GE Consumer & Industrial
Electrical Distribution

AF-650 GP™
General Purpose Drive
High Power (460/575/690V 125HP and above)

Operating Instructions

imagination at work

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1 How to Read these Operating Instructions

1.1 How to Read these Operating Instructions

1.1.1 How to Read these Operating Instructions

The frequency converter 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 frequency converter.

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 frequency converter correctly.

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

Chapter 4, **How to Programme**, shows how to operate and programme the frequency converter via the Local Control Panel.

Chapter 5, **General Specifications**, contains technical data about the frequency converter.

Chapter 6, **Warnings and Alarms**, assists in solving problems that may occur when using the frequency converter.

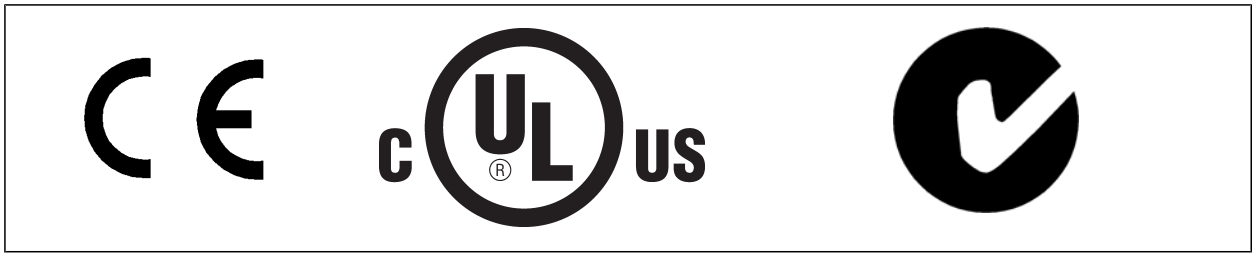
Available literature for AF-650 GP

- The AF-650 GP Operating Instructions - High Power, provide the necessary information for getting the drive up and running.
- The AF-650 GP Design Guide entails all technical information about the drive and customer design and applications.
- The AF-650 GP Programming Guide provides information on how to programme and includes complete parameter descriptions.
- The AF-650 GP Profibus Operating Instructions provide the information required for controlling, monitoring and programming the drive via a Profibus network.
- The AF-650 GP DeviceNet Operating Instructions provide the information required for controlling, monitoring and programming the drive via a Device-Net network.

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

1

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 PC Software	DCT 10
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.

Caution

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

380 - 500 V	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.

2.1.2 Safety Instructions

- Make sure the frequency converter is properly connected to earth.
- Protect users against supply voltage.
- Protect the motor against overloading according to national and local regulations.
- Motor overload protection is not included in the default settings. To add this function, set par. F-10 *Electronic Overload* to value *Elec. OL trip* or *Elec. OL warning*. For the North American market: Electronic Thermal Overload functions provide class 20 motor overload protection, in accordance with NEC.
- The earth leakage current exceeds 3.5 mA.
- The [OFF] key is not a safety switch. It does not disconnect the frequency converter from mains.

2.1.3 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.
When using the frequency converter: wait at least 40 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 rated earth wires terminated separately. For proper earthing for EMC, see section *Earthing* in the *How to Install* chapter.
Residual Current Device
The drive 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 frequency converter and the use of RCD's must always follow national and local regulations.

2.1.4 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

2.1.5 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. The frequency converter with Safe Stop provides protection against unintended start, if the Safe Stop Terminal 37 is deactivated or disconnected.

2.1.6 Safe Stop

The AF-650 GP can perform the safety function *Safe Torque Off* (As defined by draft CD 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!

2.1.7 Safe Stop Installation

To carry out an installation of a Category 0 Stop (EN60204) in conformity 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 an unscreened cable instead of a screened one.

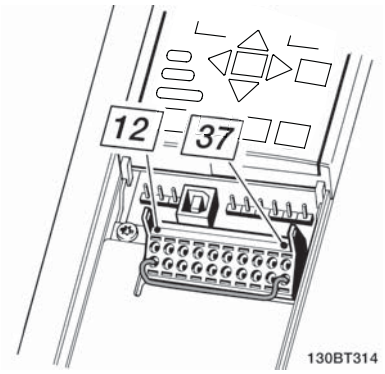


Illustration 2.1: Bridge jumper between terminal 37 and 24 VDC

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.

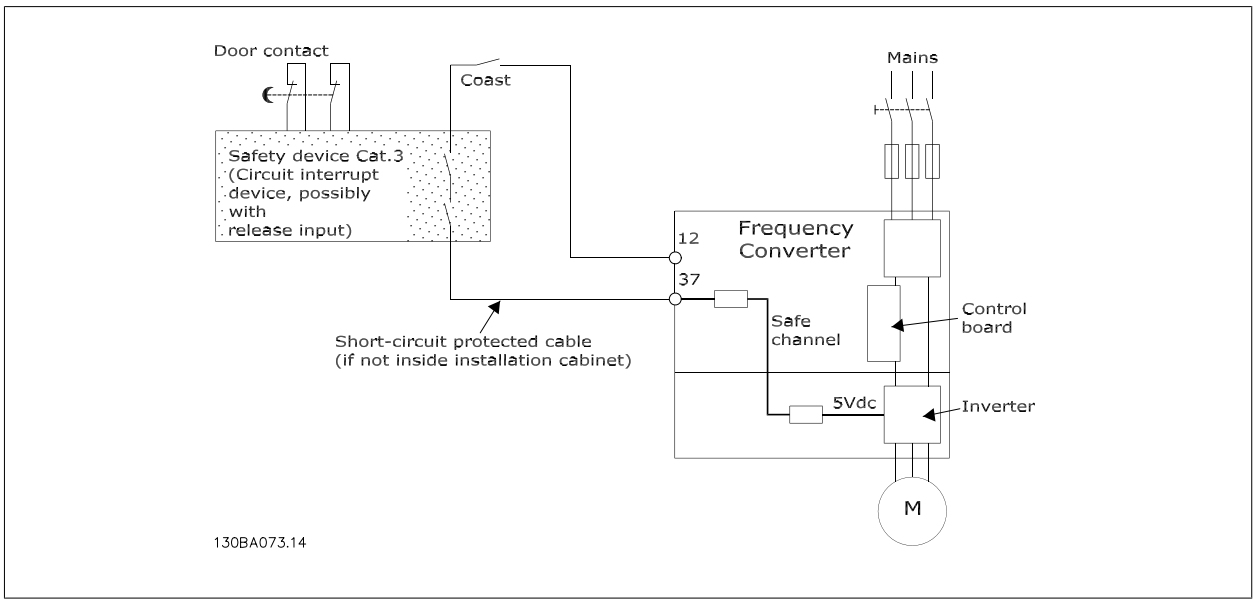


Illustration 2.2: Illustration of the essential aspects of an installation to achieve a Stopping Category 0 (EN 60204-1) with safety Category 3 (EN 954-1).

2.1.8 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 How to Get Started

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

The frequency converter 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 tune
- Programming

Unit size is depending on enclosure type, power range and mains voltage

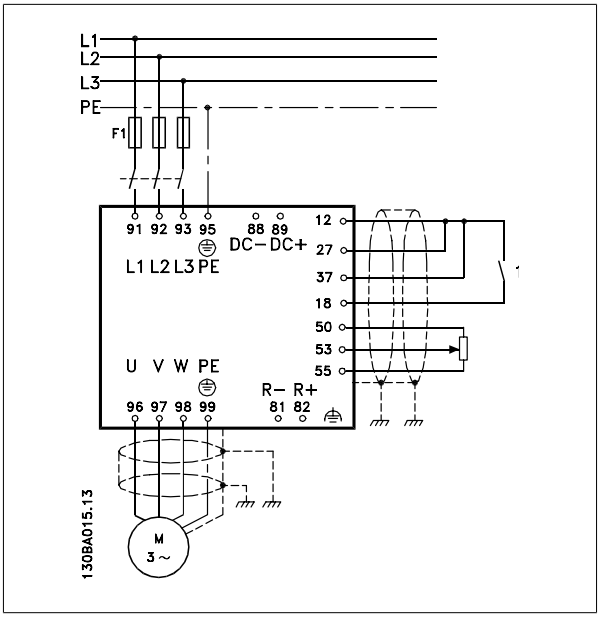


Illustration 3.1: Diagram showing basic installation including mains, motor, start/stop key, and potentiometer for speed adjustment.

3.2 Pre-installation

3.2.1 Planning the Installation Site

NB!
Before performing the installation it is important to plan the installation of the frequency converter. Neglecting this may result in extra work during and after installation.

3

Select the best possible operation site by considering the following (see details on the following pages, and the respective Design Guides):

- Ambient operating temperature
- Installation method
- How to cool the unit
- Position of the frequency converter
- Cable routing
- Ensure the power source supplies the correct voltage and necessary current
- Ensure that the motor current rating is within the maximum current from the frequency converter
- Ensure that the drive is properly protected per local regulations.

3.2.2 Receiving the Frequency Converter

When receiving the frequency converter please make sure that the packaging is intact, and be aware of any damage that might have occurred to the unit during transport. In case damage has occurred, contact immediately the shipping company to claim the damage.

3.2.3 Transportation and Unpacking

Before unpacking the frequency converter it is recommended that it is located as close as possible to the final installation site.
Remove the box and handle the frequency converter on the pallet, as long as possible.

NB!
The card board box cover contains a drilling master for the mounting holes in the Unit Size 4X. For the 5X size, please refer to section *Mechanical Dimensions* later in this chapter.

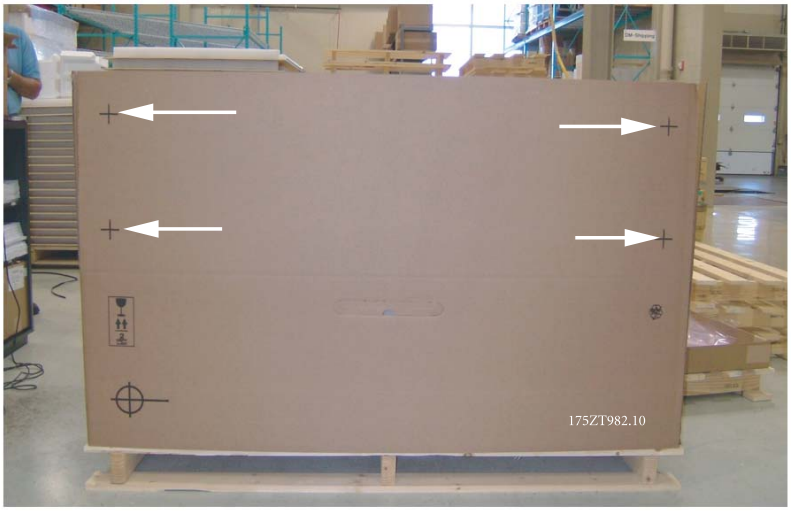


Illustration 3.2: Mounting Template for Unit Size 4X drives (460V, 125 to 300 HP, 575/690V, 125 to 400 HP)

3.2.4 Lifting

Always lift the frequency converter in the dedicated lifting eyes. For all unit size 4X and unit size 52 (IP00) Units, use a bar to avoid bending the lifting holes of the frequency converter.

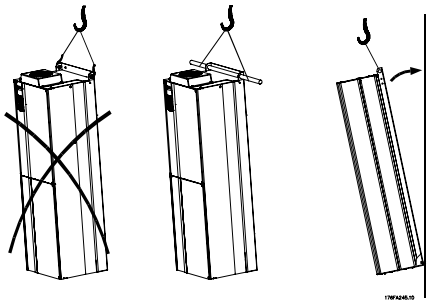


Illustration 3.3: Recommended lifting method, 4X and 5X Unit Sizes.

NB!
The lifting bar must be able to handle the weight of the frequency converter. See *Mechanical Dimensions* for the weight of the different Unit Sizes. Maximum diameter for bar is 25 cm (1 inch). The angle from the top of the drive to the lifting cable should be 60 degrees or greater.

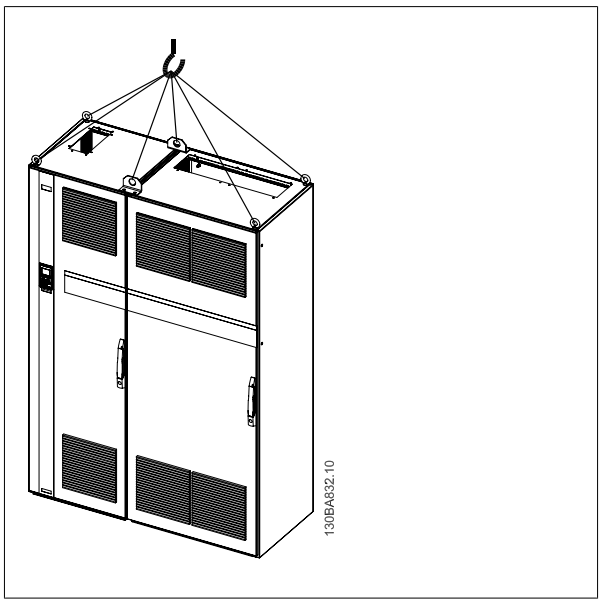


Illustration 3.4: Recommended lifting method, Unit Size 61.
(460V, 600 to 900 HP, 575/690V, 900 to 1150 HP)

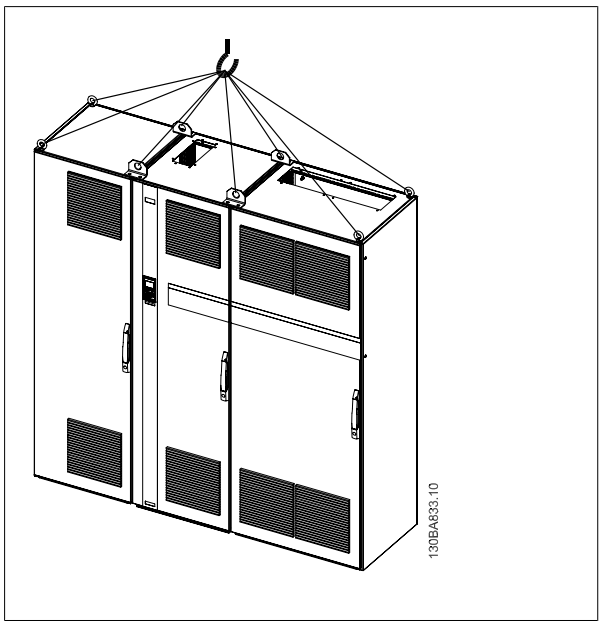


Illustration 3.6: Recommended lifting method, Unit Size 63.
(460V, 600 to 900 HP, 575/690V, 900 to 1150 HP)

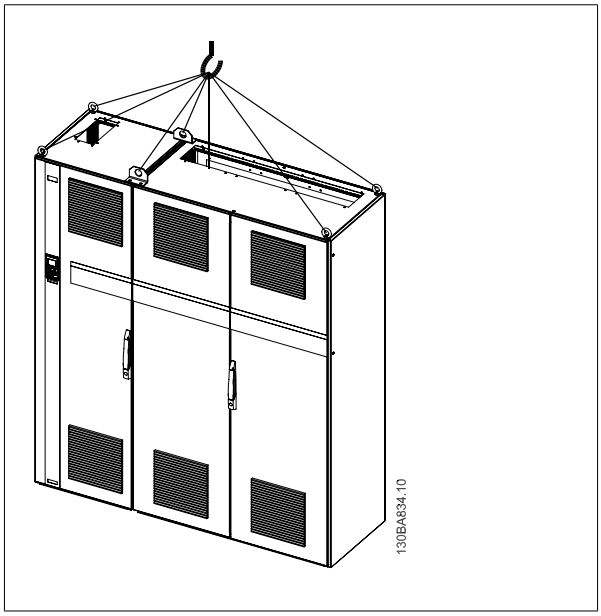


Illustration 3.5: Recommended lifting method, Unit Size 62.
(460V, 1000 to 1200 HP, 575/690V, 1250 to 1350 HP)

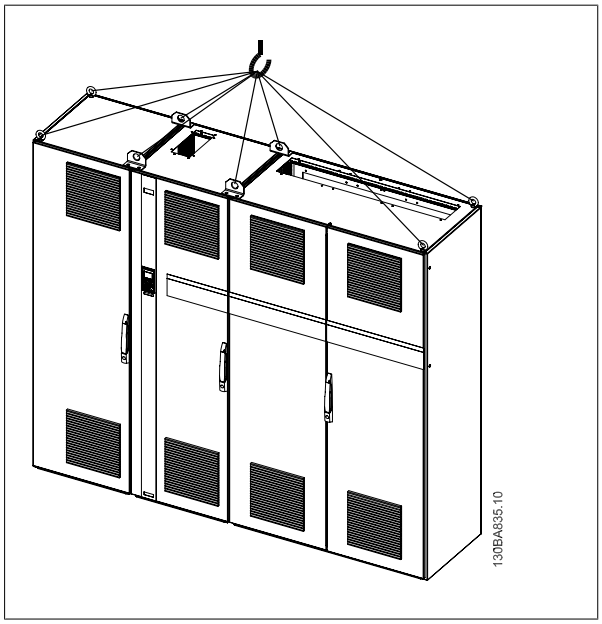
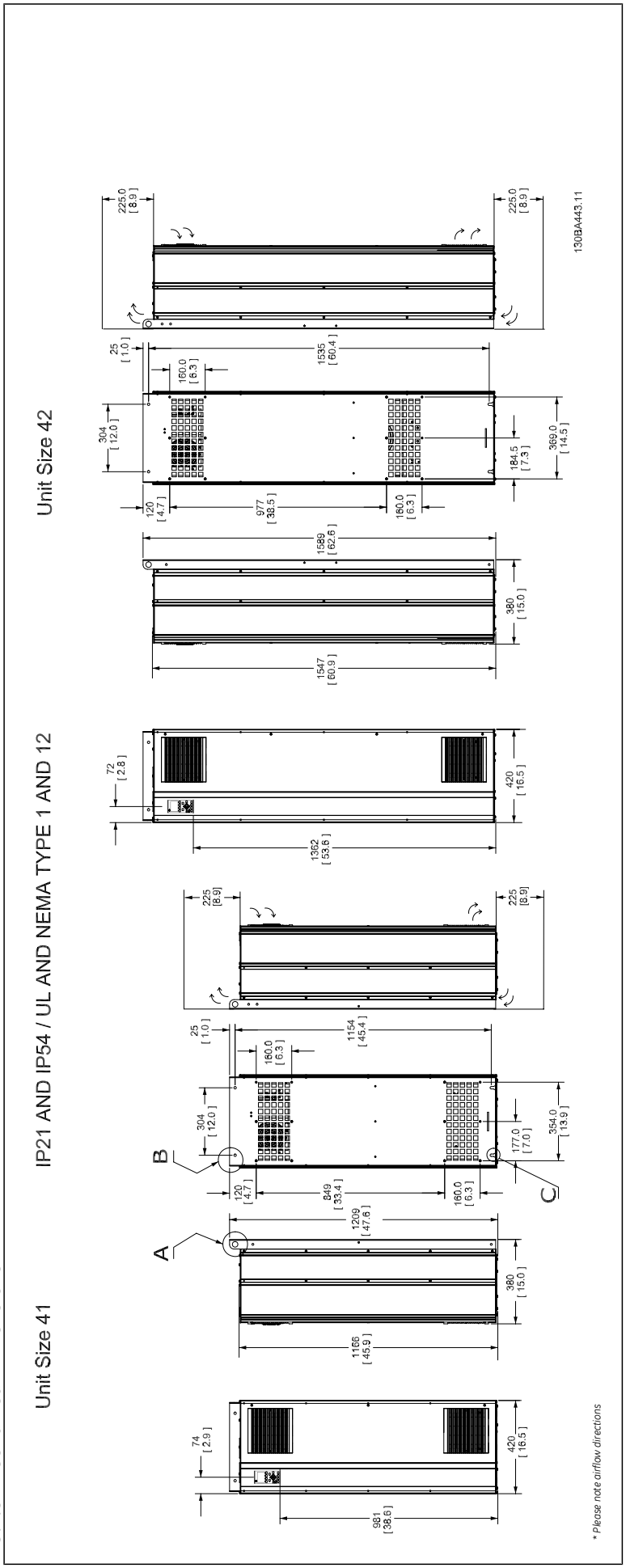
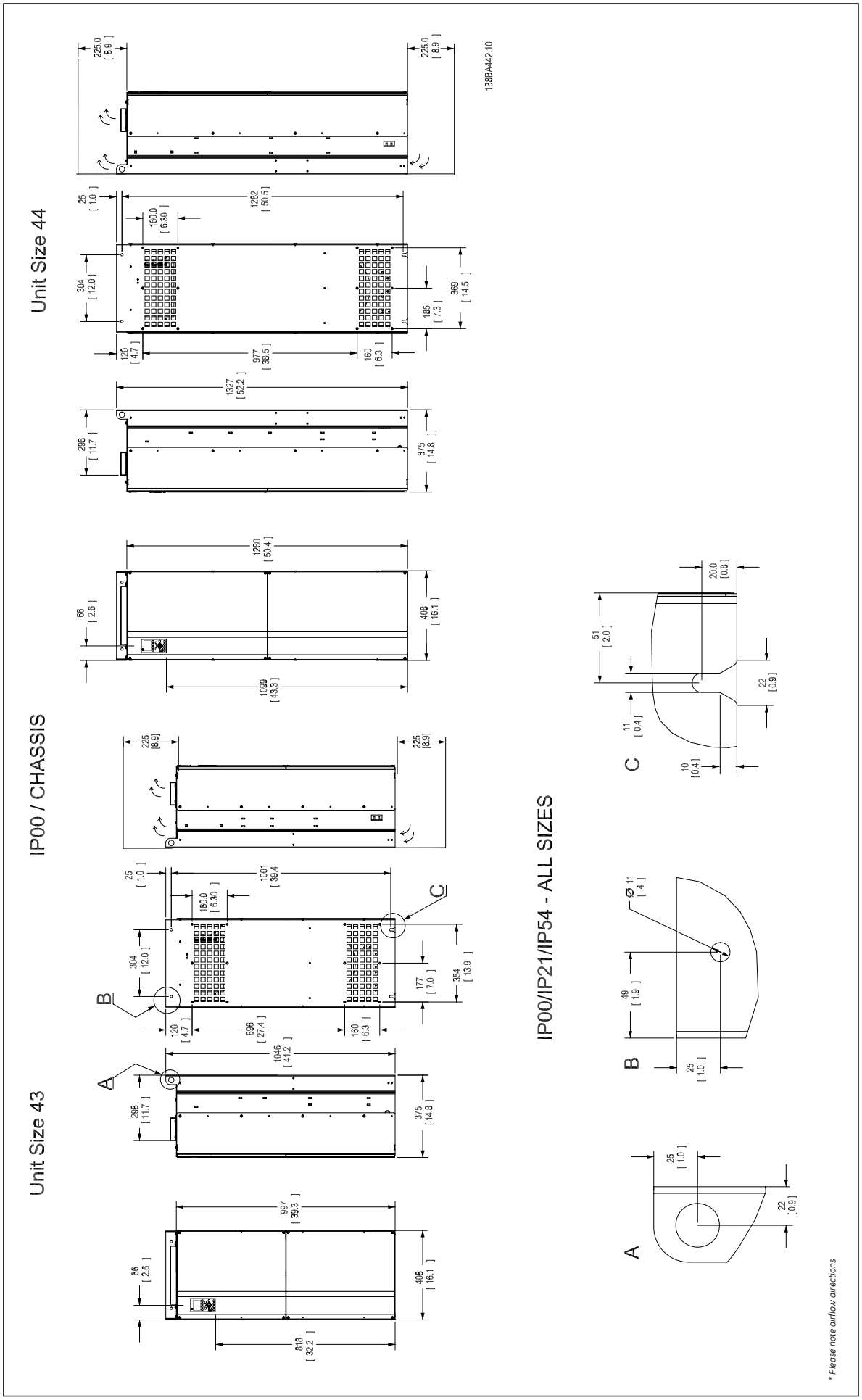


Illustration 3.7: Recommended lifting method, Unit Size 64.
(460V, 1000 to 1200 HP, 575/690V, 1250 to 1350 HP)

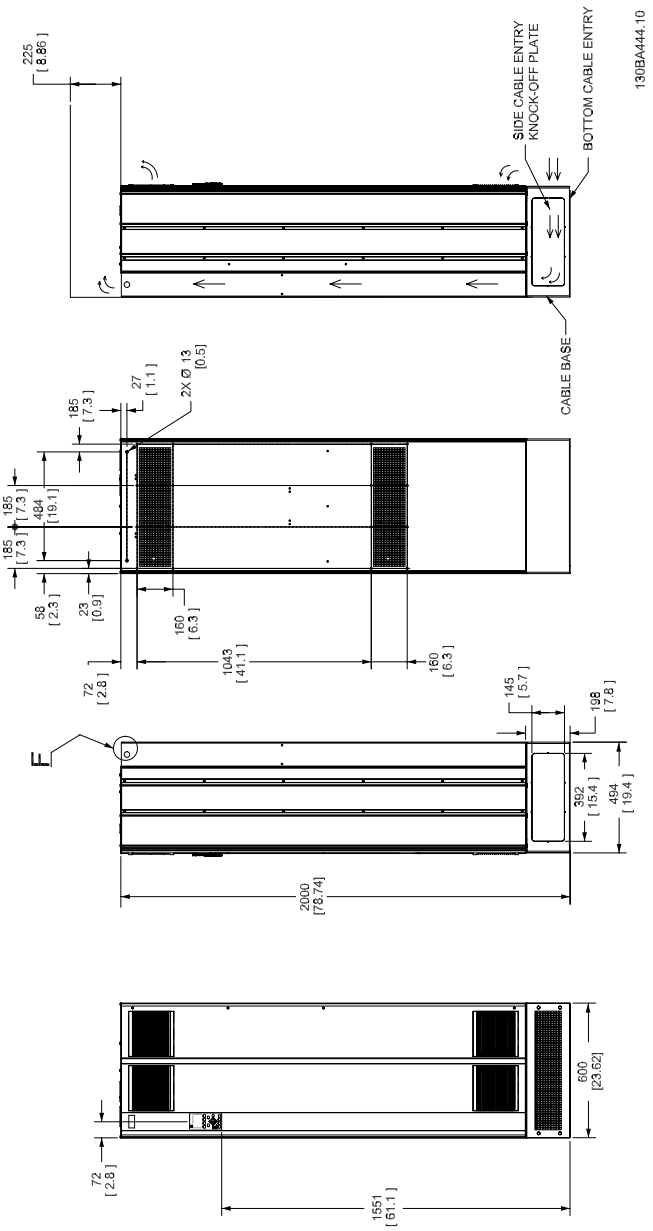
3.2.5 Mechanical Dimensions

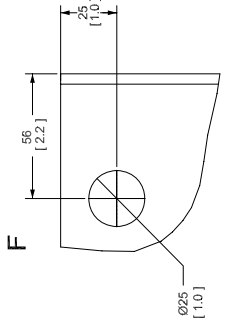



Unit Size 44
IP00 / CHASSIS
Unit Size 43
IP00/IP21/IP54 - ALL SIZES
138BA442.10
* Please note airflow directions

IP21 AND IP54 / UL AND NEMA TYPE 1 AND 12

Unit Size 51

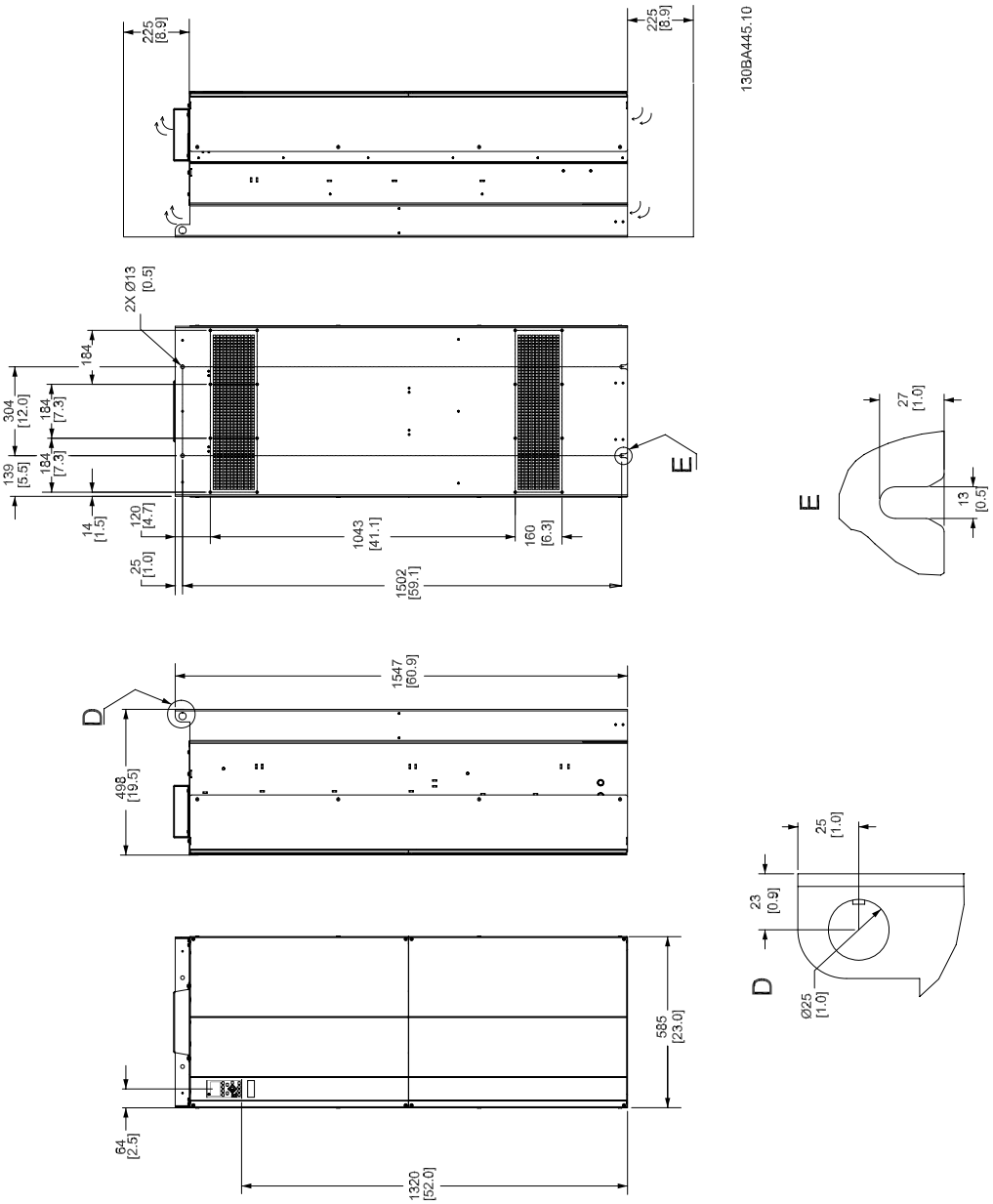


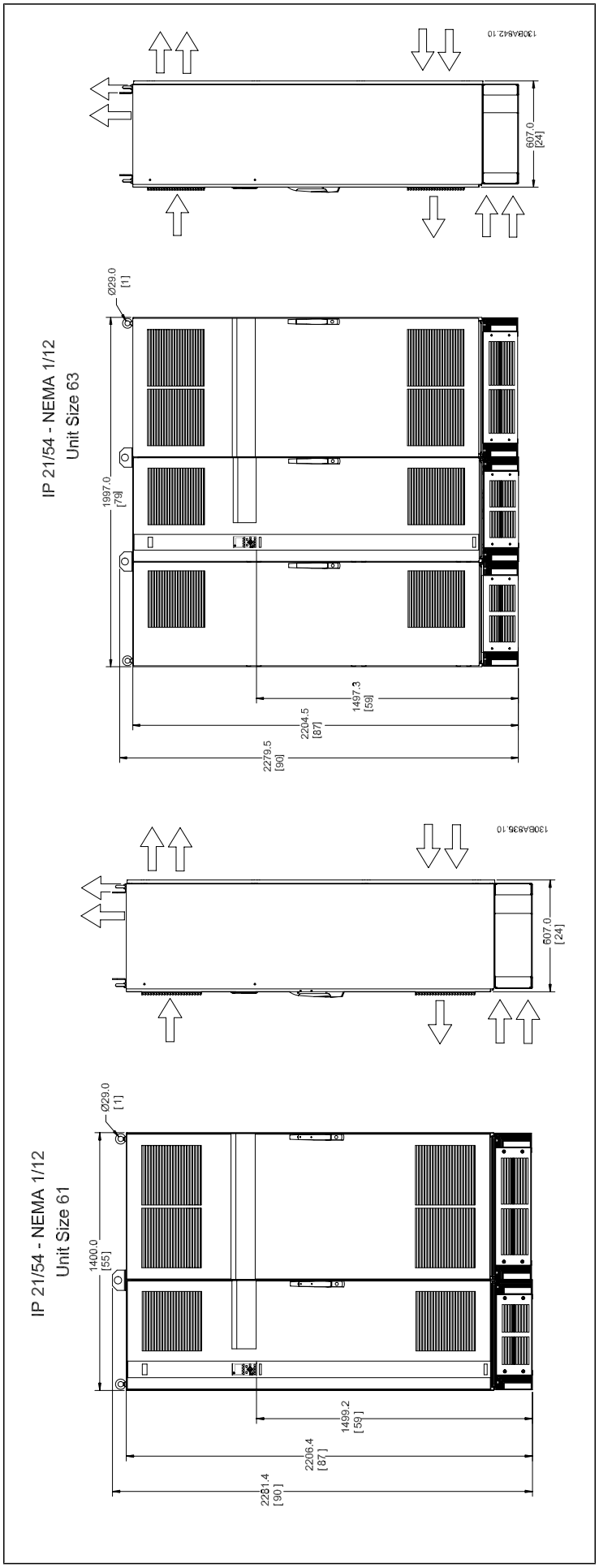


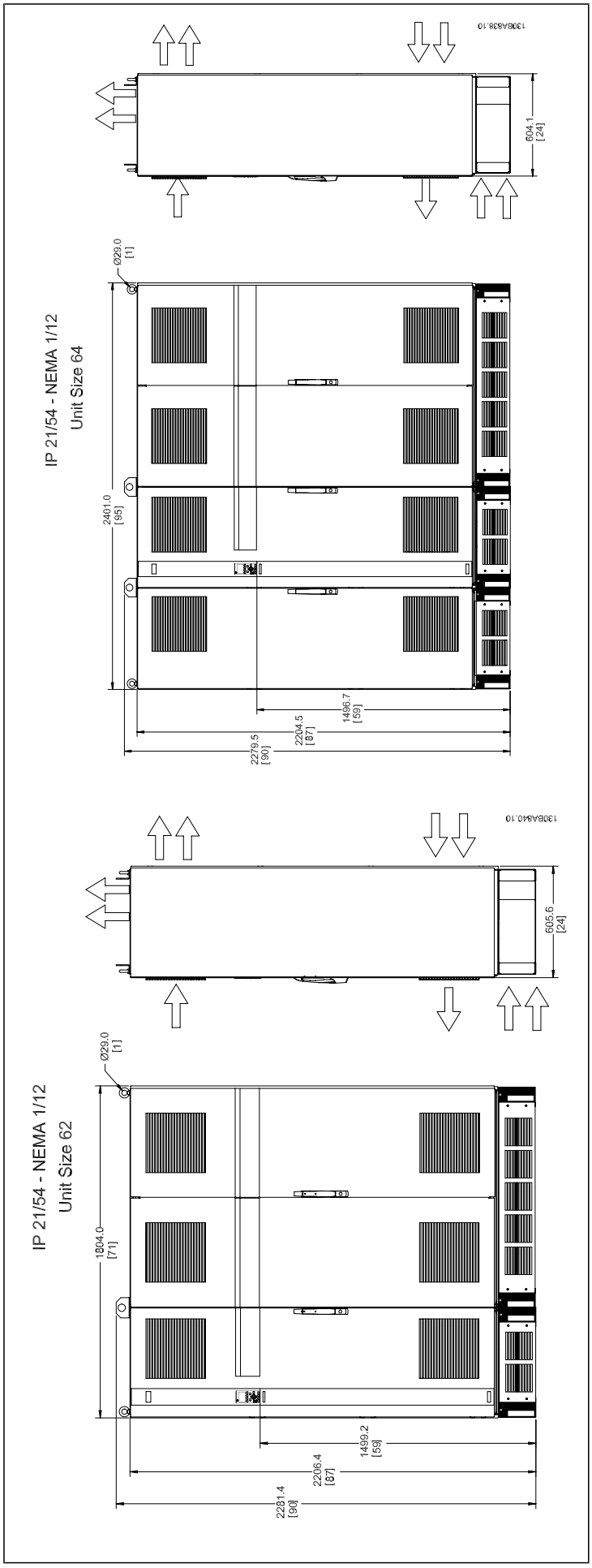
** Please note airflow directions*

IP00 / CHASSIS

Unit Size 52




130BA642.10
607.0
[24]
IP 21/54 - NEMA 1/12
Unit Size 63
Ø29.0
[1]
1997.0
[79]
1497.3
[59]
2204.5
[87]
2279.5
[90]
130BA836.10
607.0
[24]
IP 21/54 - NEMA 1/12
Unit Size 61
Ø29.0
[1]
1400.0
[55]
1499.2
[59]
2206.4
[87]
2281.4
[90]


130BA838.10
604.1
[24]
IP 21/54 - NEMA 1/12
Unit Size 64
Ø29.0
[1]
2401.0
[95]
1496.7
[59]
2204.5
[87]
2279.5
[90]
130BA840.10
605.6
[24]
IP 21/54 - NEMA 1/12
Unit Size 62
Ø29.0
[1]
1804.0
[71]
1499.2
[59]
2206.4
[87]
2281.4
[90]

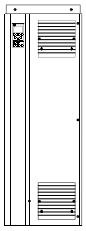
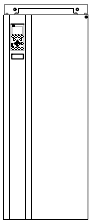
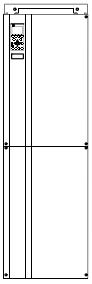
Mechanical dimensions , Unit Sizes 4

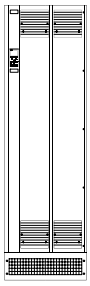
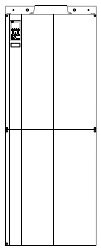
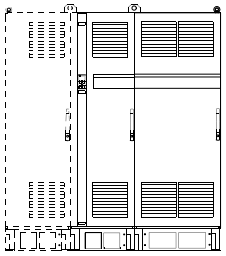
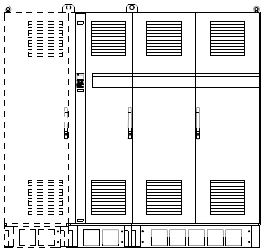
Unit size		41		42		43	44
		90 - 110 kW (380 - 500 V) 37 - 132 kW (525-690 V)		132 - 200 kW (380 - 500 V) 160 - 315 kW (525-690 V)		90 - 110 kW (380 - 500 V) 37 - 132 kW (525-690 V)	132 - 200 kW (380 - 500 V) 160 - 315 kW (525-690 V)
IP NEMA		21 Type 1	54 Type 12	21 Type 1	54 Type 12	00 Chassis	00 Chassis
Shipping dimensions	Height	650 mm	650 mm	650 mm	650 mm	650 mm	650 mm
	Width	1730 mm	1730 mm	1730 mm	1730 mm	1220 mm	1490 mm
	Depth	570 mm	570 mm	570 mm	570 mm	570 mm	570 mm
Drive dimensions	Height	1209 mm	1209 mm	1589 mm	1589 mm	1046 mm	1327 mm
	Width	420 mm	420 mm	420 mm	420 mm	408 mm	408 mm
	Depth	380 mm	380 mm	380 mm	380 mm	375 mm	375 mm
	Max weight	104 kg	104 kg	151 kg	151 kg	91 kg	138 kg

Mechanical dimensions, Unit Sizes 4 and 5

Unit size		51	52	61	62	63	64
		250 - 400 kW (380 - 500 V) 355 - 560 kW (525-690 V)	250 - 400 kW (380 - 500 V) 355 - 560 kW (525-690 V)	450 - 630 kW (380 - 500 V) 630 - 800 kW (525-690 V)	710 - 800 kW (380 - 500 V) 900 - 1000 kW (525-690 V)	450 - 630 kW (380 - 500 V) 630 - 800 kW (525-690 V)	710 - 800 kW (380 - 500 V) 900 - 1000 kW (525-690 V)
IP NEMA		21, 54 Type 12	00 Chassis	21, 54 Type 12	21, 54 Type 12	21, 54 Type 12	21, 54 Type 12
Shipping dimensions	Height	840 mm	831 mm	2324 mm	2324 mm	2324 mm	2324 mm
	Width	2197 mm	1705 mm	1569 mm	1962 mm	2159 mm	2559 mm
	Depth	736 mm	736 mm	927 mm	927 mm	927 mm	927 mm
Drive dimensions	Height	2000 mm	1547 mm	2204	2204	2204	2204
	Width	600 mm	585 mm	1400	1800	2000	2400
	Depth	494 mm	498 mm	606	606	606	606
	Max weight	313 kg	277 kg	1004	1246	1299	1541

3.2.6 Rated Power

		41	42	43	44
Unit type		 130BA481.10	 130BA482.10	 130BA478.10	 130BA479.10
Unit protection	IP	21/54	21/54	00	00
	NEMA	Type 1/ Type 12	Type 1/ Type 12	Chassis	Chassis
High overload rated power - 160% overload torque		90 - 110 - kW at 400 V (380 - 500 V) 37 - 132 kW at 690 V (525-690 V)	132 - 200 kW at 400 V (380 - 500 V) 160 - 315 kW at 690 V (525-690 V)	90 - 110 - kW at 400 V (380 - 500 V) 37 - 132 kW at 690 V (525-690 V)	132 - 200 kW at 400 V (380 - 500 V) 160 - 315 kW at 690 V (525-690 V)

		51	52	61/63	62/64
Unit type		 130BA483.10	 130BA480.10	 130BA855.10	 130BA854.10
Unit protection	IP	21/54	00	21/54	21/54
	NEMA	Type 1/ Type 12	Chassis	Type 1/ Type 12	Type 1/ Type 12
High overload rated power - 160% overload torque		250 - 400 kW at 400 V (380 - 500 V) 355 - 560 kW at 690 V (525-690 V)	240 - 400 kW at 400 V (380 - 500 V) 355 - 560 kW at 690 V (525-690 V)	450 - 630 kW at 400 V (380 - 500 V) 630 - 800 kW at 690 V (525-690 V)	710 - 800 kW at 400 V (380 - 500 V) 900 - 1000 kW at 690 V (525-690 V)

3.3 Mechanical Installation

Preparation of the mechanical installation of the frequency converter must be done carefully to ensure a proper result and to avoid additional work during installation. Start taking a close look at the mechanical drawings at the end of this instruction to become familiar with the space demands.

3.3.1 Tools Needed

To perform the mechanical installation the following tools are needed:

- Drill with 10 or 12 mm drill
- Tape measure
- Wrench with relevant metric sockets (7-17 mm)
- Extensions to wrench
- Sheet metal punch for conduits or cable glands in IP 21/Nema 1 and IP 54/Nema 12 drive types.
- Lifting bar to lift the unit (rod or tube max. Ø 25 mm (1 inch), able to lift minimum 400 kg (880 lbs)).
- Crane or other lifting aid to place the frequency converter in position
- A Torx T50 tool is needed to install the Unit Size 51IP 21/Nema 1 and IP 54/Nema 12 drive types.

3.3.2 General Considerations

Space

Ensure proper space above and below the frequency converter to allow airflow and cable access. In addition space in front of the unit must be considered to enable opening of the door of the panel.

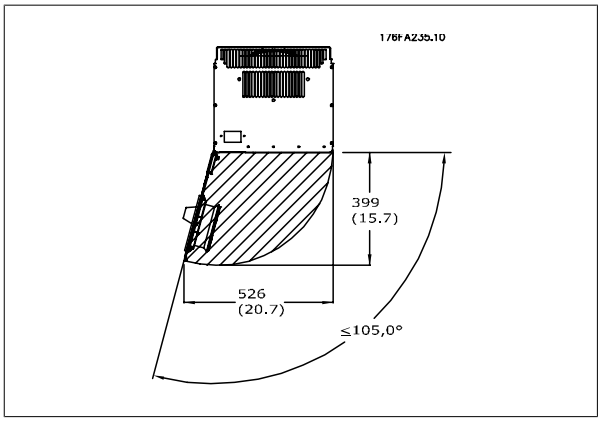


Illustration 3.8: Space in front of IP21/Nema 1 and IP54/Nema 12 drive in unit sizes 41 and 42 .

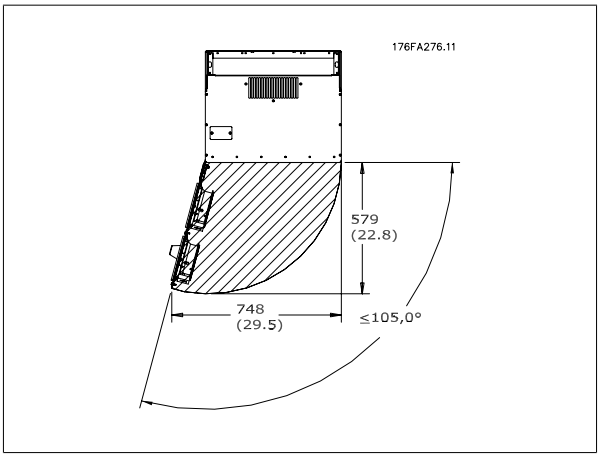


Illustration 3.9: Space in front of IP21/Nema 1 and IP54/Nema drive types for unit size 51.

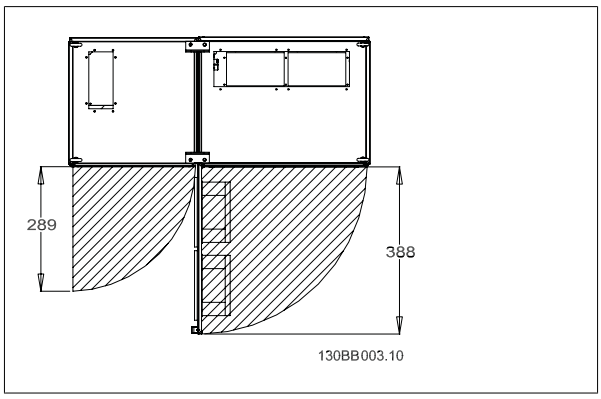


Illustration 3.10: Space in front of IP21/Nema 1 and IP54/Nema 12 drive type, for unit size 61.

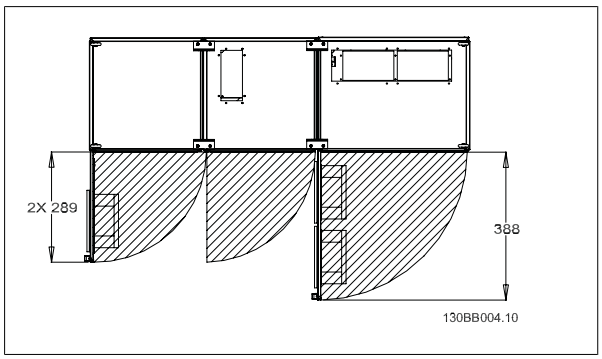


Illustration 3.11: Space in front of IP21/Nema 1 and IP54/Nema 12 drive type, for unit size 63.

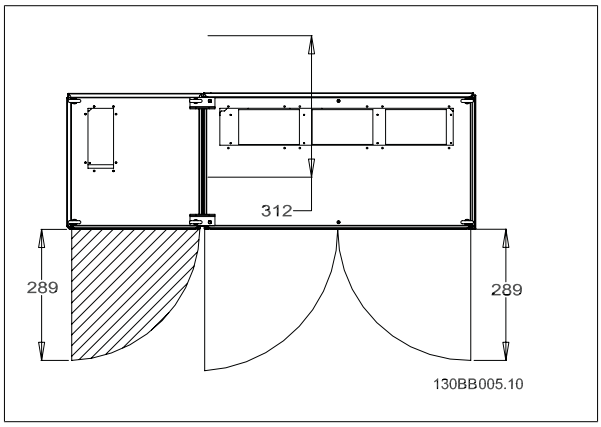


Illustration 3.12: Space in front of IP21/Nema 1 and IP54/Nema 12 drive type, for unit size 62.

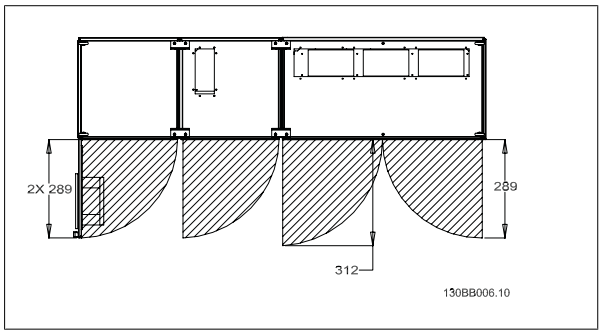


Illustration 3.13: Space in front of IP21/Nema 1 and IP54/Nema 12 drive type, for unit size 64.

NB!
Airflow direction, see *Mechanical Dimensions* on previous pages

Wire access

Ensure that proper cable access is present including necessary bending allowance. As the IP00 Open Chassis drive type is open to the bottom cables must be fixed to the back panel of the Unit where the frequency converter is mounted, i.e. by using cable clamps.

NB!
All cable lugs/ shoes must mount within the width of the terminal bus bar

3.3.3 Terminal locations - Unit Size 4X

Take the following position of the terminals into consideration when you design for cables access.

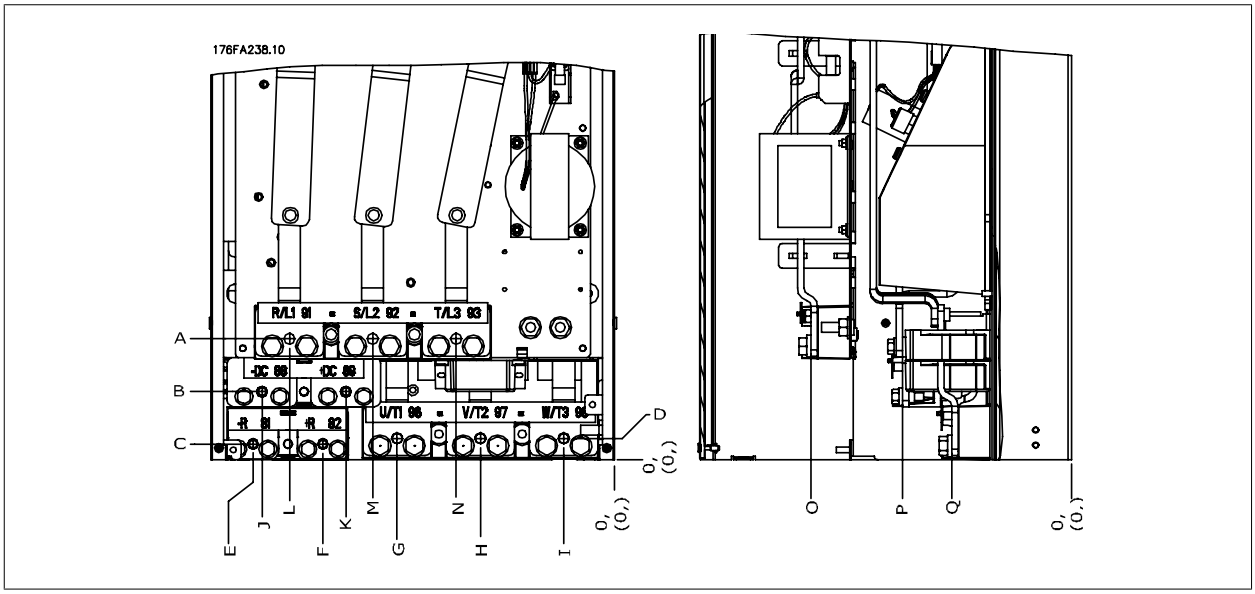


Illustration 3.14: Position of power connections, Unit Size 43/44

Be aware that the power cables are heavy and hard to bend. Consider the optimum position of the frequency converter for ensuring easy installation of the cables.

NB!
All Unit Sizes 4X are available with standard input terminals. All terminal dimensions can be found in table on next page.

	IP 21 (NEMA 1) / IP 54 (NEMA 12)		IP 00 / Chassis	
	Unit Size 41	**Unit Size 42**	**Unit Size 43**	**Unit Size 44**
A	277 (10.9)	379 (14.9)	119 (4.7)	122 (4.8)
B	227 (8.9)	326 (12.8)	68 (2.7)	68 (2.7)
C	173 (6.8)	273 (10.8)	15 (0.6)	16 (0.6)
D	179 (7.0)	279 (11.0)	20.7 (0.8)	22 (0.8)
E	370 (14.6)	370 (14.6)	363 (14.3)	363 (14.3)
F	300 (11.8)	300 (11.8)	293 (11.5)	293 (11.5)
G	222 (8.7)	226 (8.9)	215 (8.4)	218 (8.6)
H	139 (5.4)	142 (5.6)	131 (5.2)	135 (5.3)
I	55 (2.2)	59 (2.3)	48 (1.9)	51 (2.0)
J	354 (13.9)	361 (14.2)	347 (13.6)	354 (13.9)
K	284 (11.2)	277 (10.9)	277 (10.9)	270 (10.6)
L	334 (13.1)	334 (13.1)	326 (12.8)	326 (12.8)
M	250 (9.8)	250 (9.8)	243 (9.6)	243 (9.6)
N	167 (6.6)	167 (6.6)	159 (6.3)	159 (6.3)
O	261 (10.3)	260 (10.3)	261 (10.3)	261 (10.3)
P	170 (6.7)	169 (6.7)	170 (6.7)	170 (6.7)
Q	120 (4.7)	120 (4.7)	120 (4.7)	120 (4.7)
R	256 (10.1)	350 (13.8)	98 (3.8)	93 (3.7)
S	308 (12.1)	332 (13.0)	301 (11.8)	324 (12.8)
T	252 (9.9)	262 (10.3)	245 (9.6)	255 (10.0)
U	196 (7.7)	192 (7.6)	189 (7.4)	185 (7.3)
V	260 (10.2)	273 (10.7)	260 (10.2)	273 (10.7)

Table 3.1: Cable positions as shown in drawings above. Dimensions in mm (inch).

3.3.4 Terminal Locations - Unit Size 5X

Terminal locations - 51

Take the following position of the terminals into consideration when designing the cable access.

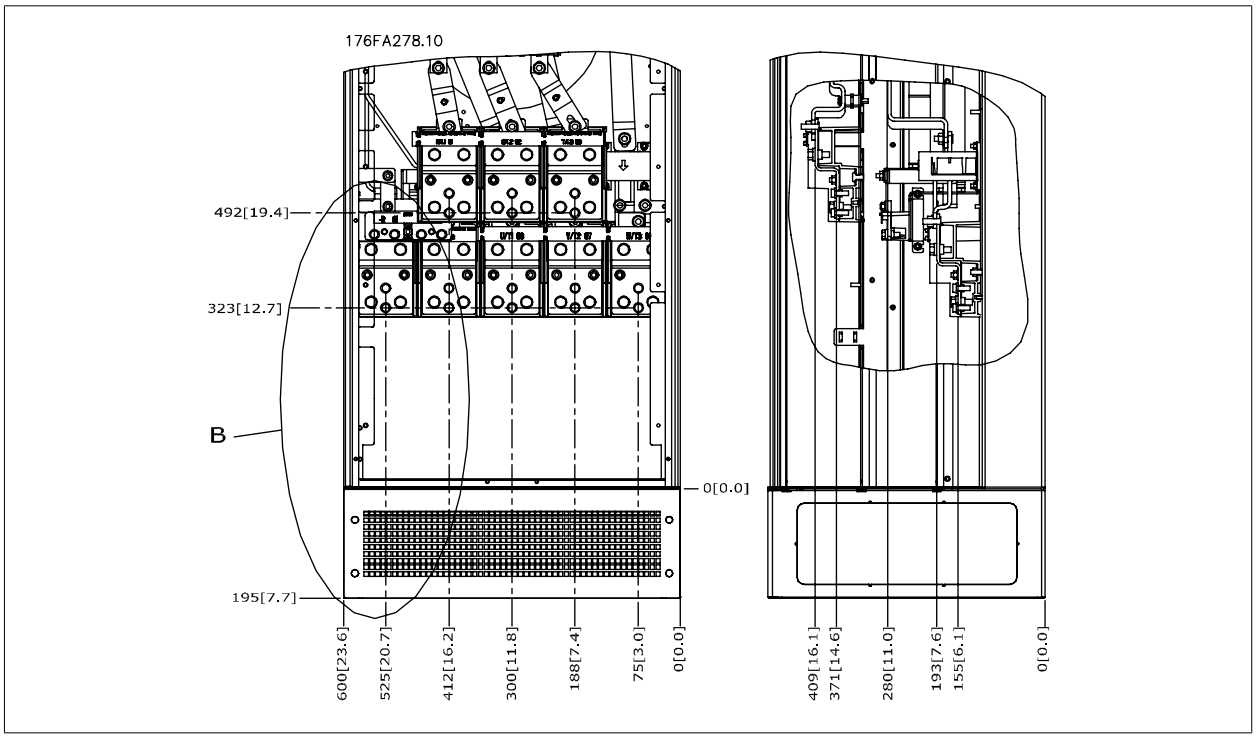


Illustration 3.16: IP21 (NEMA Type 1) and IP54 (NEMA Type 12) drive type power connection positions

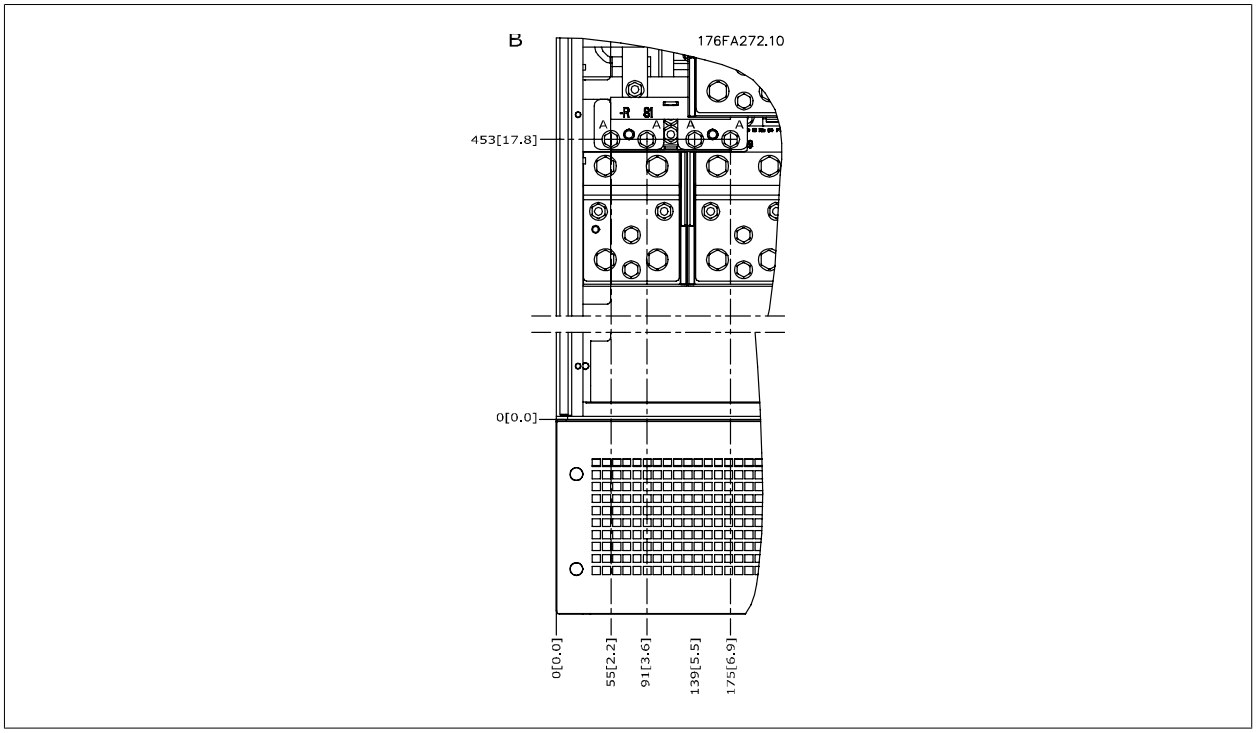


Illustration 3.17: IP21 (NEMA type 1) and IP54 (NEMA type 12) drive type power connection positions (detail B)

Unit Size	UNIT TYPE	DIMENSION FOR DISCONNECT TERMINAL					
51	IP54/IP21 UL AND NEMA1/NEMA12						
	250/315 kW (400V) AND 355/450-500/630 KW (690 V)	381 (15.0)	253 (9.9)	253 (9.9)	431 (17.0)	562 (22.1)	N/A
	315/355-400/450 kW (400V)	371 (14.6)	371 (14.6)	341 (13.4)	431 (17.0)	431 (17.0)	455 (17.9)

Terminal locations - 52

Take the following position of the terminals into consideration when designing the cable access.

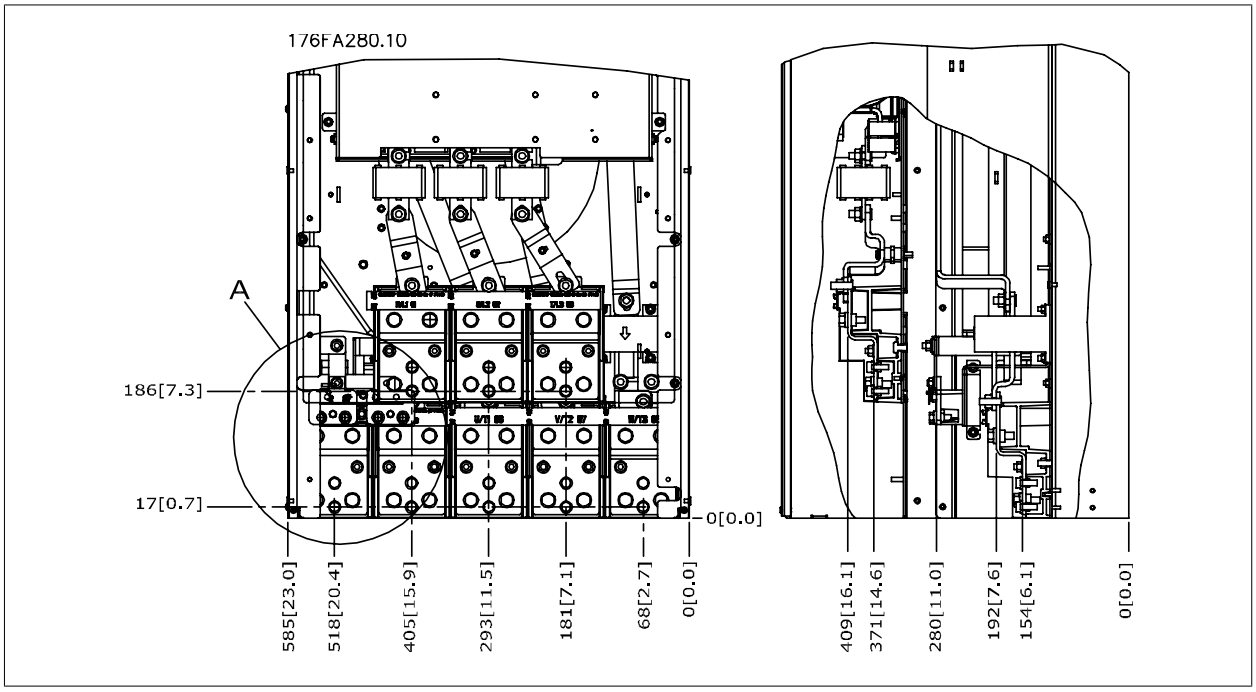


Illustration 3.19: IP00 Open Chassis drive type power connection positions

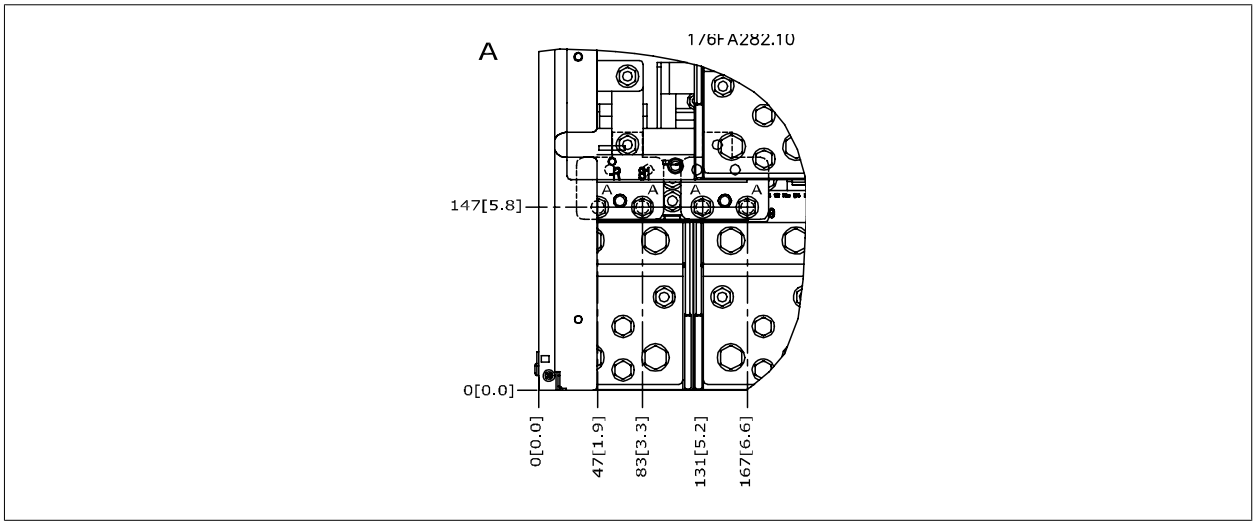


Illustration 3.20: IP00 Open Chassis drive type power connection positions

Note that the power cables are heavy and difficult to bend. Consider the optimum position of the frequency converter for ensuring easy installation of the cables. Each terminal allows use of up to 4 cables with cable lugs or use of standard box lug. Earth is connected to relevant termination point in the drive.

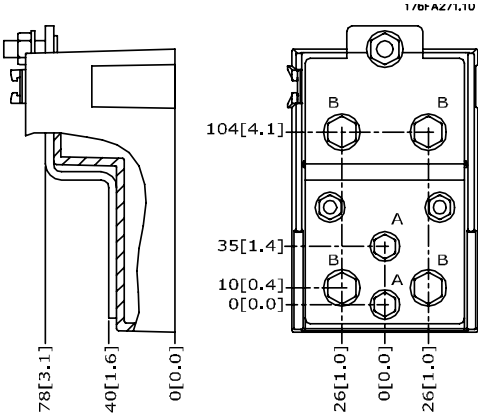


Illustration 3.22: Terminal in details

NB!

Power connections can be made to positions A or B

Unit Size	UNIT TYPE	DIMENSION FOR DISCONNECT TERMINAL					
	IPOO/CHASSIS	A	B	C	D	E	F
52	250/315 kW (400V) AND 355/450-500/630 KW (690 V)	381 (15.0)	245 (9.6)	334 (13.1)	423 (16.7)	256 (10.1)	N/A
	315/355-400/450 kW (400V)	383 (15.1)	244 (9.6)	334 (13.1)	424 (16.7)	109 (4.3)	149 (5.8)

3.3.5 Terminal Locations - Unit Sizes 6X

Terminal locations - Unit Sizes 61 and 63

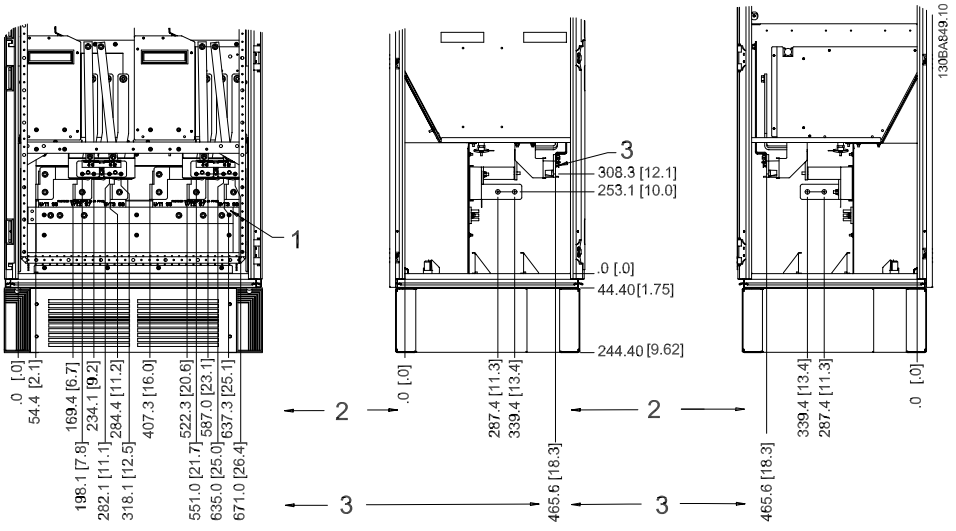


Illustration 3.23: Terminal locations - Inverter Cabinet - 61 and 63 (front, left and right side view)

1) Ground bar

2) Motor terminals

3) Brake terminals

Terminal locations - Unit Sizes 62/64

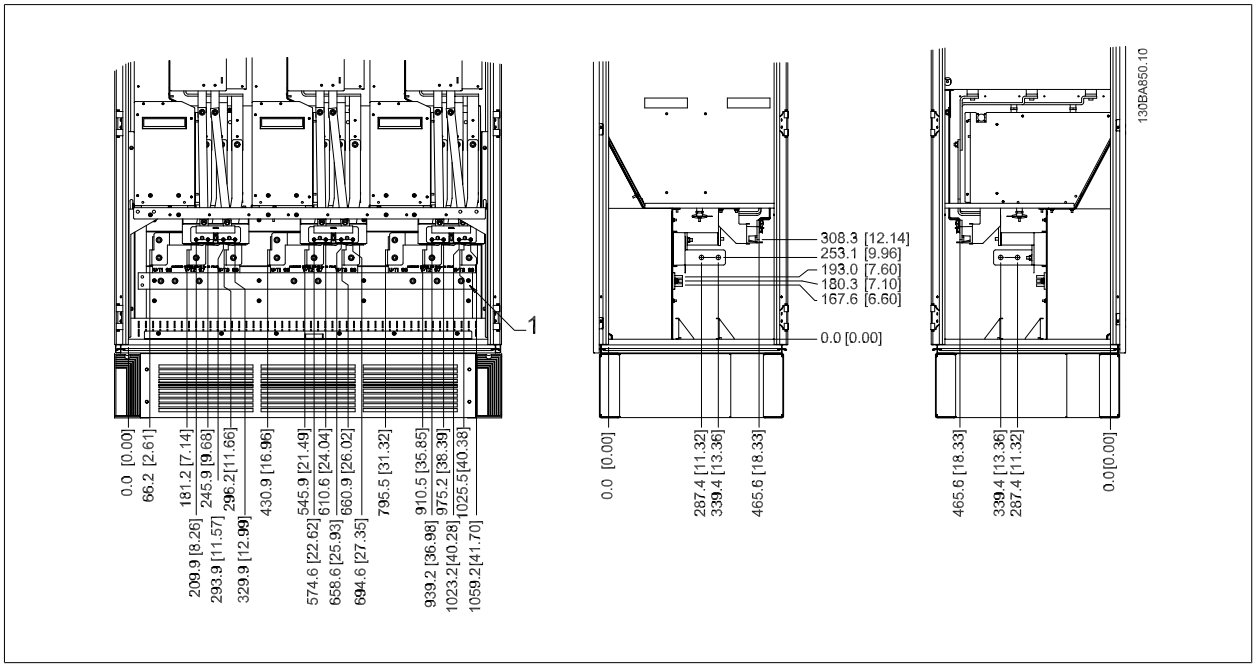


Illustration 3.24: Terminal locations - Inverter Cabinet - 62 and 64 (front, left and right side view)

1) Ground bar

Terminal locations - Rectifier (Unit Sizes 61, 62, 63 and 64)

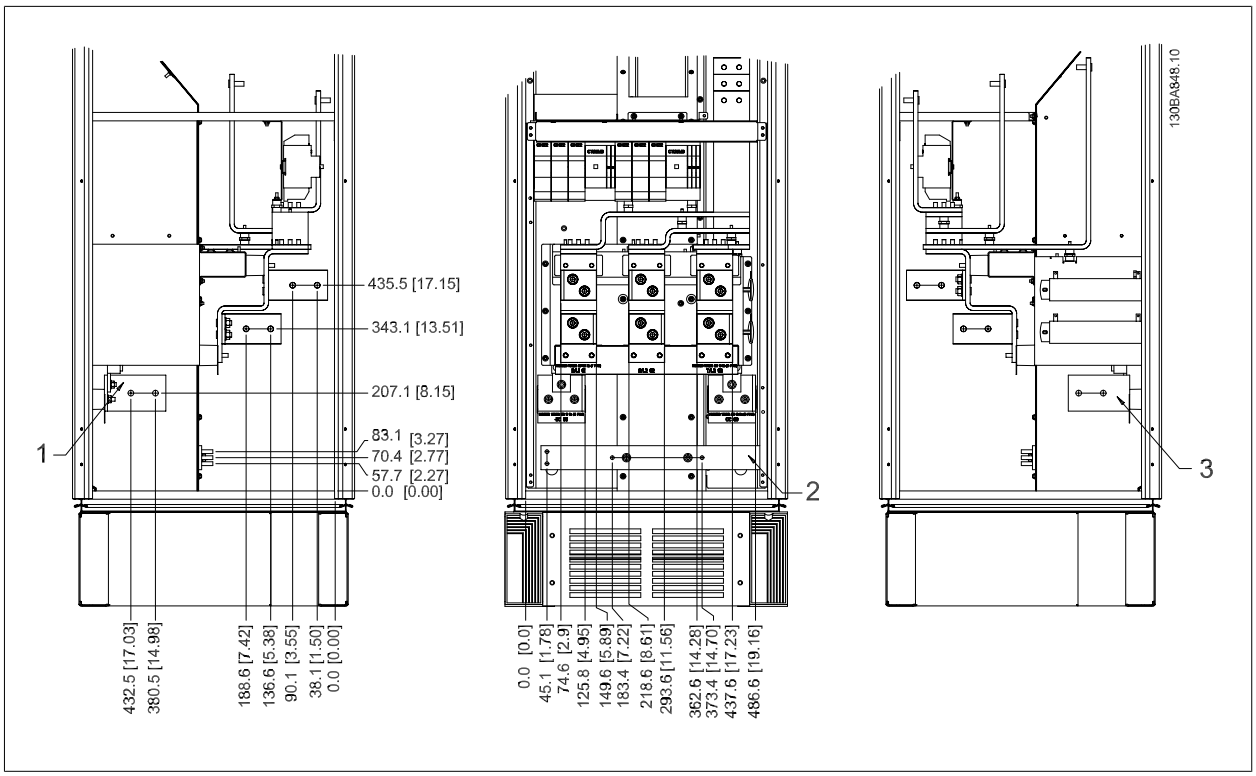


Illustration 3.25: Terminal locations - Rectifier (Left side, front and right side view)

1) Loadshare Terminal (-)

2) Ground bar

3) Loadshare Terminal (+)

Terminal locations - Options Cabinet (Unit Sizes 63 and 64)

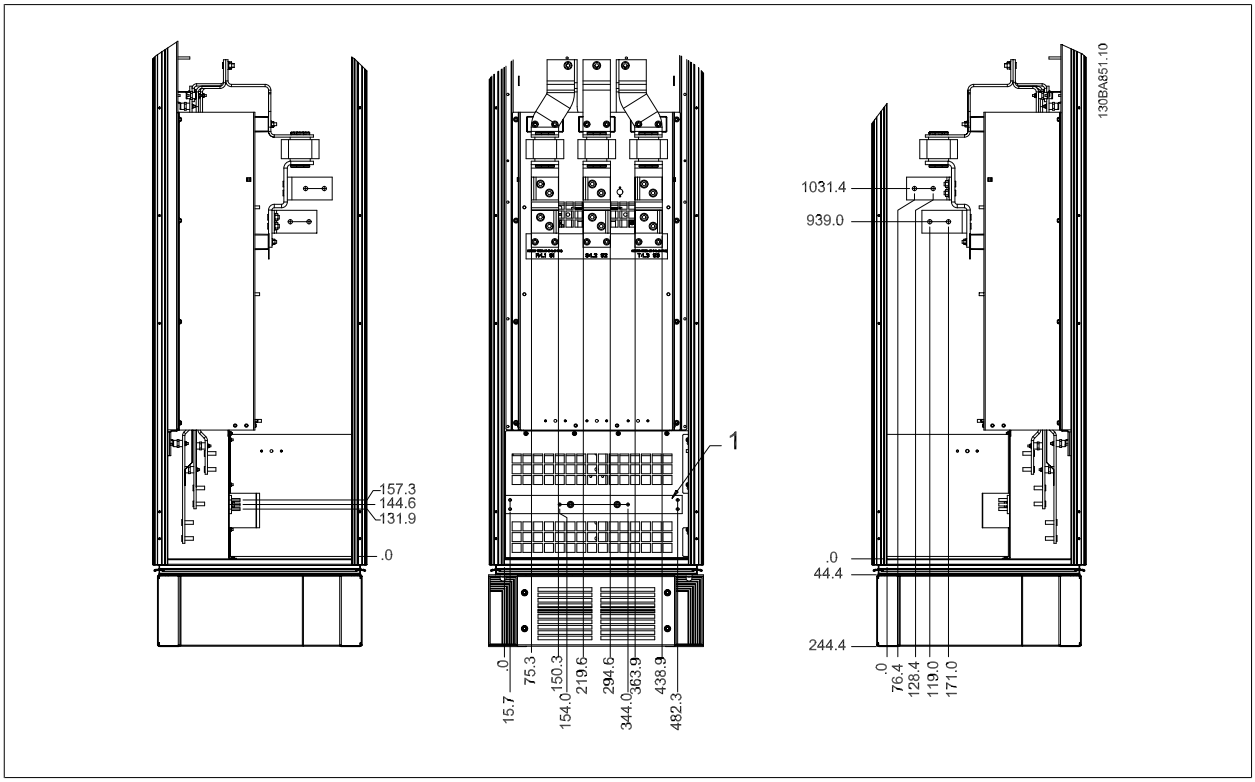


Illustration 3.26: Terminal locations - Options Cabinet (Left side, front and right side view)

1) Ground bar

Terminal locations - Options Cabinet with circuit breaker/ molded case switch (Unit Sizes 63 and 64)

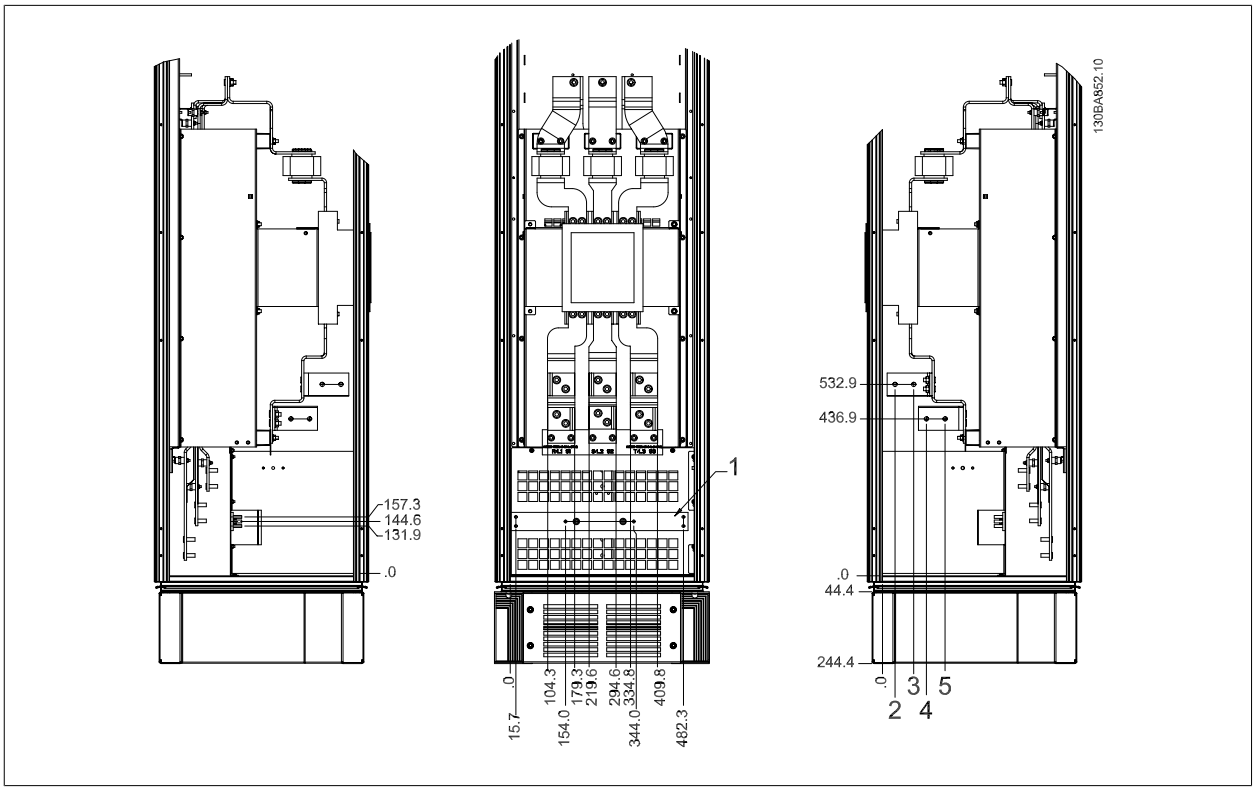


Illustration 3.27: Terminal locations - Options Cabinet with circuit breaker/ molded case switch (Left side, front and right side view)

1) Ground bar

3.3.6 Cooling and Airflow

Cooling

Cooling can be obtained in different ways, by using the cooling ducts in the bottom and the top of the unit, by taking air in and out the back of the unit or by combining the cooling possibilities.

Duct cooling

A dedicated option has been developed to optimize installation of IP00/chassis frame frequency converters in Rittal TS8 Units utilizing the fan of the frequency converter for forced air cooling of the backchannel. The air out the top of the Unit could but ducted outside a facility so the heat loses from the backchannel are not dissipated within the control room reducing air-conditioning requirements of the facility.

Please see *Installation of Duct Cooling Kit in Rittal Units*, for further information.

Back cooling

The backchannel air can also be ventilated in and out the back of a Rittal TS8 Unit. This offers a solution where the backchannel could take air from outside the facility and return the heat loses outside the facility thus reducing air-conditioning requirements.

NB!

A doorfan(s) is required on the Rittal cabinet to remove the loses not contained in the backchannel of the drive. The minimum doorfan(s) airflow required at the drive maximum ambient for the 43 and 44 is 391 m^3/h (230 cfm). The minimum doorfan(s) airflow required at the drive maximum ambient for the 52 is 782 m^3/h (460 cfm). If the ambient is below maximum or if additional components, heat loses, are added within the Unit a calculation must be made to ensure the proper airflow is provided to cool the inside of the Rittal Unit.

Airflow

The necessary airflow over the heat sink must be secured. The flow rate is shown below.

Unit Size protection	Frame size	Door fan / Top fan airflow	Airflow over heatsink
IP21 / NEMA 1	41 and 42	170 m^3/h (100 cfm)	765 m^3/h (450 cfm)
IP54 / NEMA 12	51	340 m^3/h (200 cfm)	1444 m^3/h (850 cfm)
IP21 / NEMA 1	61, 62, 63 and 64	700 m^3/h (412 cfm)*	985 m^3/h (580 cfm)
IP54 / NEMA 12	61, 62, 63 and 64	525 m^3/h (309 cfm)*	985 m^3/h (580 cfm)
IP00 / Chassis	43 and 44	255 m^3/h (150 cfm)	765 m^3/h (450 cfm)
	52	255 m^3/h (150 cfm)	1444 m^3/h (850 cfm)
* Airflow per fan. Unit Sizes 5X contain multiple fans.			

Table 3.2: Heatsink Air Flow

3.3.7 Installation on the Wall - IP21 (NEMA 1) and IP54 (NEMA 12) Units

This only applies to 41 and 42 Unit Sizes (460V, 125 - 300 HP, 575/690V, 125 - 400 HP). It must be considered where to install the unit.

Take the relevant points into consideration before you select the final installation site:

- Free space for cooling
- Access to open the door
- Cable entry from the bottom

Mark the mounting holes carefully using the mounting template on the wall and drill the holes as indicated. Ensure proper distance to the floor and the ceiling for cooling. A minimum of 225 mm (8.9 inch) below the frequency converter is needed. Mount the bolts at the bottom and lift the frequency converter up on the bolts. Tilt the frequency converter against the wall and mount the upper bolts. Tighten all four bolts to secure the frequency converter against the wall.

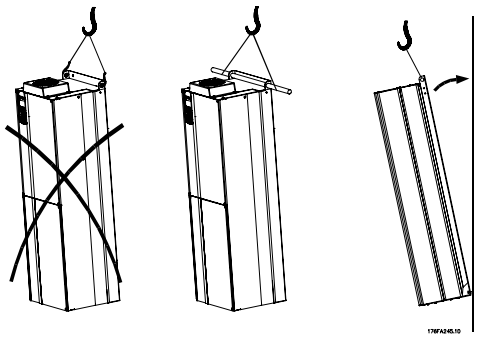
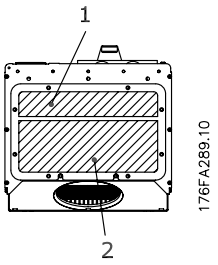


Illustration 3.28: Lifting method for mounting drive on wall

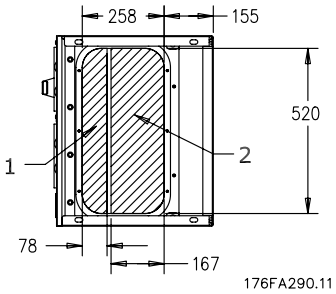
3.3.8 Gland/Conduit Entry - IP21 (NEMA 1) and IP54 (NEMA12)

Cables are connected through the gland plate from the bottom. Remove the plate and plan where to place the entry for the glands or conduits. Prepare holes in the marked area on the drawing.
The gland plate must be fitted to the frequency converter to ensure the specified protection degree, as well as ensuring proper cooling of the unit. If the gland plate is not mounted, it may trip the unit.

Unit Sizes 41 + 42

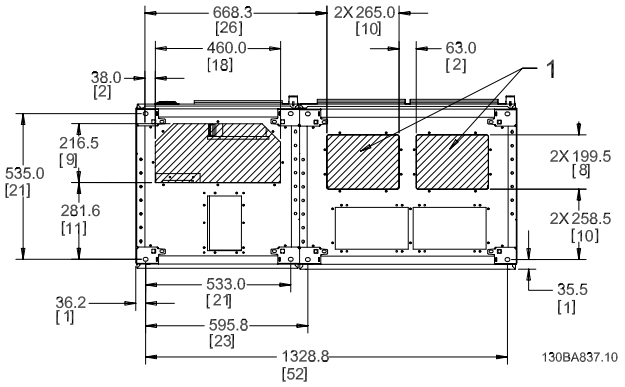


Unit Size 51

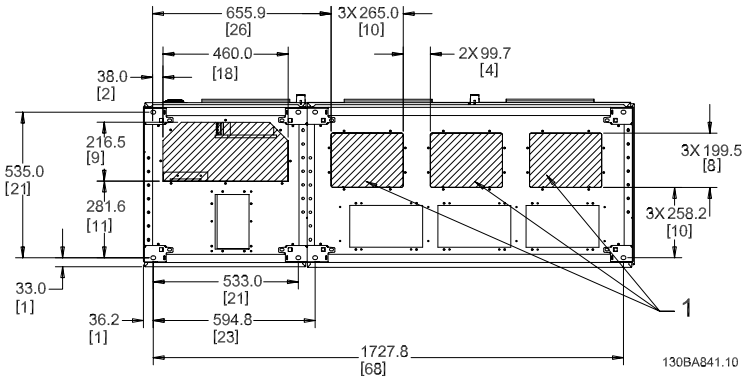


Cable entries viewed from the bottom of the frequency converter - 1) Mains side 2) Motor side

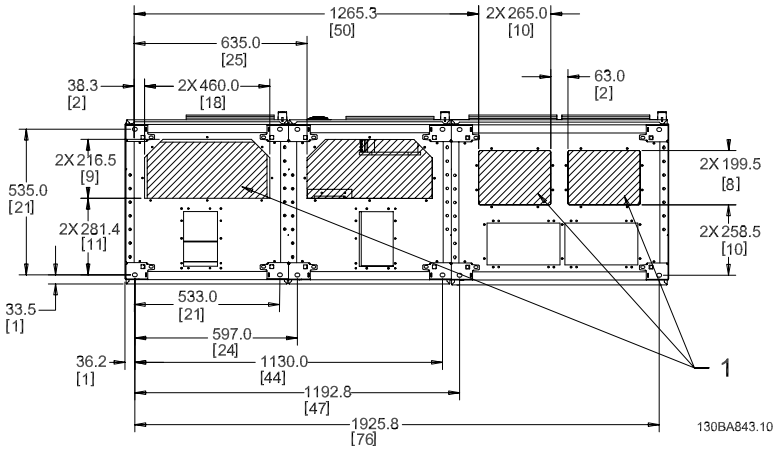
Unit Size 61



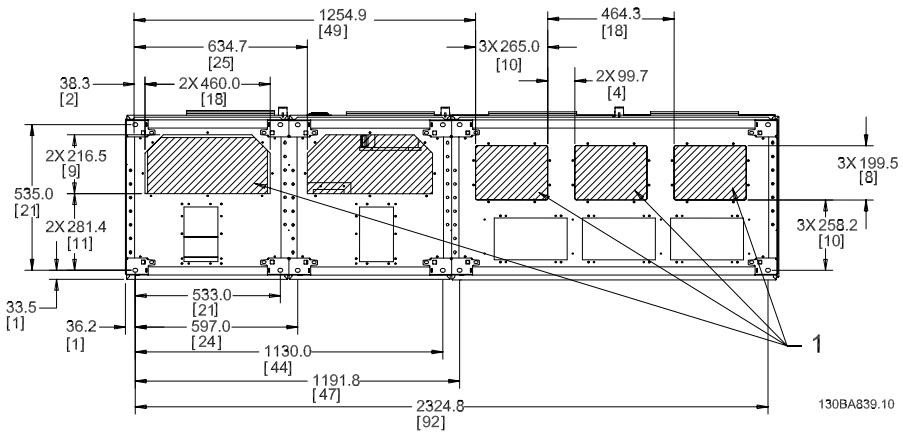
Unit Size 62



Unit Size 63



Unit Size 64



61-64: Cable entries viewed from the bottom of the frequency converter - 1) Place conduits in marked areas

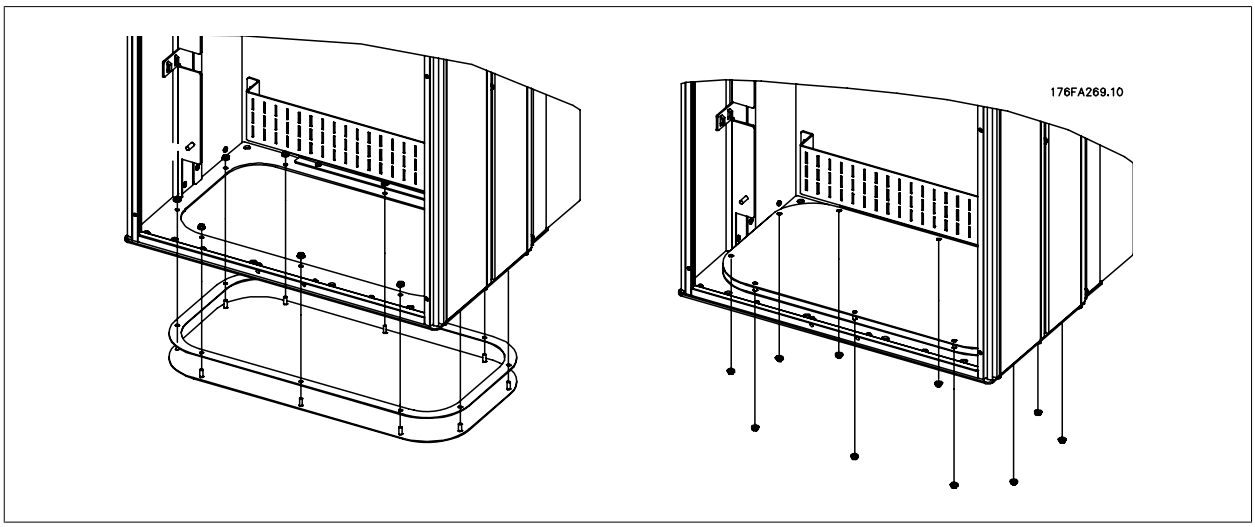


Illustration 3.29: Mounting of bottom plate,51Unit Size .

The bottom plate of the 51 Unit Size can be mounted from either in- or outside of the Unit Size, allowing flexibility in the installation process, i.e. if mounted from the bottom the glands and cables can be mounted before the frequency converter is placed on the pedestal.

3.3.9 IP21 Drip shield installation (41 and 42 Unit Size)

To comply with the IP21 rating, a separate drip shield is to be installed as explained below:

- Remove the two front screws
- Insert the drip shield and replace screws
- Torque the screws to 5,6 Nm (50 in-lbs)

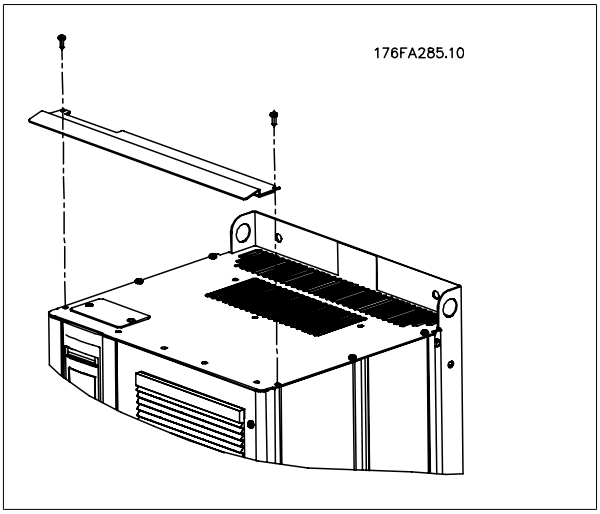


Illustration 3.30: Drip shield installation.

3.4 Field Installation of Options

3.4.1 Installation of Duct Cooling Kit in Rittal Units

This section deals with the installation of IP00 / chassis enclosed frequency converters with duct work cooling kits in Rittal Units. In addition to the Unit a 200 mm base/plinth is required. Please consult GE for more details on these field installed options.

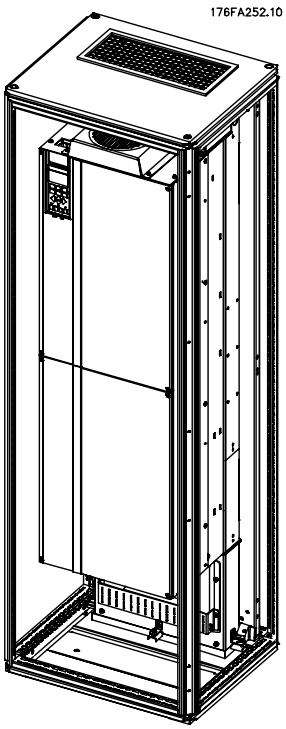


Illustration 3.31: Installation of IP00 Open Chassis drive type in Rittal TS8 Unit field installed option.

The minimum Unit dimension is:

- Unit Sizes 43 and 44: Depth 500 mm and width 600 mm.
- Unit Size 52: Depth 600 mm and width 800 mm.

The maximum depth and width are as required by the installation. When using multiple frequency converters in one Unit it is recommended that each drive is mounted on its own back panel and supported along the mid-section of the panel. These duct work kits do not support the "in frame" mounting of the panel (see Rittal TS8 catalogue for details). The duct work cooling kits listed in the table below are suitable for use only with IP 00 / Chassis frequency converters in Rittal TS8 IP 20 and UL and NEMA 1 and IP 54 and UL and NEMA 12 Units.

For the Unit Size 52 it is important to mount the plate at the absolute rear of the Rittal Unit due to the weight of the frequency converter.

NB!

A doorfan(s) is required on the Rittal cabinet to remove the loses not contained in the backchannel of the drive. The minimum doorfan(s) airflow required at the drive maximum ambient for the 43 and 44 is 391 m^3/h (230 cfm). The minimum doorfan(s) airflow required at the drive maximum ambient for the 52 is 782 m^3/h (460 cfm). If the ambient is below maximum or if additional components, heat loses, are added within the Unit a calculation must be made to ensure the proper airflow is provided to cool the inside of the Rittal Unit.

Ordering Information

Rittal TS-8 Unit	Unit Size 43 Kit Part No.	Unit Size 44Kit Part No.	Unit Size 52 Part No.
1800 mm	Consult GE	Consult GE	Not possible
2000 mm	Consult GE	Consult GE	Consult GE
2200 mm			Consult GE

Kit Contents

- Ductwork components
- Mounting hardware
- Gasket material
- Delivered with Unit Sizes 43 and 44 kits:
    - Mounting templates and top/bottom cut out for Rittal Unit.
- Delivered with Unit Size 52 kits:
    - Mounting templates and top/bottom cut out for Rittal Unit.

All fasteners are either:

- 10 mm, M5 Nuts torque to 2.3 Nm (20 in-lbs)
- T25 Torx screws torque to 2.3 Nm (20 in-lbs)

NB!

Please consult GE for more details on duct kits for AF-650 GP drives

External ducts

If additional duct work is added externally to the Rittal cabinet the pressure drop in the ducting must be calculated. Use the charts below to derate the frequency converter according to the pressure drop.

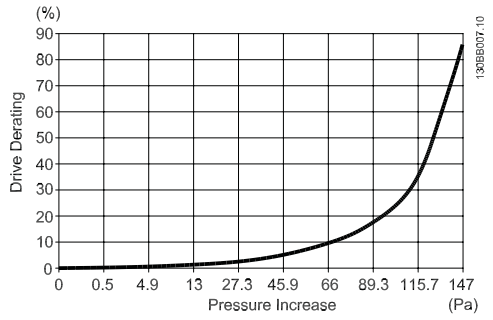


Illustration 3.32: Unit Size 4X Derating vs. Pressure Change

Drive air flow: 450 cfm (765 m3/h)

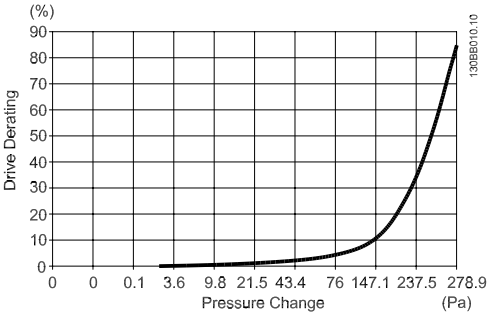


Illustration 3.33: Unit Size 5X Derating vs. Pressure Change (Small Fan)

Drive air flow: 650 cfm (1105 m3/h)

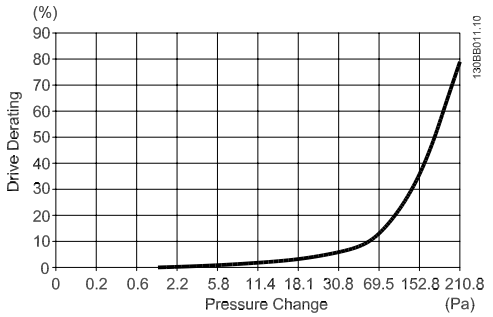


Illustration 3.34: Unit Size 5X Derating vs. Pressure Change (Large Fan)

Drive air flow: 850 cfm (1445 m3/h)

3.4.2 Installation on pedestal

This section describes the installation of a pedestal unit available for the frequency converters Unit Sizes 41 and 42. This is a 200 mm high pedestal that allows these Units to be floor mounted. The front of the pedestal has openings for input air to the power components.

The frequency converter gland plate must be installed to provide adequate cooling air to the control components of the frequency converter via the door fan and to maintain the IP21/NEMA 1 or IP54/NEMA 12 degrees of Unit protections.

Illustration 3.35: Drive on pedestal

There is one pedestal that fits both Unit Sizes 41 and 42. Please consult GE for more information. The pedestal is standard for Unit Size 51.

Required Tools:

- Socket wrench with 7-17 mm sockets
- T30 Torx Driver

Torques:

- M6 - 4.0 Nm (35 in-lbs)
- M8 - 9.8 Nm (85 in-lbs)
- M10 - 19.6 Nm (170 in-lbs)

Kit Contents:

- Pedestal parts
- Instruction manual

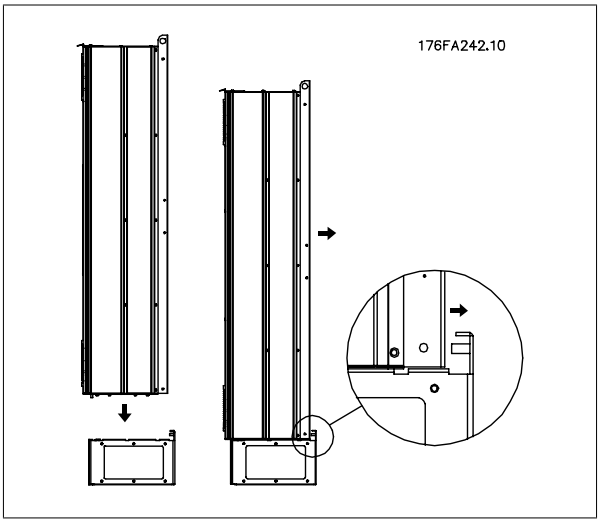


Illustration 3.36: Mounting of drive to pedestal.

Install the pedestal on the floor. Fixing holes are to be drilled according to this figure:

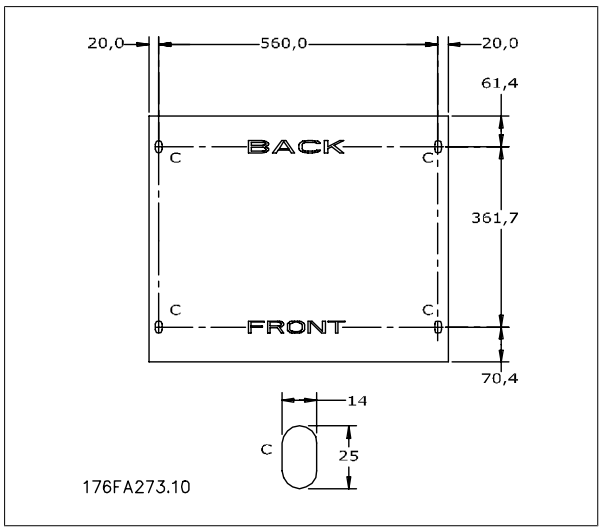


Illustration 3.37: Drill master for fixing holes in floor.

Mount the drive on the pedestal and fix it with the included bolts to the pedestal as shown on the illustration.

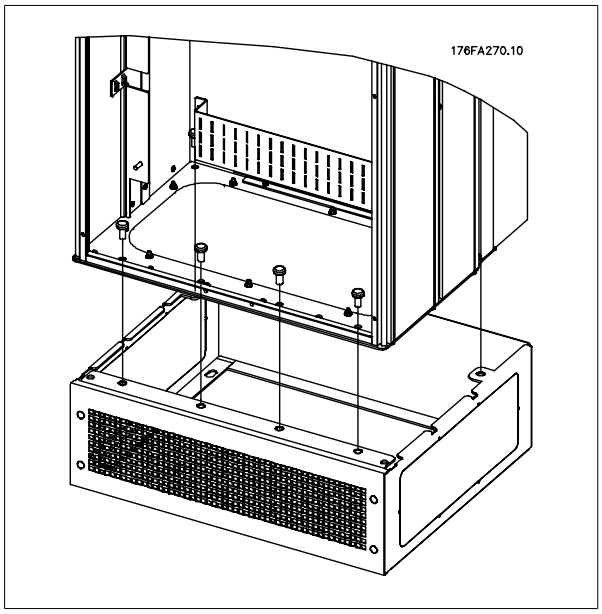


Illustration 3.38: Mounting of drive to pedestal

NB!
Please consult GE for more details on the pedestal kits.

3.4.3 Installation of Mains Shield for frequency converters

This section is for the installation of a mains shield for the frequency converter series with Unit Sizes 41, 42 and 51. It is not possible to install in the IP00/ Chassis drive types as these have included as standard a metal cover. These shields satisfy VBG-4 requirements.

Ordering numbers:
Please consult GE for more information.

Torque requirements

M6 - 35 in-lbs (4.0 N-M)

M8 - 85 in-lbs (9.8 N-M)

M10 - 170 in-lbs (19.6 N-M)

NB!
For further information, please consult GE.

3.5 Unit Size 6X Enclosure Panel Options

3.5.1 Unit Size 6X Panel Options

Please note that these options are all special order. Please consult GE for more information.

Space Heaters and Thermostat
Mounted on the cabinet interior of Unit Size 6X frequency converters, space heaters controlled via automatic thermostat help control humidity inside the Unit, extending the lifetime of drive components in damp environments.

Cabinet Light with Power Outlet
A light mounted on the cabinet interior of Unit Size 6 frequency converters increase visibility during servicing and maintenance. The housing the light includes a power outlet for temporarily powering tools or other devices, available in two voltages:

- 230V, 50Hz, 2.5A, CE/ENEC
- 120V, 60Hz, 5A, UL/cUL

Transformer Tap Setup
If the Cabinet Light & Outlet and/or the Space Heaters & Thermostat are installed Transformer T1 requires it taps to be set to the proper input voltage. A 380-500 V drive will initially be set to the 525 V tap and a 525-690 V drive will be set to the 690 V tap to insure no overvoltage of secondary equipment occurs if the tap is not changed prior to power being applied. See the table below to set the proper tap at terminal T1 located in the rectifier cabinet. For location in the drive, see illustration of rectifier in the *Power Connections* section.

Input Voltage Range	Tap to Select
380V-440V	400V
441V-490V	460V
491V-550V	525V
551V-625V	575V
626V-660V	660V
661V-690V	690V

NAMUR Terminals
NAMUR is an international association of automation technology users in the process industries, primarily chemical and pharmaceutical industries in Germany. Selection of this option provides terminals organized and labeled to the specifications of the NAMUR standard for drive input and output terminals. This requires MCB 112 PTC Thermistor Card and MCB 113 Extended Relay Card.

RCM (Residual Current Monitor)
Designed for monitoring residual leakage current to ground on supply mains (TN and TT systems), the RCM requires an external measuring transformer (supplied and installed by customer). Two relays (N.O. or N.C.) allow separate setpoints for pre-warning (50% of alarm threshold) and alarm conditions.

- Integrated into the drive's safe-stop circuit
- LED bar graph indicator of residual leakage current level
- Fault memory

- TEST / RESET button

Insulation Resistance Monitor (IRM)

Designed for monitoring of insulation resistance between system conductors and ground in ungrounded supply mains or mains with connection to ground through a high impedance (such as IT systems). Two individually adjustable relays (N.O. or N.C.) allow separate setpoints for pre-warning and alarm conditions.

- Integrated into the drive's safe-stop circuit
- LC display of insulation resistance
- Fault Memory
- INFO, TEST, and RESET buttons

IEC Emergency Stop with Pilz Safety Relay

Includes a redundant 4-wire emergency-stop pushbutton mounted on the front of the Unit and a Pilz relay that monitors it in conjunction with the drive's safe-stop circuit and the mains contactor located in the options cabinet.

Manual Motor Starters

Provide 3-phase power for electric blowers often required for larger motors. Power for the starters is provided from the load side of any supplied contactor, circuit breaker, or disconnect switch. Power is fused before each motor starter, and is off when the incoming power to the drive is off. Up to two starters are allowed (one if a 30-amp, fuse-protected circuit is ordered). Integrated into the drive's safe-stop circuit.
Unit features include:

- Operation switch (on/off)
- Short-circuit and overload protection with test function
- Manual reset function

30-Amp, Fuse-Protected Terminals

- 3-phase power matching incoming mains voltage for powering auxiliary customer equipment
- Not available if two manual motor starters are selected
- Terminals are off when the incoming power to the drive is off
- Power for the fused protected terminals will be provided from the load side of any supplied contactor, circuit breaker, or disconnect switch.

24 VDC Power Supply

- 5 amp, 120 W, 24 VDC
- Protected against output overcurrent, overload, short circuits, and overtemperature
- For powering customer-supplied accessory devices such as sensors, PLC I/O, contactors, temperature probes, indicator lights, and/or other electronic hardware
- Diagnostics include a dry DC-ok contact, a green DC-ok LED, and a red overload LED

External Temperature Monitoring

Designed for monitoring temperatures of external system components, such as the motor windings and/or bearings. Eight signal inputs are each brought to individual modules, each configurable for a different type of signal. Modules can communicate with one another and can be monitored via a fieldbus network (requires the purchase of a separate module/bus coupler). Integrated into the drive's safe-stop circuit.

Possible input signal types:

- RTD inputs (including Pt100), 3-wire or 4-wire
- Thermocouple

Additional features:

- One universal output, configurable for either analog voltage or analog current
- Two output relays (N.O.)
- Dual-line LC display and LED dignostics
- Sensor lead wire break, short-circuit, and incorrect polarity detection

In addition to the eight universal inputs described above, two dedicated Thermistor Motor Protection Modules are also included. Features include:

- One Type A PTC Thermistors input per module (2 modules total)
- Fault diagnostics for wire breakage or short-circuits of sensor leads
- ATEX/UL/CSA certification

3.6 Electrical Installation

3.6.1 Power Connections

Cabling and Fusing

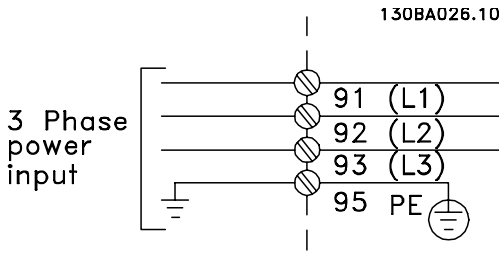
NB!

Cables General

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

The power cable connections are situated as shown below. Dimensioning of cable cross section must be done in accordance with the current ratings and local legislation. See the *Specifications section* for details.

For protection please see fuse in the tables of the fuse section. Always ensure that proper fusing is made according to local regulation.



NB!

Use a screened/armoured motor cable to comply with EMC emission specifications. For more information, see *EMC specifications* in the AF-650 GP*Design Guide*.

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

Screening of cables:

Avoid installation with twisted screen ends (pigtails). They spoil the screening effect at higher frequencies. 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 de-coupling 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 within the frequency converter.

Cable-length and cross-section:

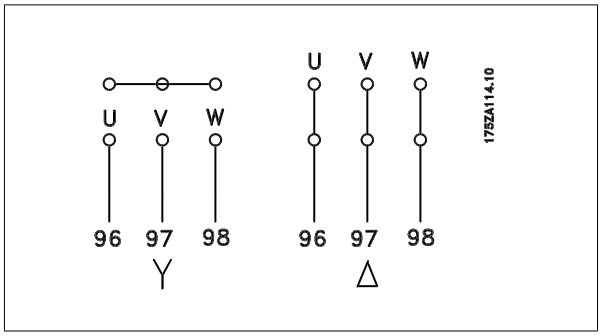
The frequency converter has been EMC tested with a given length of cable. Keep the motor cable as short as possible to reduce the noise level and leakage currents.

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 instruction in par. F-26 Motor *Noise (Carrier Freq)*.

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



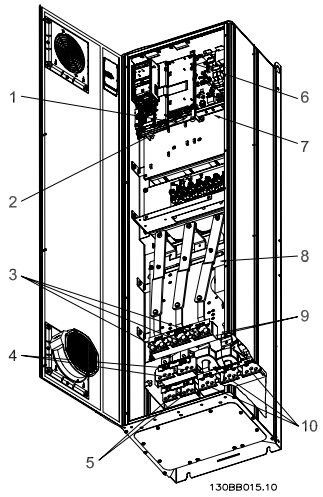


Illustration 3.39: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12), Unit Size 41

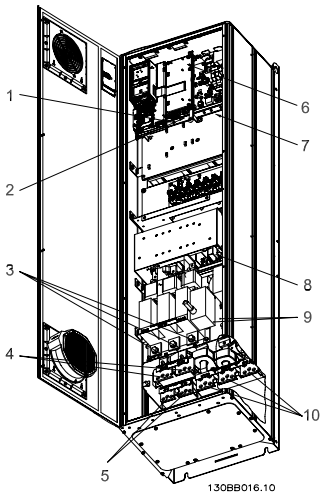


Illustration 3.40: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12) Unit Size 42

1) AUX Relay
   01 02 03
   04 05 06
2) Temp Switch
   106 104 105
3) Line
   R S T
   91 92 93
   L1 L2 L3
4) Load sharing
   -DC +DC
   88 89
5) Brake
   -R +R
   81 82
6) SMPS Fuse (see fuse tables for part number)
7) AUX Fan
   100 101 102 103
   L1 L2 L1 L2
8) Fan Fuse (see fuse tables for part number)
9) Mains ground
10) Motor
   U V W
   96 97 98
   T1 T2 T3

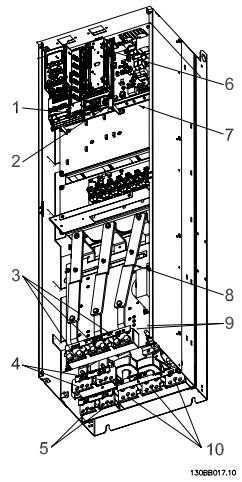


Illustration 3.41: Compact IP 00 (Chassis), Unit Size 43

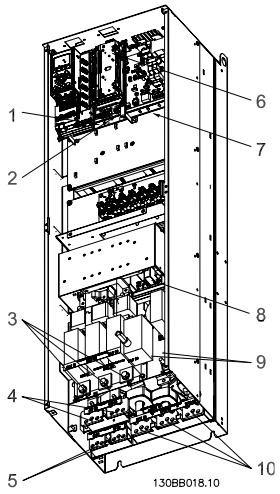


Illustration 3.42: Compact IP 00 (Chassis) Unit Size 44

1) AUX Relay
   01 02 03
   04 05 06
2) Temp Switch
   106 104 105
3) Line
   R S T
   91 92 93
   L1 L2 L3
4) Load sharing
   -DC +DC
   88 89
5) Brake
   -R +R
   81 82
6) SMPS Fuse (see fuse tables for part number)
7) AUX Fan
   100 101 102 103
   L1 L2 L1 L2
8) Fan Fuse (see fuse tables for part number)
9) Mains ground
10) Motor
   U V W
   96 97 98
   T1 T2 T3

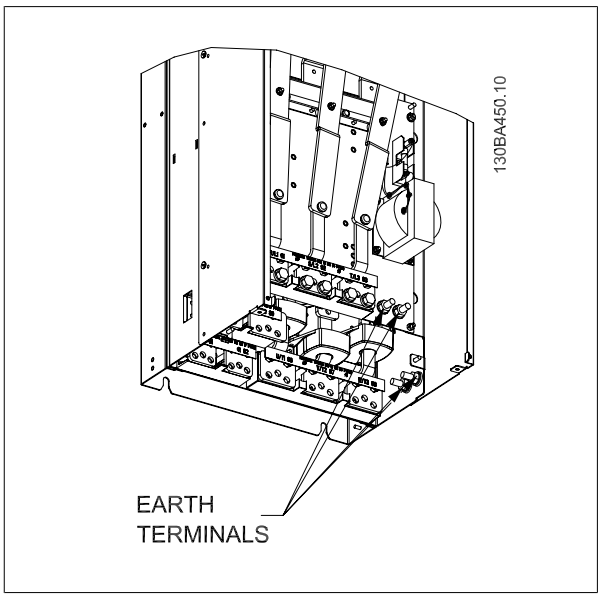


Illustration 3.43: Position of earth terminals IP00 (Chassis), Unit Size 44

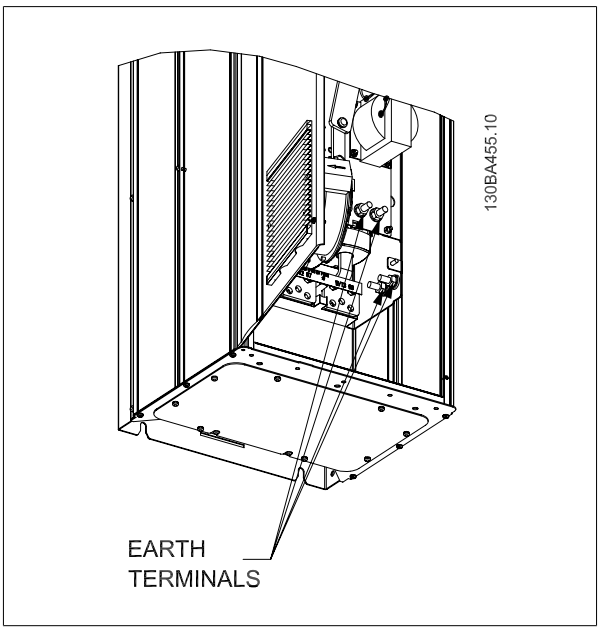


Illustration 3.44: Position of earth terminals IP21 (NEMA type 1) and IP54 (NEMA type 12)Unit Size 42

NB!

Unit Size 42 and 44 are shown in above examples. Unit Size 41 and 43 are equivalent.

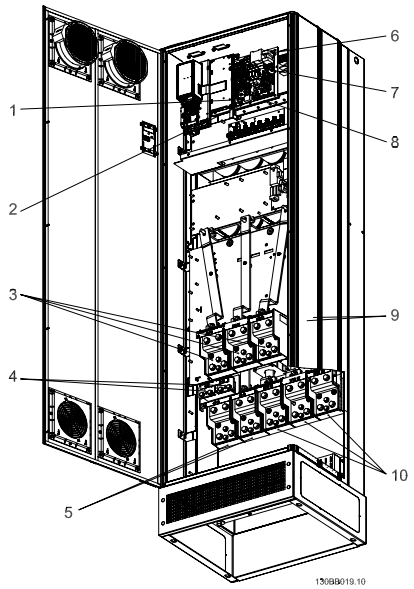


Illustration 3.45: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12) Unit Size 51

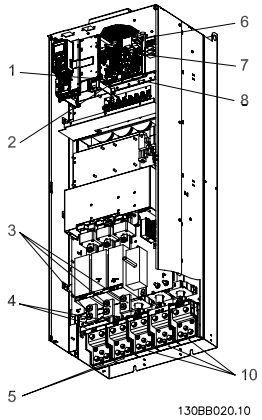


Illustration 3.46: Compact IP 00 (Chassis) Unit Size 52

1) AUX Relay
   01 02 03
   04 05 06
2) Temp Switch
   106 104 105
3) Line
   R S T
   91 92 93
   L1 L2 L3
4) Brake
   -R +R
   81 82
5) Load sharing
   -DC +DC
   88 89
6) SMPS Fuse (see fuse tables for part number)
7) Fan Fuse (see fuse tables for part number)
8) AUX Fan
   100 101 102 103
   L1 L2 L1 L2
9) Mains ground
10) Motor
   U V W
   96 97 98
   T1 T2 T3

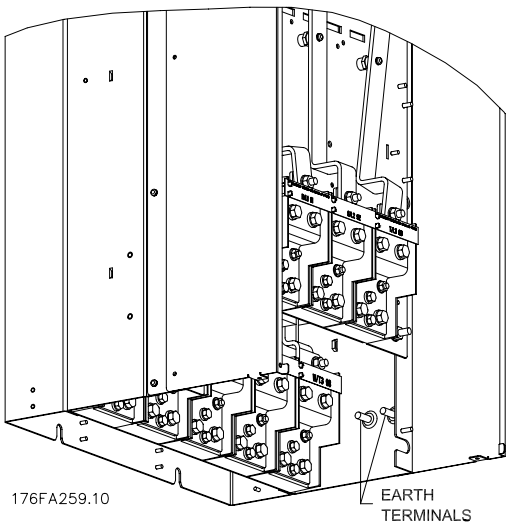


Illustration 3.47: Position of earth terminals IP00 (Chassis), Unit Size 52

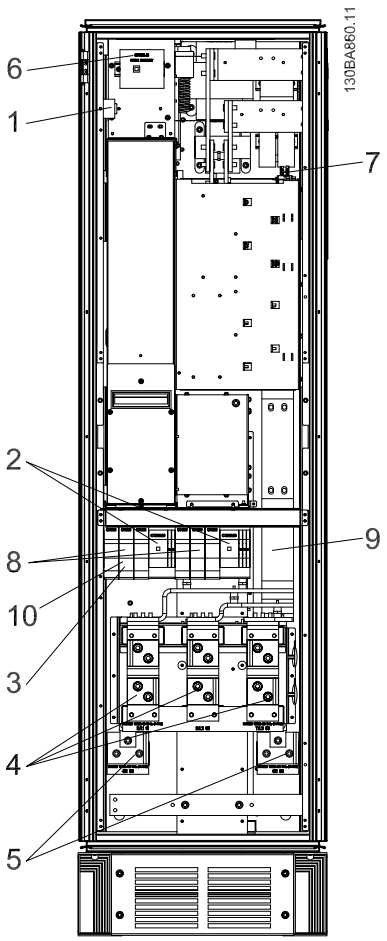


Illustration 3.48: Rectifier Cabinet, Unit Size 61, 62, 63 and 64.

1) 24 V DC, 5 A
T1 Output Taps
Temp Switch
106 104 105
2) Manual Motor Starters
3) 30 A Fuse Protected Power Terminals
4) Line
R S T
L1 L2 L3
5) Loadsharing
-DC +DC
88 89
6) Control Transformer Fuses (2 or 4 pieces). See fuse tables for part numbers
7) SMPS Fuse. See fuse tables for part numbers
8) Manual Motor Controller fuses (3 or 6 pieces). See fuse tables for part numbers
9) Line Fuses, F1 and F2 frame (3 pieces). See fuse tables for part numbers
10) 30 Amp Fuse Protected Power fuses

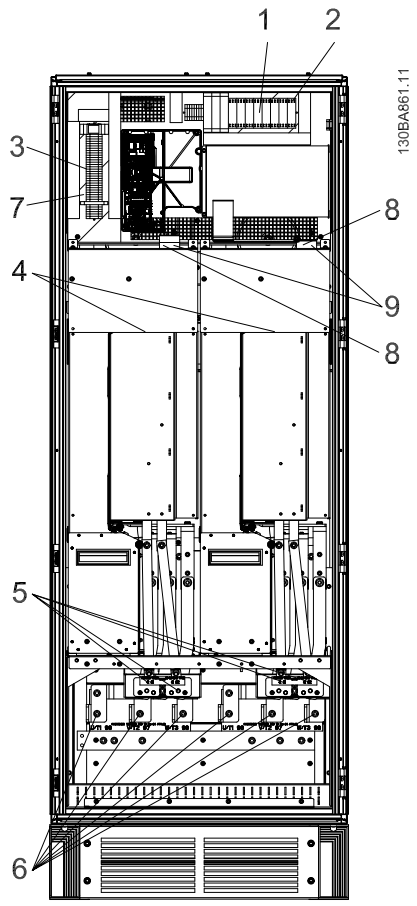


Illustration 3.49: Inverter Cabinet, Unit Size 61 and 63.

1) External Temperature Monitoring
2) AUX Relay
   01 02 03
   04 05 06
3) NAMUR
4) AUX Fan
   100 101 102 103
   L1 L2 L1 L2
5) Brake
   -R +R
   81 82
6) Motor
   U V W
   96 97 98
   T1 T2 T3
7) NAMUR Fuse. See fuse tables for part numbers
8) Fan Fuses. See fuse tables for part numbers
9) SMPS Fuses. See fuse tables for part numbers

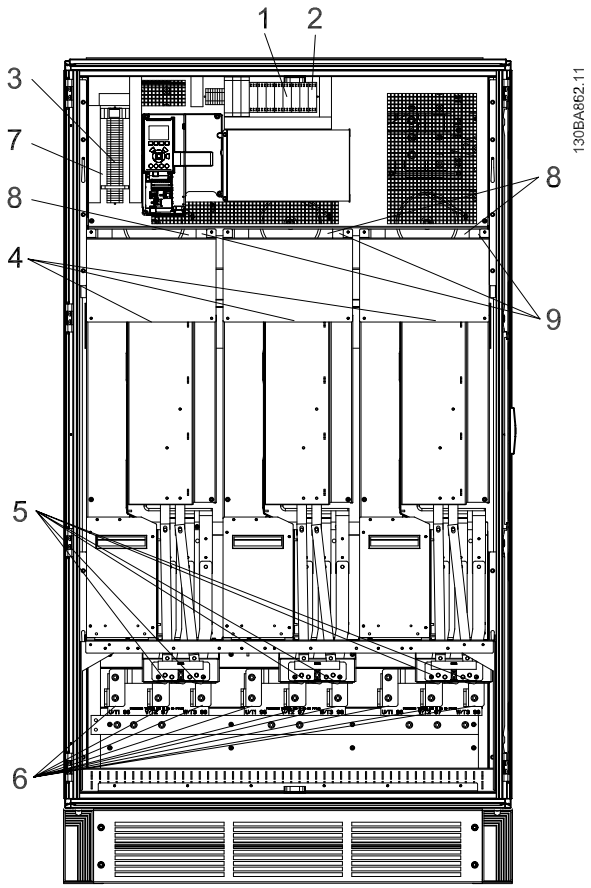


Illustration 3.50: Inverter Cabinet, Unit Size 62 and 64

1) External Temperature Monitoring
2) AUX Relay

   01 02 03
   04 05 06
3) NAMUR
4) AUX Fan

   100 101 102 103
   L1 L2 L1 L2
5) Brake

   -R +R
   81 82
6) Motor

   U V W

   96 97 98
   T1 T2 T3
7) NAMUR Fuse. See fuse tables for part numbers
8) Fan Fuses. See fuse tables for part numbers
9) SMPS Fuses. See fuse tables for part numbers

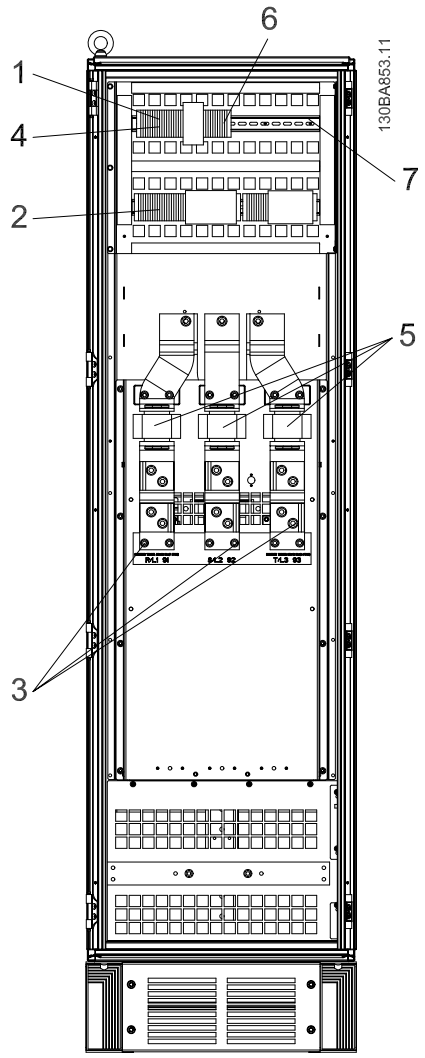


Illustration 3.51: Options Cabinet, Unit Size 63 and 64

1)	Pilz Relay Terminal	4)	Safety Relay Coil Fuse with PILS Relay
2)	RCD or IRM Terminal		See fuse tables for part numbers
3)	Mains	5)	Line Fuses, F3 and F4 (3 pieces)
	R S T		See fuse tables for part numbers
	91 92 93	6)	Contactor Relay Coil (230 VAC). N/C and N/O Aux Contacts
	L1 L2 L3	7)	Circuit Breaker Shunt Trip Control Terminals (230 VAC or 230 VDC)

3.6.2 Earthing

The following basic issues need to be considered when installing a frequency converter, so as to obtain electromagnetic compatibility (EMC).

- Safety earthing: Please note that the frequency converter has a high leakage current and must be earthed appropriately for safety reasons. Apply local safety regulations.
- High-frequency earthing: Keep the earth wire connections as short as possible.

Connect the different earth systems at the lowest possible conductor impedance. The lowest possible conductor impedance is obtained by keeping the conductor as short as possible and by using the greatest possible surface area.
The metal cabinets of the different devices are mounted on the cabinet rear plate using the lowest possible HF impedance. This avoids having different HF voltages for the individual devices and avoids the risk of radio interference currents running in connection cables that may be used between the devices. The radio interference will have been reduced.
In order to obtain a low HF impedance, use the fastening bolts of the devices as HF connection to the rear plate. It is necessary to remove insulating paint or similar from the fastening points.

3.6.3 Extra Protection (RCD)

ELCB relays, multiple protective earthing or earthing can be used as extra protection, provided that local safety regulations are complied with.

In the case of an earth fault, a DC component may develop in the fault current.

If ELCB relays are used, local regulations must be observed. Relays must be suitable for protection of 3-phase equipment with a bridge rectifier and for a brief discharge on power-up.

See also the section *Special Conditions* in the Design Guide.

3.6.4 Drives with factory installed A1/B1 RFI Filter option:

Mains supply isolated from earth

If the frequency converter is supplied from an isolated mains source (IT mains, floating delta and grounded delta) or TT/TN-S mains with grounded leg, the RFI switch is recommended to be turned off (OFF) [1] via par. SP-50 RFI *Filter*. For further reference, see IEC 364-3. In case optimum EMC performance is needed, parallel motors are connected or the motor cable length is above 25 m, it is recommended to set par. SP-50 RFI *Filter* to [ON].

[1] Not available for 525-600/690 V frequency converters.

In OFF, the internal RFI capacities (filter capacitors) between the chassis and the intermediate circuit are cut off to avoid damage to the intermediate circuit and to reduce the earth capacity currents (according to IEC 61800-3).
It is important to use isolation monitors that are capable for use together with power electronics (IEC 61557-8).

3.6.5 Torque

When tightening all electrical connections it is very important to tighten with the correct torque. Too low or too high torque results in a bad electrical connection. Use a torque wrench to ensure correct torque

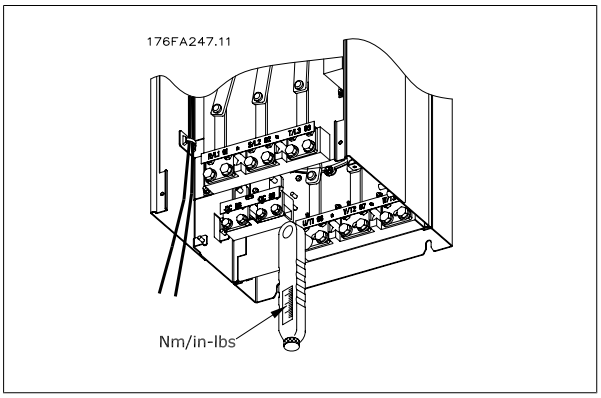


Illustration 3.52: Always use a torque wrench to tighten the bolts.

Unit Size	Terminal	Torque	Bolt size
41, 42, 43 and 44	Mains Motor	19 Nm (168 in-lbs)	M10
	Load sharing Brake	9.5 (84 in-lbs)	M8
51 and 52	Mains Motor Load sharing	19 NM (168 in-lbs)	M10
	Brake	9.5 (84 in-lbs)	M8
61, 62, 63 and 64	Mains Motor	19 Nm (168 in-lbs)	M10
	Load sharing	19 Nm (168 in-lbs)	M10
	Brake	9.5 Nm (84 in-lbs)	M8
	Regen	19 Nm (168 in-lbs)	M10

Table 3.3: Torque for terminals

3.6.6 Shielded Cables

It is important that shielded and armoured cables are connected in a proper way to ensure high EMC immunity and low emissions.

Connection can be made using either cable glands or clamps:

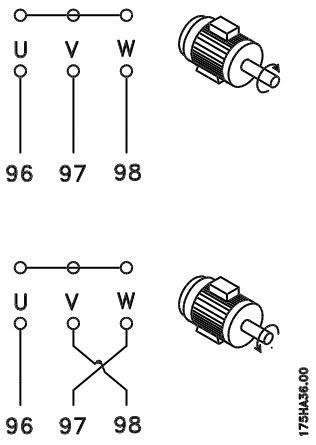
- EMC cable glands: Generally available cable glands can be used to ensure an optimum EMC connection.
- EMC cable clamp: Clamps allowing easy connection are supplied with the frequency converter.

3.6.7 Motor cable

The motor must be connected to terminals U/T1/96, V/T2/97, W/T3/98. Earth to terminal 99. All types of three-phase asynchronous standard motors can be used with a frequency converter unit. The factory setting is for clockwise rotation with the frequency converter output connected as follows:

Terminal No.	Function
96, 97, 98, 99	Mains U/T1, V/T2, W/T3 Earth

- Terminal U/T1/96 connected to U-phase
- Terminal V/T2/97 connected to V-phase
- Terminal W/T3/98 connected to W-phase



The direction of rotation can be changed by switching two phases in the motor cable or by changing the setting of par. H-08 *Reverse Lock*.
Motor rotation check can be performed using par. P-08 Motor *Rotation Check* and following the steps shown in the display.

Unit Size 6X Requirements

Unit Size 61 and 63 requirements: Motor phase cable quantities must be 2, 4, 6, or 8 (multiples of 2) to obtain equal amount of wires attached to both inverter module terminals. The cables are required to be equal length within 10% between the inverter module terminals and the first common point of a phase. The recommended common point is the motor terminals.

Unit Size 62 and 64 requirements: Motor phase cable quantities must be 3, 6, 9, or 12 (multiples of 3) to obtain equal amount of wires attached to each inverter module terminal. The wires are required to be equal length within 10% between the inverter module terminals and the first common point of a phase. The recommended common point is the motor terminals.

Output junction box requirements: The length, minimum 2.5 meters, and quantity of cables must be equal from each inverter module to the common terminal in the junction box.

3.6.8 Drives with factory installed Brake Chopper option

The connection cable to the brake resistor must be screened and the max. length from frequency converter to the DC bar is limited to 25 metres (82 feet).

Terminal No.	Function
81, 82	Brake resistor terminals

The connection cable to the brake resistor must be screened. Connect the screen by means of cable clamps to the conductive back plate at the frequency converter and to the metal cabinet of the brake resistor.
Size the brake cable cross-section to match the brake torque.

Please note that voltages up to 1099 VDC, depending on the supply voltage, may occur on the terminals.

3.6.9 Load Sharing

Terminal No.	Function
88, 89	Loadsharing

The connection cable must be screened and the max. length from the frequency converter to the DC bar is limited to 25 metres (82 feet).
Load sharing enables linking of the DC intermediate circuits of several frequency converters.

Please note that voltages up to 1099 VDC may occur on the terminals.
Load Sharing calls for extra equipment and safety considerations. For further information, see load sharing Instructions MI.50.NX.YY.

Please note that mains disconnect may not isolate the frequency converter due to DC link connection

3.6.10 Shielding against Electrical Noise

Before mounting the mains power cable, mount the EMC metal cover to ensure best EMC performance.

NOTE: The EMC metal cover is only included in units with factory installed A1/B1 RFI Filter option..

Illustration 3.53: Mounting of EMC shield.

3.6.11 Mains connection

Mains must be connected to terminals 91, 92 and 93. Earth is connected to the terminal to the right of terminal 93.

Terminal No.	Function
91, 92, 93	Mains R/L1, S/L2, T/L3
94	Earth

Check the name plate to ensure that the mains voltage of the frequency converter matches the power supply of your plant.

Ensure that the power supply can supply the necessary current to the frequency converter.

3.6.12 External Fan Supply

In case the frequency converter is supplied by DC or if the fan must run independently of the power supply, an external power supply can be applied. The connection is made on the power card.

Terminal No.	Function
100, 101	Auxiliary supply S, T
102, 103	Internal supply S, T

The connector located on the power card provides the connection of line voltage for the cooling fans. The fans are connected from factory to be supplied form a common AC line (jumpers between 100-102 and 101-103). If external supply is needed, the jumpers are removed and the supply is connected to terminals 100 and 101. A 5 Amp fuse should be used for protection. In UL applications this should be LittleFuse KLK-5 or equivalent.

3.6.13 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 over-current 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.

Over-current 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 over-current protection in the installation. Over-current protection must always be carried out according to national regulations.

380-500 V, frame sizes 4X, 5X and 6X

The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), 240V, or 480V, or 500V, or 600V depending on the drive voltage rating. With the proper fusing the drive Short Circuit Current Rating (SCCR) is 100,000 Arms.

AF-650 GP	Bussmann E1958 JFHR2**	Bussmann E4273 T/JDDZ**	SIBA E180276 RKI/JDDZ	LittelFuse E71611 JFHR2**	Ferraz-Shawmut E60314 JFHR2**	Bussmann E4274 H/JDDZ**	Bussmann E125085 JFHR2*	Internal Option Bussmann
125 HP	FWH-300	JJS-300	2028220-315	L50S-300	A50-P300	NOS-300	170M3017	170M3018
150 HP	FWH-350	JJS-350	2028220-315	L50S-350	A50-P350	NOS-350	170M3018	170M3018
200 HP	FWH-400	JJS-400	206xx32-400	L50S-400	A50-P400	NOS-400	170M4012	170M4016
250 HP	FWH-500	JJS-500	206xx32-500	L50S-500	A50-P500	NOS-500	170M4014	170M4016
300 HP	FWH-600	JJS-600	206xx32-600	L50S-600	A50-P600	NOS-600	170M4016	170M4016

Table 3.4: For Unit Sizes 41, 42, 43, and 44,380-500 V

AF-650 GP	Bussmann PN*	Rating	Ferraz	Siba
350 HP	170M4017	700 A, 700 V	6.9URD31D08A0700	20 610 32.700
400 HP	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900
500 HP	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900
550 HP	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900

Table 3.5: For Unit Sizes 51 and 52, 380-500 V

AF-650 GP	Bussmann PN*	Rating	Siba	Internal Bussmann Option
600 HP	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
650 HP	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
750 HP	170M7082	2000 A, 700 V	20 695 32.2000	170M7082
900 HP	170M7082	2000 A, 700 V	20 695 32.2000	170M7082
1000 HP	170M7083	2500 A, 700 V	20 695 32.2500	170M7083
1200 HP	170M7083	2500 A, 700 V	20 695 32.2500	170M7083

Table 3.6: Unit Sizes 61, 62, 63, and 64, 380-500 V

AF-650 GP	Bussmann PN*	Rating	Siba
600 HP	170M8611	1100 A, 1000 V	20 781 32.1000
650 HP	170M8611	1100 A, 1000 V	20 781 32.1000
750 HP	170M6467	1400 A, 700 V	20 681 32.1400
900 HP	170M6467	1400 A, 700 V	20 681 32.1400
1000 HP	170M8611	1100 A, 1000 V	20 781 32.1000
1200 HP	170M6467	1400 A, 700 V	20 681 32.1400

Table 3.7: Unit Sizes 61, 62, 63, and 64, Inverter module DC Link Fuses, 380-500 V

*170M fuses from Bussmann shown 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 for external use

**Any minimum 500 V UL listed fuse with associated current rating may be used to meet UL requirements.

525-690 V, frame sizes D, E and F

AF-650 GP	Bussmann E125085 JFHR2	Amps	SIBA E180276 JFHR2	Ferraz-Shawmut E76491 JFHR2	Internal Option Bussmann
125 HP	170M3016	250	2061032.25	6.6URD30D08A0250	170M3018
150 HP	170M3017	315	2061032.315	6.6URD30D08A0315	170M3018
200 HP	170M3018	350	2061032.35	6.6URD30D08A0350	170M3018
250 HP	170M4011	350	2061032.35	6.6URD30D08A0350	170M5011
300 HP	170M4012	400	2061032.4	6.6URD30D08A0400	170M5011
350 HP	170M4014	500	2061032.5	6.6URD30D08A0500	170M5011
400 HP	170M5011	550	2062032.55	6.6URD32D08A550	170M5011

Table 3.8: Unit Size 41, 42, 43, and 44, 525-690 V

AF-650 GP	Bussmann PN*	Rating	Ferraz	Siba
500 HP	170M4017	700 A, 700 V	6.9URD31D08A0700	20 610 32.700
550 HP	170M4017	700 A, 700 V	6.9URD31D08A0700	20 610 32.700
650 HP	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900
750 HP	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900

Table 3.9: Unit Sizes 51 and 52, 525-690 V

AF-650 GP	Bussmann PN*	Rating	Siba	Internal Bussmann Option
900 HP	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
1000 HP	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
1200 HP	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
1250 HP	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
1350 HP	170M7082	2000 A, 700 V	20 695 32.2000	170M7082

Table 3.10: Unit Sizes 61, 62, 63, and 64, 525-690 V

AF-650 GP	Bussmann PN*	Rating	Siba
900 HP	170M8611	1100 A, 1000 V	20 781 32. 1000
1000 HP	170M8611	1100 A, 1000 V	20 781 32. 1000
1200 HP	170M8611	1100 A, 1000 V	20 781 32. 1000
1250 HP	170M8611	1100 A, 1000 V	20 781 32. 1000
1350 HP	170M8611	1100 A, 1000 V	20 781 32. 1000

Table 3.11: Unit Sizes 61, 62, 63, and 64, 525-690 V

*170M fuses from Bussmann shown 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 for external use.

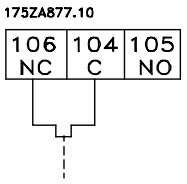
3.6.14 Brake Resistor Temperature Switch

Torque: 0.5-0.6 Nm (5 in-lbs)
Screw size: M3

This input can be used to monitor the temperature of an externally connected brake resistor. If the input between 104 and 106 is established, the frequency converter will trip on warning / alarm 27, "Brake IGBT". If the connection is closed between 104 and 105, the frequency converter will trip on warning / alarm 27, "Brake IGBT".
Normally closed: 104-106 (factory installed jumper)
Normally open: 104-105

Terminal No.	Function
106, 104, 105	Brake resistor temperature switch.

If the temperature of the brake resistor gets too high and the thermal switch drops out, the frequency converter will stop braking. The motor will start coasting.
A KLIXON switch must be installed that is `normally closed'. If this function is not used, 106 and 104 must be short-circuited together.



3.6.15 Control cable routing

Tie down all control wires to the designated control cable routing as shown in the picture. Remember to connect the shields in a proper way to ensure optimum electrical immunity.

Field Installed Network Module options connection
Connections are made to the network options on the control card. For details see the relevant network instructions. The cable must be placed to the left inside the frequency converter and tied down together with other control wires (see picture).

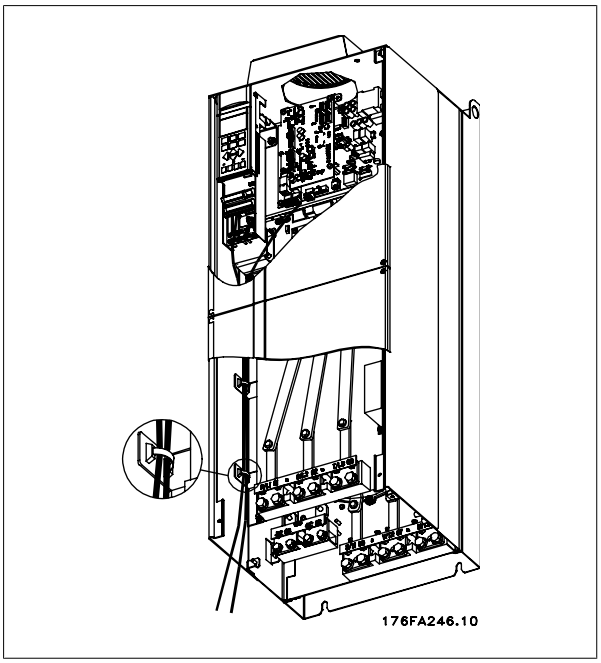


Illustration 3.54: Wire path for control wiring.

In the IP 00 (Chassis) and IP 21 (NEMA 1) units it is also possible to connect the network from the top of the unit as shown on the picture to the right. On the IP 21 (NEMA 1) unit a cover plate must be removed.

Illustration 3.55: Top connection for fieldbus.

Installation of field installed 24 Volt external DC Supply option module (OPC24VPS)

Torque: 0.5 - 0.6 Nm (5 in-lbs)

Screw size: M3

No.	Function
35 (-), 36 (+)	24 V external DC supply

24 VDC external supply can be used as low-voltage supply to the control card and any I/O or network option cards installed. This enables full operation of the Keypad (including parameter setting) without connection to mains. Please note that a warning of low voltage will be given when 24 VDC has been connected; however, there will be no tripping.

Use 24 VDC supply of type PELV to ensure correct galvanic isolation (type PELV) on the control terminals of the frequency converter.

3.6.16 Access to Control Terminals

All terminals to the control cables are located beneath the Keypad. They are accessed by opening the door of the Nema 1 / Nema 12 or removing the covers of the IP00 chassis drive type.

3.6.17 Electrical Installation, Control Terminals

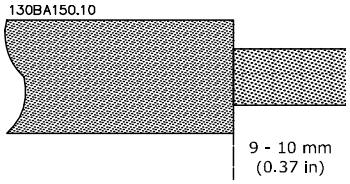
To connect the cable to the terminal:

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

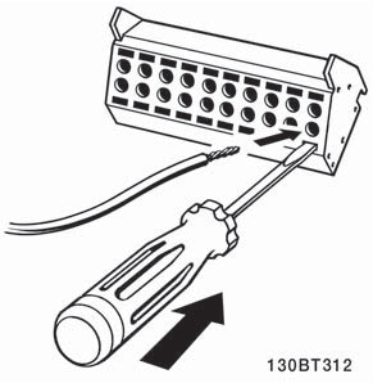
To remove the cable from the terminal:

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

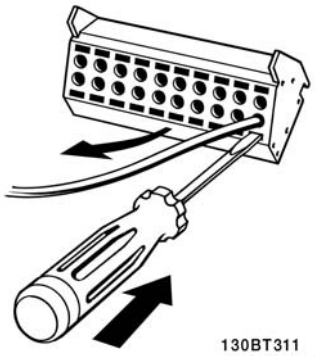
[1)] Max. 0.4 x 2.5 mm



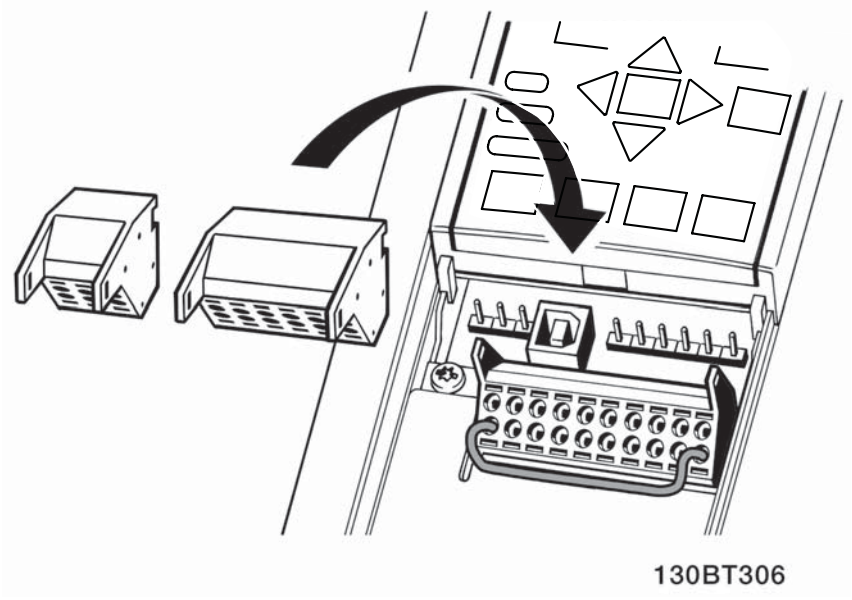
1.



2.



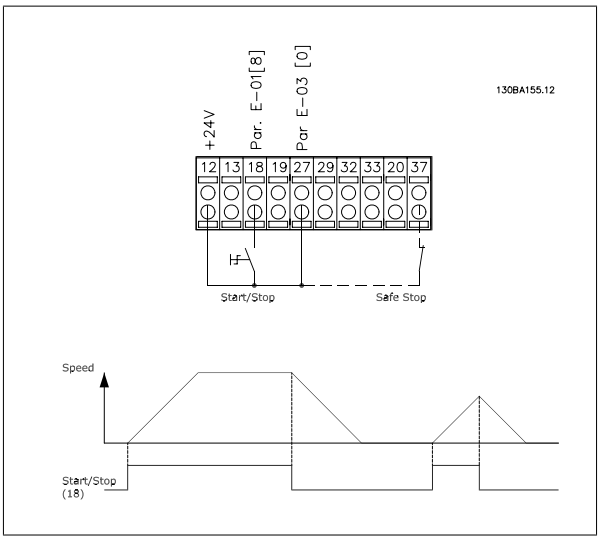
3.



3.7 Connection Examples

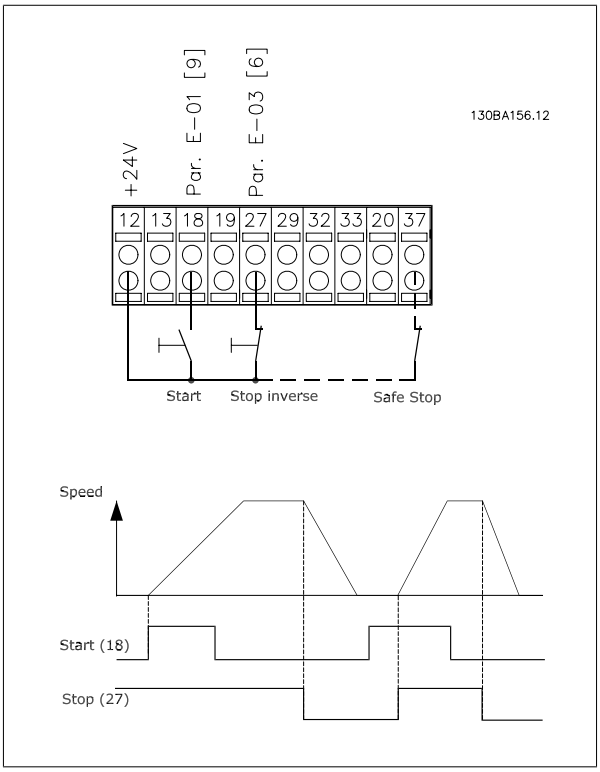
3.7.1 Start/Stop

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



3.7.2 Pulse Start/Stop

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



3.7.3 Speed Up/Down

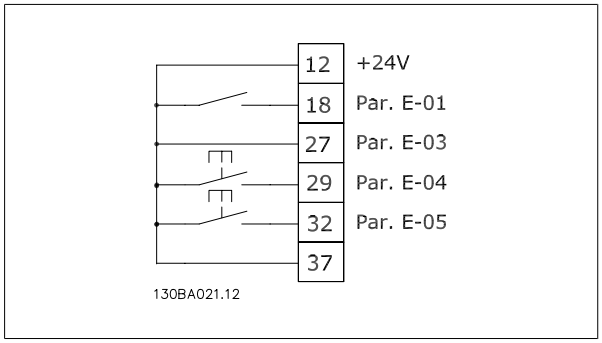
Terminals 29/32 = Speed up/down:.

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]



3.7.4 Potentiometer Reference

Voltage reference via a potentiometer:

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

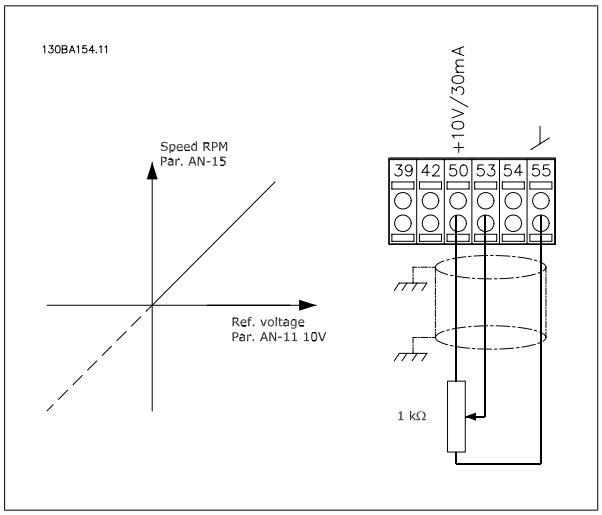
Terminal 53, Low Voltage = 0 Volt

Terminal 53, High Voltage = 10 Volt

Terminal 53, Low Ref./Feedback = 0 RPM

Terminal 53, High Ref./Feedback = 1500 RPM

Switch S201 = OFF (U)



3.8.1 Electrical Installation, Control Cables

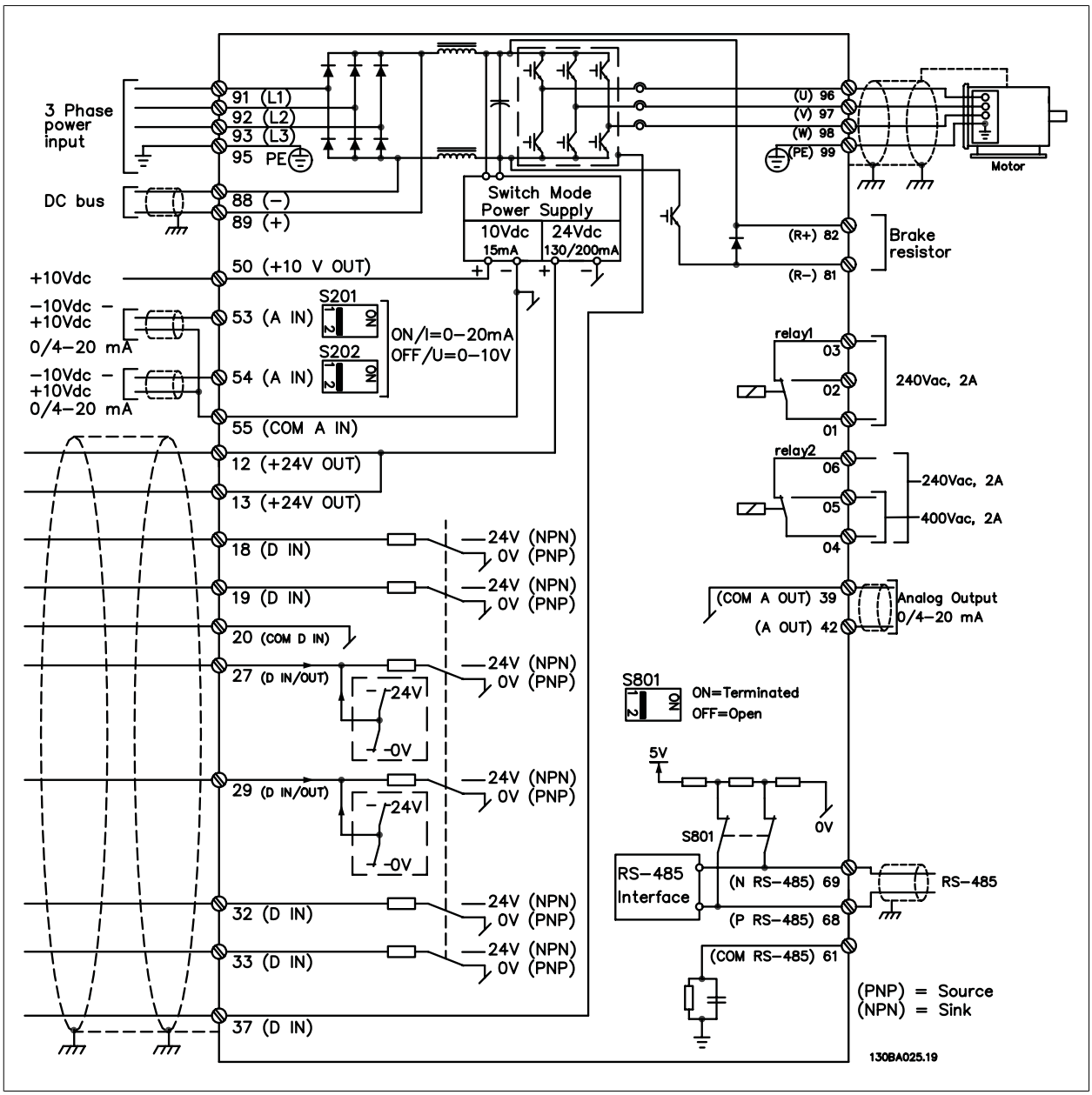


Illustration 3.56: Diagram showing all electrical terminals without options.

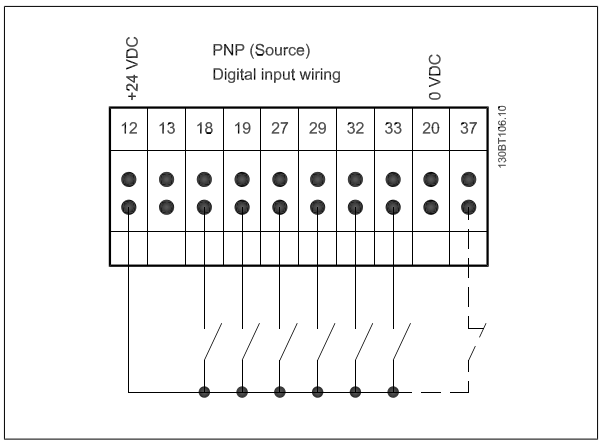
Terminal 37 is the input to be used for Safe Stop. For instructions on Safe Stop installation please refer to the section *Safe Stop Installation* in the AF-650 GP Design Guide. See also sections Safe Stop and Safe Stop Installation.

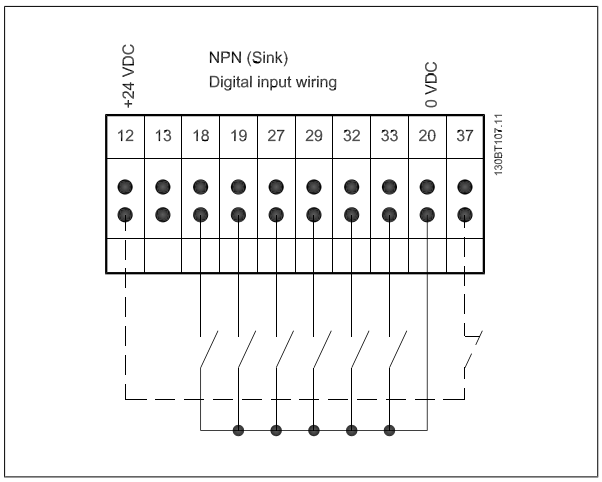
Very long control cables and analogue signals may in rare cases and depending on installation result in 50/60 Hz earth loops due to noise from mains supply cables.

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

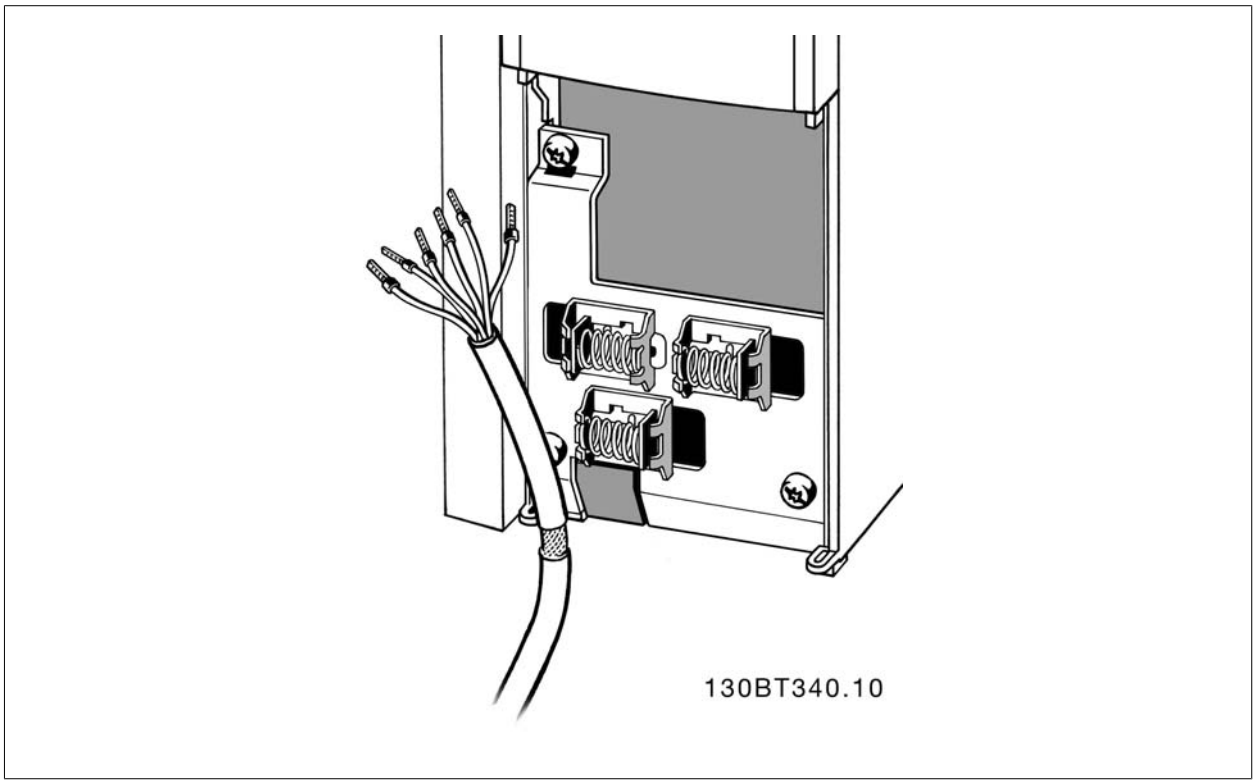
The digital and analog inputs and outputs must be connected separately to the frequency converter common inputs (terminal 20, 55, 39) to avoid earth currents from both groups to affect other groups. For example, switching on the digital input may disturb the analog input signal.

Input polarity of control terminals





NB!
Control cables must be screened/armoured.



Connect the wires as described in the Operating Instruction for the frequency converter. Remember to connect the shields in a proper way to ensure optimum electrical immunity.

3.8.2 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.*

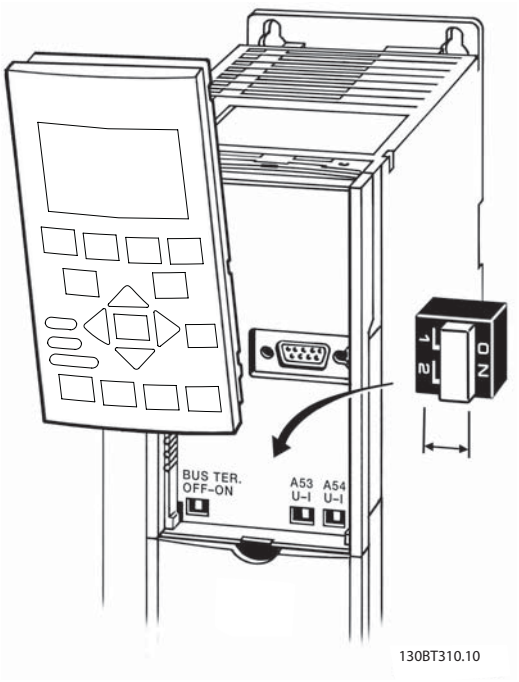
Default setting:

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.



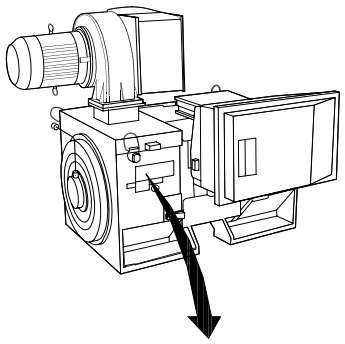
3.9 Final Set-Up and Test

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.



THREE PHASE INDUCTION MOTOR								
MOD MCV 315E		Nr. 135189 12 04				IL/IN 6.5		
kW 400		PRIMARY				SF 1.15		
HP 536		V 690	A 410.6		CONN Y	COSf 0.85	40	
mm 1481		V	A		CONN	AMB 40		°C
Hz 50		V	A		CONN	ALT 1000		m
DESIGN N		SECONDARY				RISE 80		°C
DUTY S1		V	A		CONN	ENCLOSURE IP23		
INSUL I	EFFICIENCY %	95.8%	100%	95.8%	75%	WEIGHT 1.83 ton		
⚠ CAUTION								

130BA767.10

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.
2. Connect terminal 27 to terminal 12 or set par. E-03 Terminal *27 Digital Input* to 'No function' (par. E-03 Terminal *27 Digital Input* [0])
3. Activate the auto tune par. P-04 *Auto Tune.*
4. Choose between complete or reduced auto tune. If a Sine-wave filter is mounted, 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 3.12: 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*

3.10 Additional Connections

3.10.1 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.

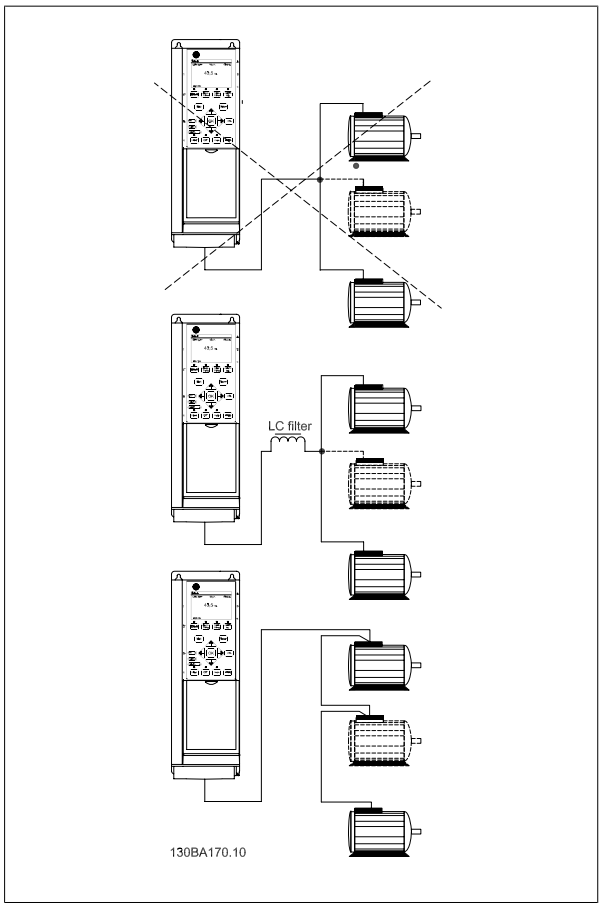
3.10.2 Parallel Connection of Motors

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.

3.10.3 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 How to Program

4.1 The Graphical Keypad

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

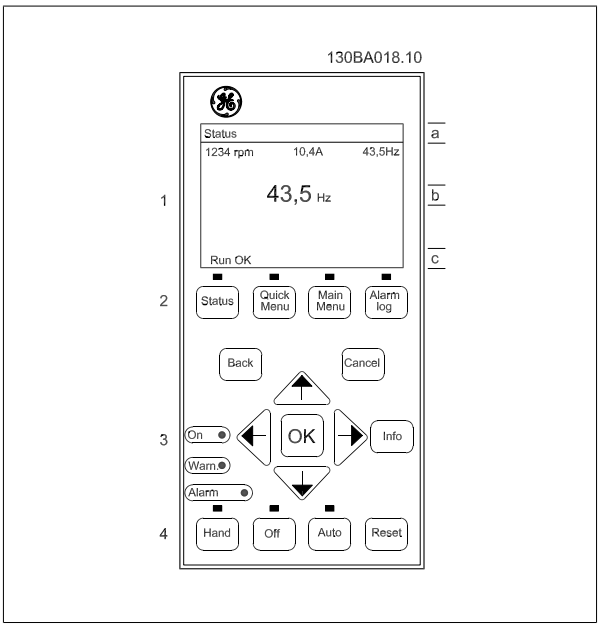
4.1.1 How to Program on the Graphical Keypad

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 Set-Up	OK	↓
par. K-01 *Language*	OK	Set language	↓	
par. K-02 Motor *Speed Unit*	OK	Set motor speed in Hz or RPM	↓	
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	Set reference source	↓	
par. F-02 Operation *Method*	OK	Select which reference site to activate	↓	
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	Set motor thermal protection	↓	
par. F-15 Motor *Speed High Limit [Hz]* or par. F-17 *Motor Speed High Limit [RPM]*	OK	Set motor speed high limit in Hz or RPM	↓	
par. F-16 *Motor Speed Low Limit [Hz]* or par. F-18 *Motor Speed Low Limit [RPM]*	OK	Set motor speed low limit in Hz or RPM	↓	
par. H-08 *Reverse Lock*	OK	Set allowed rotation direction	↓	
par. P-04 *Auto Tune*	OK	Set desired auto tune function. Enable complete auto tune is recommended	↓	

4.2 Quick Setup Parameter List

K-01 Language

Option:		Function:
		Defines the language to be used in the display. The frequency converter is delivered with 4 different languages.
[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].

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.

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	(OPCGPIO - General Purpose I/O Option Module)
[22]	Analog input X30-12	(OPCGPIO - General Purpose I/O Option Module)

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*.

$$Par.\ F-07\ = \frac{t_{acc}[s]\ x\ n_s\ [RPM]}{ref\ [RPM]}$$

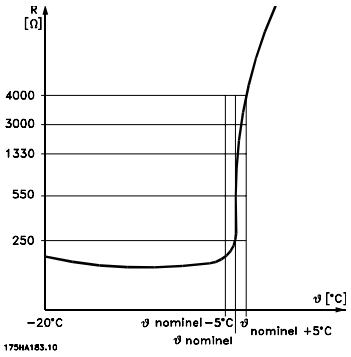
F-08 Decel Time 1

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*.

$$Par.\ F-08\ = \frac{t_{dec}[s]\ x\ n_s\ [RPM]}{ref\ [RPM]}$$

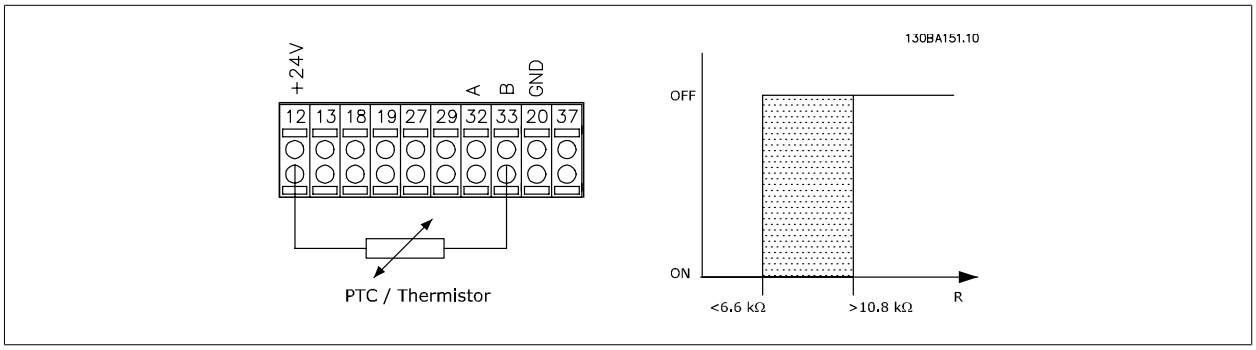
F-10 Electronic Overload

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	

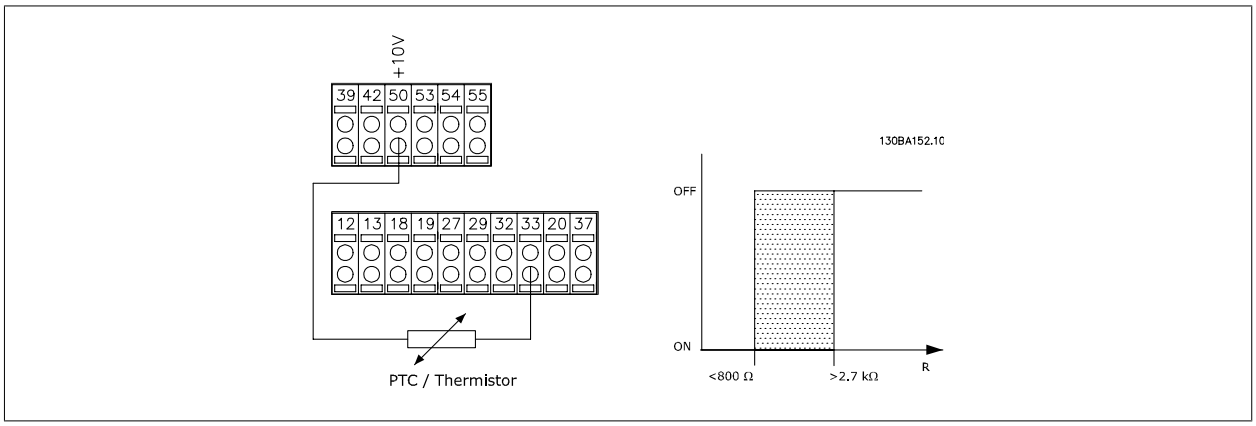


Motor protection can be implemented using a range of techniques: PTC or KTY sensor (see also section *KTY Sensor Connection*) in motor windings; mechanical thermal switch (Klixon type); or Electronic Thermal Overload.

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]



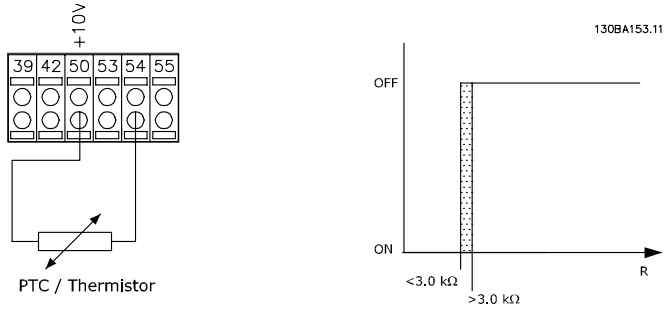
Using an analog input and 10 V as power supply:

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!

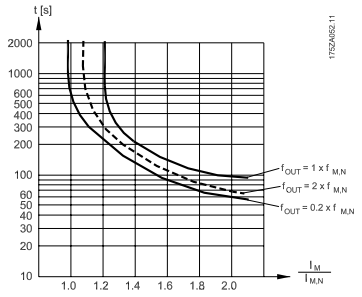
Check that the chosen supply voltage follows the specification of the used thermistor element.

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 3 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.



F-15 Motor Speed High Limit (Hz)

Range:	Function:
50/60.0 Hz* [par. H-12 - par. H-19 Hz]	Enter the maximum limit for motor speed. The Motor Speed High Limit can be set to correspond to the manufacturer's recommended maximum of the motor shaft. The Motor Speed High Limit must exceed the in par. F-16 Frequency *Limiter (Low)*. Only par. F-18 Speed *Limiter (Low)* or par. F-16 Frequency *Limiter (Low)* will be displayed depending on other parameters in the Main Menu and depending on default settings dependant on global location.

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 *Motor Speed High Limit (Hz).*

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. F-15 *Motor Speed High Limit (Hz)* or par. F-17 *Motor Speed High Limit [RPM].* 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.

Changes during operation

"TRUE" means that the parameter can be changed while the frequency converter is in operation and "FALSE" means that the frequency converter must be stopped before a change can be made.

4-Set-up

'All set-ups': the parameter can be set individually in each of the four set-ups, i. e. one single parameter can have four different data values.

'1 set-up': data value will be the same in all set-ups.

Conversion index

This number refers to a conversion figure used when writing or reading by means of a frequency converter.

Conv. index	100	67	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6
Conv. factor	1	1/60	1000000	100000	10000	1000	100	10	1	0.1	0.01	0.001	0.0001	0.00001	0.000001

Data type	**Description**	**Type**
2	Integer 8	Int8
3	Integer 16	Int16
4	Integer 32	Int32
5	Unsigned 8	Uint8
6	Unsigned 16	Uint16
7	Unsigned 32	Uint32
9	Visible String	VisStr
33	Normalized value 2 bytes	N2
35	Bit sequence of 16 boolean variables	V2
54	Time difference w/o date	TimD

4.3.1 K-## Keypad Set-up

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
K-0#						
K-01	Language	[0] English	1 set-up	TRUE	-	Uint8
K-02	Motor Speed Unit	[0] RPM	2 set-ups	FALSE	-	Uint8
K-03	Regional Settings	[1] US	2 set-ups	FALSE	-	Uint8
K-04	Operating State at Power-up	[1] Forced stop, ref=old	All set-ups	TRUE	-	Uint8
K-1#						
K-10	Active Set-up	[1] Set-up 1	1 set-up	TRUE	-	Uint8
K-11	Edit Set-up	[1] Set-up 1	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: Edit Set-ups / Channel	0 N/A	All set-ups	TRUE	0	Int32
K-2#						
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-3#						
K-30	Unit for Custom Readout	[0] None	All set-ups	TRUE	-	Uint8
K-31	Min Value of Custom Readout	0.00 CustomReadoutUnit	All set-ups	TRUE	-2	Int32
K-32	Max Value of Custom Readout	100.00 CustomReadoutUnit	All set-ups	TRUE	-2	Int32
K-4#						
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-5#						
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-6#						
K-60	Main Menu Password	100 N/A	1 set-up	TRUE	0	Int16
K-61	Access to Main Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8
K-65	Quick Menu Password	200 N/A	1 set-up	TRUE	0	Int16
K-66	Access to Quick Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8
K-67	Bus Password Access	0 N/A	All set-ups	TRUE	0	Uint16

4.3.2 F-## Fundamental Parameters

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
F-0#						
F-01	Frequency Setting 1	null	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	132.0 Hz	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-1#						
F-10	Electronic Overload	[0] No protection	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-2#						
F-22	Start Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
F-23	Start Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
F-24	Holding Time	0.0 s	All set-ups	TRUE	-1	Uint8
F-25	Start Function	[2] Coast/delay time	All set-ups	TRUE	-	Uint8
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-29	Start Current	0.00 A	All set-ups	TRUE	-2	Uint32
F-3#						
F-37	Adv. Switching Pattern	[1] SFAVM	All set-ups	TRUE	-	Uint8
F-38	Overmodulation	[1] On	All set-ups	FALSE	-	Uint8
F-4#						
F-40	Torque Limiter (Driving)	ExpressionLimit	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-5#						
F-50	Reference Range	null	All set-ups	TRUE	-	Uint8
F-51	Reference/Feedback Unit	null	All set-ups	TRUE	-	Uint8
F-52	Minimum Reference	0 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
F-53	Maximum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
F-54	Reference Function	[0] Sum	All set-ups	TRUE	-	Uint8
F-6#						
F-62	Catch up/slow Down Value	0.00 %	All set-ups	TRUE	-2	Int16
F-64	Preset Relative Reference	0.00 %	All set-ups	TRUE	-2	Int32
F-68	Relative Scaling Reference Resource	[0] No function	All set-ups	TRUE	-	Uint8
F-9#						
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	-100 %	All set-ups	TRUE	0	Int16
F-95	Accel/Decel Ramp Delay	ExpressionLimit	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	Conversion index	Type
E-0#						
E-00	Digital I/O Mode	[0] PNP	All set-ups	FALSE	-	Uint8
E-01	Terminal 18 Digital Input	null	All set-ups	TRUE	-	Uint8
E-02	Terminal 19 Digital Input	null	All set-ups	TRUE	-	Uint8
E-03	Terminal 27 Digital Input	null	All set-ups	TRUE	-	Uint8
E-04	Terminal 29 Digital Input	null	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-07	Terminal 37 Safe Stop	[1] Safe Stop Alarm	1 set-up	TRUE	-	Uint8
E-1#						
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-12	Accel Time 3	ExpressionLimit	All set-ups	TRUE	-2	Uint32
E-13	Decel Time 3	ExpressionLimit	All set-ups	TRUE	-2	Uint32
E-14	Accel Time 4	ExpressionLimit	All set-ups	TRUE	-2	Uint32
E-15	Decel Time 4	ExpressionLimit	All set-ups	TRUE	-2	Uint32
E-2#						
E-20	Terminal 27 Digital Output	null	All set-ups	TRUE	-	Uint8
E-21	Terminal 29 Digital Output	null	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-3#						
E-30	Terminal X46/1 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-31	Terminal X46/3 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-32	Terminal X46/5 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-33	Terminal X46/7 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-34	Terminal X46/9 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-35	Terminal X46/11 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-36	Terminal X46/13 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
E-5#						
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)	null	All set-ups	TRUE	-	Uint8
E-57	Term X30/7 Digi Out (OPCGPIO)	null	All set-ups	TRUE	-	Uint8
E-6#						
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 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
E-63	Term. 29 High Ref./Feedb. Value	ExpressionLimit	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 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
E-68	Term. 33 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32
E-69	Pulse Filter Time Constant #33	100 ms	All set-ups	FALSE	-3	Uint16

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
E-7#						
E-70	Terminal 27 Pulse Output Variable	null	All set-ups	TRUE	-	Uint8
E-72	Pulse Output Max Freq #27	ExpressionLimit	All set-ups	TRUE	0	Uint32
E-73	Terminal 29 Pulse Output Variable	null	All set-ups	TRUE	-	Uint8
E-75	Pulse Output Max Freq #29	ExpressionLimit	All set-ups	TRUE	0	Uint32
E-76	Terminal X30/6 Pulse Output Variable	null	All set-ups	TRUE	-	Uint8
E-78	Pulse Output Max Freq #X30/6	ExpressionLimit	All set-ups	TRUE	0	Uint32
E-8#						
E-80	Term 32/33 Pulses Per Revolution	1024 N/A	All set-ups	FALSE	0	Uint16
E-81	Term 32/33 Encoder Direction	[0] Clockwise	All set-ups	FALSE	-	Uint8
E-9#						
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

4.3.4 C-## Frequency Control Functions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
C-0#						
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-2#						
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-3#						
C-30	Frequency Command 2	null	All set-ups	TRUE	-	Uint8
C-34	Frequency Command 3	null	All set-ups	TRUE	-	Uint8

4.3.5 P-## Motor Data

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
P-0#						
P-01	Motor Poles	ExpressionLimit	All set-ups	FALSE	0	Uint8
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-05	Motor Cont. Rated Torque	ExpressionLimit	All set-ups	FALSE	-1	Uint32
P-06	Base Speed	ExpressionLimit	All set-ups	FALSE	67	Uint16
P-07	Motor Power [kW]	ExpressionLimit	All set-ups	FALSE	1	Uint32
P-09	Slip Compensation	ExpressionLimit	All set-ups	TRUE	0	Int16
P-1#						
P-10	Slip Compensation Time Constant	ExpressionLimit	All set-ups	TRUE	-2	Uint16
P-2#						
P-20	Motor Construction	[0] Asynchron	All set-ups	FALSE	-	Uint8
P-3#						
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-33	Stator Leakage Reactance (X1)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
P-34	Rotor Leakage Reactance (X2)	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-37	d-axis Inductance (Ld)	ExpressionLimit	All set-ups	FALSE	-6	Int32

4.3.6 H-## High Perf Parameters

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
H-0#						
H-03	Restore Factory Settings	[0] Normal operation	All set-ups	TRUE	-	Uint8
H-04	Auto-Reset (Times)	[0] Manual reset	All set-ups	TRUE	-	Uint8
H-05	Auto-Reset (Reset Interval)	10 s	All set-ups	TRUE	0	Uint16
H-07	Accel/Decel Time 1 Type	[0] Linear	All set-ups	TRUE	-	Uint8
H-08	Reverse Lock	null	All set-ups	FALSE	-	Uint8
H-09	Start Mode	[0] Disabled	All set-ups	FALSE	-	Uint8
H-2#						
H-20	Motor Feedback Loss Function	[2] Trip	All set-ups	TRUE	-	Uint8
H-21	Motor Feedback Speed Error	300 RPM	All set-ups	TRUE	67	Uint16
H-22	Motor Feedback Loss Timeout	0.05 s	All set-ups	TRUE	-2	Uint16
H-4#						
H-40	Configuration Mode	null	All set-ups	TRUE	-	Uint8
H-41	Motor Control Principle	null	All set-ups	FALSE	-	Uint8
H-42	Flux Motor Feedback Source	[1] 24V encoder	All set-ups	FALSE	-	Uint8
H-43	Torque Characteristics	[0] Constant torque	All set-ups	TRUE	-	Uint8
H-44	Constant or Variable Torque OL	[0] High torque	All set-ups	FALSE	-	Uint8
H-45	Local Mode Configuration	[2] As mode par H-40	All set-ups	TRUE	-	Uint8
H-46	Back EMF at 1000 RPM	ExpressionLimit	All set-ups	FALSE	0	Uint16
H-47	Motor Angle Offset	0 N/A	All set-ups	FALSE	0	Int16
H-5#						
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-53	Model Shift Frequency	ExpressionLimit	All set-ups	FALSE	-1	Uint16
H-55	U/f Characteristic - U	ExpressionLimit	All set-ups	TRUE	-1	Uint16
H-56	U/f Characteristic - F	ExpressionLimit	All set-ups	TRUE	-1	Uint16
H-6#						
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-66	Min. Current at Low Speed	100 %	All set-ups	TRUE	0	Uint8
H-7#						
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 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
H-77	Warning Feedback High	999999.999 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
H-78	Missing Motor Phase Function	null	All set-ups	TRUE	-	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
H-8#						
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
H-83	Precise Stop Function	[0] Precise ramp stop	All set-ups	FALSE	-	Uint8
H-84	Precise Stop Counter Value	100000 N/A	All set-ups	TRUE	0	Uint32
H-85	Precise Stop Speed Compensation Delay	10 ms	All set-ups	TRUE	-3	Uint8
H-87	Load Type	[0] Passive load	All set-ups	TRUE	-	Uint8
H-88	Minimum Inertia	ExpressionLimit	All set-ups	FALSE	-4	Uint32
H-89	Maximum Inertia	ExpressionLimit	All set-ups	FALSE	-4	Uint32
H-9#						
H-95	KTY Sensor Type	[0] KTY Sensor 1	All set-ups	TRUE	-	Uint8
H-96	KTY Thermistor Input	[0] None	All set-ups	TRUE	-	Uint8
H-97	KTY Threshold level	80 °C	1 set-up	TRUE	100	Int16

4.3.7 AN-## Analog In / Out

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
AN-0#						
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-1#						
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	0.14 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 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
AN-15	Terminal 53 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32
AN-16	Terminal 53 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AN-2#						
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	0.14 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 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
AN-25	Terminal 54 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32
AN-26	Terminal 54 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AN-3#						
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 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
AN-35	Term. X30/11 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32
AN-36	Term. X30/11 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AN-4#						
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 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
AN-45	Term. X30/12 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32
AN-46	Term. X30/12 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AN-5#						
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-6#						
AN-60	Terminal X30/8 Output	null	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-7#						
AN-70	Terminal X45/1 Output	null	All set-ups	TRUE	-	Uint8
AN-71	Terminal X45/1 Min. Scale	0.00 %	All set-ups	TRUE	-2	Int16
AN-72	Terminal X45/1 Max. Scale	100.00 %	All set-ups	TRUE	-2	Int16
AN-73	Terminal X45/1 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
AN-74	Terminal X45/1 Output Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
AN-8#						
AN-80	Terminal X45/3 Output	null	All set-ups	TRUE	-	Uint8
AN-81	Terminal X45/3 Min. Scale	0.00 %	All set-ups	TRUE	-2	Int16
AN-82	Terminal X45/3 Max. Scale	100.00 %	All set-ups	TRUE	-2	Int16
AN-83	Terminal X45/3 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
AN-84	Terminal X45/3 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	Conversion index	Type
SP-1#						
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-2#						
SP-23	Typecode Setting	null	2 set-ups	FALSE	-	Uint8
SP-24	Trip Delay at Current Limit	60 s	All set-ups	TRUE	0	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-29	Service Code	0 N/A	All set-ups	TRUE	0	Int32
SP-3#						
SP-30	Current Lim Cont, Proportional Gain	100 %	All set-ups	FALSE	0	Uint16
SP-31	Current Lim Contr, Integration Time	0.020 s	All set-ups	FALSE	-3	Uint16
SP-4#						
SP-40	VT Level	66 %	All set-ups	FALSE	0	Uint8
SP-41	Energy Savings Min. Magnetisation	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-5#						
SP-50	RFI Filter	[1] On	1 set-up	FALSE	-	Uint8
SP-52	Fan Operation	[0] Auto	All set-ups	TRUE	-	Uint8
SP-53	Fan Monitor	[1] Warning	All set-ups	TRUE	-	Uint8
SP-55	Output Filter	[0] No Filter	1 set-up	FALSE	-	Uint8
SP-56	Capacitance Output Filter	2.0 uF	1 set-up	FALSE	-7	Uint16
SP-57	Inductance Output Filter	7.000 mH	1 set-up	FALSE	-6	Uint16
SP-59	Actual Number of Inverter Units	ExpressionLimit	1 set-up	FALSE	0	Uint8
SP-6#						
SP-63	Option Supplied by External 24VDC	[1] Yes	2 set-ups	FALSE	-	Uint8
SP-7#						
SP-71	Accel Time 1 S-ramp Ratio at Accel. Start	50 %	All set-ups	TRUE	0	Uint8
SP-72	Accel Time 1 S-ramp Ratio at Accel. End	50 %	All set-ups	TRUE	0	Uint8
SP-73	Decel Time 1 S-ramp Ratio at Decel. Start	50 %	All set-ups	TRUE	0	Uint8
SP-74	Decel Time 1 S-ramp Ratio at Decel. End	50 %	All set-ups	TRUE	0	Uint8
SP-76	Accel/Decel Time 2 Type	[0] Linear	All set-ups	TRUE	-	Uint8
SP-79	Accel Time 2 S-ramp Ratio at Accel. Start	50 %	All set-ups	TRUE	0	Uint8
SP-8#						
SP-80	Accel Time 2 S-ramp Ratio at Accel. End	50 %	All set-ups	TRUE	0	Uint8
SP-81	Decel Time 2 S-ramp Ratio at Decel. Start	50 %	All set-ups	TRUE	0	Uint8
SP-82	Decel Time 2 S-ramp Ratio at Decel. End	50 %	All set-ups	TRUE	0	Uint8
SP-84	Accel/Decel Ramp 3 Type	[0] Linear	All set-ups	TRUE	-	Uint8
SP-87	Accel Time 3 S-ramp Ratio at Accel. Start	50 %	All set-ups	TRUE	0	Uint8
SP-88	Accel Time 3 S-ramp Ratio at Accel. End	50 %	All set-ups	TRUE	0	Uint8
SP-89	Decel Time 3 S-ramp Ratio at Decel. Start	50 %	All set-ups	TRUE	0	Uint8
SP-9#						
SP-90	Decel Time 3 S-ramp Ratio at Decel. End	50 %	All set-ups	TRUE	0	Uint8
SP-92	Accel/Decel Ramp 4 Type	[0] Linear	All set-ups	TRUE	-	Uint8
SP-95	Accel Time 4 S-ramp Ratio at Accel. Start	50 %	All set-ups	TRUE	0	Uint8
SP-96	Accel Time 4 S-ramp Ratio at Accel. End	50 %	All set-ups	TRUE	0	Uint8
SP-97	Decel Time 4 S-ramp Ratio at Decel. Start	50 %	All set-ups	TRUE	0	Uint8
SP-98	Decel Time 4 S-ramp Ratio at Decel. End	50 %	All set-ups	TRUE	0	Uint8

4.3.9 O-## Options/Comms

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
O-0#						
O-01	Control Site	[0] Digital and ctrl.word	All set-ups	TRUE	-	Uint8
O-02	Control Word Source	null	All set-ups	TRUE	-	Uint8
O-03	Control Word Timeout Time	1.0 s	1 set-up	TRUE	-1	Uint32
O-04	Control Word 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 Word Timeout	[0] Do not reset	All set-ups	TRUE	-	Uint8
O-07	Diagnosis Trigger	[0] Disable	2 set-ups	TRUE	-	Uint8
O-1#						
O-10	Control Word Profile	[0] Drive Profile	All set-ups	TRUE	-	Uint8
O-13	Configurable Status Word STW	[1] Profile Default	All set-ups	TRUE	-	Uint8
O-14	Configurable Control Word CTW	[1] Profile default	All set-ups	TRUE	-	Uint8
O-3#						
O-30	Protocol	[0] Drive	1 set-up	TRUE	-	Uint8
O-31	Address	1 N/A	1 set-up	TRUE	0	Uint8
O-32	Drive Port Baud Rate	null	1 set-up	TRUE	-	Uint8
O-33	Drive port parity	[0] Even Parity, 1 Stop Bit	1 set-up	TRUE	-	Uint8
O-35	Minimum Response Delay	10 ms	All set-ups	TRUE	-3	Uint16
O-36	Max Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
O-37	Max Inter-Char Delay	ExpressionLimit	1 set-up	TRUE	-5	Uint16
O-4#						
O-40	Telegram Selection	[1] Standard telegram 1	2 set-ups	TRUE	-	Uint8
O-5#						
O-50	Coasting Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-51	Quick Stop 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	[3] Logic OR	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-8#						
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-9#						
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

4.3.10 DN-## DevicNet

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
DN-0#						
DN-00	DeviceNet 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-1#						
DN-10	Process Data Type Selection	null	All set-ups	TRUE	-	Uint8
DN-11	Process Data Config Write	ExpressionLimit	All set-ups	TRUE	-	Uint16
DN-12	Process Data Config Read	ExpressionLimit	All 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-18	internal_process_data_config_write	ExpressionLimit	All set-ups	TRUE	0	Uint16
DN-19	internal_process_data_config_read	ExpressionLimit	All set-ups	TRUE	0	Uint16
DN-2#						
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-3#						
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	ExpressionLimit	1 set-up	TRUE	0	Uint16
DN-39	Devicenet F Parameters	0 N/A	All set-ups	TRUE	0	Uint32
DN-5#						

4.3.11 PB-## Profibus

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
PB-0#						
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-1#						
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-2#						
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-3#						
PB-31	Safe Address	0 N/A	1 set-up	TRUE	0	Uint16
PB-4#						
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-5#						
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-6#						
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-7#						
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-8#						
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-9#						
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
PB-99	Profibus Revision Counter	0 N/A	All set-ups	TRUE	0	Uint16

4.3.12 ID-## Drive Information

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
ID-0#						
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-1#						
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-2#						
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-3#						
ID-30	Fault Log: Error Code	0 N/A	All set-ups	FALSE	0	Uint8
ID-31	Fault Log: Value	0 N/A	All set-ups	FALSE	0	Int16
ID-32	Fault Log: Time	0 s	All set-ups	FALSE	0	Uint32
ID-4#						
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-44	Ordered Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
ID-45	Actual Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
ID-46	GE Product No.	0 N/A	All set-ups	FALSE	0	VisStr[8]
ID-47	Power Card Ordering 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-5#						
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-6#						
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]

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
ID-7#						
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 C0 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-76	Option in Slot C2	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-9#						
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

4.3.13 DR-## Data Readouts

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
DR-0#						
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-1#						
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	Int16
DR-17	Speed [RPM]	0 RPM	All set-ups	FALSE	67	Int32
DR-18	Motor Thermal	0 %	All set-ups	FALSE	0	Uint8
DR-19	KTY sensor temperature	0 °C	All set-ups	FALSE	100	Int16
DR-2#						
DR-20	Motor Angle	0 N/A	All set-ups	TRUE	0	Uint16
DR-22	Torque [%]	0 %	All set-ups	FALSE	0	Int16
DR-25	Torque [Nm] High	0.0 Nm	All set-ups	FALSE	-1	Int32
DR-3#						
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-33	Brake Energy /2 min	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-4#						
DR-40	Trending Buffer Full	[0] No	All set-ups	TRUE	-	Uint8
DR-5#						
DR-50	External Reference	0.0 N/A	All set-ups	FALSE	-1	Int16
DR-51	Pulse Reference	0.0 N/A	All set-ups	FALSE	-1	Int16
DR-52	Feedback [Unit]	0.000 ReferenceFeedbackUnit	All set-ups	FALSE	-3	Int32
DR-53	Digi Pot Reference	0.00 N/A	All set-ups	FALSE	-2	Int16
DR-6#						
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	Freq. Input #29 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
DR-68	Freq. 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

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
DR-7#						
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-74	Prec. Stop Counter	0 N/A	All set-ups	TRUE	0	Uint32
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
DR-78	Analog Out X45/1 [mA]	0.000 N/A	All set-ups	FALSE	-3	Int16
DR-79	Analog Out X45/3 [mA]	0.000 N/A	All set-ups	FALSE	-3	Int16
DR-8#						
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-9#						
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

4.3.14 LC-## Logic Controller

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
LC-0#						
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-1#						
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-2#						
LC-20	Logic Controller Timer	ExpressionLimit	1 set-up	TRUE	-3	TimD
LC-4#						
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-5#						
LC-51	Logic Controller Event	null	2 set-ups	TRUE	-	Uint8
LC-52	Logic Controller Action	null	2 set-ups	TRUE	-	Uint8

4.3.15 B-## Braking Functions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
B-0#						
B-00	DC Hold 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-1#						
B-10	Brake Function	null	All set-ups	TRUE	-	Uint8
B-11	Brake Resistor (ohm)	ExpressionLimit	All set-ups	TRUE	-2	Uint32
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	[0] Disabled	All set-ups	TRUE	-	Uint8
B-2#						
B-20	Release Brake Current	ImaxVLT (P1637)	All set-ups	TRUE	-2	Uint32
B-21	Activate Brake Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
B-22	Activate Brake Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
B-23	Activate Brake Delay	0.0 s	All set-ups	TRUE	-1	Uint8
B-24	Stop Delay	0.0 s	All set-ups	TRUE	-1	Uint8
B-25	Brake Release Time	0.20 s	All set-ups	TRUE	-2	Uint16
B-26	Torque Ref	0.00 %	All set-ups	TRUE	-2	Int16
B-27	Torque Ramp Time	0.2 s	All set-ups	TRUE	-1	Uint8
B-28	Gain Boost Factor	1.00 N/A	All set-ups	TRUE	-2	Uint16

4.3.16 PI-## PID Controls

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
PI-0#						
PI-00	Speed PID Feedback Source	null	All set-ups	FALSE	-	Uint8
PI-02	Speed PID Proportional Gain	ExpressionLimit	All set-ups	TRUE	-4	Uint32
PI-03	Speed PID Integral Time	ExpressionLimit	All set-ups	TRUE	-4	Uint32
PI-04	Speed PID Differentiation Time	ExpressionLimit	All set-ups	TRUE	-4	Uint16
PI-05	Speed PID Diff. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16
PI-06	Speed PID Lowpass Filter Time	10.0 ms	All set-ups	TRUE	-4	Uint16
PI-07	Speed PID Feedback Gear Ratio	1.0000 N/A	All set-ups	FALSE	-4	Uint32
PI-08	Speed PID Feed Forward Factor	0 %	All set-ups	FALSE	0	Uint16
PI-1#						
PI-12	Torque PI Proportional Gain	100 %	All set-ups	TRUE	0	Uint16
PI-13	Torque PI Integration Time	0.020 s	All set-ups	TRUE	-3	Uint16
PI-2#						
PI-20	Process CL Feedback 1 Resource	[0] No function	All set-ups	TRUE	-	Uint8
PI-22	Process CL Feedback 2 Resource	[0] No function	All set-ups	TRUE	-	Uint8
PI-3#						
PI-30	Process PID Normal/ Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
PI-31	Process PID Anti Windup	[1] On	All set-ups	TRUE	-	Uint8
PI-32	Process PID Start Speed	0 RPM	All set-ups	TRUE	67	Uint16
PI-33	Process PID Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
PI-34	Process PID Integral Time	10000.00 s	All set-ups	TRUE	-2	Uint32
PI-35	Process PID Differentiation Time	0.00 s	All set-ups	TRUE	-2	Uint16
PI-36	Process PID Diff. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16
PI-38	Process PID Feed Forward Factor	0 %	All set-ups	TRUE	0	Uint16
PI-39	On Reference Bandwidth	5 %	All set-ups	TRUE	0	Uint8

4.3.17 EC-## Feedback Option

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
EC-1#						
EC-10	Signal Type	[1] RS422 (5V TTL)	All set-ups	FALSE	-	Uint8
EC-11	Resolution (PPR)	1024 N/A	All set-ups	FALSE	0	Uint16
EC-2#						
EC-20	Protocol Selection	[0] None	All set-ups	FALSE	-	Uint8
EC-21	Resolution (Positions/Rev)	ExpressionLimit	All set-ups	FALSE	0	Uint32
EC-24	SSI Data Length	13 N/A	All set-ups	FALSE	0	Uint8
EC-25	Clock Rate	ExpressionLimit	All set-ups	FALSE	3	Uint16
EC-26	SSI Data Format	[0] Gray code	All set-ups	FALSE	-	Uint8
EC-34	HIPERFACE Baudrate	[4] 9600	All set-ups	FALSE	-	Uint8
EC-6#						
EC-60	Feedback Direction	[0] Clockwise	All set-ups	FALSE	-	Uint8
EC-61	Feedback Signal Monitoring	[1] Warning	All set-ups	TRUE	-	Uint8

4.3.18 RS-## Resolver Interface

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
RS-5#						
RS-50	Poles	2 N/A	1 set-up	FALSE	0	Uint8
RS-51	Input Voltage	7.0 V	1 set-up	FALSE	-1	Uint8
RS-52	Input Frequency	10.0 kHz	1 set-up	FALSE	2	Uint8
RS-53	Transformation Ratio	0.5 N/A	1 set-up	FALSE	-1	Uint8
RS-59	Resolver Interface	[0] Disabled	All set-ups	FALSE	-	Uint8

5 General Specifications

Mains supply (L1, L2, L3):	
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)	maximum 1 time/ 2 min.
Environment according to EN60664-1	over-voltage 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, 500/600/690 V maximum.

Motor output (U, V, W):	
Output voltage	0 - 100% of supply voltage
Output frequency	0 - 800* 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, 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 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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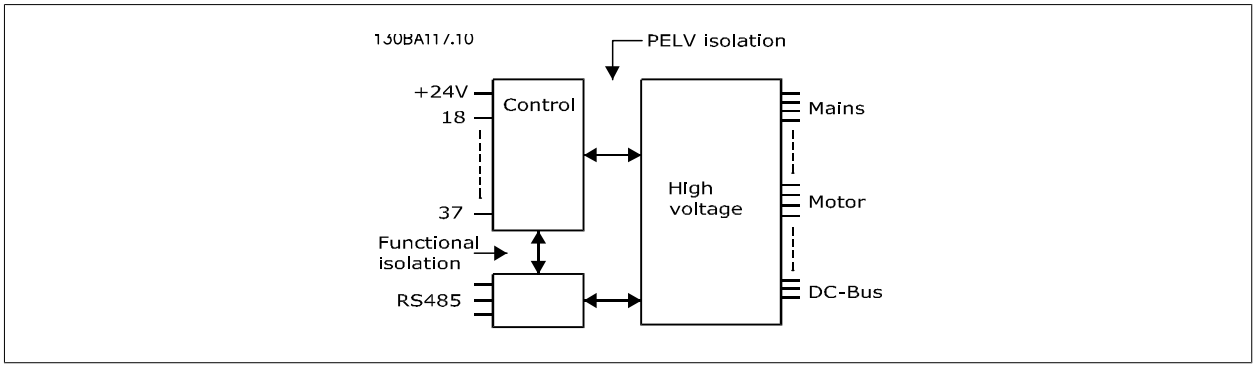
Analog inputs:	
Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switch S201 and switch S202
Voltage mode	Switch S201/switch S202 = OFF (U)
Voltage level	-10 to +10 V (scaleable)
Input resistance, R_i	approx. 10 kΩ
Max. voltage	± 20 V
Current mode	Switch S201/switch 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

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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
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)	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	over-voltage 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).

Cable lengths and cross sections:	
Max. motor cable length, screened/armoured	150 m
Max. motor cable length, unscreened/unarmoured	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

Control card performance:	
Scan interval	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

Surroundings:	
Enclosure	IP00 Open Chassis, IP21/Nema 1, and IP54/Nema 12
Vibration test	0.7 g
Max. relative humidity	5% - 95%(IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43	class H_25
Ambient temperature	Max. 45 °C

1) For higher ambient temperature, see special conditions in the AF-650 GP 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 AF-650 GP Design Guide

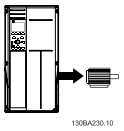
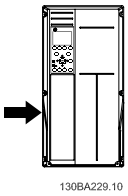
EMC standards, Emission	EN 61800-3, EN 61000-6-3/4, EN 55011
EMC standards, Immunity	EN 61800-3, EN 61000-6-1/2, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6

See section on special conditions in the AF-650 GP Design Guide Please see www.geelectrical.com/drives for more information.

Protection and Features:

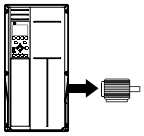
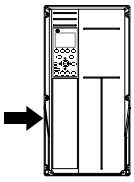
- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the frequency converter trips if the temperature reaches a predefined level. An overload temperature cannot be reset until the temperature of the heatsink is below the values stated in the tables 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.

Mains Supply 3 x 380 - 500 VAC

AF-650 GP		125 HP		150 HP		200 HP		250 HP		300 HP	
Heavy Duty/Light Duty*		HD	LD	HD	LD	HD	LD	HD	LD	HD	LD
	Typical Shaft output at 400 V [kW]	90	110	110	132	132	160	160	200	200	250
	Typical Shaft output at 460 V [HP]	125	150	150	200	200	250	250	300	300	350
	Typical Shaft output at 500 V [kW]	110	132	132	160	160	200	200	250	250	315
	IP21/Nema 1 Drive Type	41		41		42		42		42	
	IP54/Nema 12 Drive Type	41		41		42		42		42	
	IP00 Open Chassis Drive Type	43		43		44		44		44	
	Output current										
 130BA230.10	Continuous (at 400 V) [A]	177	212	212	260	260	315	315	395	395	480
	Intermittent (60 sec overload) (at 400 V) [A]	266	233	318	286	390	347	473	435	593	528
	Continuous (at 460/ 500 V) [A]	160	190	190	240	240	302	302	361	361	443
	Intermittent (60 sec overload) (at 460/ 500 V) [A]	240	209	285	264	360	332	453	397	542	487
	Continuous KVA (at 400 V) [KVA]	123	147	147	180	180	218	218	274	274	333
	Continuous KVA (at 460 V) [KVA]	127	151	151	191	191	241	241	288	288	353
	Continuous KVA (at 500 V) [KVA]	139	165	165	208	208	262	262	313	313	384
Max. input current											
 130BA229.10	Continuous (at 400 V) [A]	171	204	204	251	251	304	304	381	381	463
	Continuous (at 460/ 500 V) [A]	154	183	183	231	231	291	291	348	348	427
	Max. cable size, mains motor, brake and load share [mm² (AWG[2)])]	2 x 70 (2 x 2/0)		2 x 70 (2 x 2/0)		2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)	
	Max. external pre-fuses [A] [1]	300		350		400		500		600	
	Estimated power loss at rated max. load [W] [4)]	2641	3234	2995	3782	3425	4213	3910	5119	4625	5893
	Weight, Unit Size IP21, IP 54 [kg]	96		104		125		136		151	
	Weight, Unit Size IP00 [kg]	82		91		112		123		138	
	Efficiency[4)]	0.98									
	Output frequency	0 - 800 Hz									
	Heatsink overtemp. trip	85 °C		90 °C		105 °C		105 °C		115 °C	
	Power card ambient trip	60 °C									

* Heavy Duty = 160% torque during 60 s, Light Duty = 110% torque during 60 s

Mains Supply 3 x 380 - 500 VAC

AF-650 GP		350 HP		450 HP		500 HP		550 HP	
Heavy Duty/Light Duty*		HD	LD	HD	LD	HD	LD	HD	LD
	Typical Shaft output at 400 V [kW]	250	315	315	355	355	400	400	450
	Typical Shaft output at 460 V [HP]	350	450	450	500	500	600	550	600
	Typical Shaft output at 500 V [kW]	315	355	355	400	400	500	500	530
	IP21/Nema 1 Drive Type	51		51		51		51	
	IP54/Nema 12 Drive Type	51		51		51		51	
	IP00 Open Chassis Drive Type	52		52		52		52	
	Output current								
 130BA230.10	Continuous (at 400 V) [A]	480	600	600	658	658	745	695	800
	Intermittent (60 sec overload) (at 400 V) [A]	720	660	900	724	987	820	1043	880
	Continuous (at 460/ 500 V) [A]	443	540	540	590	590	678	678	730
	Intermittent (60 sec overload) (at 460/ 500 V) [A]	665	594	810	649	885	746	1017	803
	Continuous KVA (at 400 V) [KVA]	333	416	416	456	456	516	482	554
	Continuous KVA (at 460 V) [KVA]	353	430	430	470	470	540	540	582
	Continuous KVA (at 500 V) [KVA]	384	468	468	511	511	587	587	632
Max. input current									
 130BA229.10	Continuous (at 400 V) [A]	472	590	590	647	647	733	684	787
	Continuous (at 460/ 500 V) [A]	436	531	531	580	580	667	667	718
	Max. cable size, mains, motor and load share [mm^2 (AWG[2)])]	4x240 (4x500 mcm)		4x240 (4x500 mcm)		4x240 (4x500 mcm)		4x240 (4x500 mcm)	
	Max. cable size, brake [mm^2 (AWG[2)])	2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)	
	Max. external pre-fuses [A] [1]	700		900		900		900	
	Estimated power loss at rated max. load [W] [4)]	6005	7630	6960	7701	7691	8879	7964	9428
	Weight, Unit Size IP21, IP 54 [kg]	263		270		272		313	
	Weight, Unit Size IP00 [kg]	221		234		236		277	
	Efficiency[4)]	0.98							
	Output frequency	0 - 600 Hz							
	Heatsink overtemp. trip	95 °C							
	Power card ambient trip	68 °C							

* Heavy Duty = 160% torque during 60 s, Light Duty = 110% torque during 60 s

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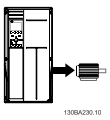
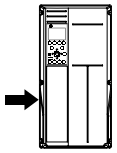
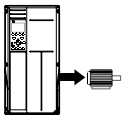
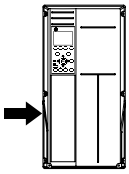
Mains Supply 3 x 380 - 500 VAC

AF-650 GP		600 HP		650 HP		750 HP		900 HP		1000 HP		1200 HP	
Heavy Duty/Light Duty*		HD	LD	HD	LD	HD	LD	HD	LD	HD	LD	HD	LD
	Typical Shaft output at 400 V [kW]	450	500	500	560	560	630	630	710	710	800	800	1000
	Typical Shaft output at 460 V [HP]	600	650	650	750	750	900	900	1000	1000	1200	1200	1350
	Typical Shaft output at 500 V [kW]	530	560	560	630	630	710	710	800	800	1000	1000	1100
	IP21/Nema 1 and IP54/Nema 12 Drive Types without/with options cabinet	61/ 63		61/ 63		61/ 63		61/ 63		62/ 64		62/ 64	
	Output current												
 130BA230.10	Continuous (at 400 V) [A]	800	880	880	990	990	1120	1120	1260	1260	1460	1460	1720
	Intermittent (60 sec overload) (at 400 V) [A]	1200	968	1320	1089	1485	1232	1680	1386	1890	1606	2190	1892
	Continuous (at 460/ 500 V) [A]	730	780	780	890	890	1050	1050	1160	1160	1380	1380	1530
	Intermittent (60 sec overload) (at 460/ 500 V) [A]	1095	858	1170	979	1335	1155	1575	1276	1740	1518	2070	1683
	Continuous KVA (at 400 V) [KVA]	554	610	610	686	686	776	776	873	873	1012	1012	1192
	Continuous KVA (at 460 V) [KVA]	582	621	621	709	709	837	837	924	924	1100	1100	1219
	Continuous KVA (at 500 V) [KVA]	632	675	675	771	771	909	909	1005	1005	1195	1195	1325
Max. input current													
 130BA229.10	Continuous (at 400 V) [A]	779	857	857	964	964	1090	1090	1227	1227	1422	1422	1675
	Continuous (at 460/ 500 V) [A]	711	759	759	867	867	1022	1022	1129	1129	1344	1344	1490
	Max. cable size,motor [mm² (AWG[2)])]	8x150 (8x300 mcm)								12x150 (12x300 mcm)			
	Max. cable size,mains [mm² (AWG[2)])]	8x240 (8x500 mcm)											
	Max. cable size, load-sharing [mm² (AWG[2)])]	4x120 (4x250 mcm)											
	Max. cable size, brake [mm² (AWG[2)])	4x185 (4x350 mcm)								6x185 (6x350 mcm)			
	Max. external pre-fuses [A] [1]	1600				2000				2500			
	Estimated power loss at rated max. load [W] [4)]												
	Weight, Unit Size IP21, IP 54 [kg]	1004/ 1299		1004/ 1299		1004/ 1299		1004/ 1299		1246/ 1541		1246/ 1541	
	Weight Rectifier Module [kg]	102		102		102		102		136		136	
	Weight Inverter Module [kg]	102		102		102		136		102		102	
	Efficiency[4)]	0.98											
	Output frequency	0-600 Hz											
	Heatsink overtemp. trip	95 °C											
	Power card ambient trip	68 °C											

* Heavy Duty = 160% torque during 60 s, Light Duty = 110% torque during 60 s

Mains Supply 3 x 525- 690 VAC

AF-650 GP		50 HP		60 HP		75 HP		100 HP		125 HP	
Heavy Duty/Light Duty*		HD	LD	HD	LD	HD	LD	HD	LD	HD	LD
	Typical Shaft output at 550 V [kW]	30	37	37	45	45	55	55	75	75	90
	Typical Shaft output at 575 V [HP]	40	50	50	60	60	75	75	100	100	125
	Typical Shaft output at 690 V [kW]	37	45	45	55	55	75	75	90	90	110
	IP21/Nema 1 Drive Type	41		41		41		41		41	
	IP54/Nema 12 Drive Type	41		41		41		41		41	
	IP00 Open Chassis Drive Type	42		42		42		42		42	
Output current											
 130BA230.10	Continuous (at 550 V) [A]	48	56	56	76	76	90	90	113	113	137
	Intermittent (60 sec overload) (at 550 V) [A]	77	62	90	84	122	99	135	124	170	151
	Continuous (at 575/ 690 V) [A]	46	54	54	73	73	86	86	108	108	131
	Intermittent (60 sec overload) (at 575/ 690 V) [A]	74	59	86	80	117	95	129	119	162	144
	Continuous KVA (at 550 V) [KVA]	46	53	53	72	72	86	86	108	108	131
	Continuous KVA (at 575 V) [KVA]	46	54	54	73	73	86	86	108	108	130
	Continuous KVA (at 690 V) [KVA]	55	65	65	87	87	103	103	129	129	157
Max. input current											
 130BA229.10	Continuous (at 550 V) [A]	53	60	60	77	77	89	89	110	110	130
	Continuous (at 575 V) [A]	51	58	58	74	74	85	85	106	106	124
	Continuous (at 690 V) [A]	50	58	58	77	77	87	87	109	109	128
	Max. cable size, mains, motor, load share and brake [mm^2 (AWG)]	2x70 (2x2/0)									
	Max. external pre-fuses [A] [1]	125		160		200		200		250	
	Estimated power loss at rated max. load [W] [4]	1355	1458	1459	1717	1721	1913	1913	2262	2264	2662
	Weight, Unit Size IP21, IP 54 [kg]	96									
	Weight, Unit Size IP00 [kg]	82									
	Efficiency[4]	0.97		0.97		0.98		0.98		0.98	
	Output frequency	0 - 600 Hz									
	Heatsink overtemp. trip	85 °C									
	Power card ambient trip	60 °C									

* Heavy Duty = 160% torque during 60 s, Light Duty = 110% torque during 60 s

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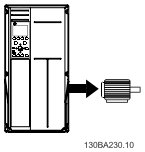
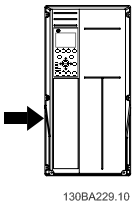
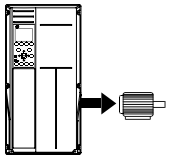
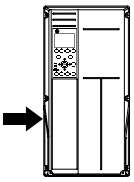
Mains Supply 3 x 525- 690 VAC

AF-650 GP		150 HP		200 HP		250 HP		300 HP	
Heavy Duty/Light Duty*		HD	LD	HD	LD	HD	LD	HD	LD
	Typical Shaft output at 550 V [kW]	90	110	110	132	132	160	160	200
	Typical Shaft output at 575 V [HP]	125	150	150	200	200	250	250	300
	Typical Shaft output at 690 V [kW]	110	132	132	160	160	200	200	250
	IP21/Nema 1 Drive Type	41		41		42		42	
	IP54/Nema 12 Drive Type	41		41		42		42	
	IP00 Open Chassis Drive Type	43		43		44		44	
	Output current								
 130BA230.10	Continuous (at 550 V) [A]	137	162	162	201	201	253	253	303
	Intermittent (60 sec overload) (at 550 V) [A]	206	178	243	221	302	278	380	333
	Continuous (at 575/ 690 V) [A]	131	155	155	192	192	242	242	290
	Intermittent (60 sec overload) (at 575/ 690 V) [A]	197	171	233	211	288	266	363	319
	Continuous KVA (at 550 V) [KVA]	131	154	154	191	191	241	241	289
	Continuous KVA (at 575 V) [KVA]	130	154	154	191	191	241	241	289
	Continuous KVA (at 690 V) [KVA]	157	185	185	229	229	289	289	347
Max. input current									
 130BA229.10	Continuous (at 550 V) [A]	130	158	158	198	198	245	245	299
	Continuous (at 575 V) [A]	124	151	151	189	189	234	234	286
	Continuous (at 690 V) [A]	128	155	155	197	197	240	240	296
	Max. cable size, mains motor, load share and brake [mm^2 (AWG)]	2 x 70 (2 x 2/0)		2 x 70 (2 x 2/0)		2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)	
	Max. external pre-fuses [A] [1]	315		350		350		400	
	Estimated power loss at rated max. load [W] [4]	2664	3114	2953	3612	3451	4292	4275	5156
	Weight, Unit Size IP21, IP 54 [kg]	96		104		125		136	
	Weight, Unit Size IP00 [kg]	82		91		112		123	
	Efficiency[4]	0.98							
	Output frequency	0 - 600 Hz							
	Heatsink overtemp. trip	85 °C		90 °C		110 °C		110 °C	
	Power card ambient trip	60 °C							

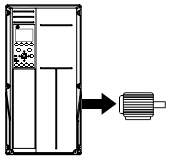
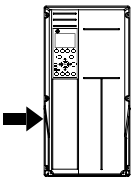
* Heavy Duty = 160% torque during 60 s, Light Duty = 110% torque during 60 s

Mains Supply 3 x 525- 690 VAC

AF-650 GP		350 HP		400 HP		500 HP	
Heavy Duty/Light Duty*		HD	LD	HD	LD	HD	LD
	Typical Shaft output at 550 V [kW]	200	250	250	315	315	355
	Typical Shaft output at 575 V [HP]	300	350	350	400	400	450
	Typical Shaft output at 690 V [kW]	250	315	315	400	355	450
	IP21/Nema 1 Drive Type	42		42		51	
	IP54/Nema 12 Drive Type	42		42		51	
	IP00 Open Chassis Drive Type	44		44		52	
	Output current						
 130BA230.10	Continuous (at 550 V) [A]	303	360	360	418	395	470
	Intermittent (60 sec overload) (at 550 V) [A]	455	396	540	460	593	517
	Continuous (at 575/ 690 V) [A]	290	344	344	400	380	450
	Intermittent (60 sec overload) (at 575/ 690 V) [A]	435	378	516	440	570	495
	Continuous KVA (at 550 V) [KVA]	289	343	343	398	376	448
	Continuous KVA (at 575 V) [KVA]	289	343	343	398	378	448
	Continuous KVA (at 690 V) [KVA]	347	411	411	478	454	538
Max. input current							
 130BA229.10	Continuous (at 550 V) [A]	299	355	355	408	381	453
	Continuous (at 575 V) [A]	286	339	339	390	366	434
	Continuous (at 690 V) [A]	296	352	352	400	366	434
	Max. cable size, mains, motor and load share [mm^2 (AWG)]	2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)		4 x 240 (4 x 500 mcm)	
	Max. cable size, brake [mm^2 (AWG)]	2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)	
	Max. external pre-fuses [A] [1]	500		550		700	
	Estimated power loss at rated max. load [W] [4]	4875	5821	5185	6149	5383	6449
	Weight, Unit Size IP21, IP 54 [kg]	151		165		263	
	Weight, Unit Size IP00 [kg]	138		151		221	
	Efficiency[4]	0.98					
	Output frequency	0 - 600 Hz		0 - 500 Hz		0 - 500 Hz	
	Heatsink overtemp. trip	110 °C		110 °C		85 °C	
	Power card ambient trip	60 °C		60 °C		68 °C	

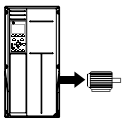
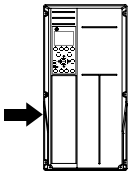
* Heavy Duty = 160% torque during 60 s, Light Duty = 110% torque during 60 s

Mains Supply 3 x 525- 690 VAC

AF-650 GP		550 HP		650 HP		750 HP	
Heavy Duty/Light Duty*		HD	LD	HD	LD	HD	LD
	Typical Shaft output at 550 V [kW]	315	400	400	450	450	500
	Typical Shaft output at 575 V [HP]	400	500	500	600	600	650
	Typical Shaft output at 690 V [kW]	400	500	500	560	560	630
	IP21/Nema 1 Drive Type	51		51		51	
	IP54/Nema Drive Type	51		51		51	
	IP00 Open Chassis Drive Type	52		52		52	
	Output current						
 130BA230.10	Continuous (at 550 V) [A]	429	523	523	596	596	630
	Intermittent (60 sec overload) (at 550 V) [A]	644	575	785	656	894	693
	Continuous (at 575/ 690 V) [A]	410	500	500	570	570	630
	Intermittent (60 sec overload) (at 575/ 690 V) [A]	615	550	750	627	855	693
	Continuous KVA (at 550 V) [KVA]	409	498	498	568	568	600
	Continuous KVA (at 575 V) [KVA]	408	498	498	568	568	627
	Continuous KVA (at 690 V) [KVA]	490	598	598	681	681	753
Max. input current							
 130BA229.10	Continuous (at 550 V) [A]	413	504	504	574	574	607
	Continuous (at 575 V) [A]	395	482	482	549	549	607
	Continuous (at 690 V) [A]	395	482	482	549	549	607
	Max. cable size, mains, motor and load share [mm² (AWG)]	4x240 (4x500 mcm)		4x240 (4x500 mcm)		4x240 (4x500 mcm)	
	Max. cable size, brake [mm² (AWG)]	2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)	
	Max. external pre-fuses [A] [1]	700		900		900	
	Estimated power loss at rated max. load [W] [4]	5818	7249	7671	8727	8715	9673
	Weight, Unit Size IP21, IP 54 [kg]	263		272		313	
	Weight, Unit Size IP00 [kg]	221		236		277	
	Efficiency[4]	0.98					
	Output frequency	0 - 500 Hz					
	Heatsink overtemp. trip	85 °C					
	Power card ambient trip	68 °C					

* Heavy Duty = 160% torque during 60 s, Light Duty = 110% torque during 60 s

Mains Supply 3 x 525- 690 VAC

AF-650 GP		900 HP		1000 HP		1200 HP		1250 HP		1350 HP	
Heavy Duty/Light Duty*		HD	LD	HD	LD	HD	LD	HD	LD	HD	LD
	Typical Shaft output at 550 V [kW]	500	560	560	670	670	750	750	850	850	1000
	Typical Shaft output at 575 V [HP]	650	750	750	950	950	1050	1050	1150	1150	1350
	Typical Shaft output at 690 V [kW]	630	710	710	800	800	900	900	1000	1000	1200
	IP21/Nema 1 and IP54/ Nema 12 Drive Types without/with options cabinet	61/ 63		61/ 63		61/ 63		62/ 64		62/ 64	
	Output current										
	Continuous (at 550 V) [A]	659	763	763	889	889	988	988	1108	1108	1317
 130BA230.10	Intermittent (60 sec overload) (at 550 V) [A]	989	839	1145	978	1334	1087	1482	1219	1662	1449
	Continuous (at 575/ 690 V) [A]	630	730	730	850	850	945	945	1060	1060	1260
	Intermittent (60 sec overload) (at 575/ 690 V) [A]	945	803	1095	935	1275	1040	1418	1166	1590	1386
	Continuous KVA (at 550 V) [KVA]	628	727	727	847	847	941	941	1056	1056	1255
	Continuous KVA (at 575 V) [KVA]	627	727	727	847	847	941	941	1056	1056	1255
	Continuous KVA (at 690 V) [KVA]	753	872	872	1016	1016	1129	1129	1267	1267	1506
Max. input current											
 130BA229.10	Continuous (at 550 V) [A]	642	743	743	866	866	962	962	1079	1079	1282
	Continuous (at 575 V) [A]	613	711	711	828	828	920	920	1032	1032	1227
	Continuous (at 690 V) [A]	613	711	711	828	828	920	920	1032	1032	1227
	Max. cable size, motor [mm² (AWG[2])]	8x150 (8x300 mcm)						12x150 (12x300 mcm)			
	Max. cable size,mains [mm² (AWG[2])]	8x240 (8x500 mcm)									
	Max. cable size, load-sharing [mm² (AWG[2])]	4x120 (4x250 mcm)									
	Max. cable size, brake [mm² (AWG[2])]	4x185 (4x350 mcm)						6x185 (6x350 mcm)			
	Max. external pre-fuses [A] [1]	1600								2000	
	Estimated power loss at rated max. load [W] [4]										
	Weight, Unit Size IP21, IP 54 [kg]	1004/ 1299		1004/ 1299		1004/ 1299		1246/ 1541		1246/ 1541	
	Weight, Rectifier Module [kg]	102		102		102		136		136	
	Weight, Inverter Module [kg]	102		102		136		102		102	
	Efficiency[4]	0.98									
	Output frequency	0-500 Hz									
	Heatsink overtemp. trip	85 °C									
	Power card ambient trip	68 °C									

* Heavy Duty = 160% torque during 60 s, Light Duty = 110% torque during 60 s

1) For type of fuse see section *Fuses.*

2) American Wire Gauge.

3) Measured using 5 m screened motor cables at rated load and rated frequency.

4) The typical power loss is at nominal load conditions and expected to be within +/-15% (tolerence relates to variety in voltage and cable conditions). Values are based on a typical motor efficiency (eff2/eff3 border line). Motors with lower efficiency will also add to the power loss in the frequency converter and opposite.

If the switching frequency is increased compared to the default setting, the power losses may rise significantly.

Keypad and typical control card power consumptions are included. Further options and customer load may add up to 30W to the losses. (Though typical only 4W extra for a fully loaded control card, or options for slot A or slot B, each).

Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (+/-5%).

6

6 Warnings and Alarms

6.1 Status Messages

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 network.

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		

Table 6.1: Alarm/Warning code list

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
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			
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
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	
251	New Model 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 Electronic OL Over		Output Current Low
9	00000200	512	Drive Overld.		Drive 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		Network 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 network 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 over-voltage 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 under-voltage 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:		
Frequency converter:	3 x 380 - 500 V [VDC]	3 x 525 - 690 V [VDC]
Under-voltage	402	553
Voltage warning low	423	585
Voltage warning high (w/o brake - w/brake)	817/828	1084/1109
Over-voltage	855	1130

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, Inverter 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 time-out:

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 22, Hoist Mech. Brake:

Report value will show what kind it is.

0 = The torque ref. was not reached before timeout.

1 = There was no brake feedback before timeout.

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, Heatsink temp:

The maximum temperature of the heatsink has been exceeded. The temperature fault will not be reset until the temperature falls below a defined heatsink temperature. The trip and reset point are different based on the drive power size.

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 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 on the communication option card is not working.

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 to the frequency converter

ALARM 38, Internal fault:

By this alarm it may be necessary to contact your GE supplier. Some typical alarm messages:

0	The serial port cannot be initialized. Serious hardware failure
256	The power EEPROM data is defect or too old
512	The control board EEPROM data is defect or too old
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 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 too old
1300	Option SW in slot B is too old
1301	Option SW in slot C0 is too old
1302	Option SW in slot C1 is too old
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
2324	The power card configuration is determined to be incorrect at power up
2325	A power card has stopped communicating while main power is applied
2326	The power card configuration is determined to be incorrect after the delay for power cards to register
2327	Too many power card locations have been registered as present
2330	The power size information between the power cards does not match
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

ALARM 39, Heatsink sensor:

No feedback from the heatsink sensor.

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 X30/6 Digital 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 Digital Out (OPCGPIO).

ALARM 46, Pwr. card supply:

The supply on the power card is out of range.

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 is presumably wrong. Check the settings.

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 big for the Auto tune to be carried out.

ALARM 55, Auto tune par. out of range:
The par. values found from 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 time-out:
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:
Contact your GE supplier.

WARNING 61, Encoder loss:
Contact your GE supplier.

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 cutout temperature of the control card is 80° C.

WARNING 66, Heatsink Temperature Low:
The heatsink 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 Configuration has Changed:
One or more options have either been added or removed since the last power-down.

ALARM 68, Safe Stop Activated:
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]). For correct and safe use of the Safe Stop function follow the related information and instructions in the AF-650 GP Design Guide

ALARM 69, Pwr.card temp:
Power card over temperature.

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

Warning 73, Safe Stop Auto Restart:
Safe Stopped, the drive may autostart when Safe Stop is removed

WARNING 77, Reduced power mode:
This warning indicates that the drive is operating in reduced power mode (i.e. less than the allowed number of inverter sections). This warning will be generated on power cycle when the drive is set to run with fewer inverters and will remain on.

ALARM 79, Illegal PS config:
Current sensor connector at power card not installed or the scaling card is the incorrect part number or is not installed

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

WARNING 81, CSIV corrupt:
CSIV file has syntax errors.

WARNING 82, CSIV parameter error:
CSIV parameter error

WARNING 85, Dang fail PB:
Profibus/Profisafe Error

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

ALARM 243, Brake IGBT:
Unit size 6 equivalent to fault 27 in Unit sizes 4X and 5X. Report value indicates source of the alarm (from left):
0-3 Inverter
4-7 Rectifier

ALARM 244, Heatsink temp:
Unit size 6 equivalent to fault 29 in Unit sizes 4X and 5X. Report value indicates source of the alarm (from left):
0-3 Inverter
4-7 Rectifier

ALARM 245, Heatsink sensor:
Unit size 6 equivalent to fault 39 in Unit sizes 4X and 5X. Report value indicates source of the alarm (from left):
0-3 Inverter
4-7 Rectifier

ALARM 246, Pwr. card supply:
Unit size 6 equivalent to fault 46 in Unit sizes 4X and 5X. Report value indicates source of the alarm (from left):
0-3 Inverter
4-7 Rectifier

ALARM 247, Pwr. card temp:
Unit size 6 equivalent to fault 69 in Unit sizes 4X and 5X. Report value indicates source of the alarm (from left):
0-3 Inverter
4-7 Rectifier

ALARM 248, Illegal PS config:
Unit size 6 equivalent to fault 79 in Unit sizes 4X and 5X. Report value indicates source of the alarm (from left):
0-3 Inverter
4-7 Rectifier

ALARM 250, New Spare Part:
The power or Switch Mode Power Supply has been exchanged. The frequency converter type code must be restored in the EEPROM. 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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