converter is dangerous whenever connected to mains. Incorrect installation of the motor, frequency converter or fieldbus may cause damage to the equipment, serious personal injury or death. Consequently, the instructions in this manual, as well as national and local rules and safety regulations, must be complied with.

2

Safety Regulations

1. The mains supply to the frequency converter must be disconnected whenever repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has elapsed before removing motor and mains supply plugs.
2. The [OFF] button on the control panel of the frequency converter does not disconnect the mains supply and consequently it must not be used as a safety switch.
3. The equipment must be properly earthed, the user must be protected against supply voltage and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The earth leakage current exceeds 3.5 mA.
5. Protection against motor overload is not included in the factory setting. If this function is desired, set par. F-10 *Electronic Overload* to data value Elec. OL trip 1 [4] or data value Elec. OL warning 1 [3].
6. Do not remove the plugs for the motor and mains supply while the frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has elapsed before removing motor and mains plugs.
7. Please note that the frequency converter has more voltage sources than L1, L2 and L3, when load sharing (linking of DC intermediate circuit) or external 24 V DC are installed. Check that all voltage sources have been disconnected and that the necessary time has elapsed before commencing repair work.

2.1.2. General Warning

Warning:
Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.
Also make sure that other voltage inputs have been disconnected, such as load-sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic back-up.
Using AF-650 GP: wait at least 15 minutes.
Shorter time is allowed only if indicated on the nameplate for the specific unit.

Leakage Current
The earth leakage current from the frequency converter exceeds 3.5 mA. To ensure that the earth cable has a good mechanical connection to the earth connection (terminal 95), the cable cross section must be at least 10 mm^2 or 2 times rated earth wires terminated separately.
Residual Current Device
This product can cause a D.C. current in the protective conductor. Where a residual current device (RCD) is used for extra protection, only an RCD of Type B (time delayed) shall be used on the supply side of this product.
Protective earthing of the AF-650 GP and the use of RCD's must always follow national and local regulations.

NB!
For vertical lifting or hoisting applications it is strongly recommended to ensure that the load can be stopped in case of an emergency or a malfunction of a single part such as a contactor, etc.
If the frequency converter is in alarm mode or in an over voltage situation, the mechanical brake cuts in.

2.1.3. Before Commencing Repair Work

1. Disconnect the frequency converter from mains
2. Disconnect DC bus terminals 88 and 89 from load share applications
3. Wait for discharge of the DC-link. See period of time on the warning label
4. Remove motor cable

2.1.4. Avoid Unintended Start

While the frequency converter is connected to mains, the motor can be started/stopped using digital commands, bus commands, references or via the (Keypad).

- Disconnect the frequency converter from mains whenever personal safety considerations make it necessary to avoid unintended start.
- To avoid unintended start, always activate the [OFF] key before changing parameters.
- An electronic fault, temporary overload, a fault in the mains supply, or lost motor connection may cause a stopped motor to start. Frequency converter with Safe Stop provides protection against unintended start, if the Safe Stop Terminal 37 is on low voltage level or disconnected.

2.1.5. Safe Stop of AF-650 GP

The AF-650 GP can perform the safety function *Safe Torque Off* (As defined by IEC 61800-5-2) or *Stop Category 0* (as defined in EN 60204-1).

It is designed and approved suitable for the requirements of Safety Category 3 in EN 954-1. This functionality is called Safe Stop. Prior to integration and use of Safe Stop in an installation, a thorough risk analysis on the installation must be carried out in order to determine whether the Safe Stop functionality and safety category are appropriate and sufficient. In order to install and use the Safe Stop function in accordance with the requirements of Safety Category 3 in EN 954-1, the related information and instructions of the AF-650 GP Design Guide must be followed! The information and instructions of the Operating Instructions are not sufficient for a correct and safe use of the Safe Stop functionality!

2.1.6. Safe Stop Installation

To carry out an installation of a Category 0 Stop (EN60204) in conformance with Safety Category 3 (EN954-1), follow these instructions:

1. The bridge (jumper) between Terminal 37 and 24 V DC must be removed. Cutting or breaking the jumper is not sufficient. Remove it entirely to avoid short-circuiting. See jumper on illustration.
2. Connect terminal 37 to 24 V DC by a short-circuit protected cable. The 24 V DC voltage supply must be interruptible by an EN954-1 Category 3 circuit interrupt device. If the interrupt device and the frequency converter are placed in the same installation panel, you can use a regular cable instead of a protected one.
3. The Safe Stop function only fulfills EN 954-1 Category 3 if it is protected by a Nema 12 or Nema 4 drive. Open Chassis or Nema 1 drives must be mounted in a Nema 12 or higher cabinet to meet protection requirements for the Safe Stop functionality.

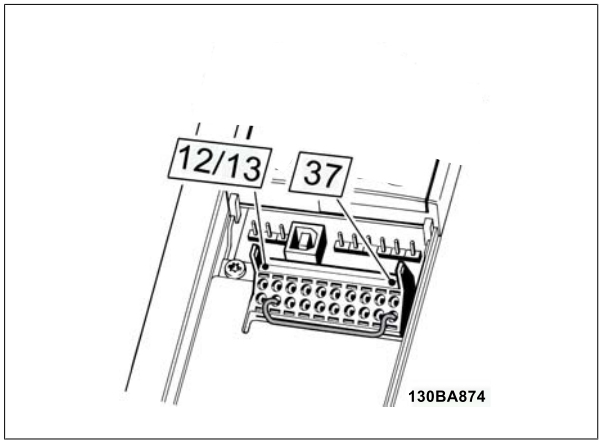


Illustration 2.1: Bridge jumper between terminal 37 and 24 VDC

The illustration below shows a Stopping Category 0 (EN 60204-1) with safety Category 3 (EN 954-1). The circuit interrupt is caused by an opening door contact. The illustration also shows how to connect a non-safety related hardware coast.

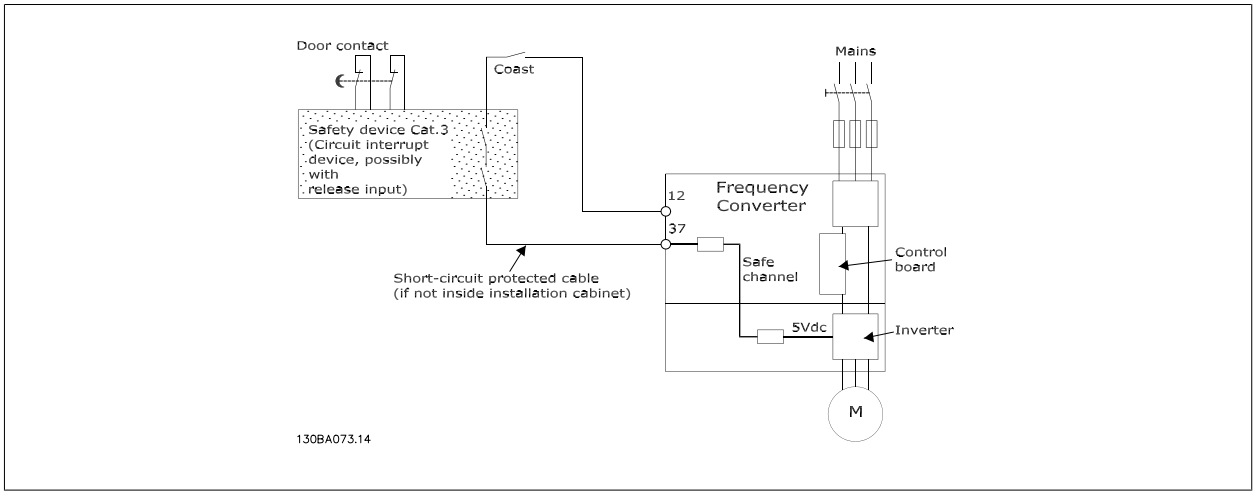


Illustration 2.2: Illustration of the essential aspects of an installation to achieve a Stopping Category 0 (EN 60204-1) with safety Category 3 (EN 954-1).

2.1.7. IT Mains

par. SP-50 RFI *Filter* can be used to disable the factory installed A1/B1 RFI filter option.. If this is done it will reduce the RFI performance to A2 level. For the 525 - 690 V frequency converters, par. SP-50 RFI *Filter* is not available as there is no A1/B1 Factory Installed RFI Filter option..

3. How to Install

3.1.1. About How to Install

This chapter covers mechanical and electrical installations to and from power terminals and control card terminals.
Electrical installation of *options* is described in the relevant Operating Instructions and Design Guide.

3.1.2. How to Get Started

AF-650 GP is designed to achieve a quick installation by following the steps described below.

Read the safety instructions before installing the unit.

Mechanical Installation

- Mechanical mounting

Electrical Installation

- Connection to Mains and Protecting Earth
- Motor connection and cables
- Fuses and circuit breakers
- Control terminals - cables

Quick setup

- Keypad
- Auto Tuning of drive
- Programming

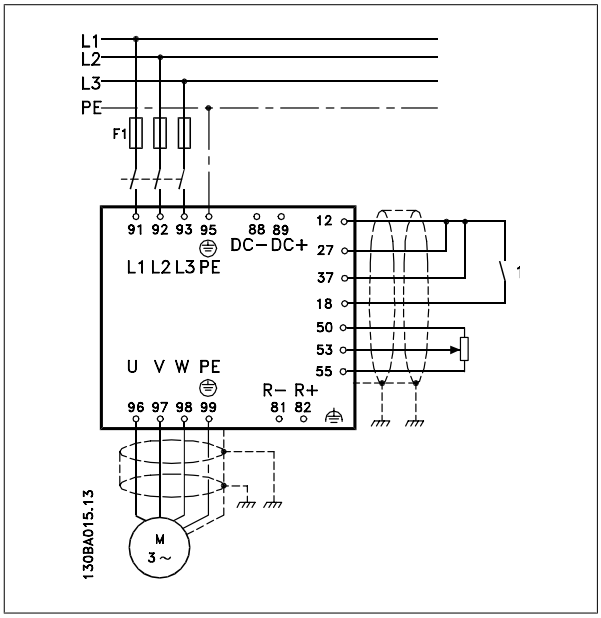


Illustration 3.1: Diagram showing basic installation including mains, motor, start/stop key, and potentiometer for speed adjustment.

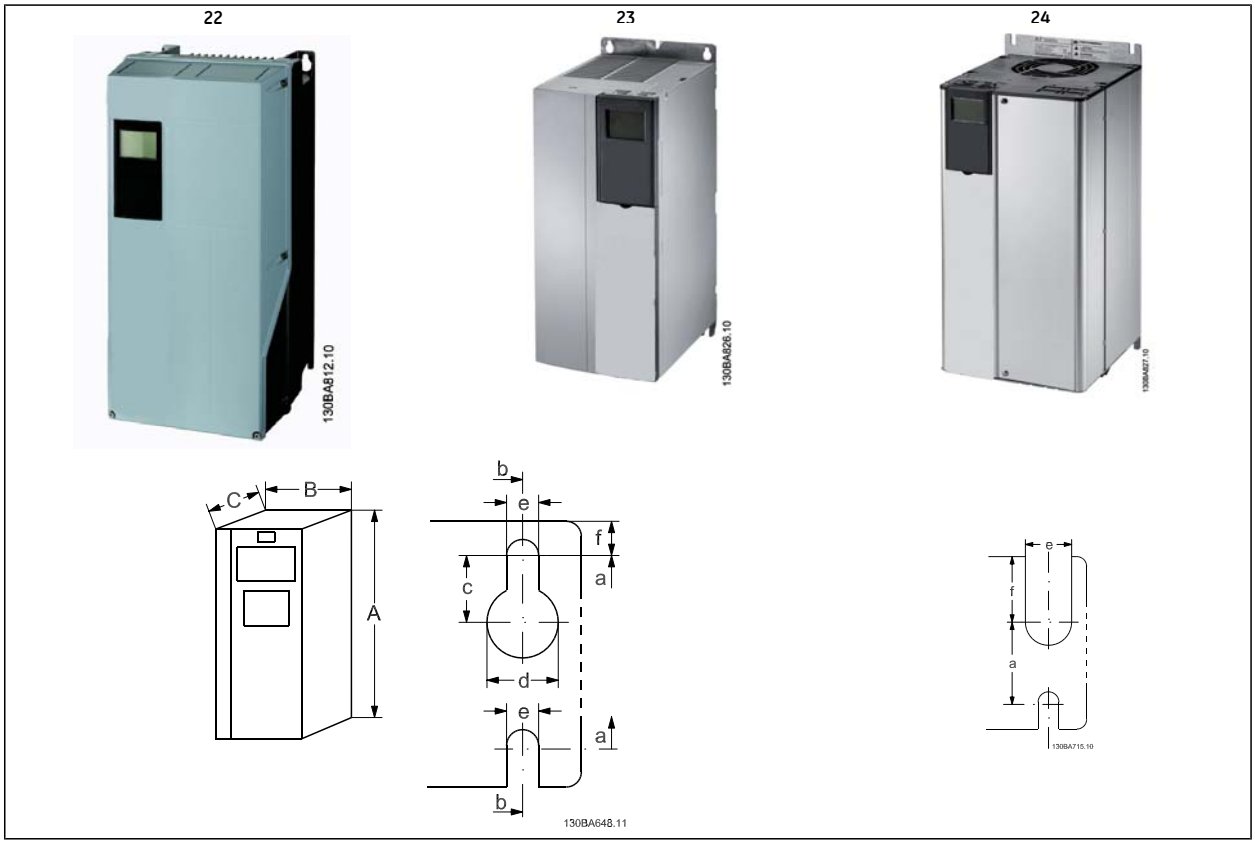
Mechanical Dimensions, 1X Unit Sizes

12/13

15

Unit Sizes		**12**		**13**		**15**
		0.25-3 kW (200-240 V) 0.37-4.0 kW (380-480/ 500 V) 0.75-4 kW (525-600 V)		**3.7 kW (200-240 V) 5.5-7.5 kW (380-480/ 500 V) 5.5-7.5 kW (525-600 V)**		**0.25-3.7 kW (200-240 V) 0.37-7.5 kW (380-480/ 500 V) 0.75-7.5 kW (525-600 V)**
IP		20	21	20	21	55/66
NEMA		Chassis	Nema 1	Chassis	Nema 1	Nema 12
Height						
Height of back plate	A	268 mm	375 mm	268 mm	375 mm	420 mm
Height with de-coupling plate	A	374 mm		374 mm	-	-
Distance between mounting holes	a	257 mm	350 mm	257 mm	350 mm	402 mm
Width						
Width of back plate	B	90 mm	90 mm	130 mm	130 mm	242 mm
Width of back plate with one C option	B	130 mm	130 mm	170 mm	170 mm	242 mm
Width of back plate with two C options	B	150 mm	150 mm	190 mm	190 mm	242 mm
Distance between mounting holes	b	70 mm	70 mm	110 mm	110 mm	215 mm
Depth						
Depth without option A/B	C	205 mm	207 mm	205 mm	207 mm	195 mm
With option A/B	C	220 mm	222 mm	220 mm	222 mm	195 mm
Screw holes						
	c	8.0 mm	8.0 mm	8.0 mm	8.0 mm	8.25 mm
	d	ø11 mm	ø11 mm	ø11 mm	ø11 mm	ø12 mm
	e	ø5.5 mm	ø5.5 mm	ø5.5 mm	ø5.5 mm	ø6.5 mm
	f	9 mm	9 mm	9 mm	9 mm	9 mm
Max weight		4.9 kg	5.3 kg	6.6 kg	7.0 kg	13.5/14.2 kg

Mechanical Dimensions, 2X Unit Sizes

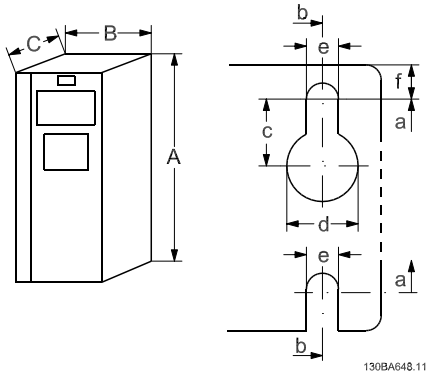


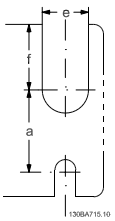
Unit Sizes		22 11 kW (200-240 V) 18.5-22 kW (380-480/ 500 V) 18.5-22 kW (525-600 V)	23 5.5-7.5 kW (200-240 V) 11-15 kW (380-480/500 V) 11-15 kW (525-600 V)	24 11-15 kW (200-240 V) 18.5-30 kW (380-480/ 500 V) 18.5-30 kW (525-600 V)
IP		55/66	20	20
NEMA		Nema 12/Nema 4	Chassis	Chassis
Height				
Height of back plate	A	650 mm	399 mm	520 mm
Height with de-coupling plate	A	-	420 mm	595 mm
Distance between mounting holes	a	624 mm	380 mm	495 mm
Width				
Width of back plate	B	242 mm	165 mm	230 mm
Width of back plate with one C option	B	242 mm	205 mm	230 mm
Width of back plate with two C options	B	242 mm	225 mm	230 mm
Distance between mounting holes	b	210 mm	140 mm	200 mm
Depth				
Depth without option A/ B	C	260 mm	249 mm	242 mm
With option A/B	C	260 mm	262 mm	242 mm
Screw holes				
	c	12 mm	8 mm	
	d	ø19 mm	12 mm	
	e	ø9 mm	6.8 mm	8.5 mm
	f	9 mm	7.9 mm	15 mm
Max weight		27 kg	12 kg	23.5 kg

Mechanical Dimensions,3X Unit Sizes

31/ 32

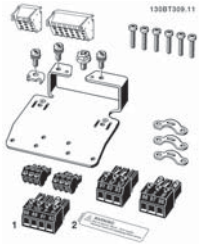
33/ 34





Unit Sizes		31	32	33	34
		15-22 kW (200-240 V) 30-45 kW (380-480/ 500 V) 30-45 kW (525-600 V)	30-37 kW (200-240 V) 55-75 kW (380-480/ 500 V) 55-90 kW (525-600 V)	18.5-22 kW (200-240 V) 37-45 kW (380-480/ 500 V) 37-45 kW (525-600 V)	30-37 kW (200-240 V) 55-75 kW (380-480/ 500 V) 55-90 kW (525-600 V)
IP		55/66	55/66	20	20
NEMA		Nema 12/Nema 4	Nema 12/Nema 4	Chassis	Chassis
Height					
Height of back plate	A	680 mm	770 mm	550 mm	660 mm
Height with de-coupling plate	A			630 mm	800 mm
Distance between mounting holes	a	648 mm	739 mm	521 mm	631 mm
Width					
Width of back plate	B	308 mm	370 mm	308 mm	370 mm
Width of back plate with one C option	B	308 mm	370 mm	308 mm	370 mm
Width of back plate with two C options	B	308 mm	370 mm	308 mm	370 mm
Distance between mounting holes	b	272 mm	334 mm	270 mm	330 mm
Depth					
Depth without option A/B	C	310 mm	335 mm	333 mm	333 mm
With option A/B	C	310 mm	335 mm	333 mm	333 mm
Screw holes					
	c	12.5 mm	12.5 mm		
	d	ø19 mm	ø19 mm		
	e	ø9 mm	ø9 mm	8.5 mm	8.5 mm
	f	9.8 mm	9.8 mm	17 mm	17 mm
Max weight		45 kg	65 kg	35 kg	50 kg

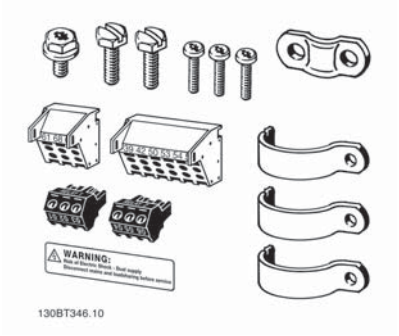
Accessory Bags: Find the following parts included in the frequency converter accessory bags



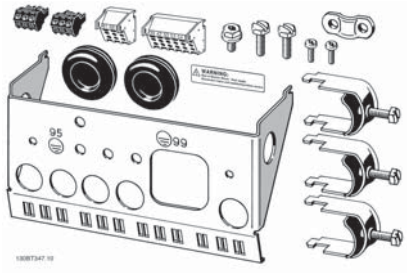
Unit Sizes 22 and 23, IP20 Open Chassis

Unit Size 15, Nema 12 or Nema 4

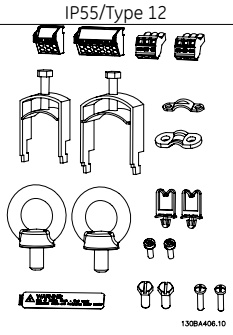
Unit Sizes 21 and 22
IP55/Type 12



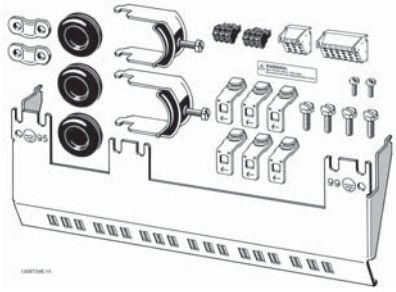
Unit Size 23, IP20 Open Chassis



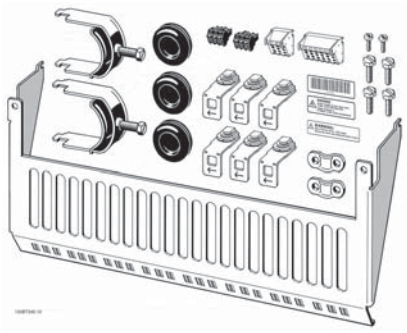
Unit Size 24, IP20 Open Chassis



Unit Sizes 31 and 32, IP55/Nema 12, IP66/Nema 4



Unit Size 23, IP20 Open Chassis



Unit Size 24, IP20 Open Chassis

1 + 2 only available in units with brake chopper. For DC link connection (Load sharing) the connector 1 can be ordered separately

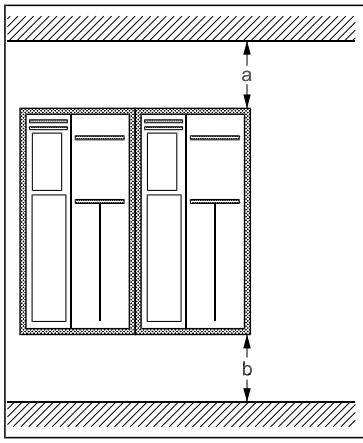
3.2. Mechanical Installation

3.2.1. Mechanical mounting

All IP20 .

If the P21/Nema 1 field installed option kits are installed, there must be a clearance of a minimum of 50mm or 2 inches between drives.

For optimal cooling conditions allow a free air passage above and below the frequency converter. See table below.



Air passage for different Unit Sizes

Unit Size:	12	13	15	21	22	23	24	31	32	33	34
a (mm):	100	100	100	200	200	200	200	200	225	200	225
b (mm):	100	100	100	200	200	200	200	200	225	200	225

Table 3.1:

1. Drill holes in accordance with the measurements given.
2. You must provide screws suitable for the surface on which you want to mount the frequency converter. Retighten all four screws.

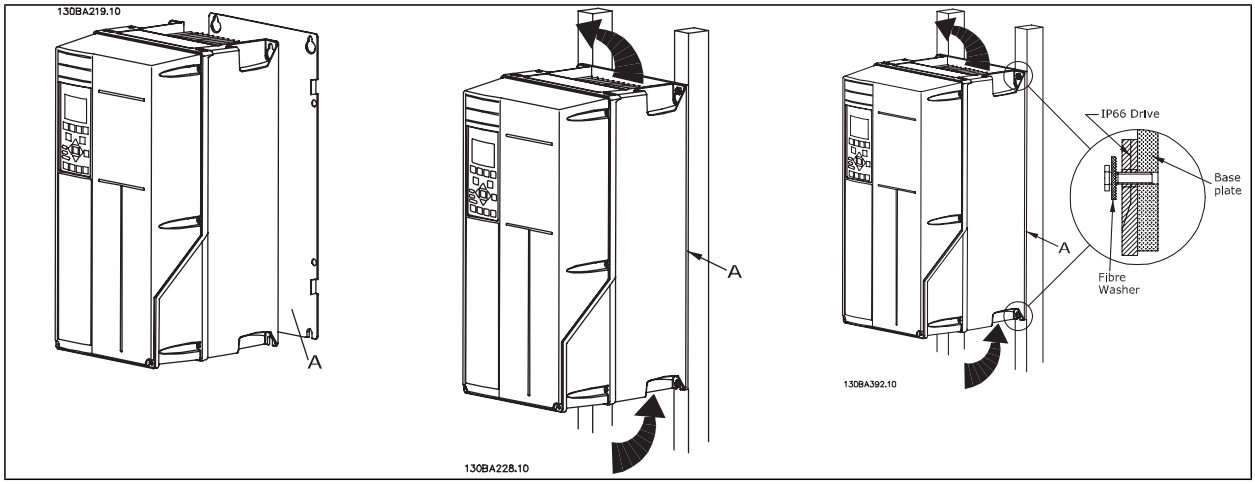


Table 3.2: Mounting Unit Sizes 15, 21, 22, 23, 24, 31, 32, 33 and 34 on a non-solid back wall, the drive must be provided with a back plate A due to insufficient cooling air over the heat sink.

3.2.2. Panel Through Mounting

A Panel Through Mount Kit is available for the AF-650 GP.

In order to increase heatsink cooling and reduce panel depth, the frequency converter may be mounted in a through panel. Furthermore the in-built fan can then be removed.

The kit is available for Unit Sizes 15 through 32 (230V, 1/3 to 50HP and 460V/575V 1/2 to 100HP) .

NB!
This kit cannot be used with cast front covers. No cover or imminent plastic cover must be used instead.

For more information please contact GE.

3.3. Electrical Installation

NB!

Cables General

All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. Copper (60/75°C) conductors are recommended.

Aluminium Conductors

Terminals can accept aluminium conductors but the conductor surface has to be clean and the oxidation must be removed and sealed by neutral acid-free Vaseline grease before the conductor is connected.

Furthermore the terminal screw must be retightened after two days due to softness of the aluminium. It is crucial to keep the connection a gas tight joint, otherwise the aluminium surface will oxidize again.

Tightening-up Torque					
Unit Size	200 - 240 V	380 - 500 V	525 - 690 V	Cable for:	Tightening up torque
11	0.25-1.5 kW	0.37-1.5 kW	-	Mains, Brake resistor, load sharing, Motor cables	0.5-0.6 Nm
12	0.25-2.2 kW	0.37-4 kW	0.75-4 kW		
13	3-3.7 kW	5.5-7.5 kW	5.5-7.5 kW		
15	3-3.7 kW	5.5-7.5 kW	0.75-7.5 kW		
21	5.5-7.5 kW	11-15 kW	-	Mains, Brake resistor, load sharing, Motor cables	1.8 Nm
				Relay	0.5-0.6 Nm
				Earth	2-3 Nm
22	11 kW	18.5-22 kW	-	Mains, Brake resistor, load sharing cables	4.5 Nm
				Motor cables	4.5 Nm
				Relay	0.5-0.6 Nm
				Earth	2-3 Nm
23	5.5-7.5 kW	11-15 kW	-	Mains, Brake resistor, load sharing, Motor cables	1.8 Nm
				Relay	0.5-0.6 Nm
				Earth	2-3 Nm
24	11-15 kW	18.5-30 kW	-	Mains, Brake resistor, load sharing, Motor cables	4.5 Nm
				Relay	0.5-0.6 Nm
				Earth	2-3 Nm
31	15-22 kW	30-45 kW	-	Mains, Brake resistor, load sharing cables	10 Nm
				Motor cables	10 Nm
				Relay	0.5-0.6 Nm
				Earth	2-3 Nm
32	30-37 kW	55-75 kW	-	Mains, motor cables	14 Nm (up to 95 mm^2) 24 Nm (over 95 mm^2)
				Load Sharing, brake cables	14 Nm
				Relay	0.5-0.6 Nm
				Earth	2-3 Nm
33	18.5-22 kW	30-37 kW	-	Mains, Brake resistor, load sharing, Motor cables	10 Nm
				Relay	0.5-0.6 Nm
				Earth	2-3 Nm
34	37-45 kW	55-75 kW	-	Mains, motor cables	14 Nm (up to 95 mm^2) 24 Nm (over 95 mm^2)
				Load Sharing, brake cables	14 Nm
				Relay	0.5-0.6 Nm
				Earth	2-3 Nm

3.3.1. Removal of Knockouts for Extra Cables

1. Remove cable entry from the frequency converter (Avoiding foreign parts falling into the frequency converter when removing knockouts)
2. Cable entry has to be supported around the knockout you intend to remove.
3. The knockout can now be removed with a strong mandrel and a hammer.
4. Remove burrs from the hole.
5. Mount Cable entry on frequency converter.

3.3.2. Connection to Mains and Earthing

NB!
The plug connector for power is plugable on frequency converters up to 7.5 kW.

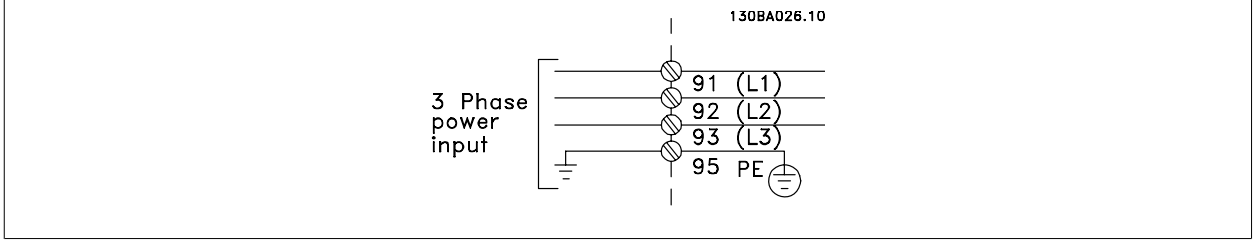
1. Fit the two screws in the de-coupling plate, slide it into place and tighten the screws.
2. Make sure the frequency converter is properly earthed. Connect to earth connection (terminal 95). Use screw from the accessory bag.
3. Place plug connector 91(L1), 92(L2), 93(L3) from the accessory bag onto the terminals labelled MAINS at the bottom of the frequency converter.
4. Attach mains wires to the mains plug connector.
5. Support the cable with the supporting enclosed brackets.

NB!
Check that mains voltage corresponds to the mains voltage of the name plate.

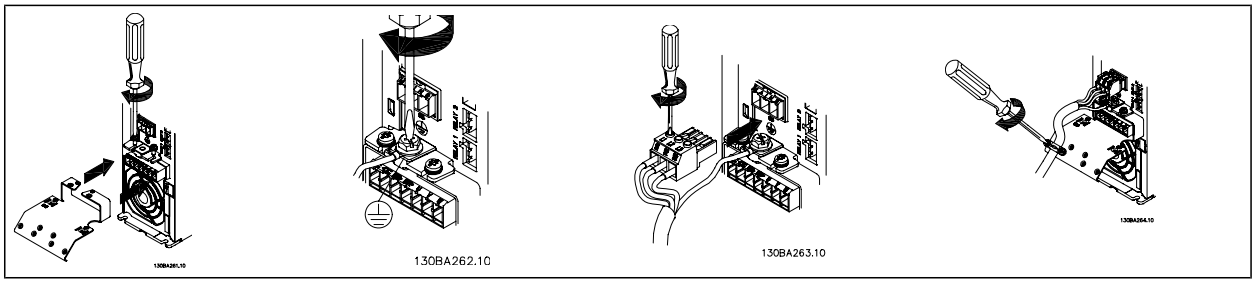
IT Mains
Do not connect 400 V frequency converters with RFI-filters to mains supplies with a voltage between phase and earth of more than 440 V.

The earth connection cable cross section must be at least 10 mm^2 or 2 x rated mains wires terminated separately according to EN 50178.

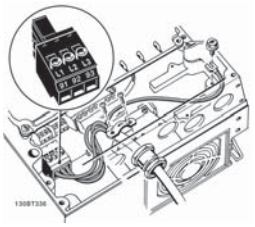
The mains connection is fitted to the mains switch if this is included.

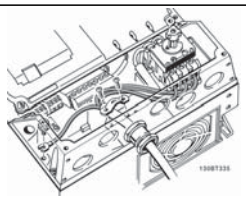


Mains connection for Unit Sizes 12 and 13 IP20 Open Chassis drive types
(230V to 5HP, 460V/575V to 10HP):



Mains connector (IP 55/66)Unit Size 15 Nema 12 or Nema 4 drive types (230V to 5HP, 460V/575V to 10HP)





When disconnector is used (frame size A5) the PE must be mounted on the left side of the drive.

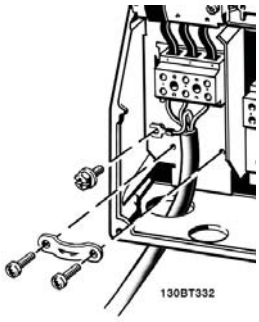


Illustration 3.2: Mains connection for unit sizes 21 and 22 Nema 12 or Nema 4 drive types (230V, 7.5 to 15HP, 460V/575V, 15 to 30HP).

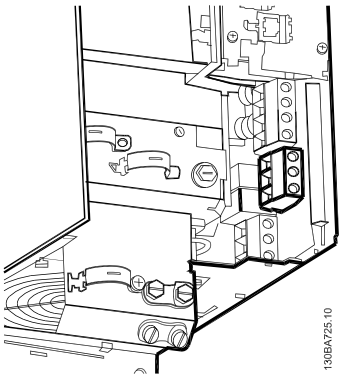


Illustration 3.3: Mains connection for unit size 23 IP20 Open Chassis drive type (230V, 7.5 to 10HP, 460V/575V, 15 to 25HP).

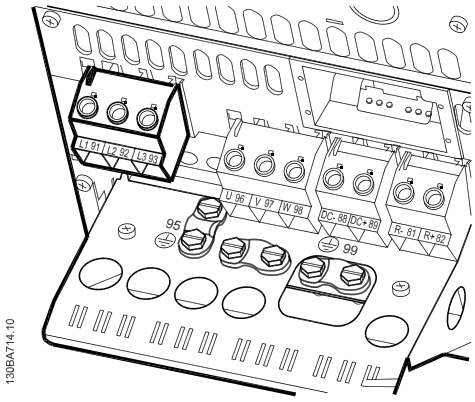


Illustration 3.4: Mains connection for unit size 24 IP20 Open Chassis drive type (230V, 15 to 20HP, 460V/575V, 25 to 40HP).

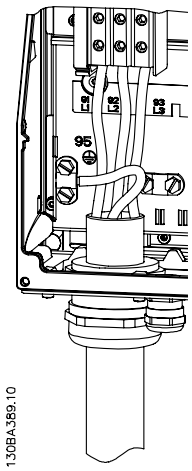


Illustration 3.5: Mains connection for unit sizes 31 and 32 Nema 12 or Nema 4 drive types (230V, 20 to 50HP, 460V, 40 to 100HP, 575V, 40 to 125HP).

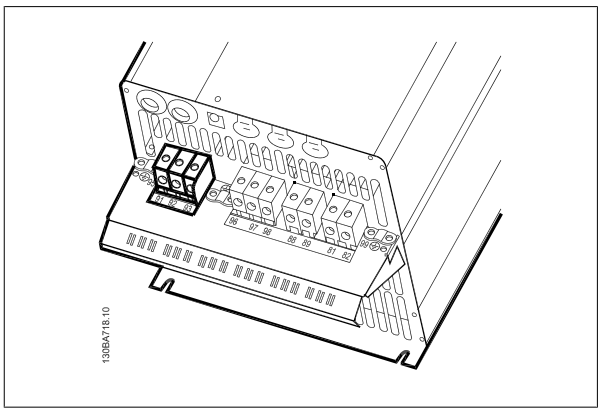


Illustration 3.6: Mains connection for unit size 33 IP20 Open Chassis drive type (230V, 25 to 30HP, 460V/575V, 50 to 60HP).

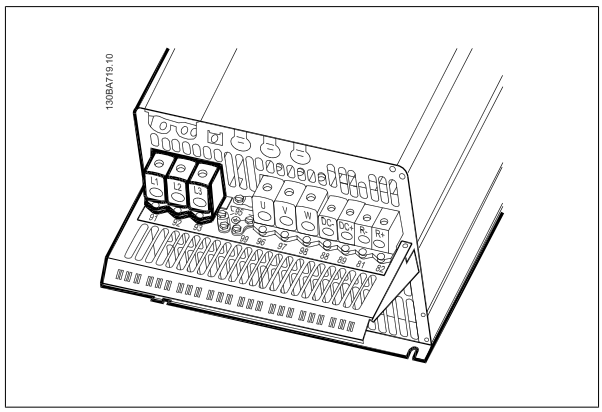


Illustration 3.7: Mains connection for unit size 34 IP20 Open Chassis drive type (230V, 40 to 50HP, 460V, 75 to 100HP, 575V, 75 to 125HP).

Usually the power cables for mains are unshielded cables.

3.3.3. Motor Connection

NB!
Use a screened/armoured motor cable to comply with EMC emission specifications. For more information, see *EMC Test Results*.

See section General Specifications for correct dimensioning of motor cable cross-section and length.

Screening of cables: Avoid installation with twisted screen ends (pigtails). If it is necessary to break the screen to install a motor isolator or motor contactor, the screen must be continued at the lowest possible HF impedance.
Connect the motor cable screen to both the decoupling plate of the frequency converter and to the metal housing of the motor.
Make the screen connections with the largest possible surface area (cable clamp). This is done by using the supplied installation devices in the frequency converter.
If it is necessary to split the screen to install a motor isolator or motor relay, the screen must be continued with the lowest possible HF impedance.

Cable-length and cross-section: The frequency converter has been tested with a given length of cable and a given cross-section of that cable. If the cross-section is increased, the cable capacitance - and thus the leakage current - may increase, and the cable length must be reduced correspondingly. Keep the motor cable as short as possible to reduce the noise level and leakage currents.

Switching frequency: When frequency converters are used together with Sine-wave filters to reduce the acoustic noise from a motor, the switching frequency must be set according to the Sine-wave filter instruction in par. F-26 Motor *Noise (Carrier Freq)*.

1. Fasten decoupling plate to the bottom of the frequency converter with screws and washers from the accessory bag.
2. Attach motor cable to terminals 96 (U), 97 (V), 98 (W).
3. Connect to earth connection (terminal 99) on decoupling plate with screws from the accessory bag.
4. Insert plug connectors 96 (U), 97 (V), 98 (W) (up to 7.5 kW) and motor cable to terminals labelled MOTOR.
5. Fasten screened cable to decoupling plate with screws and washers from the accessory bag.

All types of three-phase asynchronous standard motors can be connected to the frequency converter. Normally, small motors are star-connected (230/400 V, Y). Large motors are normally delta-connected (400/690 V, Δ). Refer to the motor name plate for correct connection mode and voltage.

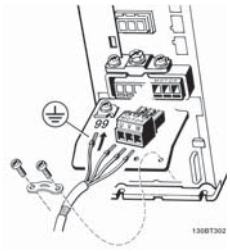


Illustration 3.8: Motor connection for units sizes 12 and 13 IP20 Open Chassis drive types (230V to 5HP, 460V/575V to 10HP)

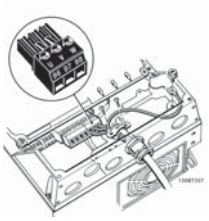


Illustration 3.9: Motor connection for unit size 15 Nema 12 or Nema 4 drive types (230V to 5HP, 460V/575V to 10HP)

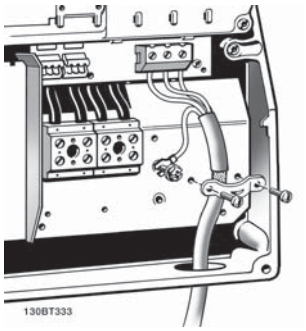


Illustration 3.10: Motor connection for unit sizes 21 and 22 Nema 12 or Nema 4 drive types (230V, 7.5 to 15HP, 460V/575V, 15 to 30HP)

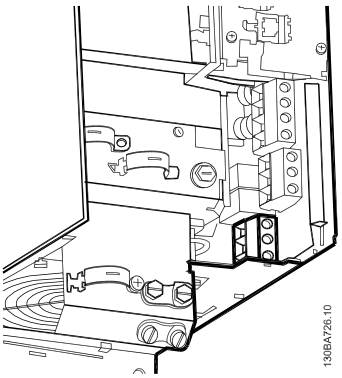


Illustration 3.11: Motor connection for for unit size 23 IP20 Open Chassis drive type (230V, 7.5 to 10HP, 460V/575V, 15 to 25HP).

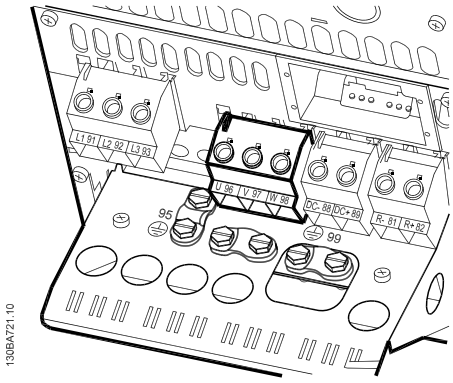


Illustration 3.12: Motor connection for for unit size 24 IP20 Open Chassis drive type (230V, 15 to 20HP, 460V/575V, 25 to 40HP).

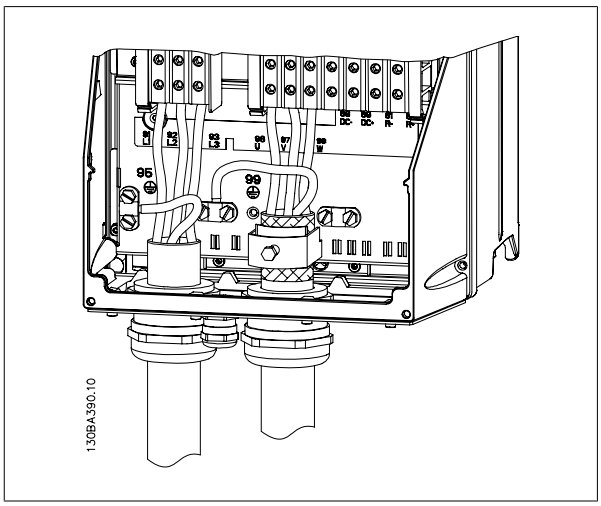


Illustration 3.13: Motor connection for unit sizes 31 and 32 Nema 12 or Nema 4 drive types (230V, 20 to 50HP, 460V, 40 to 100HP, 575V, 40 to 125HP)

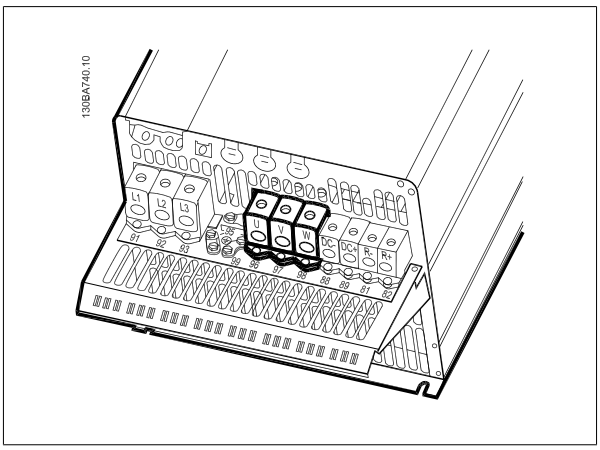


Illustration 3.14: Motor connection for unit sizes 33 and 34 IP20 Open Chassis drive types (230V, 25 to 50HP, 460V, 50 to 100HP, 575V, 50 to 125HP).

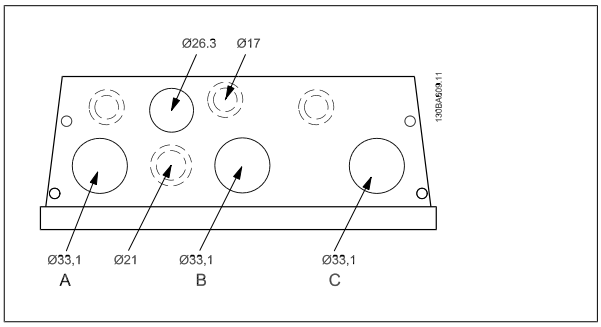


Illustration 3.15: Cable entry holes for unit size 21. The suggested use of the holes are purely recommendations and other solutions are possible.

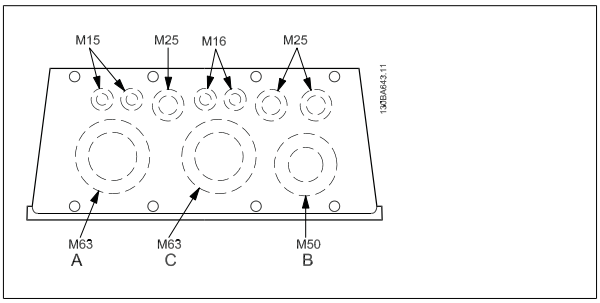


Illustration 3.17: Cable entry holes for unit size 31. The suggested use of the holes are purely recommendations and other solutions are possible.

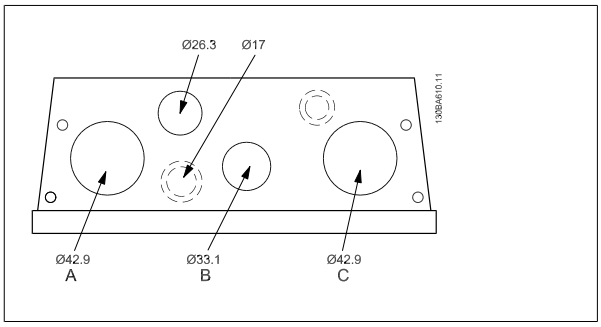


Illustration 3.16: Cable entry holes for unit size 22. The suggested use of the holes are purely recommendations and other solutions are possible.

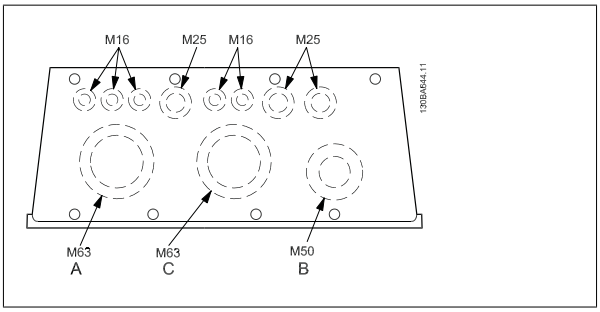
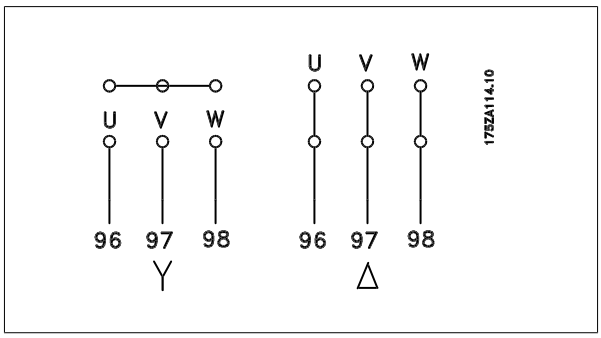


Illustration 3.18: Cable entry holes for unit size 32. The suggested use of the holes are purely recommendations and other solutions are possible.

Term. no.	96	97	98	99	
	U	V	W	PE[1)]	Motor voltage 0-100% of mains voltage. 3 wires out of motor
	U1 W2	V1 U2	W1 V2	PE[1)]	Delta-connected 6 wires out of motor
	U1	V1	W1	PE[1)]	Star-connected U2, V2, W2 U2, V2 and W2 to be interconnected separately.

[1)]Protected Earth Connection



NB!
In motors without phase insulation paper or other insulation reinforcement suitable for operation with voltage supply (such as a frequency converter), fit a Sine-wave filter on the output of the frequency converter.

3.3.4. Fuses

Branch circuit protection:

In order to protect the installation against electrical and fire hazard, all branch circuits in an installation, switch gear, machines etc., must be short-circuited and overcurrent protected according to national/international regulations.

Short-circuit protection:

The frequency converter must be protected against short-circuit to avoid electrical or fire hazard. GE recommends using the fuses mentioned below to protect service personnel and equipment in case of an internal failure in the drive. The frequency converter provides full short-circuit protection in case of a short-circuit on the motor output.

Overcurrent protection:

Provide overload protection to avoid fire hazard due to overheating of the cables in the installation. Fuses or circuit breakers can be used to provide the overcurrent protection in the installation. Overcurrent protection must always be carried out according to national regulations.

The AF-650 GP drive is suitable in a circuit capable of supplying a maximum of 100,000 A_{rms} (symmetrical), 500 V maximum.

Non UL compliance

If UL/cUL is not to be complied with, we recommend using the following fuses, which will ensure compliance with EN50178:
In case of malfunction, not following the recommendation may result in unnecessary damage to the frequency converter.

AF-650 GP	Max. fuse size[1)]	Voltage	Type
1/3 to 1 HP	10A	200-240 V	type gG
2 to 3 HP	20A	200-240 V	type gG
5 HP	32A	200-240 V	type gG
7.5 to 10 HP	63A	380-500 V	type gG
15 HP	80A	380-500 V	type gG
20 to 25 HP	125A	380-500 V	type gG
30 HP	160A	380-500 V	type aR
40 HP	200A	380-500 V	type aR
50 HP	250A	380-500 V	type aR

1) Max. fuses - refer to national/international regulations to select an appropriate fuse size.

AF-650 GP	Max. fuse size[1)]	Voltage	Type
3 to 5 HP	10A	380-500 V	type gG
3 to 5 HP	20A	380-500 V	type gG
7.5 to 10 HP	32A	380-500 V	type gG
15 to 25 HP	63A	380-500 V	type gG
30 HP	80A	380-500 V	type gG
40 HP	100A	380-500 V	type gG
50 HP	125A	380-500 V	type gG
60 HP	160A	380-500 V	type aR
75 to 100 HP	250A	380-500 V	type aR

UL Compliance

200-240 V

AF-650 GP	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
HP	Type RK1	Type J	Type T	Type CC	Type CC	Type CC
1/3 to 1/2 HP	KTN-R05	JKS-05	JJN-06	FNQ-R-5	KTK-R-5	LP-CC-5
1 HP	KTN-R10	JKS-10	JJN-10	FNQ-R-10	KTK-R-10	LP-CC-10
2 HP	KTN-R15	JKS-15	JJN-15	FNQ-R-15	KTK-R-15	LP-CC-15
3 HP	KTN-R20	JKS-20	JJN-20	FNQ-R-20	KTK-R-20	LP-CC-20
5 HP	KTN-R30	JKS-30	JJN-30	FNQ-R-30	KTK-R-30	LP-CC-30
7.5 HP	KTN-R50	KS-50	JJN-50	-	-	-
10 HP	KTN-R60	JKS-60	JJN-60	-	-	-
15 HP	KTN-R80	JKS-80	JJN-80	-	-	-
20 to 25 HP	KTN-R125	JKS-150	JJN-125	-	-	-

AF-650 GP	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
HP	Type RK1	Type RK1	Type CC	Type RK1
1/3 to 1/2 HP	5017906-005	KLN-R05	ATM-R05	A2K-05R
1 HP	5017906-010	KLN-R10	ATM-R10	A2K-10R
2 HP	5017906-016	KLN-R15	ATM-R15	A2K-15R
3 HP	5017906-020	KLN-R20	ATM-R20	A2K-20R
5 HP	5012406-032	KLN-R30	ATM-R30	A2K-30R
7.5 HP	5014006-050	KLN-R50	-	A2K-50R
10 HP	5014006-063	KLN-R60	-	A2K-60R
15 HP	5014006-080	KLN-R80	-	A2K-80R
20 to 25 HP	2028220-125	KLN-R125	-	A2K-125R

AF-650 GP	Bussmann	SIBA	Littel fuse	Ferraz-Shawmut
HP	Type JFHR2	Type RK1	JFHR2	JFHR2
30 HP	FWX-150	2028220-150	L25S-150	A25X-150
40 HP	FWX-200	2028220-200	L25S-200	A25X-200
50 HP	FWX-250	2028220-250	L25S-250	A25X-250

KTS-fuses from Bussmann may substitute KTN for 240 V frequency converters.

FWH-fuses from Bussmann may substitute FWX for 240 V frequency converters.

KLSR fuses from LITTEL FUSE may substitute KLNR fuses for 240 V frequency converters.

L50S fuses from LITTEL FUSE may substitute L50S fuses for 240 V frequency converters.

A6KR fuses from FERRAZ SHAWMUT may substitute A2KR for 240 V frequency converters.

A50X fuses from FERRAZ SHAWMUT may substitute A25X for 240 V frequency converters.

380-500 V

AF-650 GP	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
HP	Type RK1	Type J	Type T	Type CC	Type CC	Type CC
1/2 to 1 HP	KTS-R6	JKS-6	JJS-6	FNQ-R-6	KTK-R-6	LP-CC-6
2 to 3 HP	KTS-R10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
5 HP	KTS-R20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20
7.5 HP	KTS-R25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25
10 HP	KTS-R30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30
15 HP	KTS-R40	JKS-40	JJS-40	-	-	-
20 HP	KTS-R50	JKS-50	JJS-50	-	-	-
25 HP	KTS-R60	JKS-60	JJS-60	-	-	-
30 HP	KTS-R80	JKS-80	JJS-80	-	-	-
40 HP	KTS-R100	JKS-100	JJS-100	-	-	-
50 HP	KTS-R125	JKS-150	JJS-150	-	-	-
60 HP	KTS-R150	JKS-150	JJS-150	-	-	-

AF-650 GP	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
HP	Type RK1	Type RK1	Type CC	Type RK1
1/2 to 1 HP	5017906-006	KLS-R6	ATM-R6	A6K-6R
2 to 3 HP	5017906-010	KLS-R10	ATM-R10	A6K-10R
5 HP	5017906-020	KLS-R20	ATM-R20	A6K-20R
7.5 HP	5017906-025	KLS-R25	ATM-R25	A6K-25R
10 HP	5012406-032	KLS-R30	ATM-R30	A6K-30R
15 HP	5014006-040	KLS-R40	-	A6K-40R
20 HP	5014006-050	KLS-R50	-	A6K-50R
25 HP	5014006-063	KLS-R60	-	A6K-60R
30 HP	2028220-100	KLS-R80	-	A6K-80R
40 HP	2028220-125	KLS-R100	-	A6K-100R
50 HP	2028220-125	KLS-R125	-	A6K-125R
60 HP	2028220-160	KLS-R150	-	A6K-150R

AF-650 GP	Bussmann	Bussmann	Bussmann	Bussmann
HP	JFHR2	Type H	Type T	JFHR2
75 HP	FWH-200	-	-	-
100 HP	FWH-250	-	-	-

AF-650 GP	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
HP	Type RK1	JFHR2	JFHR2	JFHR2
75 HP	2028220-200	L50S-225	-	A50-P225
100 HP	2028220-250	L50S-250		A50-P250

Ferraz-Shawmut A50QS fuses may be substituted for A50P fuses.

170M fuses shown from Bussmann use the -/80 visual indicator. –TN/80 Type T, -/110 or TN/110 Type T indicator fuses of the same size and amperage may be substituted.

550 - 600V

AF-650 GP	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
HP	Type RK1	Type J	Type T	Type CC	Type CC	Type CC
1 to 2 HP	KTS-R-5	JKS-5	JJS-6	FNQ-R-5	KTK-R-5	LP-CC-5
3 to 5 HP	KTS-R10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
7.5 to 10 HP	KTS-R20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20

AF-650 GP	SIBA	Littel fuse	Ferraz-Shawmut
HP	Type RK1	Type RK1	Type RK1
1 to 2 HP	5017906-005	KLSR005	A6K-5R
3 to 5 HP	5017906-010	KLSR010	A6K-10R
7.5 to 10 HP	5017906-020	KLSR020	A6K-20R

AF-650 GP	Bussmann	SIBA	Ferraz-Shawmut
HP	JFHR2	Type RK1	Type RK1
50 HP	170M3013	2061032.125	6.6URD30D08A0125
60 HP	170M3014	2061032.160	6.6URD30D08A0160
75 HP	170M3015	2061032.200	6.6URD30D08A0200
100 HP	170M3015	2061032.200	6.6URD30D08A0200

170M fuses shown from Bussmann use the -/80 visual indicator. –TN/80 Type T, -/110 or TN/110 Type T indicator fuses of the same size and amperage may be substituted.

170M fuses from Bussmann when provided in the 525-600/690 V FC-302 P37K-P75K, FC-102 P75K, or FC-202 P45K-P90K drives are 170M3015.

170M fuses from Bussmann when provided in the 525-600/690V FC-302 P90K-P132, FC-102 P90K-P132, or FC-202 P110-P160 drives are 170M3018.

170M fuses from Bussmann when provided in the 525-600/690V FC302 P160-P315, FC-102 P160-P315, or FC-202 P200-P400 drives are 170M5011.

3.3.5. Access to Control Terminals

All terminals to the control cables are located underneath the terminal cover on the front the IP20 Open Chassis and IP20 with Nema 1 field installed kits.. Remove the terminal cover with a screwdriver.

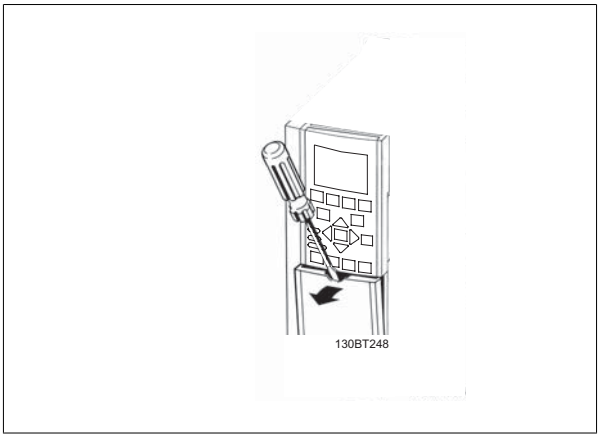


Illustration 3.19: Access to control terminals for unit sizes 12, 13, 23, 24, 33, and 34

Remove front-cover of Nema 12 and Nema 4 drive types to access control terminals. When replacing the front-cover, please ensure proper fastening by applying a torque of 2 Nm.

Illustration 3.20: Access to control terminals for unit sizes 15, 21, 22, 31, and 32

3.3.6. Electrical Installation, Control Terminals

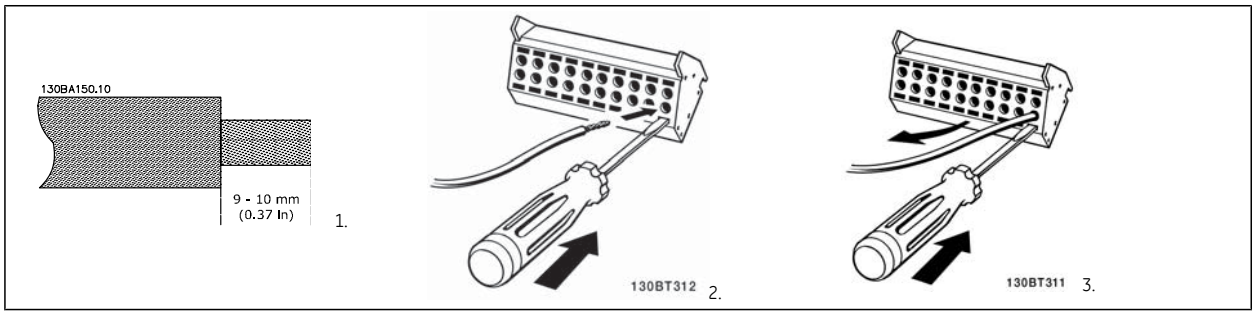
To mount the cable to the terminal:

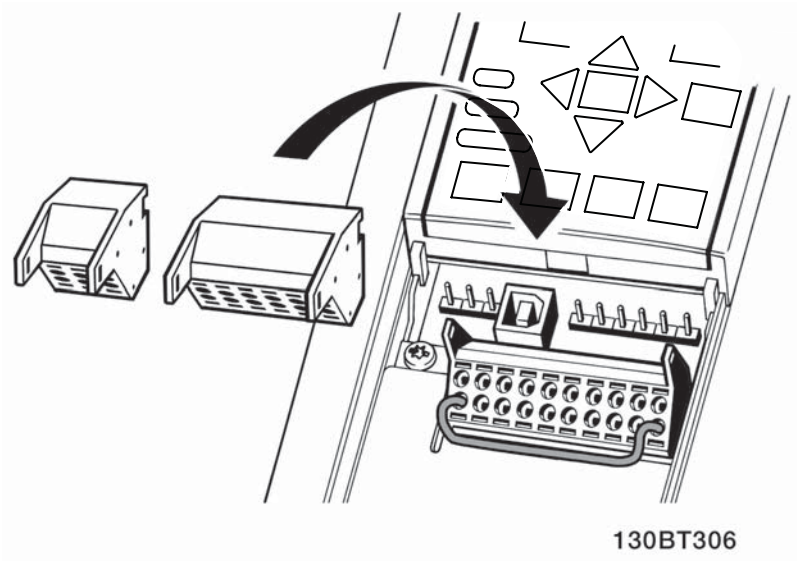
1. Strip insulation of 9-10 mm
2. Insert a screwdriver[1)] in the square hole.
3. Insert the cable in the adjacent circular hole.
4. Remove the screw driver. The cable is now mounted to the terminal.

To remove the cable from the terminal:

1. Insert a screwdriver[1)] in the square hole.
2. Pull out the cable.

[1)] Max. 0.4 x 2.5 mm

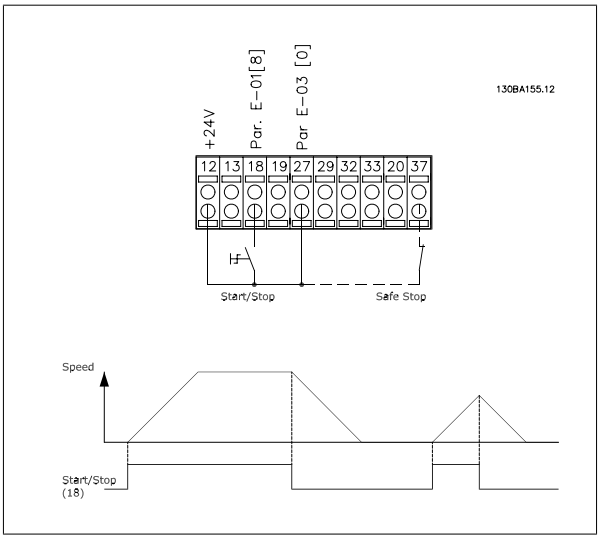




3.4. Connection Examples

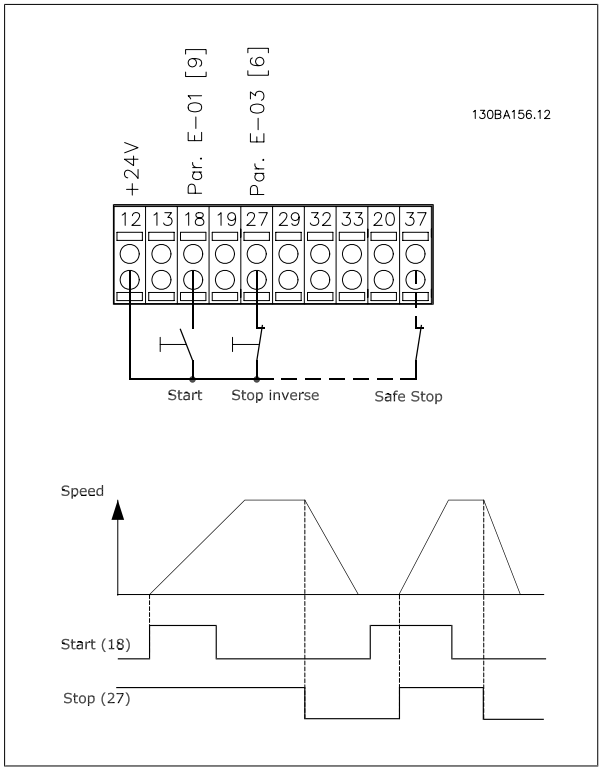
3.4.1. Start/Stop

Terminal 18 = par. E-01 Terminal *18 Digital Input* [8] *Start*
Terminal 27 = par. E-03 Terminal *27 Digital Input* [0] *No operation* (Default *coast inverse*)
Terminal 37 = Safe stop



3.4.2. Pulse Start/Stop

Terminal 18 = par. E-01 Terminal *18 Digital Input*Latched start, [9]
Terminal 27= par. E-03 Terminal *27 Digital Input*Stop inverse, [6]
Terminal 37 = Safe stop



3.4.3. Speed Up/Down

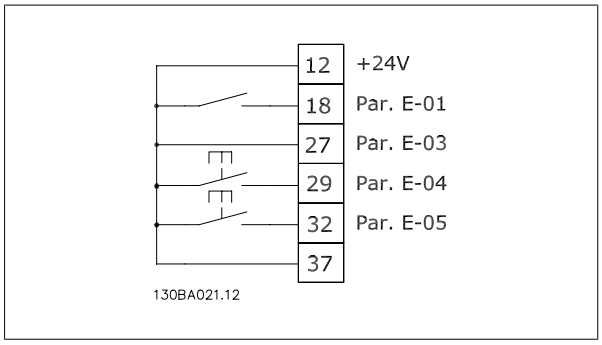
Terminals 29/32 = Speed up/down:.

Terminal 18 = par. E-01 Terminal *18 Digital Input* Start [9] (default)

Terminal 27 = par. E-03 Terminal *27 Digital Input* Freeze reference [19]

Terminal 29 = par. E-04 Terminal *29 Digital Input* Speed up [21]

Terminal 32 = par. E-05 Terminal *32 Digital Input* Speed down [22]



3.4.4. Potentiometer Reference

Voltage reference via a potentiometer:

Reference Source 1 = [1] *Analogue input 53* (default)

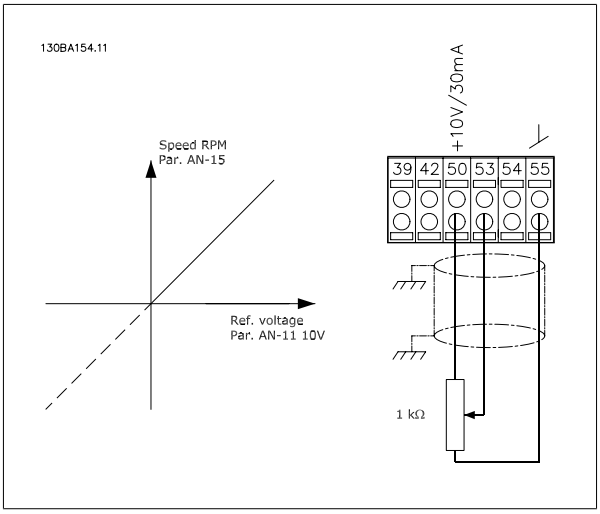
Terminal 53, Low Voltage = 0 Volt

Terminal 53, High Voltage = 10 Volt

Terminal 53, Low Ref./Feedback = 0 RPM

Terminal 53, High Ref./Feedback = 1500 RPM

Switch S201 = OFF (U)



3.5.1. Electrical Installation, Control Cables

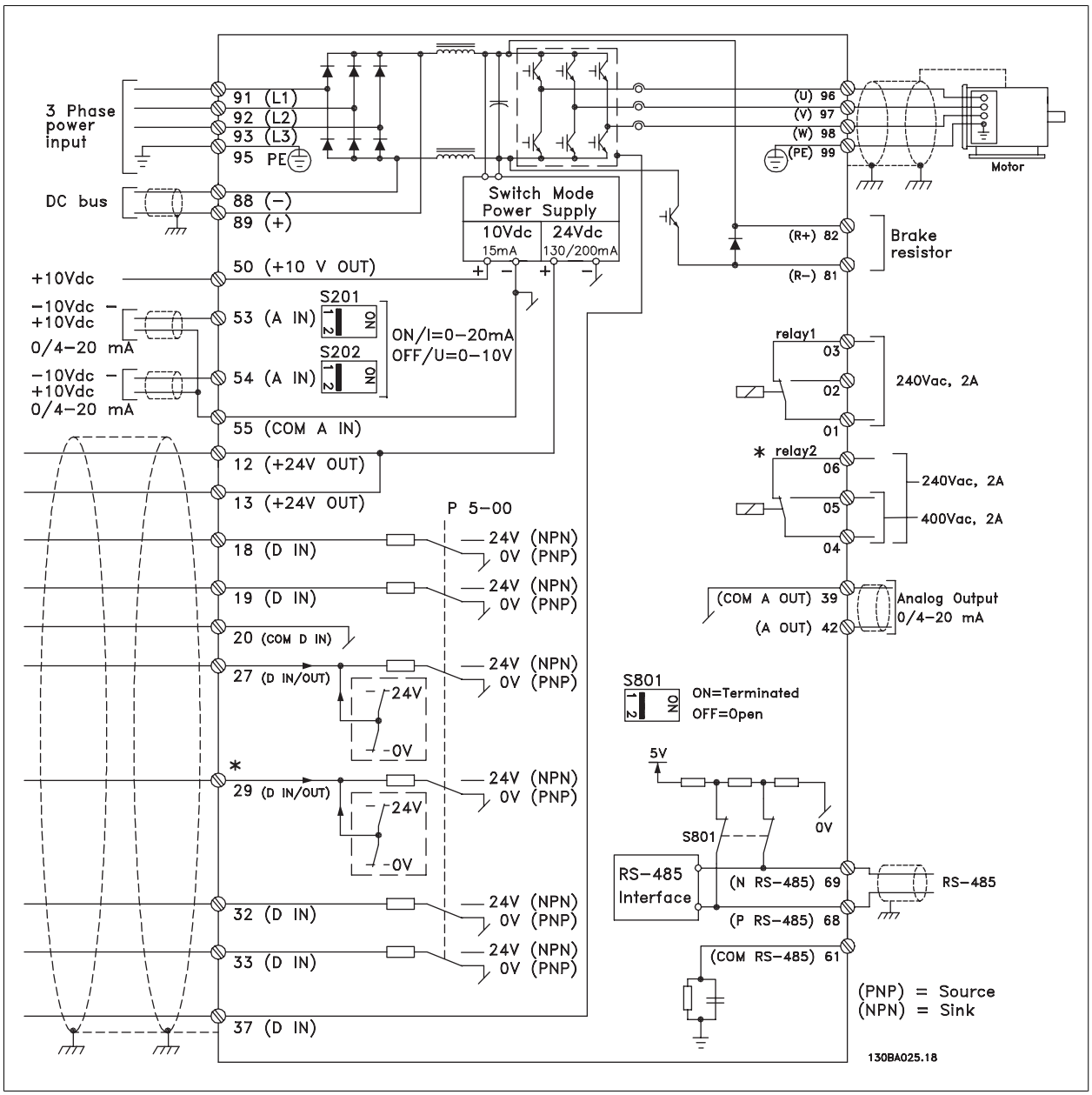


Illustration 3.21: Diagram showing all electrical terminals without options.

Terminal 37 is the input to be used for Safe Stop. For instructions on Safe Stop installation please refer to the section *Safe Stop Installation* of the AF-650 GP Design Guide.

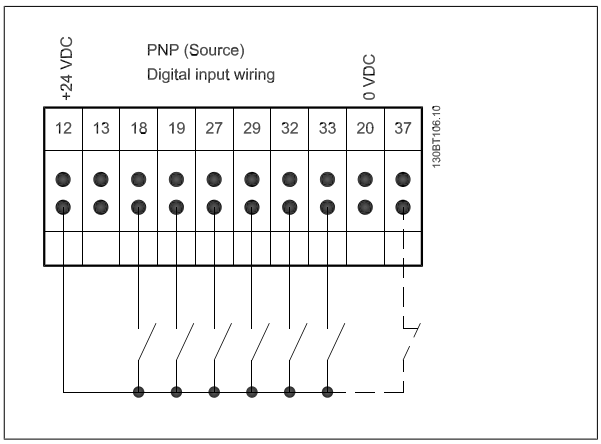
.

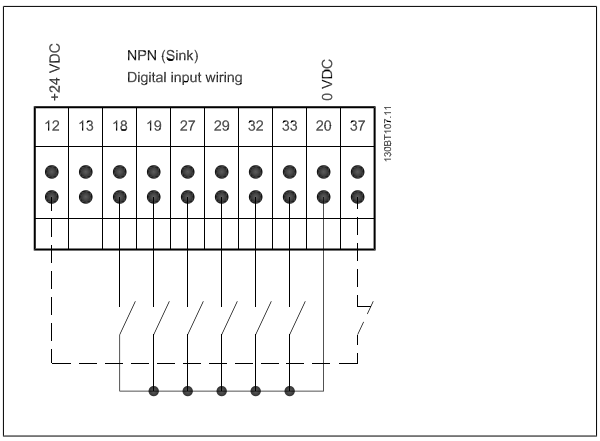
Very long control cables and analogue signals may in rare cases and depending on installation result in 50/60 Hz earth loops due to noise from mains supply cables.

If this occurs, it may be necessary to break the screen or insert a 100 nF capacitor between screen and chassis.

The digital and analogue inputs and outputs must be connected separately to the common inputs (terminal 20, 55, 39) of the frequency converter to avoid ground currents from both groups to affect other groups. For example, switching on the digital input may disturb the analog input signal.

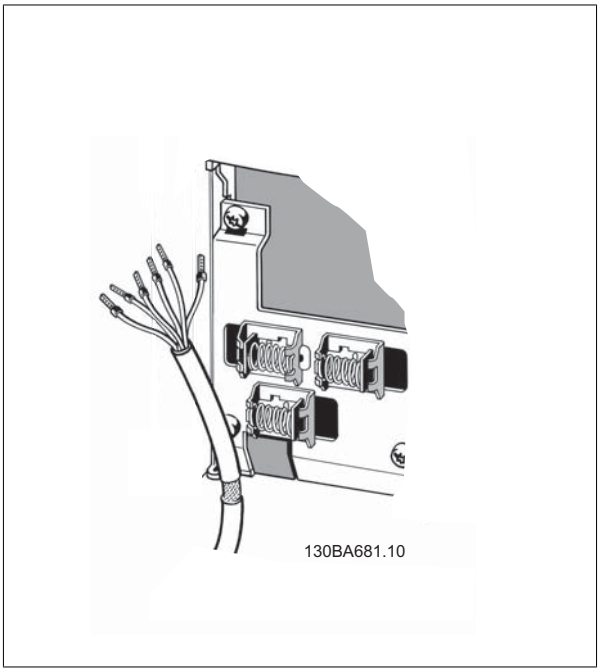
Input polarity of control terminals





NB!
Control cables must be screened/armoured.

See section entitled *Earthing of Screened/Armoured Control Cables* for the correct termination of control cables.



3.5.2. Switches S201, S202, and S801

Switches S201 (A53) and S202 (A54) are used to select a current (0-20 mA) or a voltage (-10 to 10 V) configuration of the analog input terminals 53 and 54 respectively.

Switch S801 (BUS TER.) can be used to enable termination on the RS-485 port (terminals 68 and 69).

See drawing *Diagram showing all electrical terminals* in section *Electrical Installation.*

3

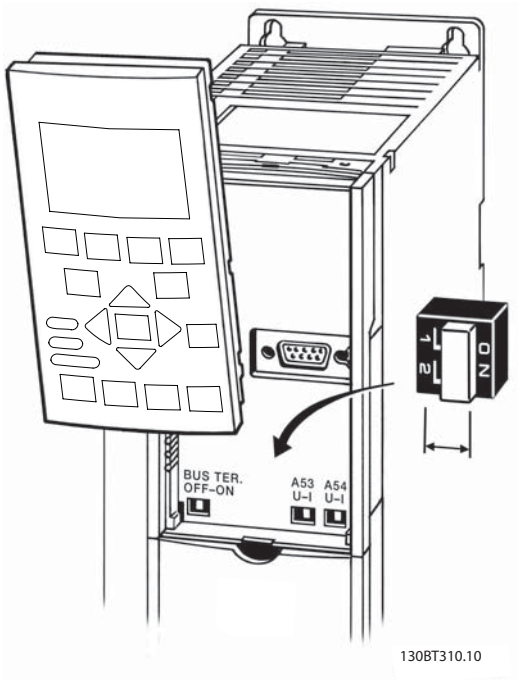
Default setting:

S201 (A53) = OFF (voltage input)

S202 (A54) = OFF (voltage input)

S801 (Bus termination) = OFF

When changing the function of S201, S202 or S801 be careful not to use force for the switch over. It is recommended to remove the Keypad fixture (cradle) when operating the switches. The switches must not be operated with power on the frequency converter.



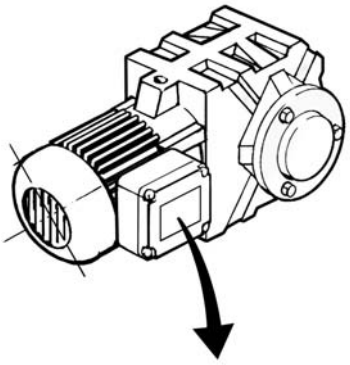
3.6.1. Final Set-Up and Test

To test the set-up and ensure that the frequency converter is running, follow these steps.

Step 1. Locate the motor name plate

NB!

The motor is either star- (Y) or delta- connected (Δ). This information is located on the motor name plate data.



3 ~ MOTOR NR. 1827421				2003
S/E005A9				
	1,5	kW		
n_2 31,5	/min.	400	Y	V
n_1 1400	/min.		50	Hz
cos φ 0,80			3,6	A
1,7L				
B	IP 65	H1/1A		

130BT307

Step 2. Enter the motor name plate data in this parameter list.

To access this list first press the [QUICK MENU] key then select "Quick Setup". Use the up and down arrow keys to navigate to the parameters associated with the motor nameplate values.

1.	par. P-07 *Motor Power [kW]* par. P-02 *Motor Power [HP]*
2.	par. F-05 Motor *Rated Voltage*
3.	par. F-04 *Base Frequency*
4.	par. P-03 Motor *Current*
5.	par. P-06 Base *Speed*

Step 3. Activate the Auto Tune

Performing an Auto Tune will ensure optimum performance. The Auto Tune measures the values from the motor model equivalent diagram.

1. Connect terminal 37 to terminal 12 (if terminal 37 is available).
2. Connect terminal 27 to terminal 12 or set par. E-03 Terminal *27 Digital Input* to 'No function'.
3. Activate the Auto Tune par. P-04 *Auto Tune*.
4. Choose between complete or reduced Auto Tune. If a Sine-wave filter is connected, run only the reduced Auto Tune, or remove the Sine-wave filter and run complete Auto Tune..
5. Press the [OK] key. The display shows "Press [Hand] to start".
6. Press the [Hand] key. A progress bar indicates if the Auto Tune is in progress.

Stop the Auto Tune during operation

1. Press the [OFF] key - the frequency converter enters into alarm mode and the display shows that the Auto Tune was terminated by the user.

Successful Auto Tune

1. The display shows "Press [OK] to finish Auto Tune".
2. Press the [OK] key to exit the Auto Tune state.

Unsuccessful Auto Tune

1. The frequency converter enters into alarm mode. A description of the alarm can be found in the *Warnings and Alarms* chapter.
2. "Report Value" in the [Alarm Log] shows the last measuring sequence carried out by the Auto Tune, before the frequency converter entered alarm mode. This number along with the description of the alarm will assist you in troubleshooting. If you contact GE for service, make sure to mention number and alarm description.

NB!

Unsuccessful Auto Tune is often caused by incorrectly entering motor name plate data or a too big difference between the motor power size and the frequency converter power size.

Step 4. Set speed limit and accel/decel times

par. F-52 Minimum *Reference*
par. F-53 Maximum *Reference*

Table 3.3: Set up the desired limits for speed and ramp time.

par. F-18 *Motor Speed Low Limit [RPM]* or par. F-16 *Motor Speed Low Limit [Hz]*
par. F-17 *Motor Speed High Limit [RPM]* or par. F-15 Motor *Speed High Limit [Hz]*

par. F-07 *Accel Time 1*
par. F-08 *Decel Time 1*

3.7. Additional Connections

3.7.1. Mechanical Brake Control

In hoisting/lowering applications, it is necessary to be able to control an electro-mechanical brake:

- Control the brake using any relay output or digital output (terminal 27 or 29).
- Keep the output closed (voltage-free) as long as the frequency converter is unable to 'support' the motor, for example due to the load being too heavy.
- Select *Mechanical brake control* [32] in E-2# for applications with an electro-mechanical brake.
- The brake is released when the motor current exceeds the preset value in par. B-20 Release *Brake Current*.
- The brake is engaged when the output frequency is less than the frequency set in par. B-21 Activate *Brake Speed [RPM]*or par. B-22 Activate *Brake Speed [Hz]*, and only if the frequency converter carries out a stop command.

If the frequency converter is in alarm mode or in an over-voltage situation, the mechanical brake immediately cuts in.

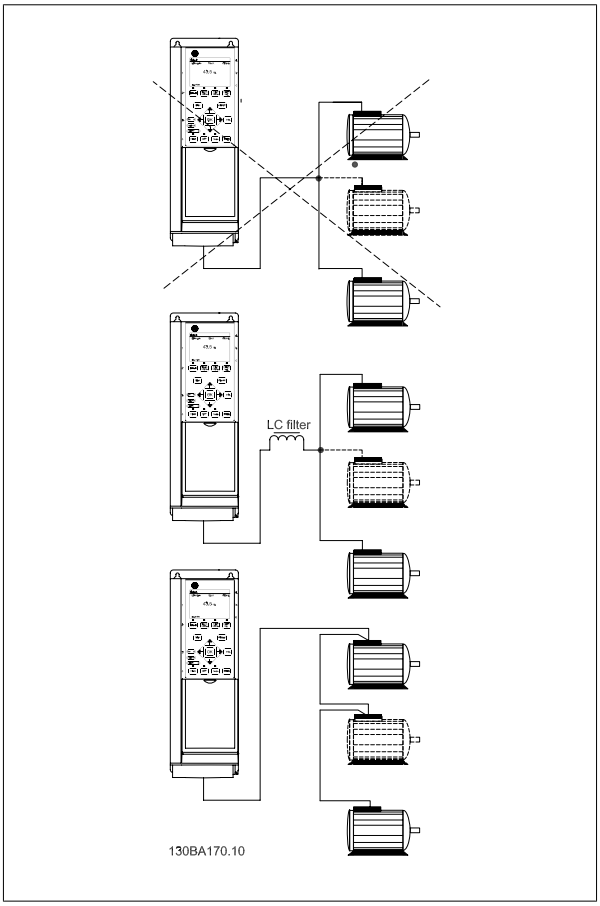
3.7.2. Parallel Connection of Motors

The frequency converter can control several parallel-connected motors. The total current consumption of the motors must not exceed the rated output current $I_{M,N}$ for the frequency converter.

NB!
Installations with cables connected in a common joint as in the illustration below, is only recommended for short cable lengths.

NB!
When motors are connected in parallel, par. P-04 *Auto Tune* cannot be used.

NB!
The electronic thermal overload of the frequency converter cannot be used as motor protection for the individual motor in systems with parallel-connected motors. Provide further motor protection by e.g. thermistors in each motor or individual thermal relays (circuit breakers are not suitable as protection).



Problems may arise at start and at low RPM values if motor sizes are widely different because small motors' relatively high ohmic resistance in the stator calls for a higher voltage at start and at low RPM values.

3.7.3. Motor Thermal Protection

The electronic thermal overload in the frequency converter has received UL-approval for single motor protection, when par. F-10 *Electronic Overload*is set for *Elec. OL Trip* and par. P-03 Motor *Current* is set to the rated motor current (see motor name plate).

4

4. How to Program

4.1. The Graphical Keypad

The easiest programming of the frequency converter is performed by the Graphical Keypad (102).

4.1.1. How to Program on the Graphical Keypad

The following instructions are valid for the graphical Keypad:

The keypad is divided into four functional groups:

1. Graphical display with Status lines.
2. Menu keys and indicator lights - changing parameters and switching between display functions.
3. Navigation keys and indicator lights (LEDs).
4. Operation keys and indicator lights (LEDs).

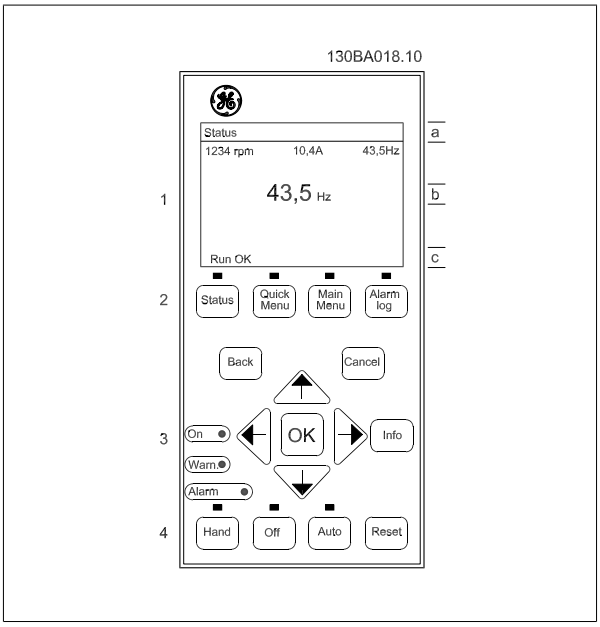
All data is displayed in the display, which can show up to five items of operating data while displaying [Status].

Display lines:

a. **Status line:** Status messages displaying icons and graphic.

b. **Line 1-2:** Operator data lines displaying data defined or chosen by the user. By pressing the [Status] key, up to one extra line can be added.

c. **Status line:** Status messages displaying text.



4.1.2. Initial Commissioning

The easiest way of carrying out the initial commissioning is by using the Quick Menu button and follow the quick set-up procedure using Keypad (read table from left to right). The example applies to open loop applications:

Press					
Quick Menu	↓	Q2 Quick Menu	OK	↓	
par. K-01 *Language*	OK	Set language	↓		
par. K-02 Motor *Speed Unit*	OK	Set motor speed (Hz)	↓		
par. P-02 *Motor Power [HP]* or par. P-07 *Motor Power [kW]*	OK	Set Motor nameplate power	↓		
par. F-05 Motor *Rated Voltage*	OK	Set Nameplate voltage	↓		
par. F-04 *Base Frequency*	OK	Set Nameplate frequency	↓		
par. P-03 Motor *Current*	OK	Set Nameplate current	↓		
par. P-06 Base *Speed*	OK	Set Nameplate speed in RPM	↓		
par. F-01 *Frequency Setting 1*	OK	If terminal default is *Coast inverse* it is possible to change this setting to *No function*. No connection to terminal 27 is then needed for running auto tune	↓		
par. F-02 Operation *Method*	OK	Set desired auto tune function. Enable complete auto tune is recommended	↓		
par. F-07 *Accel Time 1*	OK	Set the accel time with reference to synchronous motor speed, n_s	↓		
par. F-08 *Decel Time 1*	OK	Set the decel time time with reference to synchronous motor speed, n_s	↓		
par. F-10 *Electronic Overload*	OK		↓		
par. F-15 Motor *Speed High Limit [Hz]*	OK		↓		
par. F-16 *Motor Speed Low Limit [Hz]*	OK	Set the reference as local or remote	↓		
par. F-17 *Motor Speed High Limit [RPM]*	OK		↓		
par. F-18 *Motor Speed Low Limit [RPM]*	OK		↓		
par. H-08 *Reverse Lock*	OK		↓		
par. P-04 *Auto Tune*	OK		↓		

4.2. Quick Setup Parameter List

K-01 Language

Option:		Function:
		Defines the language to be used in the display. The frequency converter can be delivered with 4 different language packages. English and German are included in all packages. English cannot be erased or manipulated.
[0] *	English	Part of Language packages 1 - 4

K-02 Motor Speed Unit

Option:		Function:
		This parameter cannot be adjusted while the motor is running. The display showing depends on settings in par. K-02 *Motor Speed Unit* and par. K-03 Regional *Settings*. The default setting of par. K-02 *Motor Speed Unit* and par. K-03 Regional *Settings* depends on which region of the world the frequency converter is supplied to, but can be re-programmed as required. **NB!** Changing the *Motor Speed Unit* will reset certain parameters to their initial value. It is recommended to select the motor speed unit first, before modifying other parameters.
[0]	RPM	Selects display of motor speed variables and parameters (i.e. references, feedbacks and limits) in terms of motor speed (RPM).
[1] *	Hz	Selects display of motor speed variables and parameters (i.e. references, feedbacks and limits) in terms of output frequency to the motor (Hz).

P-02 Motor Power [HP]

Range:		Function:
4.00 hp*	[0.09 - 3000.00 hp]	Enter the nominal motor power in HP according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. This parameter is visible in Keypad if par. K-03 Regional *Settings* is *US* [1]

P-07 Motor Power [kW]

Range:		Function:
4.00 kW*	[0.09 - 3000.00 kW]	Enter the nominal motor power in kW according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. This parameter cannot be adjusted while the motor is running. This parameter is visible in Keypad if par. K-03 Regional *Settings* is *International* [0]. **NB!** Four sizes down, one size up from nominal VLT rating.

F-05 Motor Rated Voltage

Range:		Function:
400. V*	[10. - 1000. V]	Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. This parameter cannot be adjusted while the motor is running.

4

F-04 Base Frequency

Range:		Function:
50. Hz*	[20 - 1000 Hz]	Min - Max motor frequency: 20 - 1000 Hz. Select the motor frequency value from the motor nameplate data. If a value different from 50 Hz or 60 Hz is selected, it is necessary to adapt the load independent settings in par. H-50 Motor *Magnetisation at Zero Speed* to par. H-53 Model *Shift Frequency*. For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. Adapt par. F-17 *Motor Speed High Limit [RPM]* and par. F-53 Maximum *Reference* to the 87 Hz application.

P-03 Motor Current

Range:		Function:
7.20 A*	[0.10 - 10000.00 A]	Enter the nominal motor current value from the motor nameplate data. This data is used for calculating motor torque, motor thermal protection etc.

NB!
This parameter cannot be adjusted while the motor is running.

P-06 Base Speed

Range:		Function:
1420. RPM*	[100 - 60000 RPM]	Enter the nominal motor speed value from the motor nameplate data. This data is used for calculating automatic motor compensations.

NB!
This parameter cannot be changed while the motor is running.

F-01 Frequency Setting 1

Option:		Function:
		Select the reference input to be used for the first reference signal. par. F-01 *Frequency Setting 1*, par. C-30 Frequency *Command 2* and par. C-34 Frequency *Command 3* define up to three different reference signals. The sum of these reference signals defines the actual reference.
[0]	No function	
[1] *	Analog Input 53	
[2]	Analog Input 54	
[7]	Frequency input 29	
[8]	Frequency input 33	
[11]	Local bus reference	
[20]	Digital Potentiometer	
[21]	Analog input X30-11	
[22]	Analog input X30-12	

F-02 Operation Method

Option:		Function:
		Select which reference site to activate.
[0] *	Linked to Hand / Auto	Use local reference when in Hand mode; or remote reference when in Auto mode.
[1]	Remote	Use remote reference in both Hand mode and Auto mode.
[2]	Local	Use local reference in both Hand mode and Auto mode.

NB!
When set to Local [2], the frequency converter will start with this setting again following a 'power down'.

F-07 Accel Time 1

Range:		Function:
3.00 s*	[0.01 - 3600.00 s]	Enter the accel time, i.e. the acceleration time from 0 RPM to the synchronous motor speed n_S. Choose a accel time such that the output current does not exceed the current limit in par. F-43 Current *Limit* during ramping. The value 0.00 corresponds to 0.01 sec. in speed mode. See decel time in par. F-08 *Decel Time 1*. $$Par.\ F-07 = \frac{t_{acc}[s] \times n_s[RPM]}{ref[RPM]}$$

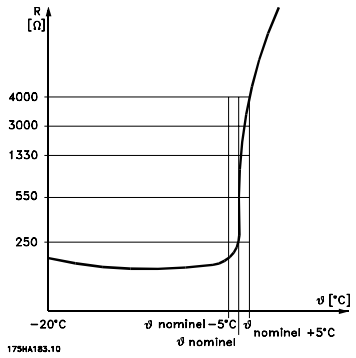
F-08 Decel Time 1

Range:		Function:
3.00 s*	[0.01 - 3600.00 s]	Enter the decel time, i.e. the deceleration time from the synchronous motor speed n_s to 0 RPM. Choose a decel time such that no over-voltage arises in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in par. F-43 Current *Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See accel time in par. F-07 *Accel Time 1*. $$Par.\ F-08 = \frac{t_{dec}[s] \times n_s[RPM]}{ref[RPM]}$$

F-10 Electronic Overload

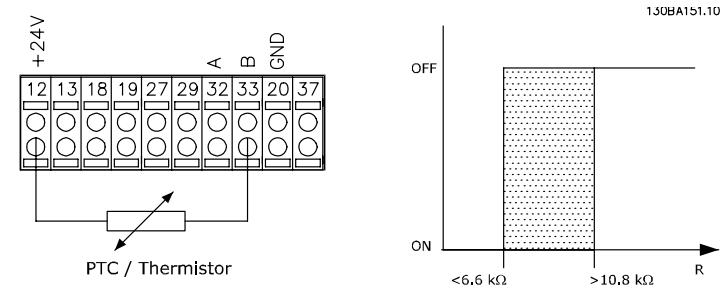
Option:		Function:
		The frequency converter determines the motor temperature for motor protection in two different ways: • Via a thermistor sensor connected to one of the analog or digital inputs (par. F-12 Motor *Thermistor Input*). • Via calculation of the thermal load, based on the actual load and time. The calculated thermal load is compared with the rated motor current $I_{M,N}$ and the rated motor frequency $f_{M,N}$. The calculations estimate the need for a lower load at lower speed due to less cooling from the fan incorporated in the motor.
[0] *	No protection	Continuously overloaded motor, when no warning or trip of the frequency converter is required.
[1]	Thermistor warning	Activates a warning when the connected thermistor or KTY-sensor in the motor reacts in the event of motor over-temperature.
[2]	Thermistor trip	Stops (trips) frequency converter when connected thermistor in motor reacts in the event of motor over-temperature. The thermistor cut-out value must be > 3 kΩ. Integrate a thermistor (PTC sensor) in the motor for winding protection.
[3]	Electronic Overload Warning 1	
[4]	Electronic Overload Trip 1	
[5]	Electronic Overload Warning 2	
[6]	Electronic Overload Trip 2	
[7]	Electronic Overload Warning 3	

[8]	Electronic Overload Trip 3
[9]	Electronic Overload Warning 4
[10]	Electronic Overload Trip 4

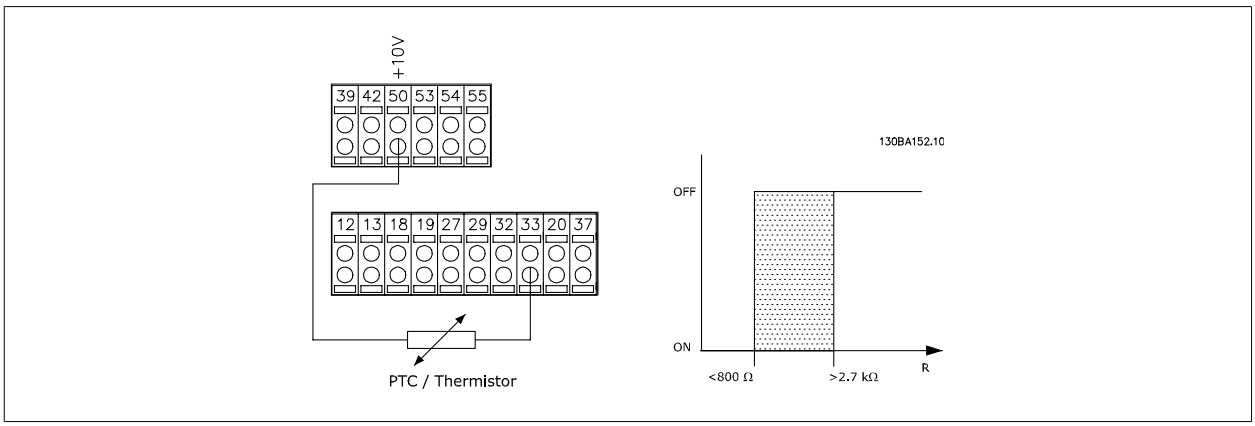


Motor protection can be implemented using a range of techniques: PTC or KTY sensor (see also section *KTY Sensor Connection*) in motor windings; mechanical thermal switch (Klixon type); or Electronic Thermal Relay (ETR).

Using a digital input and 24 V as power supply:
Example: The frequency converter trips when the motor temperature is too high
Parameter set-up:
Set par. F-10 *Electronic Overload* to *Thermistor Trip* [2]
Set par. F-12 Motor *Thermistor Input* to *Digital Input* [6]



Using a digital input and 10 V as power supply:
Example: The frequency converter trips when the motor temperature is too high.
Parameter set-up:
Set par. F-10 *Electronic Overload* to *Thermistor Trip* [2]
Set par. F-12 Motor *Thermistor Input* to *Digital Input* [6]



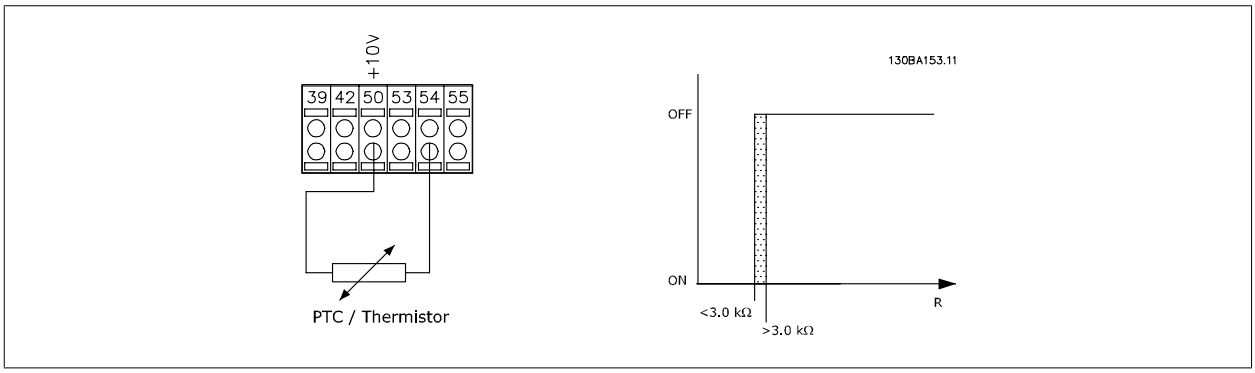
Using an analog input and 10 V as power supply:

Example: The frequency converter trips when the motor temperature is too high.

Parameter set-up:

Set par. F-10 *Electronic Overload* to *Thermistor Trip* [2]

Set par. F-12 Motor *Thermistor Input* to *Analog Input 54* [2]



Input Digital/analog	**Supply Voltage** Volt	**Threshold** Cut-out Values
Digital	24 V	< 6.6 kΩ - > 10.8 kΩ
Digital	10 V	< 800Ω - > 2.7 kΩ
Analog	10 V	< 3.0 kΩ - > 3.0 kΩ

NB!

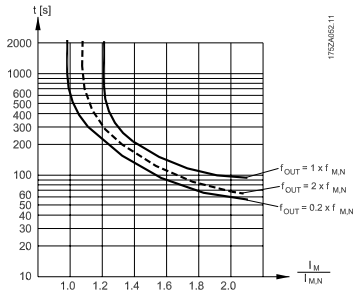
Check that the chosen supply voltage follows the specification of the used thermistor element.

Select *Electronic Overload Warning 1-4*, to activate a warning on the display when the motor is overloaded.

Select *Electronic Overload Trip 1-4* to trip the frequency converter when the motor is overloaded.

Programme a warning signal via one of the digital outputs. The signal appears in the event of a warning and if the frequency converter trips (thermal warning).

Electronic Overload functions 1-4 will calculate the load when the set-up where they were selected is active. For example Electronic Overload starts calculating when setup 3 is selected. For the North American market: The Electronic Overload functions provide class 20 motor overload protection in accordance with NEC.



4

F-15 Frequency Limiter (High)

Range:		Function:
50/60.0 Hz*	[par. H-12 - par. H-19 Hz]	

NB!
Max. output frequency cannot exceed 10% of the inverter frequency (par. F-26 Motor *Noise (Carrier Freq)*).

F-16 Motor Speed Low Limit [Hz]

Range:		Function:
0 Hz*	[0.0 - par. H-14 Hz]	Enter the minimum limit for motor speed. The Motor Speed Low Limit can be set to correspond to the minimum output frequency of the motor shaft. The Motor Speed Low Limit must not exceed the setting in par. F-15 *Frequency Limiter (High)*.

F-17 Motor Speed High Limit [RPM]

Range:		Function:
3600. RPM*	[par. H-11 - 60000. RPM]	Enter the maximum limit for motor speed. The Motor Speed High Limit can be set to correspond to the manufacturer's maximum rated motor speed. The Motor Speed High Limit must exceed the setting in par. F-18 *Motor Speed Low Limit [RPM]*.

NB!
Max. output frequency cannot exceed 10% of the inverter switching frequency (par. F-26 Motor *Noise (Carrier Freq)*).

F-18 Motor Speed Low Limit [RPM]

Range:		Function:
0 RPM*	[0 - par. H-13 RPM]	Enter the minimum limit for motor speed. The Motor Speed Low Limit can be set to correspond to the manufacturer's recommended minimum motor speed. The Motor Speed Low Limit must not exceed the setting in par. F-17 *Motor Speed High Limit [RPM]*.

H-08 Reverse Lock

Option:		Function:
		Select the motor speed direction(s) required. Use this parameter to prevent unwanted reversing. When par. H-40 Configuration *Mode* is set to *Process* [3], par. H-08 *Reverse Lock* is set to *Clockwise* [0] as default. The setting in par. H-08 *Reverse Lock* does not limit options for setting par.4-13. This parameter cannot be adjusted while the motor is running.
[0] *	Clockwise	
[1]	Counter clockwise	
[2]	Both directions	

P-04 Auto Tune	
Option:	**Function:**
	The Auto Tune function optimises dynamic motor performance by automatically optimising the advanced motor parameters (par. P-30 Stator *Resistance (Rs)* to par. P-35 Main *Reactance (Xh)*) at motor standstill. Activate the Auto Tune function by pressing [Hand] after selecting [1] or [2]. See also the section *Auto Tuning* in the AF-650 GP Design Guide. After a normal sequence, the display will read: "Press [OK] to finish Auto Tune". After pressing the [OK] key the frequency converter is ready for operation. This parameter cannot be adjusted while the motor is running.
[0] *	Off
[1]	Enable complete Auto Tune
[2]	Enable reduced Auto Tune

Note:

- For the best results run Auto Tune on a cold motor.
- Auto Tune cannot be performed while the motor is running.
- Auto Tune cannot be performed on permanent magnet motors.

NB!
It is important to set motor par. F-04, F-05, and P-02 to P-08 correctly, since these form part of the Auto Tune algorithm. An Auto Tune should be performed to achieve optimum dynamic motor performance. It may take up to 10 min, depending on the power rating of the motor.

NB!
Avoid generating external torque during Auto Tune.

NB!
If one of the settings in par. F-04, F-05, or P-02 to P-08 is changed, par. P-30 Stator *Resistance (Rs)* to par. P-01 Motor *Poles*, the advanced motor parameters, will return to default setting.

NB!
Auto Tune will work problem-free on 1 motor size down, typically work on 2 motor sizes down, rarely work on 3 sizes down and never work on 4 sizes down. Please keep in mind that the accuracy of the measured motor data will be poorer when you operate on motors smaller than nominal drive size.

4.3. Parameter Lists

4.3.1. K-## Keypad Set-up

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
K-01	Language	[0] English	1 set-up	TRUE	-	Uint8
K-02	Motor Speed Unit	[1] Hz	2 set-ups	FALSE	-	Uint8
K-03	Regional Settings	[0] International	2 set-ups	FALSE	-	Uint8
K-04	Operating State at Power-up	[0] Resume	All set-ups	TRUE	-	Uint8
K-05	Local Mode Unit	[0] As Motor Speed Unit	2 set-ups	FALSE	-	Uint8
K-10	Active Set-up	[1] Set-up 1	1 set-up	TRUE	-	Uint8
K-11	Programming Set-up	[9] Active Set-up	All set-ups	TRUE	-	Uint8
K-12	This Set-up Linked to	[0] Not linked	All set-ups	FALSE	-	Uint8
K-13	Readout: Linked Set-ups	0 N/A	All set-ups	FALSE	0	Uint16
K-14	Readout: Prog. Set-ups / Channel	0 N/A	All set-ups	TRUE	0	Int32
K-20	Display Line 1.1 Small	ExpressionLimit	All set-ups	TRUE	-	Uint16
K-21	Display Line 1.2 Small	ExpressionLimit	All set-ups	TRUE	-	Uint16
K-22	Display Line 1.3 Small	ExpressionLimit	All set-ups	TRUE	-	Uint16
K-23	Display Line 2 Large	ExpressionLimit	All set-ups	TRUE	-	Uint16
K-24	Display Line 3 Large	ExpressionLimit	All set-ups	TRUE	-	Uint16
K-25	Quick Start	ExpressionLimit	1 set-up	TRUE	0	Uint16
K-30	Custom Readout Unit	[1] %	All set-ups	TRUE	-	Uint8
K-31	Custom Readout Min Value	ExpressionLimit	All set-ups	TRUE	-2	Int32
K-32	Custom Readout Max Value	100.00 CustomReadoutUnit	All set-ups	TRUE	-2	Int32
K-37	Display Text 1	0 N/A	1 set-up	TRUE	0	VisStr[25]
K-38	Display Text 2	0 N/A	1 set-up	TRUE	0	VisStr[25]
K-39	Display Text 3	0 N/A	1 set-up	TRUE	0	VisStr[25]
K-40	[Hand] Button on Keypad	[1] Enabled	All set-ups	TRUE	-	Uint8
K-41	[Off] Button on Keypad	[1] Enabled	All set-ups	TRUE	-	Uint8
K-42	[Auto] Button on Keypad	[1] Enabled	All set-ups	TRUE	-	Uint8
K-43	[Reset] Button on Keypad	[1] Enabled	All set-ups	TRUE	-	Uint8
K-44	[Off/Reset] Key on Keypad	[1] Enabled	All set-ups	TRUE	-	Uint8
K-45	[Drive Bypass] Key on Keypad	[1] Enabled	All set-ups	TRUE	-	Uint8
K-50	Keypad Copy	[0] No copy	All set-ups	FALSE	-	Uint8
K-51	Set-up Copy	[0] No copy	All set-ups	FALSE	-	Uint8
K-60	Main Menu Password	100 N/A	1 set-up	TRUE	0	Uint16
K-61	Access to Main Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8
K-65	Quick Start Menu Password	200 N/A	1 set-up	TRUE	0	Uint16
K-66	Access to Quick Start Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8
K-70	Date and Time	ExpressionLimit	All set-ups	TRUE	0	TimeOfDay
K-71	Date Format	null	1 set-up	TRUE	-	Uint8
K-72	Time Format	null	1 set-up	TRUE	-	Uint8
K-74	DST/Summertime	[0] Off	1 set-up	TRUE	-	Uint8
K-76	DST/Summertime Start	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
K-77	DST/Summertime End	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
K-79	Clock Fault	null	1 set-up	TRUE	-	Uint8
K-81	Working Days	null	1 set-up	TRUE	-	Uint8
K-82	Additional Working Days	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
K-83	Additional Non-Working Days	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
K-89	Date and Time Readout	0 N/A	All set-ups	TRUE	0	VisStr[25]

4.3.2. F-## Fundamental Parameters

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
F-01	Frequency Setting 1	[1] Analog input 53	All set-ups	TRUE	-	Uint8
F-02	Operation Method	[0] Linked to Hand / Auto	All set-ups	TRUE	-	Uint8
F-03	Max Output Frequency 1	ExpressionLimit	All set-ups	FALSE	-1	Uint16
F-04	Base Frequency	ExpressionLimit	All set-ups	FALSE	0	Uint16
F-05	Motor Rated Voltage	ExpressionLimit	All set-ups	FALSE	0	Uint16
F-07	Accel Time 1	ExpressionLimit	All set-ups	TRUE	-2	Uint32
F-08	Decel Time 1	ExpressionLimit	All set-ups	TRUE	-2	Uint32
F-09	Torque Boost	100 %	All set-ups	TRUE	0	Int16
F-10	Electronic Overload	[4] Electronic Overload Trip 1	All set-ups	TRUE	-	Uint8
F-11	Motor External Fan	[0] No	All set-ups	TRUE	-	Uint16
F-12	Motor Thermistor Input	[0] None	All set-ups	TRUE	-	Uint8
F-15	Motor Speed High Limit [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
F-16	Motor Speed Low Limit [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
F-17	Motor Speed High Limit [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
F-18	Motor Speed Low Limit [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
F-24	Holding Time	0.0 s	All set-ups	TRUE	-1	Uint16
F-25	Trip Speed Low [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
F-26	Motor Noise (Carrier Freq)	null	All set-ups	TRUE	-	Uint8
F-27	Motor Tone Random	[0] Off	All set-ups	TRUE	-	Uint8
F-28	Trip Speed Low [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
F-37	Adv. Switching Pattern	[0] 60 AVM	All set-ups	TRUE	-	Uint8
F-38	Overmodulation	[1] On	All set-ups	FALSE	-	Uint8
F-40	Torque Limiter (Driving)	110.0 %	All set-ups	TRUE	-1	Uint16
F-41	Torque Limiter (Braking)	100.0 %	All set-ups	TRUE	-1	Uint16
F-43	Current Limit	ExpressionLimit	All set-ups	TRUE	-1	Uint32
F-52	Minimum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
F-53	Maximum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
F-54	Reference Function	null	All set-ups	TRUE	-	Uint8
F-64	Preset Relative Reference	0.00 %	All set-ups	TRUE	-2	Int32
F-90	Step Size	0.10 %	All set-ups	TRUE	-2	Uint16
F-91	Accel/Decel Time	1.00 s	All set-ups	TRUE	-2	Uint32
F-92	Power Restore	[0] Off	All set-ups	TRUE	-	Uint8
F-93	Maximum Limit	100 %	All set-ups	TRUE	0	Int16
F-94	Minimum Limit	0 %	All set-ups	TRUE	0	Int16
F-95	Ramp Delay	1.000 N/A	All set-ups	TRUE	-3	TimD

4.3.3. E-## Digital In/Outs

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
E-00	Digital I/O Mode	[0] PNP - Active at 24V	All set-ups	FALSE	-	Uint8
E-01	Terminal 18 Digital Input	[8] Start	All set-ups	TRUE	-	Uint8
E-02	Terminal 19 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-03	Terminal 27 Digital Input	null	All set-ups	TRUE	-	Uint8
E-04	Terminal 29 Digital Input	[14] Jog	All set-ups	TRUE	-	Uint8
E-05	Terminal 32 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-06	Terminal 33 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-10	Accel Time 2	ExpressionLimit	All set-ups	TRUE	-2	Uint32
E-11	Decel Time 2	ExpressionLimit	All set-ups	TRUE	-2	Uint32
E-20	Terminal 27 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
E-21	Terminal 29 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
E-24	Function Relay	null	All set-ups	TRUE	-	Uint8
E-26	On Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
E-27	Off Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
E-51	Terminal 27 Mode	[0] Input	All set-ups	TRUE	-	Uint8
E-52	Terminal 29 Mode	[0] Input	All set-ups	TRUE	-	Uint8
E-53	Terminal X30/2 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-54	Terminal X30/3 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-55	Terminal X30/4 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-56	Term X30/6 Digi Out (OPCGPIO)	[0] No operation	All set-ups	TRUE	-	Uint8
E-57	Term X30/7 Digi Out (OPCGPIO)	[0] No operation	All set-ups	TRUE	-	Uint8
E-60	Term. 29 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
E-61	Term. 29 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
E-62	Term. 29 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
E-63	Term. 29 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
E-64	Pulse Filter Time Constant #29	100 ms	All set-ups	FALSE	-3	Uint16
E-65	Term. 33 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
E-66	Term. 33 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
E-67	Term. 33 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
E-68	Term. 33 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
E-69	Pulse Filter Time Constant #33	100 ms	All set-ups	FALSE	-3	Uint16
E-70	Terminal 27 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
E-71	Pulse Output Max Freq #27	5000 Hz	All set-ups	TRUE	0	Uint32
E-72	Terminal 29 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
E-74	Pulse Output Max Freq #29	5000 Hz	All set-ups	TRUE	0	Uint32
E-75	Terminal X30/6 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
E-76	Pulse Output Max Freq #X30/6	5000 Hz	All set-ups	TRUE	0	Uint32
E-90	Digital & Relay Bus Control	0 N/A	All set-ups	TRUE	0	Uint32
E-93	Pulse Out #27 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
E-94	Pulse Out #27 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
E-95	Pulse Out #29 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
E-96	Pulse Out #29 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
E-97	Pulse Out #X30/6 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
E-98	Pulse Out #X30/6 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16

4.3.4. C-## Frequency Control Functions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
C-01	Jump Frequency From [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
C-02	Jump Speed From [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
C-03	Jump Speed To [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
C-04	Jump Frequency To [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
C-05	Multi-step Frequency 1 - 8	0.00 %	All set-ups	TRUE	-2	Int16
C-20	Jog Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
C-21	Jog Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
C-22	Jog Accel/Decel Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
C-23	Quick Stop Decel Time	ExpressionLimit	2 set-ups	TRUE	-2	Uint32
C-30	Frequency Command 2	[20] Digital Potentiometer	All set-ups	TRUE	-	Uint8
C-34	Frequency Command 3	[0] No function	All set-ups	TRUE	-	Uint8
C-40	Semi-Auto Jump Freq Set-up	[0] Off	All set-ups	FALSE	-	Uint8

4.3.5. P-## Motor Data

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
P-02	Motor Power [HP]	ExpressionLimit	All set-ups	FALSE	-2	Uint32
P-03	Motor Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
P-04	Auto Tune	[0] Off	All set-ups	FALSE	-	Uint8
P-06	Base Speed	ExpressionLimit	All set-ups	FALSE	67	Uint16
P-07	Motor Power [kW]	ExpressionLimit	All set-ups	FALSE	1	Uint32
P-08	Motor Rotation Check	[0] Off	All set-ups	FALSE	-	Uint8
P-09	Slip Compensation	0 %	All set-ups	TRUE	0	Int16
P-10	Slip Compensation Time Constant	ExpressionLimit	All set-ups	TRUE	-2	Uint16
P-30	Stator Resistance (Rs)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
P-31	Rotor Resistance (Rr)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
P-35	Main Reactance (Xh)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
P-36	Iron Loss Resistance (Rfe)	ExpressionLimit	All set-ups	FALSE	-3	Uint32
P-39	Motor Poles	ExpressionLimit	All set-ups	FALSE	0	Uint8

4.3.6. H-## High Perf Parameters

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
H-03	Reset Drive to Factory Settings	[0] Normal operation	All set-ups	TRUE	-	Uint8
H-04	Auto-Reset (Times)	null	All set-ups	TRUE	-	Uint8
H-05	Auto-Reset (Reset Interval)	10 s	All set-ups	TRUE	0	Uint16
H-06	Fan Operation	[0] Auto	All set-ups	TRUE	-	Uint8
H-08	Reverse Lock	[2] Both directions	All set-ups	FALSE	-	Uint8
H-09	Start Mode	[0] Disabled	All set-ups	FALSE	-	Uint8
H-40	Configuration Mode	null	All set-ups	TRUE	-	Uint8
H-43	Torque Characteristics	[3] Auto Energy Optim. VT	All set-ups	TRUE	-	Uint8
H-50	Motor Magnetisation at Zero Speed	100 %	All set-ups	TRUE	0	Uint16
H-51	Min Speed Normal Magnetising [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
H-52	Min Speed Normal Magnetising [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
H-61	High Speed Load Compensation	100 %	All set-ups	TRUE	0	Int16
H-64	Resonance Dampening	100 %	All set-ups	TRUE	0	Uint16
H-65	Resonance Dampening Time Constant	5 ms	All set-ups	TRUE	-3	Uint8
H-70	Warning Current Low	0.00 A	All set-ups	TRUE	-2	Uint32
H-71	Warning Current High	ImaxVLT (P1637)	All set-ups	TRUE	-2	Uint32
H-72	Warning Speed Low	0 RPM	All set-ups	TRUE	67	Uint16
H-73	Warning Speed High	outputSpeedHighLimit (P413)	All set-ups	TRUE	67	Uint16
H-74	Warning Reference Low	-999999.999 N/A	All set-ups	TRUE	-3	Int32
H-75	Warning Reference High	999999.999 N/A	All set-ups	TRUE	-3	Int32
H-76	Warning Feedback Low	-999999.999 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
H-77	Warning Feedback High	999999.999 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
H-78	Missing Motor Phase Function	[1] On	All set-ups	TRUE	-	Uint8
H-80	Function at Stop	[0] Coast	All set-ups	TRUE	-	Uint8
H-81	Min Speed for Function at Stop [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
H-82	Min Speed for Function at Stop [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16

4.3.7. AN-## Analog In / Out

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
AN-00	Live Zero Timeout Time	10 s	All set-ups	TRUE	0	Uint8
AN-01	Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	Uint8
AN-02	Fire Mode Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	Uint8
AN-10	Terminal 53 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AN-11	Terminal 53 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
AN-12	Terminal 53 Low Current	4.00 mA	All set-ups	TRUE	-5	Int16
AN-13	Terminal 53 High Current	20.00 mA	All set-ups	TRUE	-5	Int16
AN-14	Terminal 53 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
AN-15	Terminal 53 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32
AN-17	Terminal 53 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AN-20	Terminal 54 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AN-21	Terminal 54 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
AN-22	Terminal 54 Low Current	4.00 mA	All set-ups	TRUE	-5	Int16
AN-23	Terminal 54 High Current	20.00 mA	All set-ups	TRUE	-5	Int16
AN-24	Terminal 54 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
AN-25	Terminal 54 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
AN-27	Terminal 54 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AN-30	Terminal X30/11 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AN-31	Terminal X30/11 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
AN-34	Term. X30/11 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
AN-35	Term. X30/11 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
AN-36	Term. X30/11 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AN-37	Term. X30/11 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AN-40	Terminal X30/12 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AN-41	Terminal X30/12 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
AN-44	Term. X30/12 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
AN-45	Term. X30/12 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
AN-46	Term. X30/12 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AN-47	Term. X30/12 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AN-50	Terminal 42 Output	null	All set-ups	TRUE	-	Uint8
AN-51	Terminal 42 Output Min Scale	0.00 %	All set-ups	TRUE	-2	Int16
AN-52	Terminal 42 Output Max Scale	100.00 %	All set-ups	TRUE	-2	Int16
AN-53	Terminal 42 Output Bus Control	0.00 %	All set-ups	TRUE	-2	N2
AN-54	Terminal 42 Output Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
AN-60	Terminal X30/8 Output	[0] No operation	All set-ups	TRUE	-	Uint8
AN-61	Terminal X30/8 Min. Scale	0.00 %	All set-ups	TRUE	-2	Int16
AN-62	Terminal X30/8 Max. Scale	100.00 %	All set-ups	TRUE	-2	Int16
AN-63	Terminal X30/8 Output Bus Control	0.00 %	All set-ups	TRUE	-2	N2
AN-64	Terminal X30/8 Output Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16

4.3.8. SP-## Special Functions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
SP-10	Line failure	[0] No function	All set-ups	FALSE	-	Uint8
SP-11	Line Voltage at Input Fault	ExpressionLimit	All set-ups	TRUE	0	Uint16
SP-12	Function at Line Imbalance	[0] Trip	All set-ups	TRUE	-	Uint8
SP-23	Typecode Setting	null	2 set-ups	FALSE	-	Uint8
SP-25	Trip Delay at Torque Limit	60 s	All set-ups	TRUE	0	Uint8
SP-26	Trip Delay at Drive Fault	ExpressionLimit	All set-ups	TRUE	0	Uint8
SP-28	Production Settings	[0] No action	All set-ups	TRUE	-	Uint8
SP-30	Current Lim Ctrl, Proportional Gain	100 %	All set-ups	FALSE	0	Uint16
SP-31	Current Lim Ctrl, Integration Time	0.020 s	All set-ups	FALSE	-3	Uint16
SP-40	VT Level	66 %	All set-ups	FALSE	0	Uint8
SP-41	Energy Savings Min. Magnetization	ExpressionLimit	All set-ups	TRUE	0	Uint8
SP-42	Energy Savings Min. Frequency	10 Hz	All set-ups	TRUE	0	Uint8
SP-43	Motor Cosphi	ExpressionLimit	All set-ups	TRUE	-2	Uint16
SP-50	RFI Filter	[1] On	1 set-up	FALSE	-	Uint8
SP-53	Fan Monitor	[1] Warning	All set-ups	TRUE	-	Uint8
SP-60	Function at Over Temperature	[0] Trip	All set-ups	TRUE	-	Uint8
SP-61	Function at Drive Overload	[0] Trip	All set-ups	TRUE	-	Uint8
SP-62	Drive Overload Derate Current	95 %	All set-ups	TRUE	0	Uint16

4.3.9. O-## Options/Comms

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
O-01	Control Site	null	All set-ups	TRUE	-	Uint8
O-02	Control Source	null	All set-ups	TRUE	-	Uint8
O-03	Control Timeout Time	ExpressionLimit	1 set-up	TRUE	-1	Uint32
O-04	Control Timeout Function	[0] Off	1 set-up	TRUE	-	Uint8
O-05	End-of-Timeout Function	[1] Resume set-up	1 set-up	TRUE	-	Uint8
O-06	Reset Control Timeout	[0] Do not reset	All set-ups	TRUE	-	Uint8
O-07	Diagnosis Trigger	[0] Disable	2 set-ups	TRUE	-	Uint8
O-10	Control Profile	[0] Drive Profile	All set-ups	TRUE	-	Uint8
O-13	Configurable Status Word STW	[1] Profile Default	All set-ups	TRUE	-	Uint8
O-30	Protocol	null	1 set-up	TRUE	-	Uint8
O-31	Address	ExpressionLimit	1 set-up	TRUE	0	Uint8
O-32	Baud Rate	null	1 set-up	TRUE	-	Uint8
O-33	Parity / Stop Bits	null	1 set-up	TRUE	-	Uint8
O-35	Minimum Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
O-36	Maximum Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
O-37	Maximum Inter-Char Delay	ExpressionLimit	1 set-up	TRUE	-5	Uint16
O-40	Telegram Selection	[1] Standard telegram 1	2 set-ups	TRUE	-	Uint8
O-50	Coasting Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-52	DC Brake Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-53	Start Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-54	Reversing Select	null	All set-ups	TRUE	-	Uint8
O-55	Set-up Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-56	Preset Reference Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-80	Bus Message Count	0 N/A	All set-ups	TRUE	0	Uint32
O-81	Bus Error Count	0 N/A	All set-ups	TRUE	0	Uint32
O-82	Slave Messages Rcvd	0 N/A	All set-ups	TRUE	0	Uint32
O-83	Slave Error Count	0 N/A	All set-ups	TRUE	0	Uint32
O-89	Diagnostics Count	0 N/A	2 set-ups	TRUE	0	Uint32
O-90	Bus Jog 1 Speed	100 RPM	All set-ups	TRUE	67	Uint16
O-91	Bus Jog 2 Speed	200 RPM	All set-ups	TRUE	67	Uint16
O-94	Bus Feedback 1	0 N/A	1 set-up	TRUE	0	N2
O-95	Bus Feedback 2	0 N/A	1 set-up	TRUE	0	N2
O-96	Bus Feedback 3	0 N/A	1 set-up	TRUE	0	N2

4.3.10. AO-## Analog I/O Option

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
AO-00	Terminal X42/1 Mode	[1] Voltage	All set-ups	TRUE	-	Uint8
AO-01	Terminal X42/3 Mode	[1] Voltage	All set-ups	TRUE	-	Uint8
AO-02	Terminal X42/5 Mode	[1] Voltage	All set-ups	TRUE	-	Uint8
AO-10	Terminal X42/1 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AO-11	Terminal X42/1 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
AO-14	Term. X42/1 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
AO-15	Term. X42/1 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
AO-16	Term. X42/1 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AO-17	Term. X42/1 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AO-20	Terminal X42/3 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AO-21	Terminal X42/3 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
AO-24	Term. X42/3 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
AO-25	Term. X42/3 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
AO-26	Term. X42/3 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AO-27	Term. X42/3 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AO-30	Terminal X42/5 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AO-31	Terminal X42/5 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
AO-34	Term. X42/5 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
AO-35	Term. X42/5 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
AO-36	Term. X42/5 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AO-37	Term. X42/5 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AO-40	Terminal X42/7 Output	[0] No operation	All set-ups	TRUE	-	Uint8
AO-41	Terminal X42/7 Min. Scale	0.00 %	All set-ups	TRUE	-2	Int16
AO-42	Terminal X42/7 Max. Scale	100.00 %	All set-ups	TRUE	-2	Int16
AO-43	Terminal X42/7 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
AO-44	Terminal X42/7 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
AO-50	Terminal X42/9 Output	[0] No operation	All set-ups	TRUE	-	Uint8
AO-51	Terminal X42/9 Min. Scale	0.00 %	All set-ups	TRUE	-2	Int16
AO-52	Terminal X42/9 Max. Scale	100.00 %	All set-ups	TRUE	-2	Int16
AO-53	Terminal X42/9 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
AO-54	Terminal X42/9 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
AO-60	Terminal X42/11 Output	[0] No operation	All set-ups	TRUE	-	Uint8
AO-61	Terminal X42/11 Min. Scale	0.00 %	All set-ups	TRUE	-2	Int16
AO-62	Terminal X42/11 Max. Scale	100.00 %	All set-ups	TRUE	-2	Int16
AO-63	Terminal X42/11 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
AO-64	Terminal X42/11 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16

4.3.11. DN-## DevicNet

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
DN-00	CAN Protocol	null	2 set-ups	FALSE	-	Uint8
DN-01	Baud Rate Select	null	2 set-ups	TRUE	-	Uint8
DN-02	MAC ID	ExpressionLimit	2 set-ups	TRUE	0	Uint8
DN-05	Readout Transmit Error Counter	0 N/A	All set-ups	TRUE	0	Uint8
DN-06	Readout Receive Error Counter	0 N/A	All set-ups	TRUE	0	Uint8
DN-07	Readout Bus Off Counter	0 N/A	All set-ups	TRUE	0	Uint8
DN-10	Process Data Type Selection	null	All set-ups	TRUE	-	Uint8
DN-11	Process Data Config Write	ExpressionLimit	2 set-ups	TRUE	-	Uint16
DN-12	Process Data Config Read	ExpressionLimit	2 set-ups	TRUE	-	Uint16
DN-13	Warning Parameter	0 N/A	All set-ups	TRUE	0	Uint16
DN-14	Net Reference	[0] Off	2 set-ups	TRUE	-	Uint8
DN-15	Net Control	[0] Off	2 set-ups	TRUE	-	Uint8
DN-20	COS Filter 1	0 N/A	All set-ups	FALSE	0	Uint16
DN-21	COS Filter 2	0 N/A	All set-ups	FALSE	0	Uint16
DN-22	COS Filter 3	0 N/A	All set-ups	FALSE	0	Uint16
DN-23	COS Filter 4	0 N/A	All set-ups	FALSE	0	Uint16
DN-30	Array Index	0 N/A	2 set-ups	TRUE	0	Uint8
DN-31	Store Data Values	[0] Off	All set-ups	TRUE	-	Uint8
DN-32	Devicenet Revision	ExpressionLimit	All set-ups	TRUE	0	Uint16
DN-33	Store Always	[0] Off	1 set-up	TRUE	-	Uint8
DN-34	DeviceNet Product Code	120 N/A	1 set-up	TRUE	0	Uint16
DN-39	Devicenet F Parameters	0 N/A	All set-ups	TRUE	0	Uint32

4.3.12. PB-## Profibus

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
PB-00	Setpoint	0 N/A	All set-ups	TRUE	0	Uint16
PB-07	Actual Value	0 N/A	All set-ups	FALSE	0	Uint16
PB-15	PCD Write Configuration	ExpressionLimit	2 set-ups	TRUE	-	Uint16
PB-16	PCD Read Configuration	ExpressionLimit	2 set-ups	TRUE	-	Uint16
PB-18	Node Address	126 N/A	1 set-up	TRUE	0	Uint8
PB-22	Telegram Selection	[108] PPO 8	1 set-up	TRUE	-	Uint8
PB-23	Parameters for Signals	0	All set-ups	TRUE	-	Uint16
PB-27	Parameter Edit	[1] Enabled	2 set-ups	FALSE	-	Uint16
PB-28	Process Control	[1] Enable cyclic master	2 set-ups	FALSE	-	Uint8
PB-44	Fault Message Counter	0 N/A	All set-ups	TRUE	0	Uint16
PB-45	Fault Code	0 N/A	All set-ups	TRUE	0	Uint16
PB-47	Fault Number	0 N/A	All set-ups	TRUE	0	Uint16
PB-52	Fault Situation Counter	0 N/A	All set-ups	TRUE	0	Uint16
PB-53	Profibus Warning Word	0 N/A	All set-ups	TRUE	0	V2
PB-63	Actual Baud Rate	[255] No baudrate found	All set-ups	TRUE	-	Uint8
PB-64	Device Identification	0 N/A	All set-ups	TRUE	0	Uint16
PB-65	Profile Number	0 N/A	All set-ups	TRUE	0	OctStr[2]
PB-67	Control Word 1	0 N/A	All set-ups	TRUE	0	V2
PB-68	Status Word 1	0 N/A	All set-ups	TRUE	0	V2
PB-71	Profibus Save Data Values	[0] Off	All set-ups	TRUE	-	Uint8
PB-72	ProfibusDriveReset	[0] No action	1 set-up	FALSE	-	Uint8
PB-80	Defined Parameters (1)	0 N/A	All set-ups	FALSE	0	Uint16
PB-81	Defined Parameters (2)	0 N/A	All set-ups	FALSE	0	Uint16
PB-82	Defined Parameters (3)	0 N/A	All set-ups	FALSE	0	Uint16
PB-83	Defined Parameters (4)	0 N/A	All set-ups	FALSE	0	Uint16
PB-84	Defined Parameters (5)	0 N/A	All set-ups	FALSE	0	Uint16
PB-90	Changed Parameters (1)	0 N/A	All set-ups	FALSE	0	Uint16
PB-91	Changed Parameters (2)	0 N/A	All set-ups	FALSE	0	Uint16
PB-92	Changed Parameters (3)	0 N/A	All set-ups	FALSE	0	Uint16
PB-93	Changed Parameters (4)	0 N/A	All set-ups	FALSE	0	Uint16
PB-94	Changed Parameters (5)	0 N/A	All set-ups	FALSE	0	Uint16

4.3.13. LN-## LonWorks

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
LN-00	Neuron ID	0 N/A	All set-ups	TRUE	0	OctStr[6]
LN-10	Drive Profile	[0] VSD profile	All set-ups	TRUE	-	Uint8
LN-15	LON Warning Word	0 N/A	All set-ups	TRUE	0	Uint16
LN-17	XIF Revision	0 N/A	All set-ups	TRUE	0	VisStr[5]
LN-18	LonWorks Revision	0 N/A	All set-ups	TRUE	0	VisStr[5]
LN-21	Store Data Values	[0] Off	All set-ups	TRUE	-	Uint8

4.3.14. BN-## BACnet

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
BN-70	BACnet Device Instance	1 N/A	1 set-up	TRUE	0	Uint32
BN-72	MS/TP Max Masters	127 N/A	1 set-up	TRUE	0	Uint8
BN-73	MS/TP Max Info Frames	1 N/A	1 set-up	TRUE	0	Uint16
BN-74	"I-Am" Service	[0] Send at power-up	1 set-up	TRUE	-	Uint8
BN-75	Initialization Password	ExpressionLimit	1 set-up	TRUE	0	VisStr[20]

4.3.15. ID-## Drive Information

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
ID-00	Operating Hours	0 h	All set-ups	FALSE	74	Uint32
ID-01	Running Hours	0 h	All set-ups	FALSE	74	Uint32
ID-02	kWh Counter	0 kWh	All set-ups	FALSE	75	Uint32
ID-03	Power Up's	0 N/A	All set-ups	FALSE	0	Uint32
ID-04	Over Temp's	0 N/A	All set-ups	FALSE	0	Uint16
ID-05	Over Volt's	0 N/A	All set-ups	FALSE	0	Uint16
ID-06	Reset kWh Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
ID-07	Reset Running Hours Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
ID-08	Number of Starts	0 N/A	All set-ups	FALSE	0	Uint32
ID-10	Trending Source	0	2 set-ups	TRUE	-	Uint16
ID-11	Trending Interval	ExpressionLimit	2 set-ups	TRUE	-3	TimD
ID-12	Trigger Event	[0] False	1 set-up	TRUE	-	Uint8
ID-13	Trending Mode	[0] Trend always	2 set-ups	TRUE	-	Uint8
ID-14	Samples Before Trigger	50 N/A	2 set-ups	TRUE	0	Uint8
ID-20	Historic Log: Event	0 N/A	All set-ups	FALSE	0	Uint8
ID-21	Historic Log: Value	0 N/A	All set-ups	FALSE	0	Uint32
ID-22	Historic Log: Time	0 ms	All set-ups	FALSE	-3	Uint32
ID-23	Historic Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
ID-30	Alarm Log: Error Code	0 N/A	All set-ups	FALSE	0	Uint8
ID-31	Alarm Log: Value	0 N/A	All set-ups	FALSE	0	Int16
ID-32	Alarm Log: Time	0 s	All set-ups	FALSE	0	Uint32
ID-33	Alarm Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
ID-40	Drive Type	0 N/A	All set-ups	FALSE	0	VisStr[6]
ID-41	Power Section	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-42	Voltage	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-43	Software Version	0 N/A	All set-ups	FALSE	0	VisStr[5]
ID-46	GE Model No.	0 N/A	All set-ups	FALSE	0	VisStr[8]
ID-47	GE Power Card Model No	0 N/A	All set-ups	FALSE	0	VisStr[8]
ID-48	Keypad ID Number	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-49	SW ID Control Card	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-50	SW ID Power Card	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-51	Drive Serial Number	0 N/A	All set-ups	FALSE	0	VisStr[10]
ID-53	Power Card Serial Number	0 N/A	All set-ups	FALSE	0	VisStr[19]
ID-60	Option Mounted	0 N/A	All set-ups	FALSE	0	VisStr[30]
ID-61	Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-62	Option Ordering No	0 N/A	All set-ups	FALSE	0	VisStr[8]
ID-63	Option Serial No	0 N/A	All set-ups	FALSE	0	VisStr[18]
ID-70	Option in Slot A	0 N/A	All set-ups	FALSE	0	VisStr[30]
ID-71	Slot A Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-72	Option in Slot B	0 N/A	All set-ups	FALSE	0	VisStr[30]
ID-73	Slot B Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-74	Option in Slot C1	0 N/A	All set-ups	FALSE	0	VisStr[30]
ID-75	Slot C1 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-76	Option in Slot C1	0 N/A	All set-ups	FALSE	0	VisStr[30]
ID-77	Slot C1 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-92	Defined Parameters	0 N/A	All set-ups	FALSE	0	Uint16
ID-93	Modified Parameters	0 N/A	All set-ups	FALSE	0	Uint16
ID-98	Drive Identification	0 N/A	All set-ups	FALSE	0	VisStr[40]
ID-99	Parameter Metadata	0 N/A	All set-ups	FALSE	0	Uint16

4.3.16. DR-## Data Readouts

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
DR-00	Control Word	0 N/A	All set-ups	FALSE	0	V2
DR-01	Reference [Unit]	0.000 ReferenceFeedbackUnit	All set-ups	FALSE	-3	Int32
DR-02	Reference [%]	0.0 %	All set-ups	FALSE	-1	Int16
DR-03	Status Word	0 N/A	All set-ups	FALSE	0	V2
DR-05	Main Actual Value [%]	0.00 %	All set-ups	FALSE	-2	N2
DR-09	Custom Readout	0.00 CustomReadoutUnit	All set-ups	FALSE	-2	Int32
DR-10	Power [kW]	0.00 kW	All set-ups	FALSE	1	Int32
DR-11	Power [hp]	0.00 hp	All set-ups	FALSE	-2	Int32
DR-12	Motor Rated Voltage	0.0 V	All set-ups	FALSE	-1	Uint16
DR-13	Frequency	0.0 Hz	All set-ups	FALSE	-1	Uint16
DR-14	Motor Current	0.00 A	All set-ups	FALSE	-2	Int32
DR-15	Frequency [%]	0.00 %	All set-ups	FALSE	-2	N2
DR-16	Torque [Nm]	0.0 Nm	All set-ups	FALSE	-1	Int32
DR-17	Speed [RPM]	0 RPM	All set-ups	FALSE	67	Int32
DR-22	Torque [%]	0 %	All set-ups	FALSE	0	Int16
DR-30	DC Link Voltage	0 V	All set-ups	FALSE	0	Uint16
DR-32	Brake Energy /s	0.000 kW	All set-ups	FALSE	0	Uint32
DR-34	Heatsink Temp.	0 °C	All set-ups	FALSE	100	Uint8
DR-35	Drive Thermal	0 %	All set-ups	FALSE	0	Uint8
DR-36	Drive Nominal Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
DR-37	Drive Max. Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
DR-38	Logic Controller State	0 N/A	All set-ups	FALSE	0	Uint8
DR-39	Control Card Temp.	0 °C	All set-ups	FALSE	100	Uint8
DR-40	Trending Buffer Full	[0] No	All set-ups	TRUE	-	Uint8
DR-50	External Reference	0.0 N/A	All set-ups	FALSE	-1	Int16
DR-52	Feedback [Unit]	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
DR-53	Digi Pot Reference	0.00 N/A	All set-ups	FALSE	-2	Int16
DR-54	Feedback 1 [Unit]	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
DR-55	Feedback 2 [Unit]	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
DR-56	Feedback 3 [Unit]	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
DR-58	PID Output [%]	0.0 %	All set-ups	TRUE	-1	Int16
DR-60	Digital Input	0 N/A	All set-ups	FALSE	0	Uint16
DR-61	Terminal 53 Switch Setting	[0] Current	All set-ups	FALSE	-	Uint8
DR-62	Analog Input 53	0.000 N/A	All set-ups	FALSE	-3	Int32
DR-63	Terminal 54 Switch Setting	[0] Current	All set-ups	FALSE	-	Uint8
DR-64	Analog Input 54	0.000 N/A	All set-ups	FALSE	-3	Int32
DR-65	Analog Output 42 [mA]	0.000 N/A	All set-ups	FALSE	-3	Int16
DR-66	Digital Output [bin]	0 N/A	All set-ups	FALSE	0	Int16
DR-67	Pulse Input #29 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
DR-68	Pulse Input #33 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
DR-69	Pulse Output #27 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
DR-70	Pulse Output #29 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
DR-71	Relay Output [bin]	0 N/A	All set-ups	FALSE	0	Int16
DR-72	Counter A	0 N/A	All set-ups	TRUE	0	Int32
DR-73	Counter B	0 N/A	All set-ups	TRUE	0	Int32
DR-75	Analog In X30/11	0.000 N/A	All set-ups	FALSE	-3	Int32
DR-76	Analog In X30/12	0.000 N/A	All set-ups	FALSE	-3	Int32
DR-77	Analog Out X30/8 [mA]	0.000 N/A	All set-ups	FALSE	-3	Int16

Par. No. #	Parameter description	Default value	4-set-up	Change during opera-tion	Conver-sion index	Type
DR-80	Fieldbus CTW 1	0 N/A	All set-ups	FALSE	0	V2
DR-82	Fieldbus REF 1	0 N/A	All set-ups	FALSE	0	N2
DR-84	Comm. Option STW	0 N/A	All set-ups	FALSE	0	V2
DR-85	Drive Port CTW 1	0 N/A	All set-ups	FALSE	0	V2
DR-86	Drive Port REF 1	0 N/A	All set-ups	FALSE	0	N2
DR-90	Alarm Word	0 N/A	All set-ups	FALSE	0	Uint32
DR-91	Alarm Word 2	0 N/A	All set-ups	FALSE	0	Uint32
DR-92	Warning Word	0 N/A	All set-ups	FALSE	0	Uint32
DR-93	Warning Word 2	0 N/A	All set-ups	FALSE	0	Uint32
DR-94	Ext. Status Word	0 N/A	All set-ups	FALSE	0	Uint32
DR-95	Ext. Status Word 2	0 N/A	All set-ups	FALSE	0	Uint32
DR-96	Maintenance Word	0 N/A	All set-ups	FALSE	0	Uint32

4.3.17. LG-## Logs & I/O Opt. Status

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
LG-00	Maintenance Log: Item	0 N/A	All set-ups	FALSE	0	Uint8
LG-01	Maintenance Log: Action	0 N/A	All set-ups	FALSE	0	Uint8
LG-02	Maintenance Log: Time	0 s	All set-ups	FALSE	0	Uint32
LG-03	Maintenance Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
LG-10	Fire Mode Log: Event	0 N/A	All set-ups	FALSE	0	Uint8
LG-11	Fire Mode Log: Time	0 s	All set-ups	FALSE	0	Uint32
LG-12	Fire Mode Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
LG-33	Analog Out X42/7 [V]	0.000 N/A	All set-ups	FALSE	-3	Int16
LG-34	Analog Out X42/9 [V]	0.000 N/A	All set-ups	FALSE	-3	Int16
LG-35	Analog Out X42/11 [V]	0.000 N/A	All set-ups	FALSE	-3	Int16

4.3.18. AP-## HVAC Appl. Param.

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
AP-00	External Interlock Delay	0 s	All set-ups	TRUE	0	Uint16
AP-20	Low Power Auto Set-up	[0] Off	All set-ups	FALSE	-	Uint8
AP-21	Low Power Detection	[0] Disabled	All set-ups	TRUE	-	Uint8
AP-22	Low Speed Detection	[0] Disabled	All set-ups	TRUE	-	Uint8
AP-23	No-Flow Function	[0] Off	All set-ups	TRUE	-	Uint8
AP-24	No-Flow Delay	10 s	All set-ups	TRUE	0	Uint16
AP-26	Dry Pump Function	[0] Off	All set-ups	TRUE	-	Uint8
AP-27	Dry Pump Delay	10 s	All set-ups	TRUE	0	Uint16
AP-30	No-Flow Power	0.00 kW	All set-ups	TRUE	1	Uint32
AP-31	Power Correction Factor	100 %	All set-ups	TRUE	0	Uint16
AP-32	Low Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
AP-33	Low Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
AP-34	Low Speed Power [kW]	ExpressionLimit	All set-ups	TRUE	1	Uint32
AP-35	Low Speed Power [HP]	ExpressionLimit	All set-ups	TRUE	-2	Uint32
AP-36	High Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
AP-37	High Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
AP-38	High Speed Power [kW]	ExpressionLimit	All set-ups	TRUE	1	Uint32
AP-39	High Speed Power [HP]	ExpressionLimit	All set-ups	TRUE	-2	Uint32
AP-40	Minimum Run Time	10 s	All set-ups	TRUE	0	Uint16
AP-41	Minimum Sleep Time	10 s	All set-ups	TRUE	0	Uint16
AP-42	Wake-up Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
AP-43	Wake-up Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
AP-44	Wake-up Ref./FB Difference	10 %	All set-ups	TRUE	0	Int8
AP-45	Setpoint Boost	0 %	All set-ups	TRUE	0	Int8
AP-46	Maximum Boost Time	60 s	All set-ups	TRUE	0	Uint16
AP-50	End of Curve Function	[0] Off	All set-ups	TRUE	-	Uint8
AP-51	End of Curve Delay	10 s	All set-ups	TRUE	0	Uint16
AP-60	Broken Belt Function	[0] Off	All set-ups	TRUE	-	Uint8
AP-61	Broken Belt Torque	10 %	All set-ups	TRUE	0	Uint8
AP-62	Broken Belt Delay	10 s	All set-ups	TRUE	0	Uint16
AP-75	Short Cycle Protection	[0] Disabled	All set-ups	TRUE	-	Uint8
AP-76	Interval between Starts	start_to_start_min_on_time (P2277)	All set-ups	TRUE	0	Uint16
AP-77	Minimum Run Time	0 s	All set-ups	TRUE	0	Uint16
AP-80	Flow Compensation	[0] Disabled	All set-ups	TRUE	-	Uint8
AP-81	Square-linear Curve Approximation	100 %	All set-ups	TRUE	0	Uint8
AP-82	Work Point Calculation	[0] Disabled	All set-ups	TRUE	-	Uint8
AP-83	Speed at No-Flow [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
AP-84	Speed at No-Flow [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
AP-85	Speed at Design Point [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
AP-86	Speed at Design Point [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
AP-87	Pressure at No-Flow Speed	0.000 N/A	All set-ups	TRUE	-3	Int32
AP-88	Pressure at Rated Speed	999999.999 N/A	All set-ups	TRUE	-3	Int32
AP-89	Flow at Design Point	0.000 N/A	All set-ups	TRUE	-3	Int32
AP-90	Flow at Rated Speed	0.000 N/A	All set-ups	TRUE	-3	Int32

4.3.19. FB-## Fire/Bypass Operation

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
FB-00	Fire Mode Function	[0] Disabled	2 set-ups		TRUE	-	Uint8
FB-01	Fire Mode Configuration	[0] Open Loop	All set-ups		TRUE	-	Uint8
FB-02	Fire Mode Unit	null	All set-ups		TRUE	-	Uint8
FB-03	Fire Mode Min Reference	ExpressionLimit	All set-ups		TRUE	-3	Int32
FB-04	Fire Mode Max Reference	ExpressionLimit	All set-ups		TRUE	-3	Int32
FB-05	Fire Mode Preset Reference	0.00 %	All set-ups		TRUE	-2	Int16
FB-06	Fire Mode Reference Source	[0] No function	All set-ups		TRUE	-	Uint8
FB-07	Fire Mode Feedback Source	[0] No function	All set-ups		TRUE	-	Uint8
FB-09	Fire Mode Alarm Handling	[1] Trip, Critical Alarms	2 set-ups		FALSE	-	Uint8
FB-10	Drive Bypass Function	[0] Disabled	2 set-ups		TRUE	-	Uint8
FB-11	Drive Bypass Delay Time	0 s	2 set-ups		TRUE	0	Uint16

4.3.20. T-## Timed Functions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
T-00	ON Time	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDayWoDate
T-01	ON Action	[0] Disabled	2 set-ups	TRUE	-	Uint8
T-02	OFF Time	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDayWoDate
T-03	OFF Action	[0] Disabled	2 set-ups	TRUE	-	Uint8
T-04	Occurrence	[0] All days	2 set-ups	TRUE	-	Uint8
T-10	Maintenance Item	[1] Motor bearings	1 set-up	TRUE	-	Uint8
T-11	Maintenance Action	[1] Lubricate	1 set-up	TRUE	-	Uint8
T-12	Maintenance Time Base	[0] Disabled	1 set-up	TRUE	-	Uint8
T-13	Maintenance Time Interval	1 h	1 set-up	TRUE	74	Uint32
T-14	Maintenance Date and Time	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
T-15	Reset Maintenance Word	[0] Do not reset	All set-ups	TRUE	-	Uint8
T-16	Maintenance Text	0 N/A	1 set-up	TRUE	0	VisStr[20]
T-50	Energy Log Resolution	[5] Last 24 Hours	2 set-ups	TRUE	-	Uint8
T-51	Period Start	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay
T-53	Energy Log	0 N/A	All set-ups	TRUE	0	Uint32
T-54	Reset Energy Log	[0] Do not reset	All set-ups	TRUE	-	Uint8
T-60	Trend Variable	[0] Power [kW]	2 set-ups	TRUE	-	Uint8
T-61	Continuous Bin Data	0 N/A	All set-ups	TRUE	0	Uint32
T-62	Timed Bin Data	0 N/A	All set-ups	TRUE	0	Uint32
T-63	Timed Period Start	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay
T-64	Timed Period Stop	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay
T-65	Minimum Bin Value	ExpressionLimit	2 set-ups	TRUE	0	Uint8
T-66	Reset Continuous Bin Data	[0] Do not reset	All set-ups	TRUE	-	Uint8
T-67	Reset Timed Bin Data	[0] Do not reset	All set-ups	TRUE	-	Uint8
T-80	Power Reference Factor	100 %	2 set-ups	TRUE	0	Uint8
T-81	Energy Cost	1.00 N/A	2 set-ups	TRUE	-2	Uint32
T-82	Investment	0 N/A	2 set-ups	TRUE	0	Uint32
T-83	Energy Savings	0 kWh	All set-ups	TRUE	75	Int32
T-84	Cost Savings	0 N/A	All set-ups	TRUE	0	Int32

4.3.21. CL-## PID Closed Loop

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
CL-00	Feedback 1 Source	[2] Analog input 54	All set-ups	TRUE	-	Uint8
CL-01	Feedback 1 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
CL-02	Feedback 1 Source Unit	null	All set-ups	TRUE	-	Uint8
CL-03	Feedback 2 Source	[0] No function	All set-ups	TRUE	-	Uint8
CL-04	Feedback 2 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
CL-05	Feedback 2 Source Unit	null	All set-ups	TRUE	-	Uint8
CL-06	Feedback 3 Source	[0] No function	All set-ups	TRUE	-	Uint8
CL-07	Feedback 3 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
CL-08	Feedback 3 Source Unit	null	All set-ups	TRUE	-	Uint8
CL-12	Reference/Feedback Unit	null	All set-ups	TRUE	-	Uint8
CL-13	Minimum Reference/Feedb.	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
CL-14	Maximum Reference/Feedb.	100.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
CL-20	Feedback Function	[3] Minimum	All set-ups	TRUE	-	Uint8
CL-21	Setpoint 1	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
CL-22	Setpoint 2	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
CL-23	Setpoint 3	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
CL-30	Refrigerant	[0] R22	All set-ups	TRUE	-	Uint8
CL-31	User Defined Refrigerant A1	10.0000 N/A	All set-ups	TRUE	-4	Uint32
CL-32	User Defined Refrigerant A2	-2250.00 N/A	All set-ups	TRUE	-2	Int32
CL-33	User Defined Refrigerant A3	250.000 N/A	All set-ups	TRUE	-3	Uint32
CL-70	Closed Loop Type	[0] Auto	2 set-ups	TRUE	-	Uint8
CL-71	PID Performance	[0] Normal	2 set-ups	TRUE	-	Uint8
CL-72	PID Output Change	0.10 N/A	2 set-ups	TRUE	-2	Uint16
CL-73	Minimum Feedback Level	-999999.000 ProcessCtrlUnit	2 set-ups	TRUE	-3	Int32
CL-74	Maximum Feedback Level	999999.000 ProcessCtrlUnit	2 set-ups	TRUE	-3	Int32
CL-79	PID Autotuning	[0] Disabled	All set-ups	TRUE	-	Uint8
CL-81	PID Normal/ Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
CL-82	PID Start Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
CL-83	PID Start Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
CL-84	On Reference Bandwidth	5 %	All set-ups	TRUE	0	Uint8
CL-91	PID Anti Windup	[1] On	All set-ups	TRUE	-	Uint8
CL-93	PID Proportional Gain	0.50 N/A	All set-ups	TRUE	-2	Uint16
CL-94	PID Integral Time	20.00 s	All set-ups	TRUE	-2	Uint32
CL-95	PID Differentiation Time	0.00 s	All set-ups	TRUE	-2	Uint16
CL-96	PID Diff. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16

4.3.22. XC-## Ext. PID Closed Loop

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
XC-00	Closed Loop Type	[0] Auto	2 set-ups	TRUE	-	Uint8
XC-01	PID Performance	[0] Normal	2 set-ups	TRUE	-	Uint8
XC-02	PID Output Change	0.10 N/A	2 set-ups	TRUE	-2	Uint16
XC-03	Minimum Feedback Level	-999999.000 N/A	2 set-ups	TRUE	-3	Int32
XC-04	Maximum Feedback Level	999999.000 N/A	2 set-ups	TRUE	-3	Int32
XC-09	PID Autotuning	[0] Disabled	All set-ups	TRUE	-	Uint8
XC-10	Ext. 1 Ref./Feedback Unit	[1] %	All set-ups	TRUE	-	Uint8
XC-11	Ext. 1 Minimum Reference	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
XC-12	Ext. 1 Maximum Reference	100.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
XC-13	Ext. 1 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
XC-14	Ext. 1 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
XC-15	Ext. 1 Setpoint	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
XC-17	Ext. 1 Reference [Unit]	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
XC-18	Ext. 1 Feedback [Unit]	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
XC-19	Ext. 1 Output [%]	0 %	All set-ups	TRUE	0	Int32
XC-20	Ext. 1 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
XC-21	Ext. 1 Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
XC-22	Ext. 1 Integral Time	10000.00 s	All set-ups	TRUE	-2	Uint32
XC-23	Ext. 1 Differentation Time	0.00 s	All set-ups	TRUE	-2	Uint16
XC-24	Ext. 1 Dif. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16
XC-30	Ext. 2 Ref./Feedback Unit	[1] %	All set-ups	TRUE	-	Uint8
XC-31	Ext. 2 Minimum Reference	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
XC-32	Ext. 2 Maximum Reference	100.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
XC-33	Ext. 2 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
XC-34	Ext. 2 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
XC-35	Ext. 2 Setpoint	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
XC-37	Ext. 2 Reference [Unit]	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
XC-38	Ext. 2 Feedback [Unit]	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
XC-39	Ext. 2 Output [%]	0 %	All set-ups	TRUE	0	Int32
XC-40	Ext. 2 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
XC-41	Ext. 2 Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
XC-42	Ext. 2 Integral Time	10000.00 s	All set-ups	TRUE	-2	Uint32
XC-43	Ext. 2 Differentation Time	0.00 s	All set-ups	TRUE	-2	Uint16
XC-44	Ext. 2 Dif. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16
XC-50	Ext. 3 Ref./Feedback Unit	[1] %	All set-ups	TRUE	-	Uint8
XC-51	Ext. 3 Minimum Reference	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
XC-52	Ext. 3 Maximum Reference	100.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
XC-53	Ext. 3 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
XC-54	Ext. 3 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
XC-55	Ext. 3 Setpoint	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
XC-57	Ext. 3 Reference [Unit]	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
XC-58	Ext. 3 Feedback [Unit]	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
XC-59	Ext. 3 Output [%]	0 %	All set-ups	TRUE	0	Int32
XC-60	Ext. 3 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
XC-61	Ext. 3 Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
XC-62	Ext. 3 Integral Time	10000.00 s	All set-ups	TRUE	-2	Uint32
XC-63	Ext. 3 Differentation Time	0.00 s	All set-ups	TRUE	-2	Uint16
XC-64	Ext. 3 Dif. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16

4.3.23. BP-## Bypass Option

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
BP-00	Bypass Mode	[0] Drive	All set-ups	TRUE	-	Uint8
BP-01	Bypass Start Time Delay	30 s	All set-ups	TRUE	0	Uint16
BP-02	Bypass Trip Time Delay	0 s	All set-ups	TRUE	0	Uint16
BP-03	Test Mode Activation	[0] Disabled	All set-ups	TRUE	-	Uint8
BP-10	Bypass Status Word	0 N/A	All set-ups	FALSE	0	V2
BP-11	Bypass Running Hours	0 h	All set-ups	FALSE	74	Uint32
BP-19	Remote Bypass Activation	[0] Disabled	2 set-ups	TRUE	-	Uint8

4.3.24. PC-## Pump Controller

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
PC-00	Pump Controller	[0] Disabled	2 set-ups	FALSE	-	Uint8
PC-02	Motor Start	[0] Direct on Line	2 set-ups	FALSE	-	Uint8
PC-04	Pump Cycling	[0] Disabled	All set-ups	TRUE	-	Uint8
PC-05	Fixed Lead Pump	[1] Yes	2 set-ups	FALSE	-	Uint8
PC-06	Number of Pumps	2 N/A	2 set-ups	FALSE	0	Uint8
PC-20	Staging Bandwidth	10 %	All set-ups	TRUE	0	Uint8
PC-21	Override Bandwidth	100 %	All set-ups	TRUE	0	Uint8
PC-22	Fixed Speed Bandwidth	casco_staging_bandwidth (P2520)	All set-ups	TRUE	0	Uint8
PC-23	SBW Staging Delay	15 s	All set-ups	TRUE	0	Uint16
PC-24	SBW Destaging Delay	15 s	All set-ups	TRUE	0	Uint16
PC-25	OBW Time	10 s	All set-ups	TRUE	0	Uint16
PC-26	Destage At No-Flow	[0] Disabled	All set-ups	TRUE	-	Uint8
PC-27	Stage Function	[1] Enabled	All set-ups	TRUE	-	Uint8
PC-28	Stage Function Time	15 s	All set-ups	TRUE	0	Uint16
PC-29	Destage Function	[1] Enabled	All set-ups	TRUE	-	Uint8
PC-30	Destage Function Time	15 s	All set-ups	TRUE	0	Uint16
PC-40	Decel Ramp Delay	10.0 s	All set-ups	TRUE	-1	Uint16
PC-41	Accel Ramp Delay	2.0 s	All set-ups	TRUE	-1	Uint16
PC-42	Staging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
PC-43	Destaging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
PC-44	Staging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
PC-45	Staging Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
PC-46	Destaging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
PC-47	Destaging Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
PC-50	Lead Pump Alternation	[0] Off	All set-ups	TRUE	-	Uint8
PC-51	Alternation Event	[0] External	All set-ups	TRUE	-	Uint8
PC-52	Alternation Time Interval	24 h	All set-ups	TRUE	74	Uint16
PC-53	Alternation Timer Value	0 N/A	All set-ups	TRUE	0	VisStr[7]
PC-54	Alternation Predefined Time	ExpressionLimit	All set-ups	TRUE	0	TimeOfDayWoDate
PC-55	Alternate if Load < 50%	[1] Enabled	All set-ups	TRUE	-	Uint8
PC-56	Staging Mode at Alternation	[0] Slow	All set-ups	TRUE	-	Uint8
PC-58	Run Next Pump Delay	0.1 s	All set-ups	TRUE	-1	Uint16
PC-59	Run on Line Delay	0.5 s	All set-ups	TRUE	-1	Uint16
PC-80	Pump Status	0 N/A	All set-ups	TRUE	0	VisStr[25]
PC-81	Pump Status	0 N/A	All set-ups	TRUE	0	VisStr[25]
PC-82	Lead Pump	0 N/A	All set-ups	TRUE	0	Uint8
PC-83	Relay Status	0 N/A	All set-ups	TRUE	0	VisStr[4]
PC-84	Pump ON Time	0 h	All set-ups	TRUE	74	Uint32
PC-85	Relay ON Time	0 h	All set-ups	TRUE	74	Uint32
PC-86	Reset Relay Counters	[0] Do not reset	All set-ups	TRUE	-	Uint8
PC-90	Pump Interlock	[0] Off	All set-ups	TRUE	-	Uint8
PC-91	Manual Alternation	0 N/A	All set-ups	TRUE	0	Uint8

4.3.25. LC-## Logic Controller

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
LC-00	Logic Controller Mode	null	2 set-ups	TRUE	-	Uint8
LC-01	Start Event	null	2 set-ups	TRUE	-	Uint8
LC-02	Stop Event	null	2 set-ups	TRUE	-	Uint8
LC-03	Reset Logic Controller	[0] Do not reset Logic Controller	All set-ups	TRUE	-	Uint8
LC-10	Comparator Operand	null	2 set-ups	TRUE	-	Uint8
LC-11	Comparator Operator	null	2 set-ups	TRUE	-	Uint8
LC-12	Comparator Value	ExpressionLimit	2 set-ups	TRUE	-3	Int32
LC-20	Logic Controller Timer	ExpressionLimit	1 set-up	TRUE	-3	TimD
LC-40	Logic Rule Boolean 1	null	2 set-ups	TRUE	-	Uint8
LC-41	Logic Rule Operator 1	null	2 set-ups	TRUE	-	Uint8
LC-42	Logic Rule Boolean 2	null	2 set-ups	TRUE	-	Uint8
LC-43	Logic Rule Operator 2	null	2 set-ups	TRUE	-	Uint8
LC-44	Logic Rule Boolean 3	null	2 set-ups	TRUE	-	Uint8
LC-51	Logic Controller Event	null	2 set-ups	TRUE	-	Uint8
LC-52	Logic Controller Action	null	2 set-ups	TRUE	-	Uint8

4.3.26. B-## Braking Functions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
B-00	DC Hold/Preheat Current	50 %	All set-ups	TRUE	0	Uint8
B-01	DC Brake Current	50 %	All set-ups	TRUE	0	Uint16
B-02	DC Braking Time	10.0 s	All set-ups	TRUE	-1	Uint16
B-03	DC Brake Cut In Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
B-04	DC Brake Cut In Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
B-10	Brake Function	[0] Off	All set-ups	TRUE	-	Uint8
B-11	Brake Resistor (ohm)	ExpressionLimit	All set-ups	TRUE	0	Uint16
B-12	Brake Power Limit (kW)	ExpressionLimit	All set-ups	TRUE	0	Uint32
B-13	Braking Thermal Overload	[0] Off	All set-ups	TRUE	-	Uint8
B-15	Brake Check	[0] Off	All set-ups	TRUE	-	Uint8
B-16	AC brake Max. Current	100.0 %	All set-ups	TRUE	-1	Uint32
B-17	Over-voltage Control	[2] Enabled	All set-ups	TRUE	-	Uint8

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5. General Specifications

Mains supply (L1, L2, L3):	
Supply voltage	200-240 V ±10%
Supply voltage	380-500 V ±10%
Supply voltage	525-690 V ±10%
Supply frequency	50/60 Hz
Max. imbalance temporary between mains phases	3.0 % of rated supply voltage
True Power Factor (λ)	≥ 0.9 nominal at rated load
Displacement Power Factor (cos ϕ)	near unity (> 0.98)
Switching on input supply L1, L2, L3 (power-ups) ≤ 7.5 kW	maximum 2 times/min.
Switching on input supply L1, L2, L3 (power-ups) 11-75 kW	maximum 1 time/min.
Switching on input supply L1, L2, L3 (power-ups) ≥ 90 kW	maximum 1 time/2 min.
Environment according to EN60664-1	overvoltage category III/pollution degree 2

The unit is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes, 240/500/600/ 690 V maximum.

Motor output (U, V, W):	
Output voltage	0 - 100% of supply voltage
Output frequency (0.25-75 kW)	0 - 1000 Hz
Output frequency (90-1000 kW)	0 - 800* Hz
Output frequency in Flux Mode	0 - 300 Hz
Switching on output	Unlimited
Ramp times	0.01 - 3600 sec.

** Voltage and power dependent*

Torque characteristics:	
Starting torque (Constant torque)	maximum 160% for 60 sec.*
Starting torque	maximum 180% up to 0.5 sec.*
Overload torque (Constant torque)	maximum 160% for 60 sec.*
Starting torque (Variable torque)	maximum 110% for 60 sec.*
Overload torque (Variable torque)	maximum 110% for 60 sec.

**Percentage relates to the nominal torque.*

Digital inputs:	
Programmable digital inputs	4 (6)
Terminal number	18, 19, 27[1)], 29[4)], 32, 33,
Logic	PNP or NPN
Voltage level	0 - 24 V DC
Voltage level, logic'0' PNP	< 5 V DC
Voltage level, logic'1' PNP	> 10 V DC
Voltage level, logic '0' NPN[2)]	> 19 V DC
Voltage level, logic '1' NPN[2)]	< 14 V DC
Maximum voltage on input	28 V DC
Pulse frequency range	0 - 110 kHz
(Duty cycle) Min. pulse width	4.5 ms
Input resistance, R_i	approx. 4 kΩ

Safe stop Terminal 37[3] (Terminal 37 is fixed PNP logic):	
Voltage level	0 - 24 V DC
Voltage level, logic'0' PNP	< 4 V DC
Voltage level, logic'1' PNP	>20 V DC
Nominal input current at 24 V	50 mA rms
Nominal input current at 20 V	60 mA rms
Input capacitance	400 nF

All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

1) Terminals 27 and 29 can also be programmed as output.

2) Except safe stop input Terminal 37.

3) Terminal 37 is only available in AF-650 GP. It can only be used as safe stop input. Terminal 37 is suitable for category 3 installations according to EN 954-1 (safe stop according to category 0 EN 60204-1) as required by the EU Machinery Directive 98/37/EC. Terminal 37 and the Safe Stop function are designed in conformance with EN 60204-1, EN 50178, EN 61800-2, EN 61800-3, and EN 954-1. For correct and safe use of the Safe Stop function follow the related information and instructions in the AF-650 GP Design Guide.

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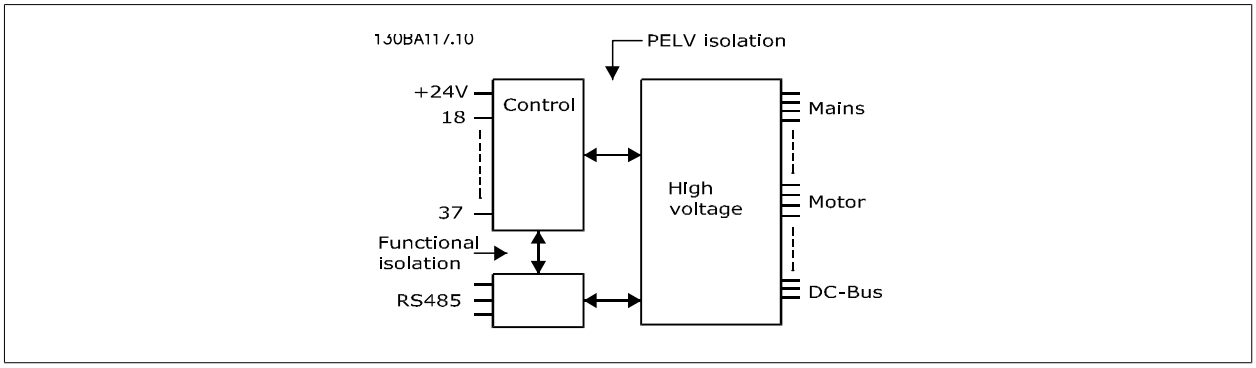
Analog inputs:	
Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switch S201 and switch S202
Voltage mode	Switch S201/switch S202 = OFF (U)
Voltage level	-10 to +10 V (scaleable)
Input resistance, R_i	approx. 10 kΩ
Max. voltage	± 20 V
Current mode	Switch S201/switch S202 = ON (I)
Current level	0/4 to 20 mA (scaleable)
Input resistance, R_i	approx. 200 Ω
Max. current	30 mA
Resolution for analog inputs	10 bit (+ sign)
Accuracy of analog inputs	Max. error 0.5% of full scale
Bandwidth	100 Hz

The analog inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.



Pulse/encoder inputs:	
Programmable pulse/encoder inputs	2/1
Terminal number pulse/encoder	29, 33[1] / 32[2], 33[2]
Max. frequency at terminal 29, 32, 33	110 kHz (Push-pull driven)
Max. frequency at terminal 29, 32, 33	5 kHz (open collector)
Min. frequency at terminal 29, 32, 33	4 Hz
Voltage level	see section on Digital input
Maximum voltage on input	28 V DC
Input resistance, R_i	approx. 4 kΩ
Pulse input accuracy (0.1 - 1 kHz)	Max. error: 0.1% of full scale
Encoder input accuracy (1 - 110 kHz)	Max. error: 0.05 % of full scale

The pulse and encoder inputs (terminals 29, 32, 33) are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

1) Pulse inputs are 29 and 33

2) Encoder inputs: 32 = A, and 33 = B

5

Digital output:	
Programmable digital/pulse outputs	2
Terminal number	27, 29 [1]
Voltage level at digital/frequency output	0 - 24 V
Max. output current (sink or source)	40 mA
Max. load at frequency output	1 kΩ
Max. capacitive load at frequency output	10 nF
Minimum output frequency at frequency output	0 Hz
Maximum output frequency at frequency output	32 kHz
Accuracy of frequency output	Max. error: 0.1 % of full scale
Resolution of frequency outputs	12 bit

1) Terminal 27 and 29 can also be programmed as input.

The digital output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Analog output:	
Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4 - 20 mA
Max. load GND - analog output	500 Ω
Accuracy on analog output	Max. error: 0.5 % of full scale
Resolution on analog output	12 bit

The analog output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control card, 24 V DC output:	
Terminal number	12, 13
Output voltage	24 V +1, -3 V
Max. load	200 mA

The 24 V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analog and digital inputs and outputs.

Control card, 10 V DC output:	
Terminal number	50
Output voltage	10.5 V ±0.5 V
Max. load	15 mA

The 10 V DC supply is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control card, RS 485 serial communication:	
Terminal number	68 (P,TX+, RX+), 69 (N,TX-, RX-)
Terminal number 61	Common for terminals 68 and 69

The RS 485 serial communication circuit is functionally separated from other central circuits and galvanically isolated from the supply voltage (PELV).

Control card, USB serial communication:	
USB standard	1.1 (Full speed)
USB plug	USB type B "device" plug

Connection to PC is carried out via a standard host/device USB cable.

The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

The USB ground connection is not galvanically isolated from protection earth. Use only an isolated laptop as PC connection to the USB connector on the frequency converter.

Relay outputs:	
Programmable relay outputs	2 Form C
Relay 01 Terminal number	1-3 (break), 1-2 (make)
Max. terminal load (AC-1)[1] on 1-3 (NC), 1-2 (NO) (Resistive load)	240 V AC, 2 A
Max. terminal load (AC-15)[1] (Inductive load @ cosϕ 0.4)	240 V AC, 0.2 A
Max. terminal load (DC-1)[1] on 1-2 (NO), 1-3 (NC) (Resistive load)	60 V DC, 1A
Max. terminal load (DC-13)[1] (Inductive load)	24 V DC, 0.1A
Relay 02 Terminal number	4-6 (break), 4-5 (make)
Max. terminal load (AC-1)[1] on 4-5 (NO) (Resistive load)[2][3] Overvoltage cat. II	400 V AC, 2 A
Max. terminal load (AC-15)[1] on 4-5 (NO) (Inductive load @ cosϕ 0.4)	240 V AC, 0.2 A
Max. terminal load (DC-1)[1] on 4-5 (NO) (Resistive load)	80 V DC, 2 A
Max. terminal load (DC-13)[1] on 4-5 (NO) (Inductive load)	24 V DC, 0.1A
Max. terminal load (AC-1)[1] on 4-6 (NC) (Resistive load)	240 V AC, 2 A
Max. terminal load (AC-15)[1] on 4-6 (NC) (Inductive load @ cosϕ 0.4)	240 V AC, 0.2A
Max. terminal load (DC-1)[1] on 4-6 (NC) (Resistive load)	50 V DC, 2 A
Max. terminal load (DC-13)[1] on 4-6 (NC) (Inductive load)	24 V DC, 0.1 A
Min. terminal load on 1-3 (NC), 1-2 (NO), 4-6 (NC), 4-5 (NO)	24 V DC 10 mA, 24 V AC 20 mA
Environment according to EN 60664-1	overvoltage category III/pollution degree 2

1) IEC 60947 part 4 and 5

The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation (PELV).

2) Overvoltage Category II

3) UL applications 300 V AC 2A

Cable lengths and cross sections for control cables*:	
Max. motor cable length, screened	150 m
Max. motor cable length, unscreened	300 m
Maximum cross section to control terminals, flexible/ rigid wire without cable end sleeves	1.5 mm^2/16 AWG
Maximum cross section to control terminals, flexible wire with cable end sleeves	1 mm^2/18 AWG
Maximum cross section to control terminals, flexible wire with cable end sleeves with collar	0.5 mm^2/20 AWG
Minimum cross section to control terminals	0.25 mm^2/ 24 AWG

** Power cables, see tables in section "Electrical Data" of the AF-650 GP Design Guide*

Control card performance:	
Scan interval	AF-650 GP: 1 ms

Control characteristics:	
Resolution of output frequency at 0 - 1000 Hz	+/- 0.003 Hz
Repeat accuracy of *Precise start/stop* (terminals 18, 19)	≤± 0.1 msec
System response time (terminals 18, 19, 27, 29, 32, 33)	≤ 2 ms
Speed control range (open loop)	1:100 of synchronous speed
Speed control range (closed loop)	1:1000 of synchronous speed
Speed accuracy (open loop)	30 - 4000 rpm: error ±8 rpm
Speed accuracy (closed loop), depending on resolution of feedback device	0 - 6000 rpm: error ±0.15 rpm

All control characteristics are based on a 4-pole asynchronous motor

Protection and Features:

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the frequency converter trips if the temperature reaches a predefined level. An overload temperature cannot be reset until the temperature of the heatsink is below the values stated in the tables on the following pages (Guideline - these temperatures may vary for different power sizes, Unit Sizes, enclosure ratings etc.).
- The frequency converter is protected against short-circuits on motor terminals U, V, W.
- If a mains phase is missing, the frequency converter trips or issues a warning (depending on the load).
- Monitoring of the intermediate circuit voltage ensures that the frequency converter trips if the intermediate circuit voltage is too low or too high.
- The frequency converter constantly checks for critical levels of internal temperature, load current, high voltage on the intermediate circuit and low motor speeds. As a response to a critical level, the frequency converter can adjust the switching frequency and/ or change the switching pattern in order to ensure the performance of the drive.

Surroundings:	
Enclosure	IP20 Open Chassis, Nema 1 with field installed kit, Nema 12, and Nema 4
Vibration test	1.0 g
Max. relative humidity	5% - 93%(IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H_2S test	class Kd
Ambient temperature	Max. 50 °C

1) Only for ≤3.7 kW (200 - 240 V), ≤7.5 kW (400 - 480/ 500 V)

2) As enclosure kit for ≤3.7 kW (200 - 240 V), ≤7.5 kW (400 - 480/ 500 V)

3) Derating for high ambient temperature, see special conditions in the Design Guide

Minimum ambient temperature during full-scale operation	0 °C
Minimum ambient temperature at reduced performance	- 10 °C
Temperature during storage/transport	-25 - +65/70 °C
Maximum altitude above sea level without derating	1000 m

Derating for high altitude, see special conditions in the Design Guide

EMC standards, Emission	EN 61800-3, EN 61000-6-3/4, EN 55011
EMC standards, Immunity	EN 61800-3, EN 61000-6-1/2, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6

See section on special conditions in the Design Guide. Please see www.geelectrical.com/drives for more information.

6. Troubleshooting

6.1.1. Warnings/Alarm Messages

A warning or an alarm is signalled by the relevant LED on the front of the frequency converter and indicated by a code on the display.

A warning remains active until its cause is no longer present. Under certain circumstances operation of the motor may still be continued. Warning messages may be critical, but are not necessarily so.

In the event of an alarm, the frequency converter will have tripped. Alarms must be reset to restart operation once their cause has been rectified.

This may be done in three ways:

1. By using the [RESET] control button on the Keypad control panel.
2. Via a digital input with the "Reset" function.
3. Via serial communication/optional fieldbus.

NB!
After a manual reset using the [RESET] button on the Keypad, the [AUTO] button must be pressed to restart the motor.

If an alarm cannot be reset, the reason may be that its cause has not been rectified, or the alarm is trip-locked (see also table on following page).

Alarms that are trip-locked offer additional protection, meaning that the mains supply must be switched off before the alarm can be reset. After being switched back on, the frequency converter is no longer blocked and may be reset as described above once the cause has been rectified.

Alarms that are not trip-locked can also be reset using the automatic reset function in par. H-04 Auto-Reset *(Times)* (Warning: automatic wake-up is possible!)

If a warning and alarm is marked against a code in the table on the following page, this means that either a warning occurs before an alarm, or else that you can specify whether it is a warning or an alarm that is to be displayed for a given fault.

This is possible, for instance, in par. F-10 *Electronic Overload*. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash. Once the problem has been rectified, only the alarm continues flashing until the frequency converter is reset.

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts low	X			
2	Live zero error	(X)	(X)		par. AN-01 Live *Zero Time-out Function*
3	No motor	(X)			par. H-80 Function *at Stop*
4	Mains phase loss	(X)	(X)	(X)	par. SP-12 Function *at Line Imbalance*
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC over-voltage	X	X		
8	DC under voltage	X	X		
9	Inverter overloaded	X	X		
10	Motor Electronic OL over temperature	(X)	(X)		par. F-10 *Electronic Overload*
11	Motor thermistor over temperature	(X)	(X)		par. F-10 *Electronic Overload*
12	Torque limit	X	X		
13	Over Current	X	X	X	
14	Earth Fault	X	X	X	
15	Hardware mismatch		X	X	
16	Short Circuit		X	X	
17	Control word time-out	(X)	(X)		par. O-04 Control *Word Timeout Function*
22	Hoist Mech. Brake				
23	Internal Fan Fault	X			
24	External Fan Fault	X			par. SP-53 Fan *Monitor*
25	Brake resistor short-circuited	X			
26	Brake resistor power limit	(X)	(X)		par. B-13 Braking *Thermal Overload*
27	Brake chopper short-circuited	X	X		
28	Brake check	(X)	(X)		par. B-15 Brake *Check*
29	Heatsink temp	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	par. H-78 Missing *Motor Phase Function*
31	Motor phase V missing	(X)	(X)	(X)	par. H-78 Missing *Motor Phase Function*
32	Motor phase W missing	(X)	(X)	(X)	par. H-78 Missing *Motor Phase Function*
33	Inrush Fault		X	X	
34	Network communication fault	X	X		
36	Mains failure	X	X		
38	Internal Fault		X	X	
39	Heatsink sensor		X	X	
40	Overload of Digital Output Terminal 27	(X)			par. E-00 Digital *I/O Mode*, par. E-51 Terminal *27 Mode*
41	Overload of Digital Output Terminal 29	(X)			par. E-00 Digital *I/O Mode*, par. E-52 Terminal *29 Mode*
42	Overload of Digital Output On X30/6	(X)			par. E-56 Term *X30/6 Digi Out (OPCGPIO)*
42	Overload of Digital Output On X30/7	(X)			par. E-57 Term *X30/7 Digi Out (OPCGPIO)*
46	Pwr. card supply		X	X	
47	24 V supply low	X	X	X	
48	1.8 V supply low		X	X	
49	Speed limit	X			
50	Auto Tune calibration failed		X		
51	Auto Tune check U_{nom} and I_{nom}		X		
52	Auto Tune low I_{nom}		X		
53	Auto Tune motor too big		X		
54	Auto Tune motor too small		X		
55	Auto Tune parameter out of range		X		
56	Auto Tune interrupted by user		X		
57	Auto Tune time-out		X		
58	Auto Tune internal fault	X	X		
59	Current limit	X			

Table 6.1: Alarm/Warning code list

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
61	Tracking Error	(X)	(X)		par. H-20 Motor *Feedback Loss Function*
62	Output Frequency at Maximum Limit	X			
63	Mechanical Brake Low		(X)		par. B-20 Release *Brake Current*
64	Voltage Limit	X			
65	Control Board Over-temperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Module Configuration has Changed		X		
68	Safe Stop	(X)	(X)[1)]		par. E-07 Terminal *37 Safe Stop*
69	Pwr. Card Temp		X	X	
70	Illegal drive configuration			X	
71	Safe Stop	X	X[1)]		par. E-07 Terminal *37 Safe Stop*
72	Dangerous Failure			X[1)]	par. E-07 Terminal *37 Safe Stop*
73	Safe Stop Auto Restart				
77	Reduced power mode	X			par. SP-59 Actual *Number of Inverter Units*
79	Illegal PS config		X	X	
80	Drive Restored to Factory Settings		X		
81	CSIV corrupt				
82	CSIV parameter error				
85	Profibus/Profisafe Error				
90	Encoder Loss	(X)	(X)		par. EC-61 Feedback *Signal Monitoring*
91	Analog input 54 wrong settings			X	S202
100-199	See Operating Instructions for MCO 305				
243	Brake IGBT	X	X		
244	Heatsink temp	X	X	X	
245	Heatsink sensor		X	X	
246	Pwr.card supply		X	X	
247	Pwr.card temp		X	X	
248	Illegal PS config		X	X	
250	New spare part			X	par. SP-23 Typecode *Setting*
251	New Module Number		X	X	

Table 6.2: Alarm/Warning code list

(X) Dependent on parameter

1) Can not be Auto reset via par. H-04 Auto-Reset *(Times)*

A trip is the action when an alarm has appeared. The trip will coast the motor and can be reset by pressing the reset button or make a reset by a digital input (Par. E-1# [1]). The origin event that caused an alarm cannot damage the frequency converter or cause dangerous conditions. A trip lock is an action when an alarm occurs, which may cause damage to frequency converter or connected parts. A Trip Lock situation can only be reset by a power cycling.

LED indication	
Warning	yellow
Alarm	flashing red
Trip locked	yellow and red

Alarm Word Extended Status Word							
Bit	**Hex**	**Dec**	**Alarm Word**	**Alarm Word 2**	**Warning Word**	**Warning Word 2**	**Extended Status Word**
0	00000001	1	Brake Check	ServiceTrip, Read/ Write	Brake Check		Ramping
1	00000002	2	Pwr. Card Temp	ServiceTrip, (re-served)	Pwr. Card Temp		Auto Tune Running
2	00000004	4	Earth Fault	ServiceTrip, Type-code/Sparepart	Earth Fault		Start CW/CCW
3	00000008	8	Ctrl.Card Temp	ServiceTrip, (re-served)	Ctrl.Card Temp		Slow Down
4	00000010	16	Ctrl. Word TO	ServiceTrip, (re-served)	Ctrl. Word TO		Catch Up
5	00000020	32	Over Current		Over Current		Feedback High
6	00000040	64	Torque Limit		Torque Limit		Feedback Low
7	00000080	128	Motor Th Over		Motor Th Over		Output Current High
8	00000100	256	Motor Electronic OL Over		Motor ETR Over		Output Current Low
9	00000200	512	Drive Overld.		Inverter Overld.		Output Freq High
10	00000400	1024	DC under Volt		DC under Volt		Output Freq Low
11	00000800	2048	DC over Volt		DC over Volt		Brake Check OK
12	00001000	4096	Short Circuit		DC Voltage Low		Braking Max
13	00002000	8192	Inrush Fault		DC Voltage High		Braking
14	00004000	16384	Mains ph. Loss		Mains ph. Loss		Out of Speed Range
15	00008000	32768	Auto Tune Not OK		No Motor		OVC Active
16	00010000	65536	Live Zero Error		Live Zero Error		AC Brake
17	00020000	131072	Internal Fault	KTY error	10V Low	KTY Warn	Password Timelock
18	00040000	262144	Brake Overload	Fans error	Brake Overload	Fans Warn	Password Protection
19	00080000	524288	U phase Loss	ECB error	Brake Resistor	ECB Warn	
20	00100000	1048576	V phase Loss		Brake IGBT		
21	00200000	2097152	W phase Loss		Speed Limit		
22	00400000	4194304	Network Fault		Fieldbus Fault		Unused
23	00800000	8388608	24 V Supply Low		24V Supply Low		Unused
24	01000000	16777216	Mains Failure		Mains Failure		Unused
25	02000000	33554432	1.8V Supply Low		Current Limit		Unused
26	04000000	67108864	Brake Resistor		Low Temp		Unused
27	08000000	134217728	Brake IGBT		Voltage Limit		Unused
28	10000000	268435456	Option Change		Encoder loss		Unused
29	20000000	536870912	Drive Restored to factory settings		Output freq. lim.		Unused
30	40000000	1073741824	Safe Stop (A68)	Safe Stop (A71)	Safe Stop (W68)	Safe Stop (W71)	Unused
31	80000000	2147483648	Mech. brake low	Dangerous Failure (A72)	Extended Status Word		Unused

Table 6.3: Description of Alarm Word, Warning Word and extended Status Word

The alarm words, warning words and extended status words can be read out via serial bus or optional fieldbus for diagnose. See alsopar. DR-94 Ext. *Status Word*.

WARNING 1, 10 Volts low:

The 10 V voltage from terminal 50 on the control card is below 10 V.

Remove some of the load from terminal 50, as the 10 V supply is overloaded. Max. 15 mA or minimum 590 Ω.

WARNING/ALARM 2, Live zero error:

The signal on terminal 53 or 54 is less than 50% of the value set in par. AN-10 Terminal *53 Low Voltage*, par. AN-12 Terminal *53 Low Current*, par. AN-20 Terminal *54 Low Voltage*, or par. AN-22 Terminal *54 Low Current* respectively.

WARNING/ALARM 3, No motor:

No motor has been connected to the output of the frequency converter.

WARNING/ALARM 4, Mains phase loss:

A phase is missing on the supply side, or the mains voltage imbalance is too high.

This message also appears in case of a fault in the input rectifier on the frequency converter.

Check the supply voltage and supply currents to the frequency converter.

WARNING 5, DC link voltage high:

The intermediate circuit voltage (DC) is higher than the overvoltage limit of the control system. The frequency converter is still active.

WARNING 6, DC link voltage low

The intermediate circuit voltage (DC) is below the undervoltage limit of the control system. The frequency converter is still active.

WARNING/ALARM 7, DC over voltage:

If the intermediate circuit voltage exceeds the limit, the frequency converter trips after a time.

Possible corrections:

Connect a brake resistor

Extend the ramp time

Activate functions in par. B-10 Brake *Function*

Increase par. SP-26 Trip *Delay at Drive Fault*

Alarm/warning limits:			
	3 x 200 - 240 V [VDC]	3 x 380 - 500 V [VDC]	3 x 525 - 600 V [VDC]
Undervoltage	185	373	532
Voltage warning low	205	410	585
Voltage warning high (w/o brake - w/brake)	390/405	810/840	943/965
Overvoltage	410	855	975
The voltages stated are the intermediate circuit voltage of the frequency converter with a tolerance of ± 5 %. The corresponding mains voltage is the intermediate circuit voltage (DC-link) divided by 1.35			

WARNING/ALARM 8, DC under voltage:
If the intermediate circuit voltage (DC) drops below the "voltage warning low" limit (see table above), the frequency converter checks if 24 V backup supply is connected.
If no 24 V backup supply is connected, the frequency converter trips after a given time depending on the unit.
To check whether the supply voltage matches the frequency converter, see *General Specifications*.

WARNING/ALARM 9, Drive overloaded:
The frequency converter is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection gives a warning at 98% and trips at 100%, while giving an alarm. You cannot reset the frequency converter until the counter is below 90%.
The fault is that the frequency converter is overloaded by more than 100% for too long.

WARNING/ALARM 10, Motor electronic overload over temperature:
According to the electronic thermal protection, the motor is too hot. You can choose if you want the frequency converter to give a warning or an alarm when the counter reaches 100% in par. F-10 *Electronic Overload*. The fault is that the motor is overloaded by more than 100% for too long. Check that the motor par. P-03 Motor *Current* is set correctly.

WARNING/ALARM 11, Motor thermistor over temp:
The thermistor or the thermistor connection is disconnected. You can choose if you want the frequency converter to give a warning or an alarm when the counter reaches 100% in par. F-10 *Electronic Overload*. Check that the thermistor is connected correctly between terminal 53 or 54 (analog voltage input) and terminal 50 (+ 10 V supply), or between terminal 18 or 19 (digital input PNP only) and terminal 50. If aKTY sensoris used, check for correct connection between terminal 54 and 55.

WARNING/ALARM 12, Torque limit:
The torque is higher than the value in par. F-40 Torque *Limiter (Driving)* (in motor operation) or the torque is higher than the value in par. F-41 Torque *Limiter (Braking)* (in regenerative operation).

WARNING/ALARM 13, Over Current:
The inverter peak current limit (approx. 200% of the rated current) is exceeded. The warning will last approx. 8-12 sec., then the frequency converter trips and issues an alarm. Turn off the frequency converter and check if the motor shaft can be turned and if the motor size matches the frequency converter.
If extended mechanical brake control is selected, trip can be reset externally.

ALARM 14, Earth fault:
There is a discharge from the output phases to earth, either in the cable between the frequency converter and the motor or in the motor itself.
Turn off the frequency converter and remove the earth fault.

ALARM 15, Incomplete hardware:
A fitted option is not handled by the present control board (hardware or software).

ALARM 16, Short-circuit
There is short-circuiting in the motor or on the motor terminals.
Turn off the frequency converter and remove the short-circuit.

WARNING/ALARM 17, Control word timeout:
There is no communication to the frequency converter.
The warning will only be active when par. O-04 Control *Word Timeout Function* is NOT set to *OFF*.
If par. O-04 Control *Word Timeout Function* is set to *Stop* and *Trip*, a warning appears and the frequency converter ramps down until it trips, while giving an alarm.
par. O-03 Control *Word Timeout Time* could possibly be increased.

WARNING 23, Internal fan fault:
The fan warning function is an extra protection function that checks if the fan is running / mounted. The fan warning can be disabled in par. SP-53 Fan *Monitor* (set to [0] Disabled).

WARNING 24, External fan fault:
The fan warning function is an extra protection function that checks if the fan is running / mounted. The fan warning can be disabled in par. SP-53 Fan *Monitor* (set to [0] Disabled).

WARNING 25, Brake resistor short-circuited:
The brake resistor is monitored during operation. If it short-circuits, the brake function is disconnected and the warning appears. The frequency converter still works, but without the brake function. Turn off the frequency converter and replace the brake resistor (see par. B-15 Brake *Check*).

ALARM/WARNING 26, Brake resistor power limit:
The power transmitted to the brake resistor is calculated as a percentage, as a mean value over the last 120 s, on the basis of the resistance value of the brake resistor (par. B-11 Brake *Resistor (ohm)*) and the intermediate circuit voltage. The warning is active when the dissipated braking power is higher than 90%. If *Trip* [2] has been selected in par. B-13 Braking *Thermal Overload*, the frequency converter cuts out and issues this alarm, when the dissipated braking power is higher than 100%.

ALARM/ WARNING 27, Brake chopper fault:
The brake transistor is monitored during operation and if it short-circuits, the brake function disconnects and the warning comes up. The frequency converter is still able to run, but since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.
Turn off the frequency converter and remove the brake resistor.
This alarm/ warning could also occur should the brake resistor overheat. Terminal 104 to 106 are available as brake resistor. Klixon inputs, see section Brake Resistor Temperature Switch.

Warning: There is a risk of substantial power being transmitted to the brake resistor if the brake transistor is short-circuited.

ALARM/WARNING 28, Brake check failed:
Brake resistor fault: the brake resistor is not connected/working.

ALARM 29, Drive over temperature:
If the drive type is IP20 Open Chassis, IP20 with Nema 1 kit, or Nema 1 the cut-out temperature of the heat-sink is 95 °C ±5 °C. The temperature fault cannot be reset, until the temperature of the heatsink is below 70 °C ±5 °C.

The fault could be:

- Ambient temperature too high
- Too long motor cable

ALARM 30, Motor phase U missing:
Motor phase U between the frequency converter and the the motor is missing.
Turn off the frequency converter and check motor phase U.

ALARM 31, Motor phase V missing:
Motor phase V between the frequency converter and the motor is missing.
Turn off the frequency converter and check motor phase V.

ALARM 32, Motor phase W missing:
Motor phase W between the frequency converter and the motor is missing.
Turn off the frequency converter and check motor phase W.

ALARM 33, Inrush fault:

Too many power ups have occured within a short time period. See the chapter *General Specifications* for the allowed number of power ups within one minute.

WARNING/ALARM 34, Network communication fault:

The network option card is not working correctly. Please check parameters associated with the module and make sure module is properly inserted in Slot A of the drive.

WARNING/ALARM 36, Mains failure:

This warning/alarm is only active if the supply voltage to the frequency converter is lost and par. SP-10 Line *failure* is NOT set to OFF. Possible correction: check the fuses/circuit breaker connected to the frequency converter

ALARM 38, Internal fault:

Internal drive fault. Please contact your GE supplier. Some typical alarm messages:

0	The serial port cannot be initialized. Serious hardware failure
256	The power EEPROM data is defected or outdated.
512	The control board EEPROM data is defected or outdated.
513	Communication time out Reading EEPROM data
514	Communication time out Reading EEPROM data
515	The Application Orientated Control cannot recognize the EEPROM data
516	Cannot write write to the EEPROM because a write command is on progress
517	The write command is under time out
518	Failure in the EEPROM
519	Missing or invalid BarCode data in EEPROM 1024 – 1279 CAN telegram cannot be sent. (1027 indicate a possible hardware failure)
1281	Digital Signal Processor flash time-out
1282	Power micro software version mismatch
1283	Power EEPROM data version mismatch
1284	Cannot read Digital Signal Processor software version
1299	Option SW in slot A is outdated
1300	Option SW in slot B is outdated
1311	Option SW in slot C0 is outdated
1312	Option SW in slot C1 is outdated
1315	Option SW in slot A is not supported (not allowed)
1316	Option SW in slot B is not supported (not allowed)
1317	Option SW in slot C0 is not supported (not allowed)
1318	Option SW in slot C1 is not supported (not allowed)
1536	An exception in the Application Orientated Control is registered. Debug information written in Keypad
1792	DSP watchdog is active. Debugging of power part data Motor Orientated Control data not transferred correctly
2049	Power data restarted
2315	Missing SW version from power unit
2816	Stack overflow Control board module
2817	Scheduler slow tasks
2818	Fast tasks
2819	Parameter thread
2820	Keypad stack overflow
2821	Serial port overflow
2822	USB port overflow
3072-5122	Parameter value is outside its limits. Perform a initialization. Parameter number causing the alarm: Subtract the code from 3072. Ex Error code 3238: 3238-3072 = 166 is outside the limit
5123	Option in slot A: Hardware incompatible with Control board hardware
5124	Option in slot B: Hardware incompatible with Control board hardware
5125	Option in slot C0: Hardware incompatible with Control board hardware
5126	Option in slot C1: Hardware incompatible with Control board hardware
5376-6231	Out of memory

WARNING 40, Overload of Digital Output Terminal 27

Check the load connected to terminal 27 or remove short-circuit connection. Check par. E-00 Digital *I/O Mode* and par. E-51 Terminal *27 Mode*.

WARNING 41, Overload of Digital Output Terminal 29:

Check the load connected to terminal 29 or remove short-circuit connection. Check par. E-00 Digital *I/O Mode* and par. E-52 Terminal *29 Mode*.

WARNING 42, Overload of Digital Output On X30/6 :

Check the load connected to X30/6 or remove short-circuit connection. Check par. E-56 Term *X30/6 Digi Out (OPCGPIO)*.

WARNING 42, Overload of Digital Output On X30/7 :

Check the load connected to X30/7 or remove short-circuit connection. Check par. E-57 Term *X30/7 Digi Out (OPCGPIO)*.

WARNING 47, 24 V supply low:

The external 24 V DC backup power supply may be overloaded, otherwise Contact your GE supplier.

WARNING 48, 1.8 V supply low:

Contact your GE supplier.

WARNING 49, Speed limit:

The speed is not within the specified range in par. F-18 *Motor Speed Low Limit [RPM]* and par. F-17 *Motor Speed High Limit [RPM]*.

ALARM 50, Auto Tune calibration failed:

Contact your GE supplier.

ALARM 51, Auto Tune check Unom and Inom:

The setting of motor voltage, motor current, and motor power are set set correctly. Please check parameters (P-##).

ALARM 52, Auto Tune low Inom:

The motor current is too low. Check the settings.

ALARM 53, Auto Tune motor too big:

The motor is too big for the Auto Tune to be carried out.

ALARM 54, Auto Tune motor too small:

The motor is too small for the Auto Tune to be carried out.

ALARM 55, Auto Tune par. out of range:

The motor parameter values set for the motor are outside acceptable range.

ALARM 56, Auto Tune interrupted by user:

The Auto Tune has been interrupted by the user.

ALARM 57, Auto Tune timeout:

Try to start the Auto Tune again a number of times, until the Auto Tune is carried out. Please note that repeated runs may heat the motor to a level where the resistance Rs and Rr are increased. In most cases, however, this is not critical.

ALARM 58, Auto Tune internal fault:

Contact your GE supplier.

WARNING 59, Current limit:

The current is higher than the value in par. F-43 Current *Limit*.

WARNING 61, Tracking Error:

An error has been detected between calculated speed and speed measurement from feedback device. The function Warning/Alarm/Disabling setting is in par. H-20 Motor *Feedback Loss Function*. Accepted error setting in par. H-21 Motor *Feedback Speed Error* and the allowed time the error occur setting in par. H-22 Motor *Feedback Loss Timeout*. During a commissioning procedure the function may be effective.

WARNING 62, Output Frequency at Maximum Limit:

The output frequency is higher than the value set in par. F-03 Max *Output Frequency 1*

ALARM 63, Mechanical Brake Low:

The actual motor current has not exceeded the "release brake" current within the "Start delay" time window.

WARNING 64, Voltage Limit:
The load and speed combination demands a motor voltage higher than the actual DC link voltage.

WARNING/ALARM/TRIP 65, Control Card Over Temperature:
Control card over temperature: The cut-out temperature of the control card is 80° C.

WARNING 66, Heatsink Temperature Low:
The heat sink temperature is measured as 0° C. This could indicate that the temperature sensor is defect and thus the fan speed is increased to the maximum in case the power part or control card is very hot.

ALARM 67, Option Module Configuration has Changed:
One or more options modules have either been added or removed since the last power down.

ALARM 68, Safe Stop:
Safe Stop has been activated. To resume normal operation, apply 24 V DC to terminal # 37,, then send a reset signal (via Bus, Digital I/O, or by pressing [RESET]).

WARNING 68, Safe Stop:
Safe Stop has been activated. Normal operation is resumed when Safe Stop is disabled. Warning: Automatic Restart!

ALARM 70, Illegal Drive Configuration:
Actual combination of control board and power board is illegal.

ALARM 71, PTC 1 Safe Stop:
Safe Stop has been activated from external source. Normal operation can be resumed when 24V dc is applied to terminal # 37. When that happens, a reset signal must be is be sent (via Bus, Digital I/O, or by pressing [RESET]).

WARNING 71, Safe Stop:
Safe Stop has been activated from external source. Normal operation can be resumed when 24V dc is applied to terminal # 37.. Warning: Automatic Restart.

ALARM 72, Dangerous Failure:
Safe Stop with Trip Lock. Unexpected signal levels on Safe Stop.

ALARM 80, Drive Restored to Factory Settings:
Parameter settings are restored to factory settings after a manual (three-finger) reset.

ALARM 90, Encoder loss:
Check the connection to encoder option and eventually replace the MCB 102 or MCB 103.

ALARM 91, Analogue Input 54 Wrong Settings:
Switch S202 has to be set in position OFF (voltage input) when a KTY sensor is connected to analogue input terminal 54.

ALARM 250, New Spare Part:
The power or Switch Mode Power Supply has been exchanged. The frequency converter model number must be restored in the EEPROM. Select the correct type code in par. SP-23 Typecode *Setting*according to the label on unit. Remember to select 'Save to EEPROM' to complete.

ALARM 251, New Model Number:
The Frequency Converter has got a new model number.

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The instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the GE company.

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