

Contents

1. How to Read these Operating Instructions	3
How to Read these Operating Instructions	3
Approvals	4
Symbols	4
Abbreviations	5
2. Safety Instructions and General Warning	7
Disposal Instruction	7
High Voltage	7
Safety Instructions	8
Avoid Unintended Start	9
Safe Stop	9
Safe Stop Installation	10
IT Mains	10
3. How to Install	11
How to Get Started	11
Pre-installation	12
Planning the Installation Site	12
Receiving the Frequency Converter	12
Transportation and Unpacking	12
Lifting	13
Rated Power	19
Mechanical Installation	19
Tools Needed	20
General Considerations	20
Installation in Enclosures - IP00 / Chassis units	30
Installation on the Wall - IP21 (NEMA 1) and IP54 (NEMA 12) Units	30
Floor Mounting - Pedestal Installation IP21 (NEMA1) and IP54 (NEMA12)	31
Gland/Conduit Entry - IP21 (NEMA 1) and IP54 (NEMA12)	33
IP21 Drip shield installation (D1 and D2 enclosure)	34
Field Installation of Options	34
Installation on pedestal	44
Electrical Installation	47
Control Wires	47
Power Connections	48
Mains connection	56
Fuses	57
Electrical Installation, Control Terminals	60

Connection Examples	62
Start/Stop	62
Pulse Start/Stop	62
Speed Up/Down	63
Potentiometer Reference	63
Electrical Installation, Control Cables	64
Switches S201, S202, and S801	66
Final Set-Up and Test	67
Additional Connections	69
Mechanical Brake Control	69
Motor Thermal Protection	70
4. How to Programme	71
The Graphical and Numerical LCP	71
How to Programme on the Graphical LCP	71
How to Programme on the Numerical Local Control Panel	72
Quick Setup	74
Parameter Lists	78
5. General Specifications	107
Electrical Data:	112
6. Warnings and Alarms	123
Status Messages	123
Warnings/Alarm Messages	123
Index	131

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 FC 300

- The VLT® Automation Drive FC 300 Operating Instructions provide the necessary information for getting the drive up and running.
- The VLT® Automation Drive FC 300 Design Guide entails all technical information about the drive design and applications including encoder, resolver and relay options.
- The VLT® Automation Drive FC 300 Profibus Operating Instructions provide the information required for controlling, monitoring and programming the drive via aProfibusfieldbus.
- The VLT® Automation Drive FC 300 DeviceNet Operating Instructions provide the information required for controlling, monitoring and programming the drive via aDevice-Netfieldbus.
- The VLT® Automation Drive FC 300MCT 10 Operating Instructions provide information for installation and use of the software on a PC.
- The VLT® Automation Drive FC 300 24 V DC Backup Instruction provides information for installing the 24 V DC Backup option.

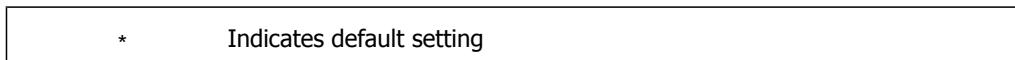
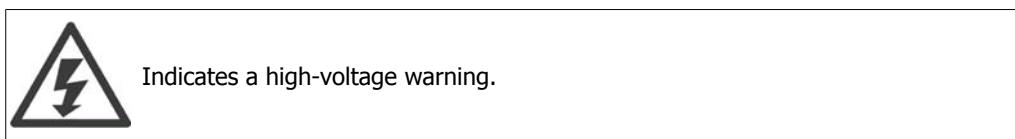
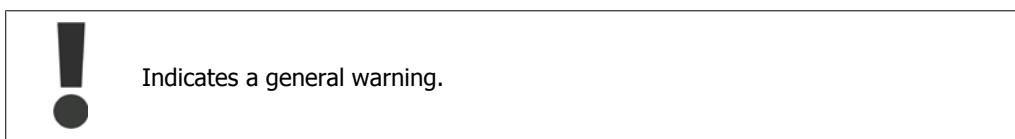
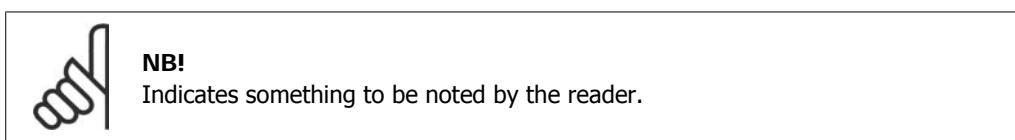
Danfoss Drives technical literature is also available online at www.danfoss.com/drives.

1.1.2. Approvals



1.1.3. Symbols

Symbols used in these Operating Instructions.



1.1.4. Abbreviations

Alternating current	AC
American wire gauge	AWG
Ampere/AMP	A
Automatic Motor Adaptation	AMA
Current limit	I _{LIM}
Degrees Celsius	°C
Direct current	DC
Drive Dependent	D-TYPE
Electro Magnetic Compatibility	EMC
Electronic Thermal Relay	ETR
drive	FC
Gram	g
Hertz	Hz
Kilohertz	kHz
Local Control Panel	LCP
Meter	m
Millihenry Inductance	mH
Milliampere	mA
Millisecond	ms
Minute	min
Motion Control Tool	MCT
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
Second	s
Torque limit	T _{LIM}
Volts	V

2. Safety Instructions and General Warning

2.1.1. Disposal Instruction



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 - 400 kW	40 minutes
525 - 690 V	37 - 250 kW	20 minutes
	315 - 560 kW	30 minutes

FC 300

Operating Instructions
Software version: 4.5x



These Operating Instructions can be used for all FC 300 frequency converters with software version 4.5x.

The software version number can be seen from parameter 15-43.

2.1.2. 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**

At altitudes above 2 km, please contact Danfoss Drives regarding PELV.

2**2.1.3. 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 parameter 1-90 *Motor thermal protection* to value *ETR trip* or *ETR warning*. For the North American market: ETR 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.

2.1.4. 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 mm² or 2 rated earth wires terminated separately.

Residual Current Device

This product can cause a D.C. current in the protective conductor. Where a residual current device (RCD) is used for extra protection, only an RCD of Type B (time delayed) shall be used on the supply side of this product. See also RCD Application Note MN.90.Gx.02 (x=version number).

Protective earthing of the frequency converter and the use of RCD's must always follow national and local regulations.

2.1.5. Before Commencing Repair Work

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

2.1.6. 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 Local Control Panel (LCP):

- 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.

2.1.7. Safe Stop

The FC 302 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 FC 300 Design Guide MG.33.BX.YY 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!

Prüf- und Zertifizierungsstelle im BG-PRÜFZERT		 BGIA Berufsgenossenschaftliches Institut für Arbeitsschutz Hauptverband der gewerblichen Berufsgenossenschaften	130BA373.10
Type Test Certificate			
<small>Translation In any case, the German original shall prevail.</small>		No. of certificate	05 06004
Name and address of the holder of the certificate: (customer)	Donfoss Drives A/S, Ulnaes 1 DK-6300 Graasten, Denmark		
Name and address of the manufacturer:	Donfoss Drives A/S, Ulnaes 1 DK-6300 Graasten, Denmark		
Ref. of customer:	Ref. of Test and Certification Body: ApfKöh VE-Nr. 2003 23220	Date of issue: 13.04.2005	
Product designation:	Frequency converter with integrated safety functions		
Type:	VLT® Automation Drive FC 302		
Intended purpose:	Implementation of safety function „Safe Stop“		
Testing based on:	EN 954-1, 1997-03, DKE AK 226.03, 1998-06, EN ISO 13849-2, 2003-12, EN 61800-3, 2001-02, EN 61800-5-1, 2003-09,		
Test certificate:	No.: 2003 23220 from 13.04.2005		
Remarks:	The presented types of the frequency converter FC 302 meet the requirements laid down in the test bases. With correct wiring a category 3 according to DIN EN 954-1 is reached for the safety function.		
<small>The type tested complies with the provisions laid down in the directive 98/37/EC (Machinery).</small>			
<small>Further conditions are laid down in the Rules of Procedure for Testing and Certification of April 2004.</small>			
 Head of certification body <small>(Prof. Dr. rer. nat. Dieter Reineke)</small>		 Certification officer <small>(Dipl.-Ing. R. Apfeld)</small>	
FZB10E 01.05	Postal address: 53754 Söldt Augustin	Office: Alte Münzstraße 111 53757 Söldt Augustin	Phone: 0 22 41/2 31-09 Fax: 0 22 41/2 31-22 34

2.1.8. 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.

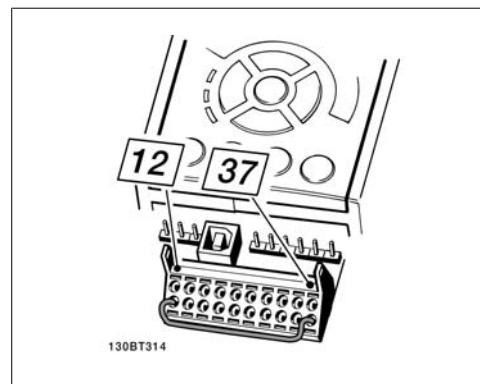


Illustration 2.1: Bridge jumper between terminal 37 and 24 VDC

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.

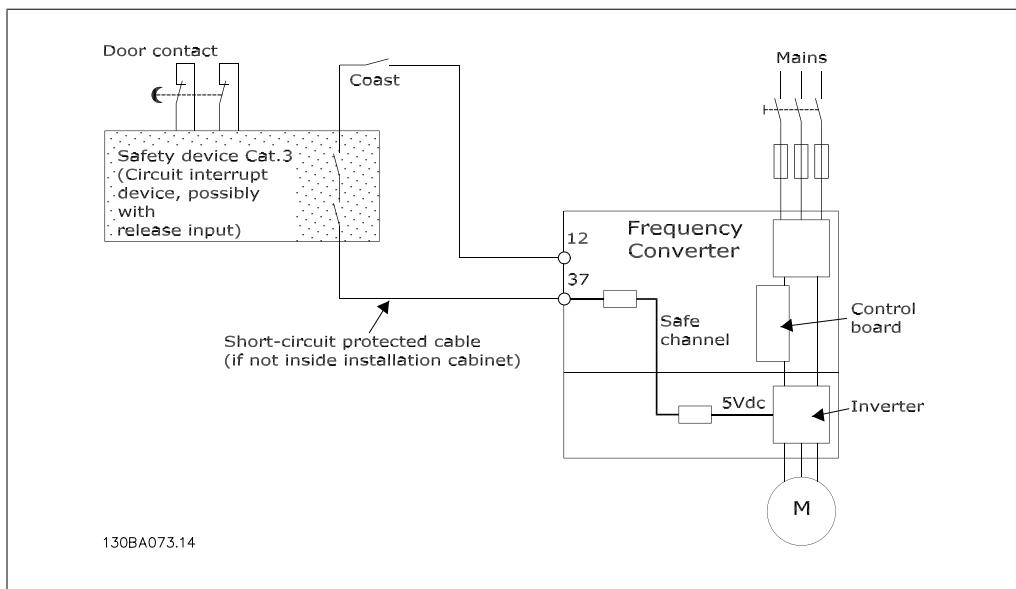


Illustration 2.2: Illustration of the essential aspects of an installation to achieve a Stopping Category 0 (EN 60204-1) with safety Category 3 (EN 954-1).

2.1.9. IT Mains

Par. 14-50 *RFI 1* can on FC 102/202/302 be used to disconnect the internal RFI capacitors from the RFI filter to ground. If this is done it will reduce the RFI performance to A2 level.

3. How to Install

3.1. How to Get Started

3.1.1. About How to Install

3

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 and EMC-correct 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

- Local Control Panel, LCP
- Automatic Motor Adaptation, AMA
- Programming

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

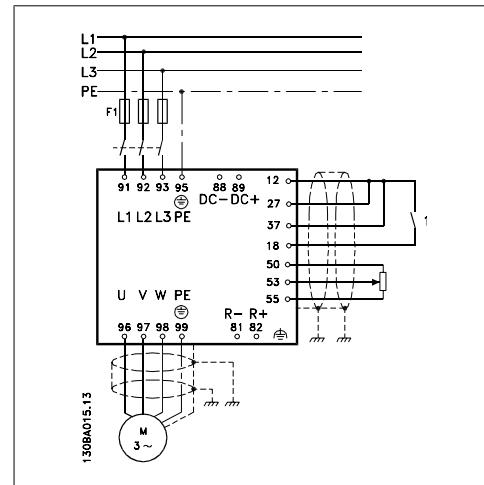


Illustration 3.1: Diagram showing basic installation including mains, motor, start/stop key, and potentiometer for speed adjustment.

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.

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
- If the frequency converter is without built-in fuses, ensure that the external fuses are rated correctly.

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 cardboard box and handle the frequency converter on the pallet, as long as possible.

Remark: The card box cover contains a drilling master for the mounting holes.

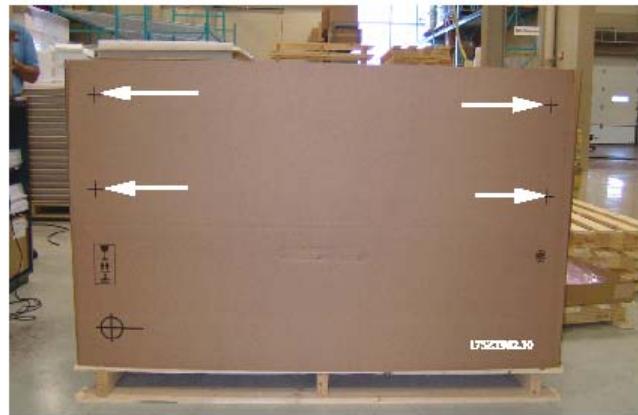


Illustration 3.2: Mounting Template

3.2.4. Lifting

Always lift the frequency converter in the dedicated lifting eyes. Use a bar to avoid bending the lifting holes of the frequency converter.

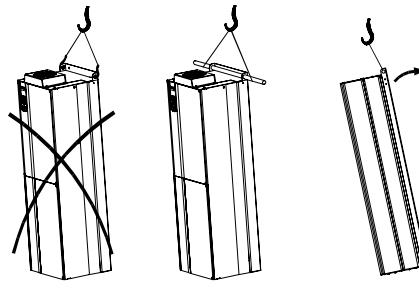
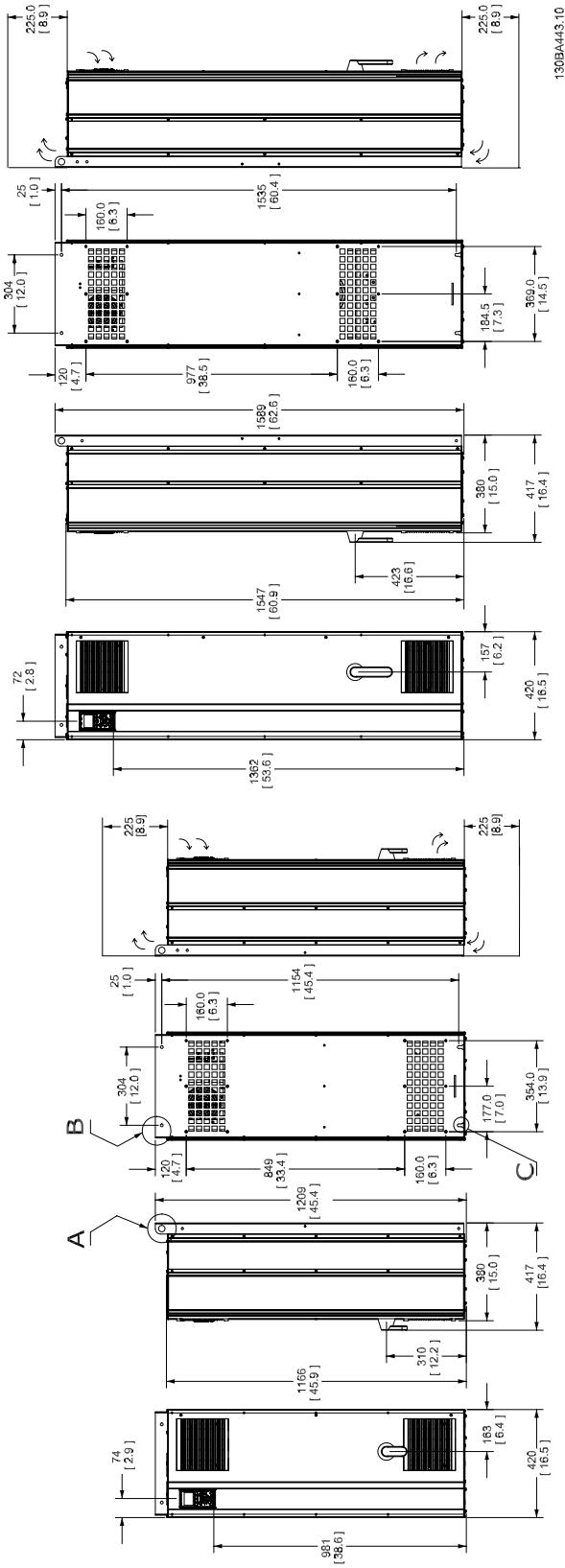


Illustration 3.3: Recommended lifting method

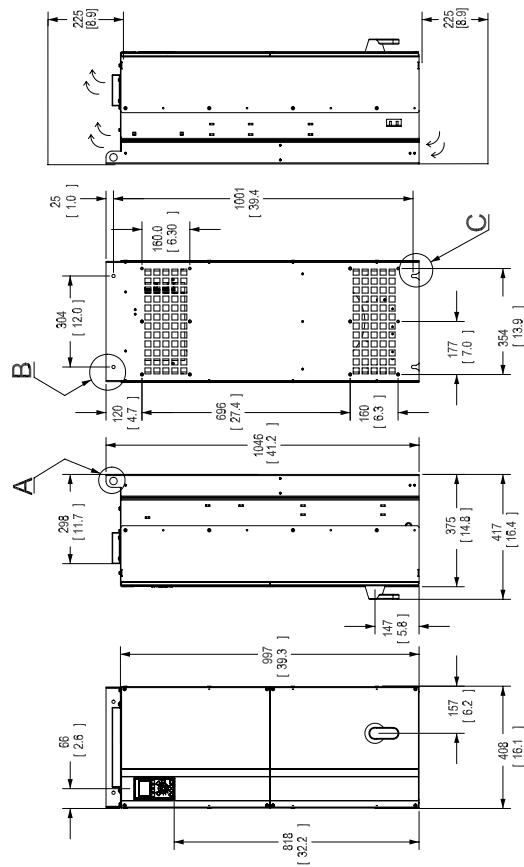
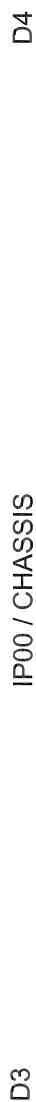
3.2.5. Mechanical Dimensions

D1 IP21 AND IP54 / UL AND NEMA TYPE 1 AND 12

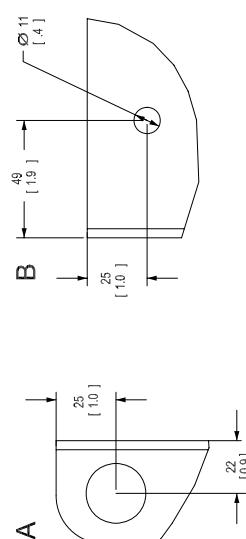
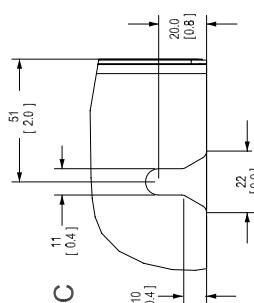
D2



IP00 / CHASSIS

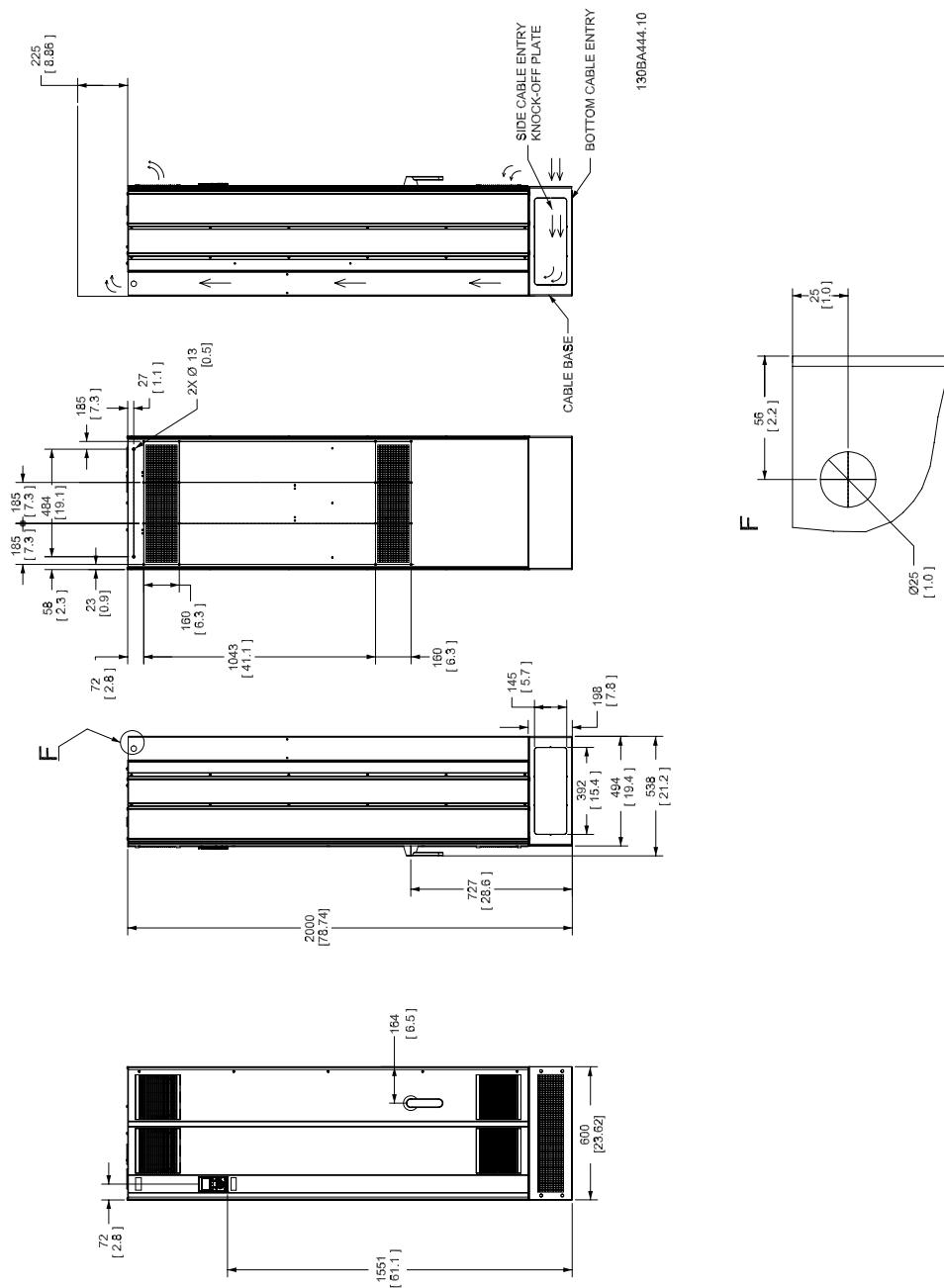


IP00/IP21/IP54 - ALL SIZES



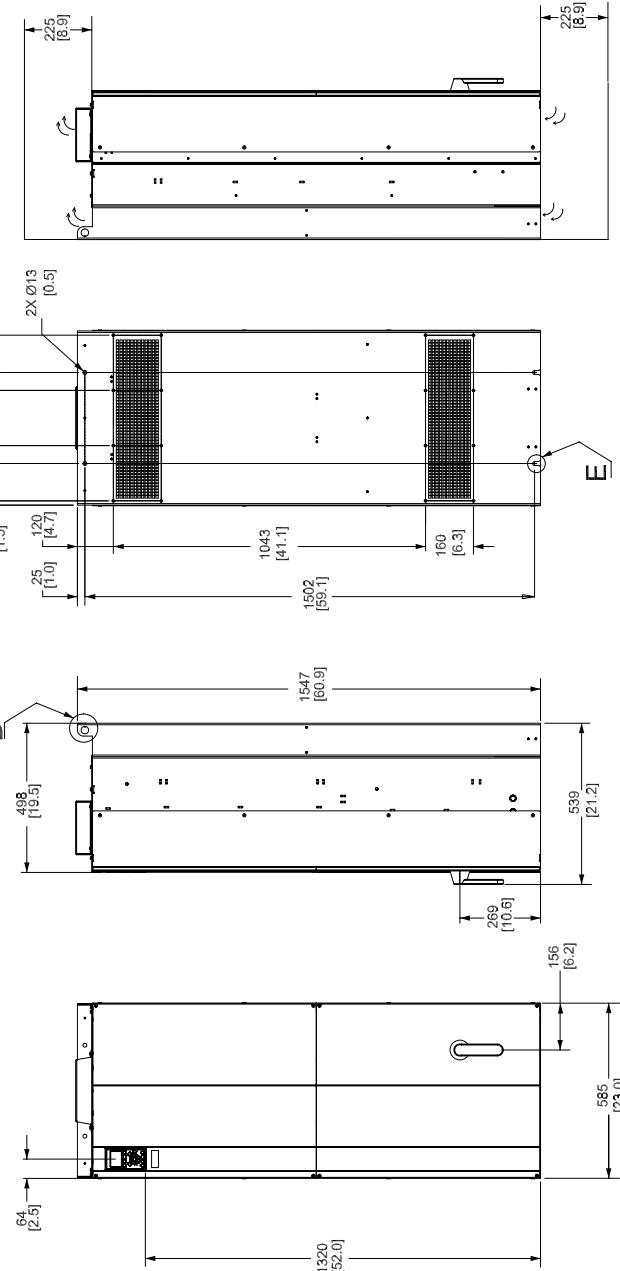
3

IP21 AND IP54 / UL AND NEMA TYPE 1 AND 12

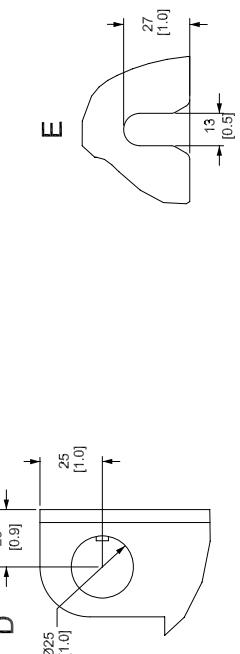


IP00 / CHASSIS

E2



130BA445.10



Mechanical dimensions , D Enclosures									
Frame size		D1		D2		D3		D4	
		90 - 110 kW (380 - 500 V)		132 - 200 kW (380 - 500 V)		90 - 110 kW (380 - 500 V)		132 - 200 kW (380 - 500 V)	
		110 - 132 kW (525-690 V)		160 - 315 kW (525-690 V)		110 - 132 kW (525-690 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		
Card board box size	Height	650 mm	650 mm	650 mm	650 mm	650 mm	650 mm		
Shipping dimensions									
	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	1159 mm	1159 mm	1540 mm	1540 mm	997 mm	1277 mm		
	Width	420 mm	420 mm	420 mm	420 mm	408 mm	408 mm		
	Depth	373 mm	373 mm	373 mm	373 mm	373 mm	373 mm		
	Max weight	104 kg	104 kg	151 kg	151 kg	91 kg	138 kg		

Mechanical dimensions, E Enclosures							
Frame size		E1			E2		
		250 - 400 kW (380 - 500 V)			250 - 400 kW (380 - 500 V)		
		355 - 560 kW (525-690 V)			355 - 560 kW (525-690 V)		
IP NEMA		21 Type 12	54 Type 12		00 Chassis		
Card board box size	Height	840 mm		840 mm		831 mm	
Shipping dimensions							
	Width	2197 mm		2197 mm		1705 mm	
	Depth	736 mm		736 mm		736 mm	
Drive dimensions	Height	2000 mm		2000 mm		1499 mm	
	Width	600 mm		600 mm		585 mm	
	Depth	494 mm		494 mm		494 mm	
	Max weight	313 kg		313 kg		277 kg	

3.2.6. Rated Power

	D1	D2	D3	D4
Enclosure type				
	130BA481.10	130BA482.10	130BA478.10	130BA479.10
Enclosure protection	IP 21/54	IP 21/54	IP 00	IP 00
NEMA	Type 1/ Type 12	Type 1/ Type 12	Chassis	Chassis
Rated power	90 - 110 - kW at 400 V (380 - 500 V) 110 - 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) 110 - 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)

	E1	E2
Enclosure type		
	130BA483.10	130BA480.10
Enclosure protection	IP 21/54	IP 00
NEMA	Type 1/ Type 12	Chassis
Rated power	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)

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 and IP 54 units
- Lifting bar to lift the unit (rod or tube Ø 20 mm (0.75 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 E1 enclosure in IP21 and IP54 enclosure 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.

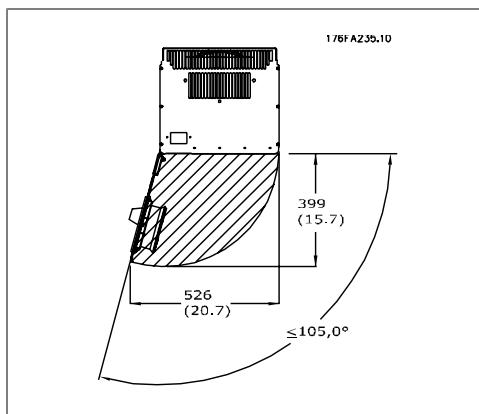


Illustration 3.4: Space in front of IP21/IP54 enclosure type D1 and D2.

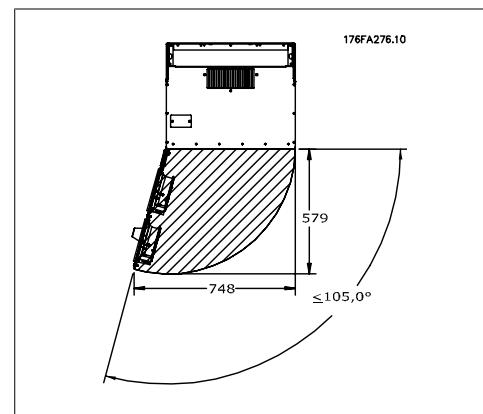


Illustration 3.5: Space in front of IP21/IP54 enclosure type E1.

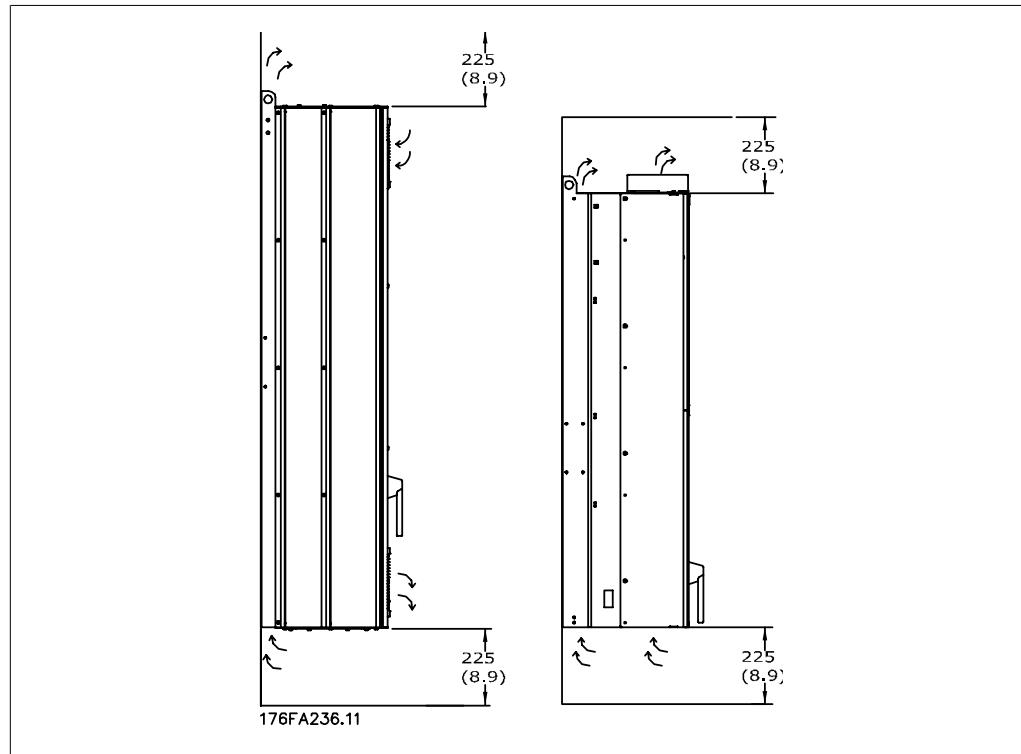


Illustration 3.6: Airflow direction and necessary space for cooling

Left: Enclosure IP21/54, D1 and D2.

Right: Enclosure IP00, D3, D4 and E2.

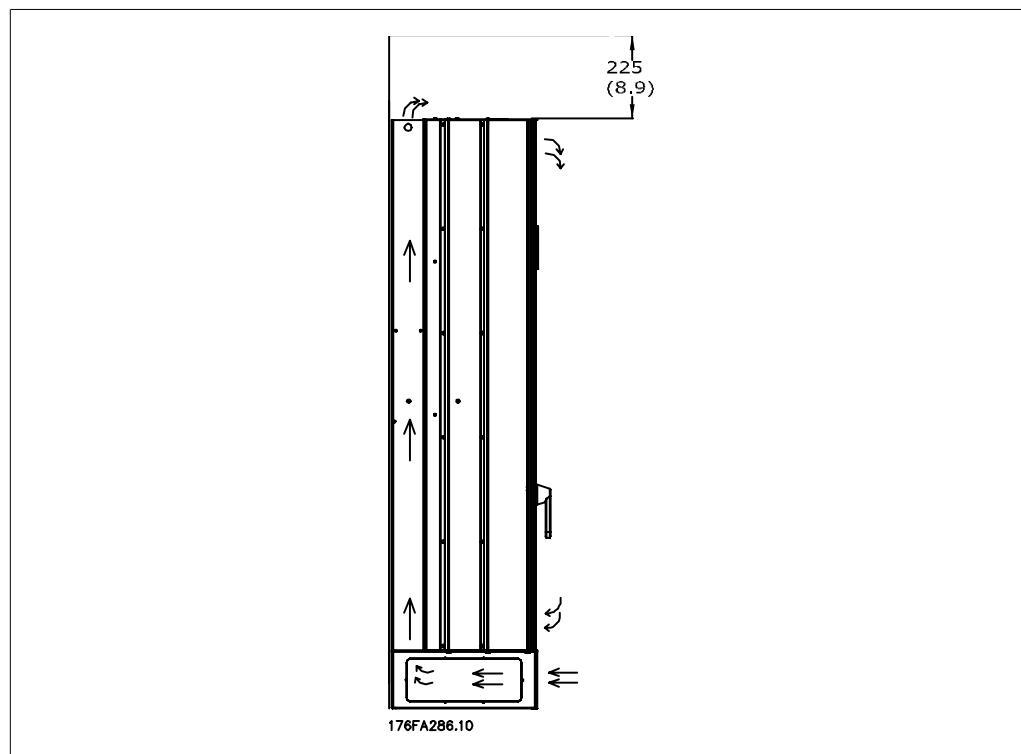


Illustration 3.7: Airflow direction and necessary space for cooling - Enclosure IP21/54, E1

Wire access

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

Terminal locations**(D1 and D2 enclosures)**

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

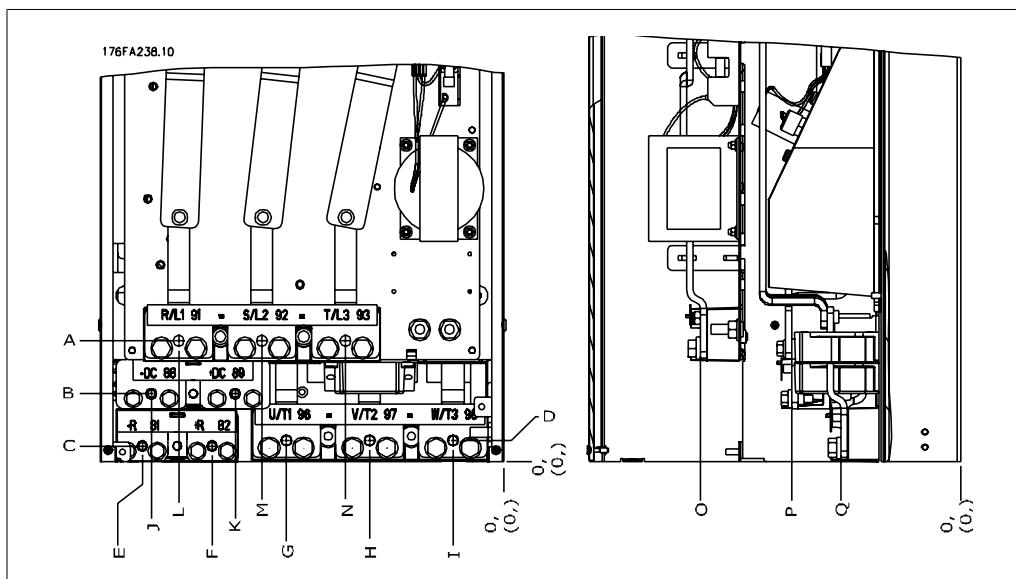


Illustration 3.8: Position of power connections

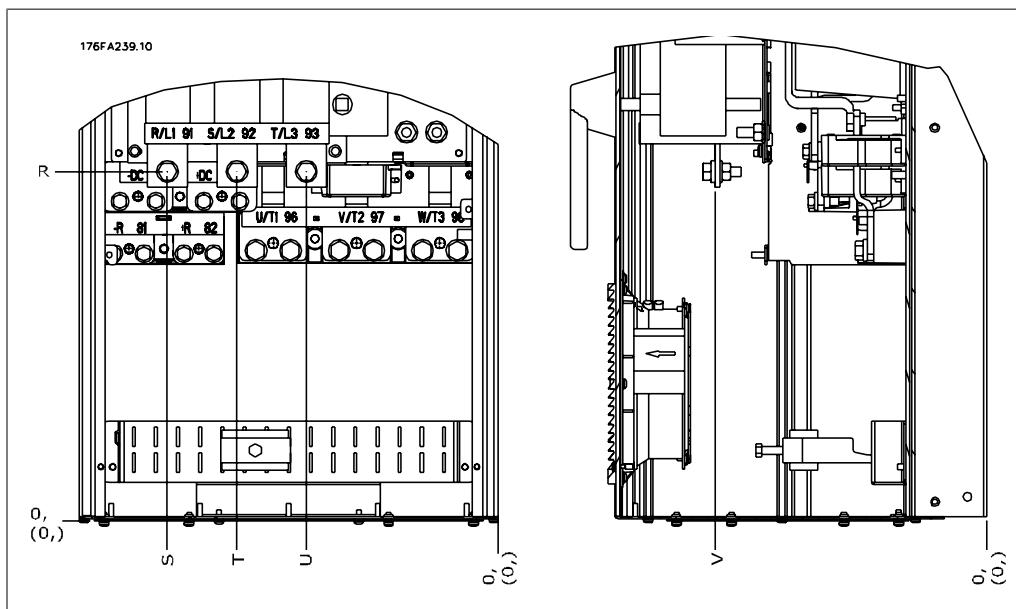


Illustration 3.9: Position of power connections - Disconnect

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.

	IP 21 (NEMA 1) / IP 54 (NEMA 12)		IP 00 / Chassis	
	Enclosure D1	Enclosure D2	Enclosure D3	Enclosure D4
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).

Terminal locations - E1 enclosures

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

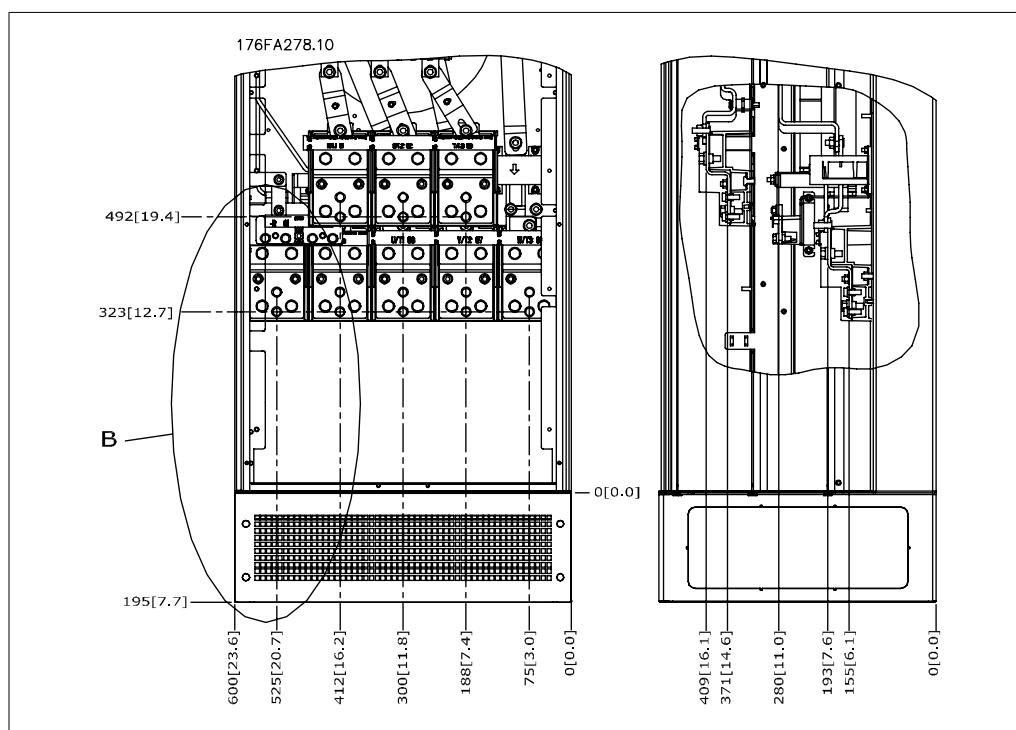


Illustration 3.10: IP21 (NEMA Type 1) and IP54 (NEMA Type 12) enclosure power connection positions

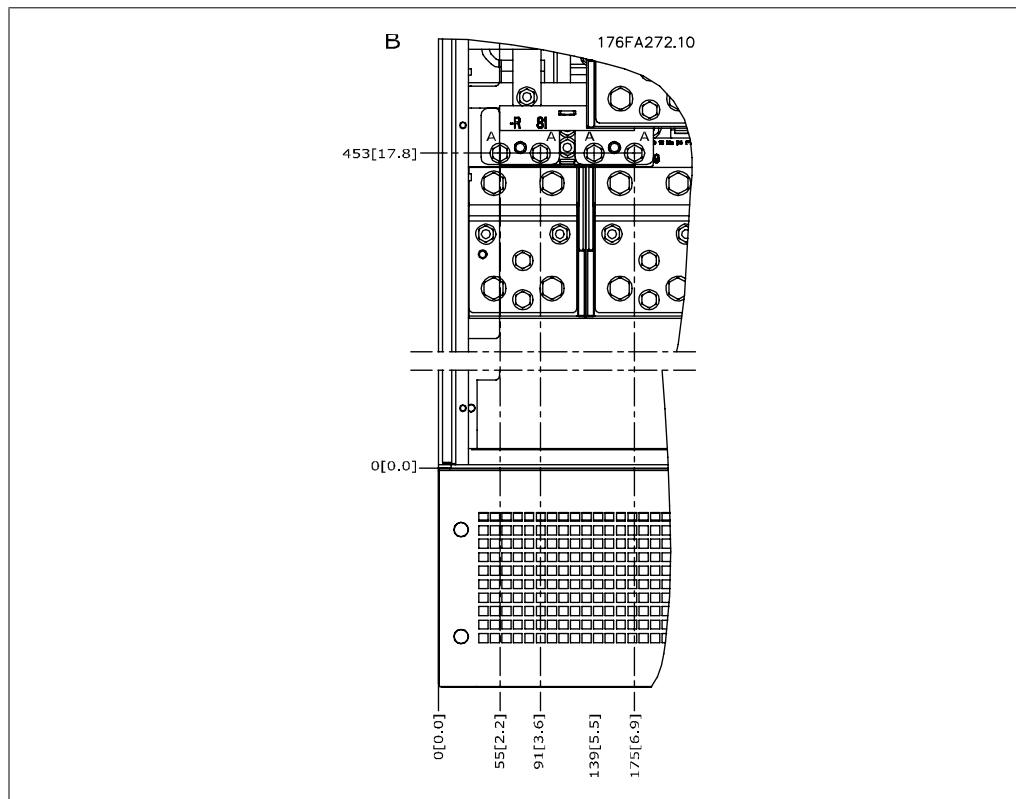


Illustration 3.11: IP21 (NEMA type 1) and IP54 (NEMA type 12) enclosure power connection positions (detail B)

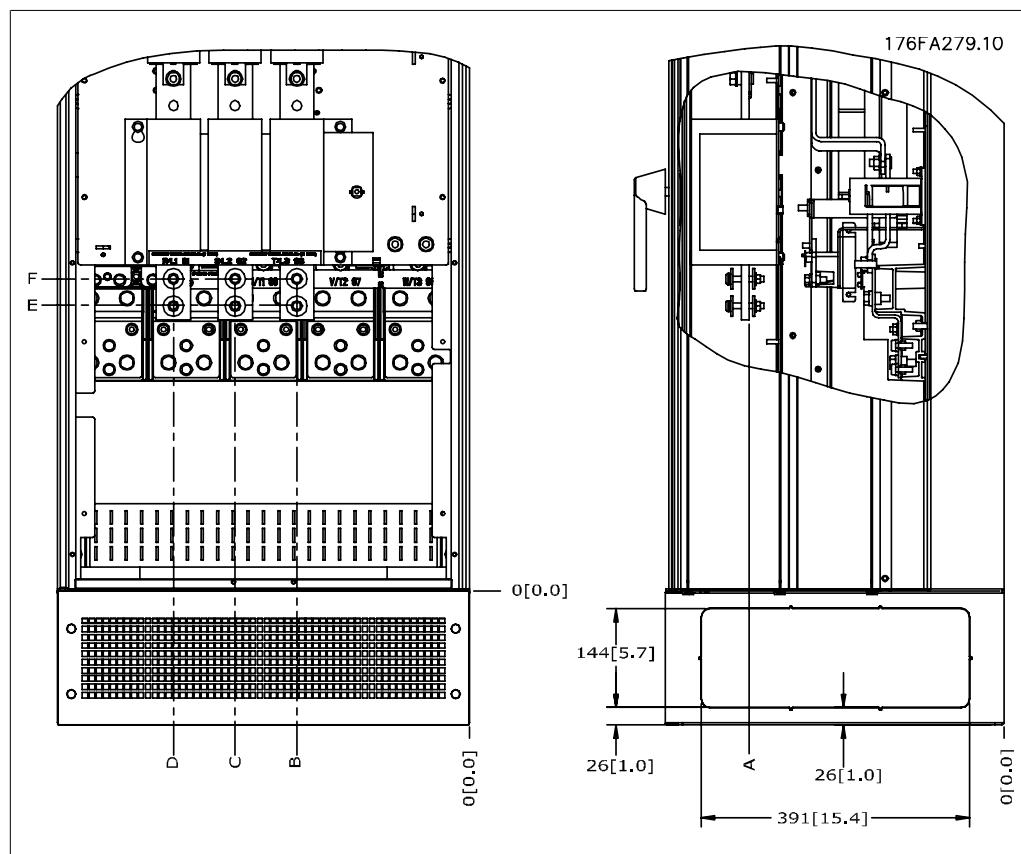


Illustration 3.12: IP21 (NEMA type 1) and IP54 (NEMA type 12) enclosure power connection position of disconnect switch

Terminal locations - E2 enclosures

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

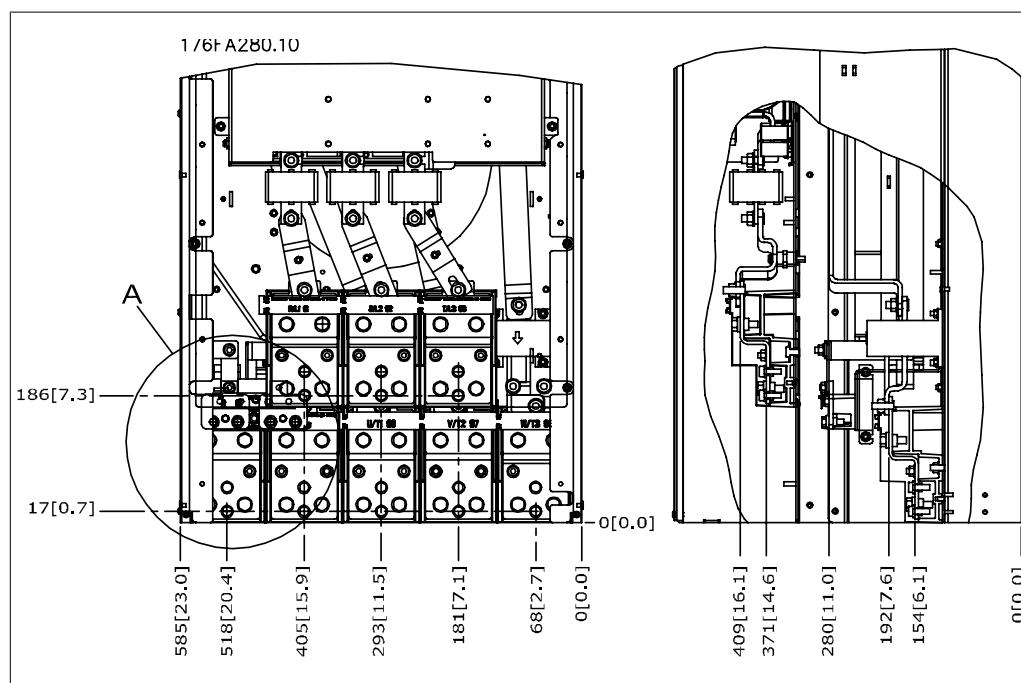


Illustration 3.13: IP00 enclosure power connection positions

3

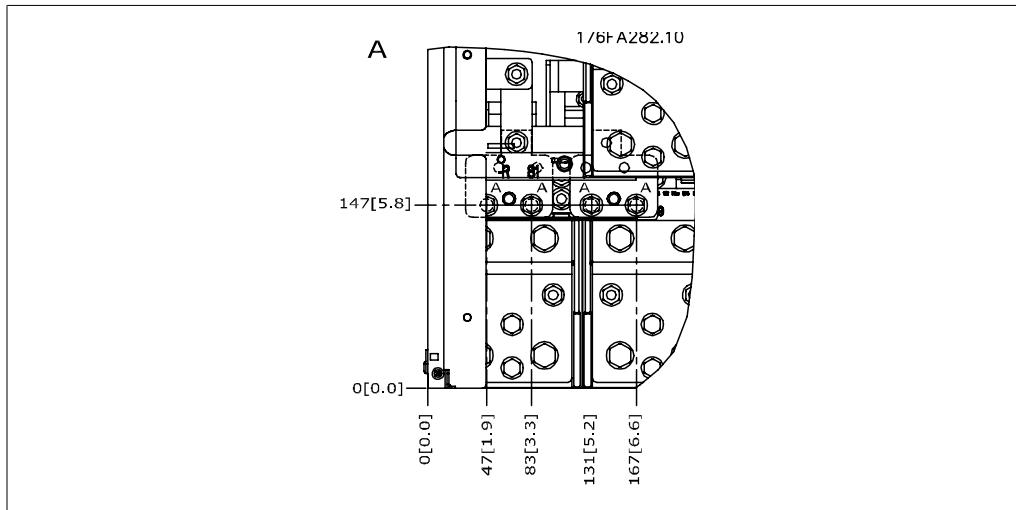


Illustration 3.14: IP00 enclosure power connection positions

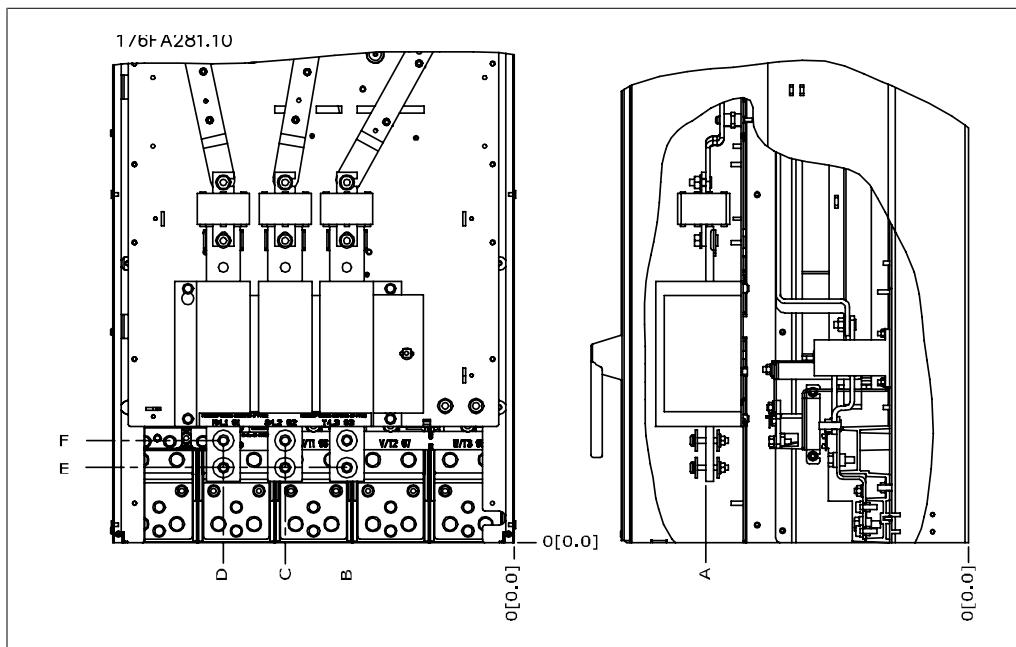


Illustration 3.15: IP00 enclosure power connections positions of disconnect switch

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.

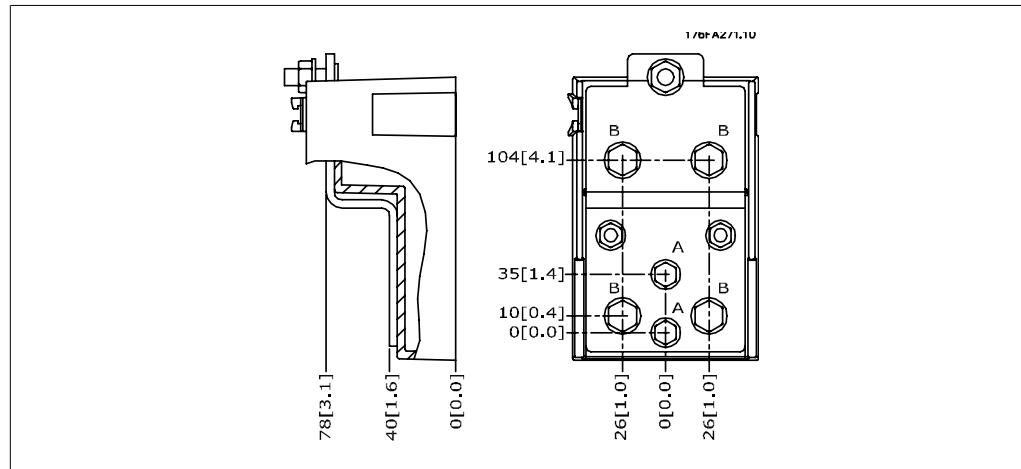


Illustration 3.16: Terminal in details

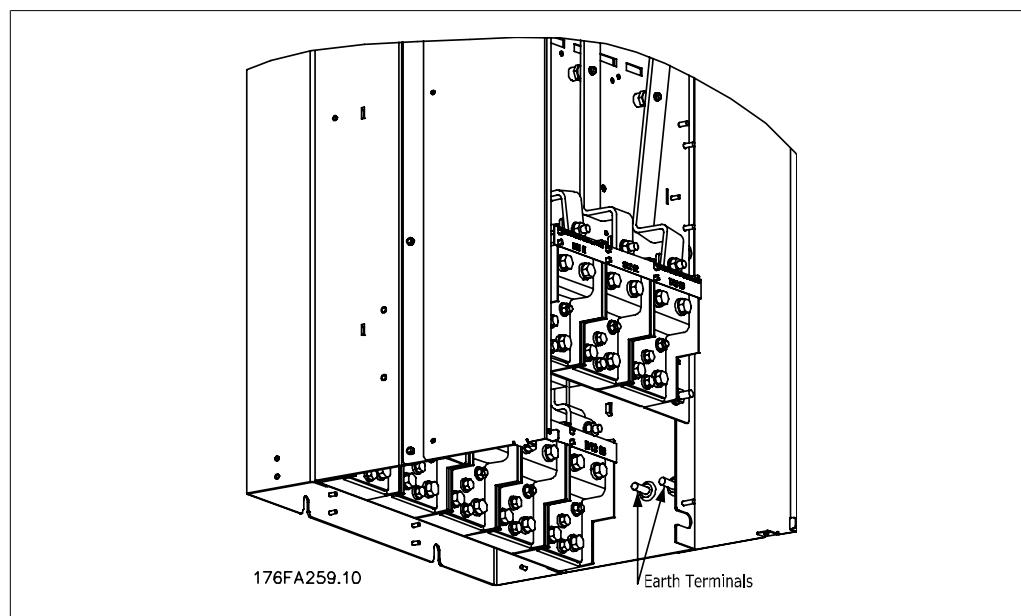


Illustration 3.17: Position of earth terminals IP00

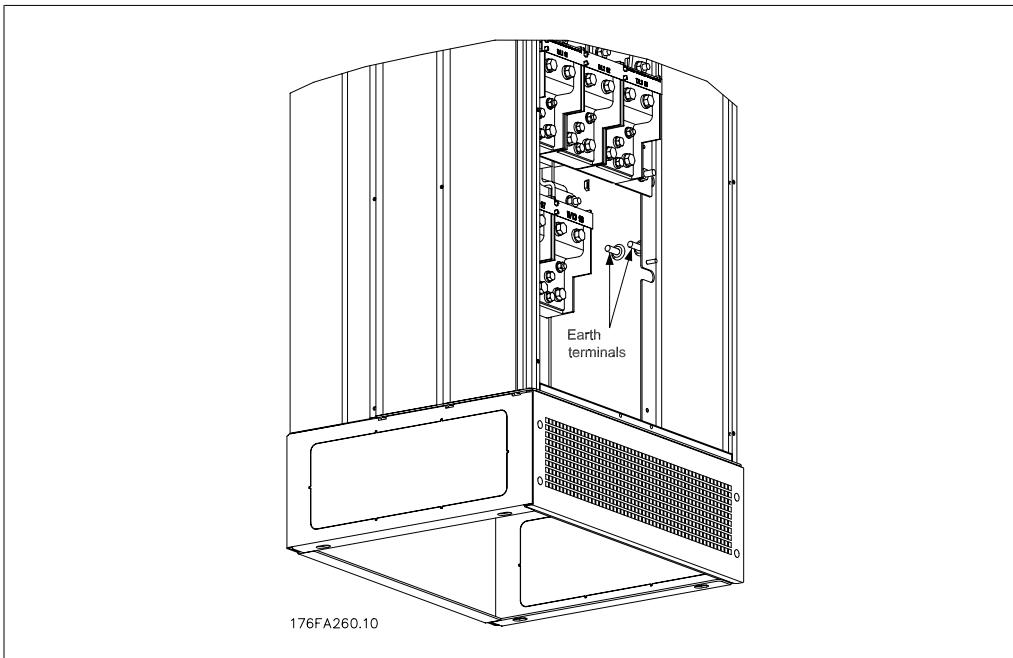


Illustration 3.18: Position of earth terminals IP21 (NEMA type 1) and IP54 (NEMA type 12)

Cooling

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

Airflow

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

Enclosure	Door fan / Top fan airflow	Airflow over heat-sink
IP21 / NEMA 1 &	D1 and D2	170 m ³ /h (100 cfm) 765 m ³ /h (450 cfm)
IP54 / NEMA 12	E1	340 m ³ /h (200 cfm) 1444 m ³ /h (850 cfm)
IP00 / Chassis	D3 and D4	255 m ³ /h (150 cfm) 765 m ³ /h (450 cfm)
	E2	255 m ³ /h (150 cfm) 1444 m ³ /h (850 cfm)

Table 3.2: Heatsink Air Flow

Duct cooling

A dedicated option has been developed to optimise installation of IP00 / Chassis enclosed frequency converters in Rittal TS8 enclosures utilizing the fan of the frequency converter for forced cooling.

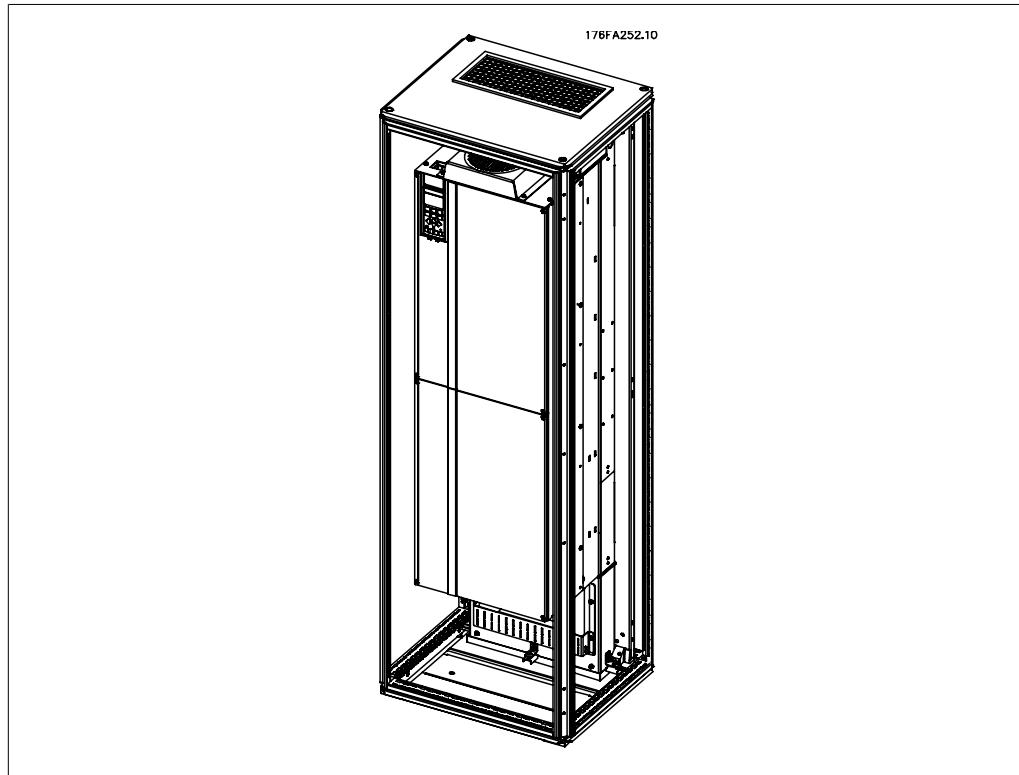


Illustration 3.19: Installation of IP00 in Rittal TS8 enclosure

Rittal TS8 Enclosure	Frame D3 Kit Part No.	Frame D4 Kit Part No.	Frame E2 Part No.
1800 mm	176F1824	176F1823	Not possible
2000 mm	176F1826	176F1825	176F1850
2200 mm			176F0299

Table 3.3: Duct Kit Ordering Numbers

Back cooling

Using the channel from the back allows easy installation in for example control rooms. The unit mounted to the rear of the enclosure allows a similar easy cooling of the units as the duct cooling principle. The hot air is ventilated out of the back of the enclosure. This offers a solution where the hot cooling air from the frequency converter does not cause heating of the control room.



NB!

A small door fan is required on the Rittal cabinet to provide additional cooling within the drive.



Illustration 3.20: Combined use of cooling principles

The above mentioned solution can of course also be combined for an optimized solution in the actual installation.

Please see the *Duct Kit Instruction Manual, 175R5640*, for further information.

3.3.3. Installation in Enclosures - IP00 / Chassis units

As the IP00 version is intended for panel mounting, it is important to know how to install the frequency converter and utilize the possibilities for cooling the units. A detailed description of how to install the frequency converter in a Rittal TS8 enclosure by using the installation kit can be found in a later section of this Installation Guide. This can also be used as a guide for other installations.

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

This only applies for D1 and D2 enclosures.

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.

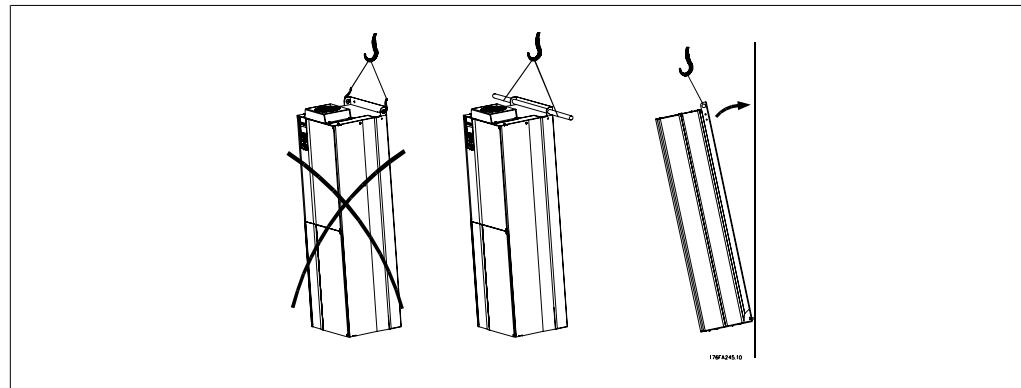


Illustration 3.21: Lifting method for mounting drive on wall

3.3.5. Floor Mounting - Pedestal Installation IP21 (NEMA1) and IP54 (NEMA12)

IP21 (NEMA type 1) and IP54 (NEMA type 12) enclosed frequency converters can also be installed on a pedestal.

D1 and D2 enclosures

Ordering No. 176F1827

Please see the *Pedestal Kit Instruction Manual, 175R5642*, for further information.



Illustration 3.22: Drive on pedestal

The E1 enclosure is always delivered with a pedestal as standard. Install the pedestal on the floor. Fixing holes are to be drilled according to this figure:

3

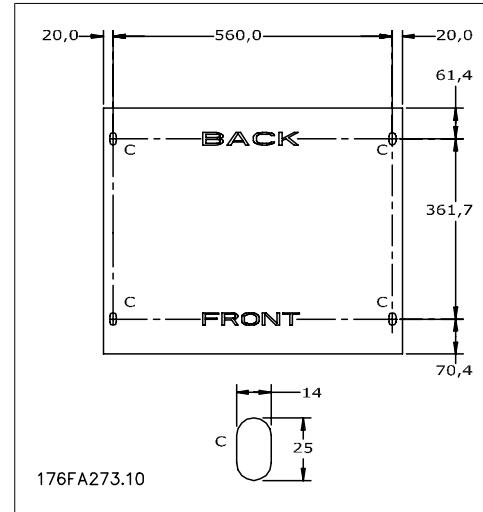


Illustration 3.23: Drill master for fixing holes in floor.

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

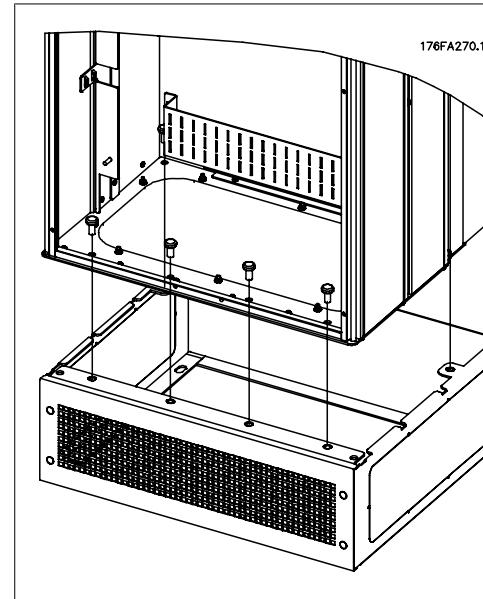


Illustration 3.24: Mounting of drive to pedestal

3.3.6. 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.

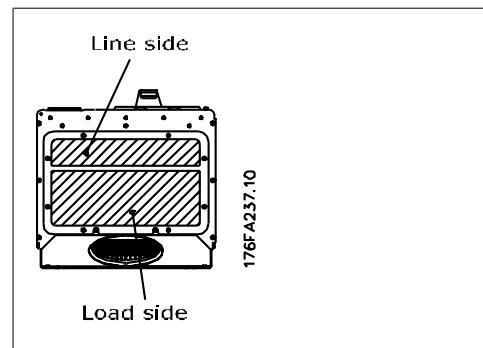


Illustration 3.25: Cable entry viewed from the bottom of the frequency converter - Enclosure D1 and D2.

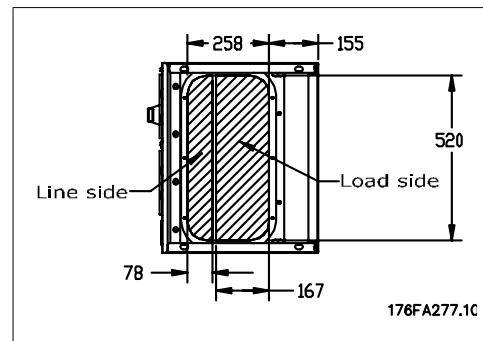


Illustration 3.26: Cable entry seen from the bottom of the frequency converter - Enclosure E1.

The bottom plate of the E1 enclosure can be mounted from either in- or outside of the enclosure, 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.

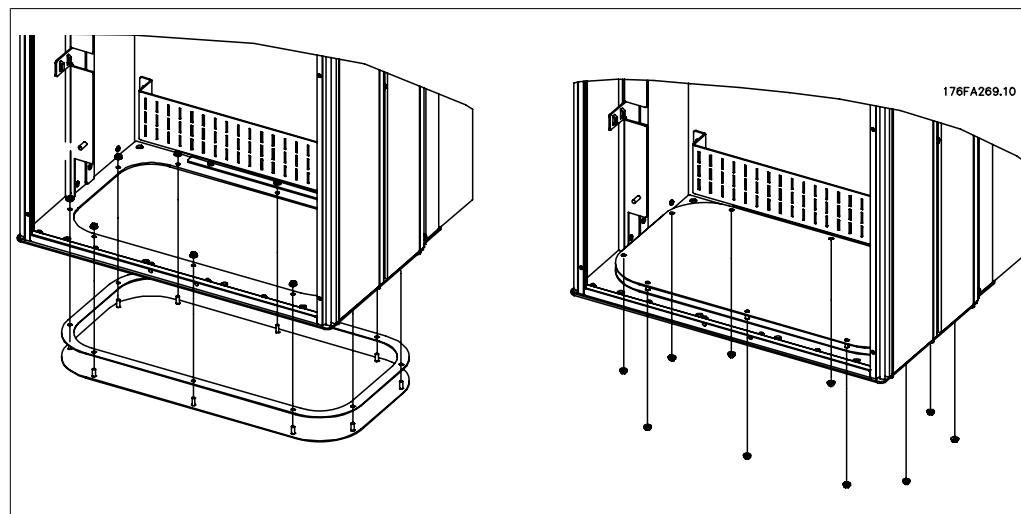


Illustration 3.27: Mounting of bottom plate, E1 enclosure.

3.3.7. IP21 Drip shield installation (D1 and D2 enclosure)

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)

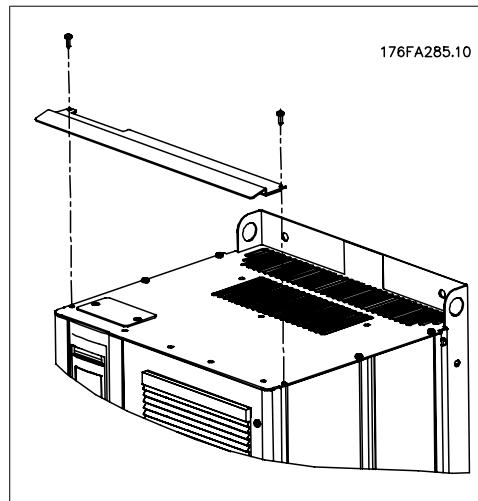


Illustration 3.28: Drip shield installation.

3.4. Field Installation of Options

This chapter deals with the installation of IP00 / chassis enclosed frequency converters with duct work cooling kits in Rittal enclosures. These kits are designed and tested to be used with Rittal TS8 enclosures 1800 mm (Frame D1 and D2 only) and 2000 mm height as well as 2200 mm for E2 enclosures. Other enclosure heights are not supported. In addition to the enclosure a 200 mm base/plinth is required.

The minimum enclosure dimension is:

- D1 and D2 frame: Depth 500 mm and width 600 mm.
- E1 frame: 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 enclosure 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 enclosures.

The duct work shown is for D1 and D2 enclosures. The duct work for E1 enclosures has a different look, but is installed in the same way.



For the E1 enclosures it is important to mount the plate at the absolute rear of the Rittal enclosure due to the weight of the frequency converter.

Ordering Information

Rittal TS-8 Enclosure	Frame D3 Kit Part No.	Frame D4 Kit Part No.	Frame E2 Part No.
1800 mm	176F1824	176F1823	Not possible
2000 mm	176F1826	176F1825	176F1850
2200 mm			176F0299

Kit Contents

- Ductwork components
- Mounting hardware
- Gasket material
- Delivered with D1 and D2 frame kits:
 - 175R5639 - Mounting templates and top/bottom cut out for Rittal enclosure.
- Delivered with E1 frame kits:
 - 175R1036 - Mounting templates and top/bottom cut out for Rittal enclosure.

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)

3.4.1. Installation of Rittal Enclosures

This illustration shows the full size template included with the kit and two drawings that may be used to locate the cutouts for the enclosure top and bottom plates. The duct work may also be used to locate the openings.



Illustration 3.29: Templates

Install gasket material on the back openings of the frequency converter prior to installation on the enclosure back panel.

Use the template provided with the kit (shown above) and install the frequency converter on the back panel of the Rittal enclosure. The template is referenced to the top-left corner of the back panel. Therefore the template may be used with any size back panel and both the 1800 mm and 2000 mm high enclosures.



Illustration 3.30: Openings on rear not used in this application

Before installing the back panel in the enclosure assemble the gasket on both sides of the bottom duct adapter as shown below, and install on the bottom of the frequency converter.

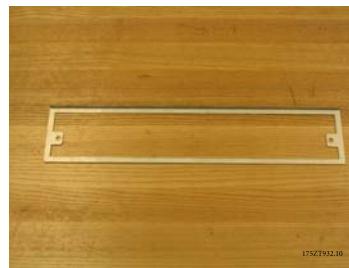
3

Illustration 3.31: Bottom duct adapter



Illustration 3.32: Bottom duct adapter with gasket installed



Illustration 3.33: Bottom duct adapter installed

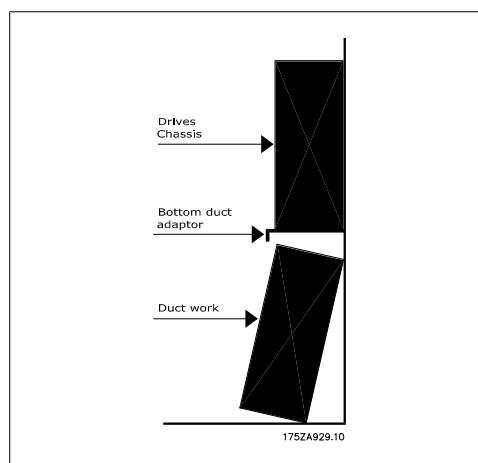


Illustration 3.34: Side view



NB!

Install the bottom plate after the frequency converter has been installed on the back to assure proper gasket coverage.

Install the two mounting brackets on the frequency converter chassis and then install the bottom duct adapter on the bottom of the frequency converter as shown below.

The installation of the bottom plate is easier while the back panel is outside the enclosure. The curved leading edge of the bottom duct adapter is to the front of the frequency converter and down.

Before installing the back panel with the frequency converter in the Rittal TS8 enclosure remove and discard the rearmost 5 screws (see illustration below) located on the top cover of the frequency converter. The holes will be used to fasten the top ductwork with longer screws provided with the kit.



Illustration 3.35: Top of IP 00 / Chassis frequency converter

Install the back panel in the enclosure, see illustration below. Use Rittal PS4593.000 brackets (minimum one per side at the middle of the frequency converter) with appropriate support strip for additional support of the back panel. For the D4 and E2 frame use two supports per side. If additional components are mounted on the same back panel, consult Rittal manual for additional support requirements.



Illustration 3.36: Frequency converter installed in cabinet

3.4.2. Installation of Rittal Enclosures, cont.

The top ductwork cover is composed of the following pieces as shown below. From left to right: 1. top duct closing plate, 2. frequency

converter bracket, 3. duct, 4. duct vented top cover.

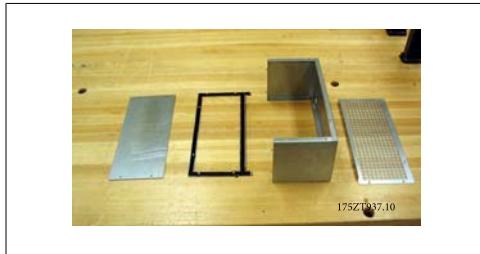


Illustration 3.37: Top duct assembly



Illustration 3.38: Top duct work and enclosure top installed

Temporarily install the top duct section as shown above. Use the top duct cover piece to mark the enclosure top for the opening. Alternatively the mounting template (supplied drawing) can be used to make the enclosure cutout.



Illustration 3.39: The top duct work partially assembled with frequency converter bracket

Illustration 3.40: Rittal enclosure top with cutout
Standard Rittal enclosures top is cut. Gasket is not used on the cutout. Gasket is part of duct work.

Illustration 3.41: Gasket folds over the edge to form seal between the duct and top vented cover



Illustration 3.42: Top duct installed



Illustration 3.43: Gasket applied to both sides of the frequency converter bracket and duct vented top cover.



Illustration 3.44: Top duct ready to be installed on the frequency converter

For the final installation of the duct work, assemble the top duct as shown below.

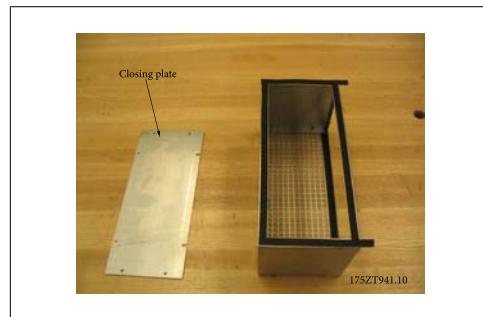


Illustration 3.45: Top duct assembled with gasket

The top duct closing plate is left off for the installation of the duct work on the frequency converter. The top duct work is attached to the frequency converter using existing holes on the top cover of the frequency converter. Use the longer T25 screws provided with the kit in the existing frequency converter top cover holes. The duct work will fit over the frequency converter mounting bolts.

Once the ductwork is attached to the frequency converter, the duct closing plate can be attached. The top ductwork assembly is complete.

Apply the gasket to the top duct closing plate and install. Install the enclosure top. Top duct installation is complete.



Illustration 3.46: Top duct installed



Illustration 3.47: Top duct closing plate with gasket

3



Illustration 3.48: Top duct closing plate installed



Illustration 3.49: Enclosure top installed



Illustration 3.50: Top view of Rittal enclosure

3.4.3. Installation of Rittal Enclosures, cont.

The bottom duct assembly pieces. Refer to drawing showing exploded view of duct work components. Gasket is installed as shown. Assemble the bottom duct less the cover. Assembly includes the mounting of 3 angle brackets on the front and sides of the partially assembled bottom duct. The bottom duct collar is bolted to the duct using 3 - T25 screws in the outermost holes of the brackets. Tighten the screws to compress the gasket.



Illustration 3.51: Bottom ductwork pieces



Illustration 3.52: Bottom ductwork partially assembled



Illustration 3.53: Completely assembled bottom duct work

The duct assembly is used to mark the bottom cutout. Temporarily install the bottom duct work as shown to the right. Use the inside of the ductwork to mark the bottom of the enclosure for the opening.



Illustration 3.54: Temporarily install duct work to mark cutout on the gland

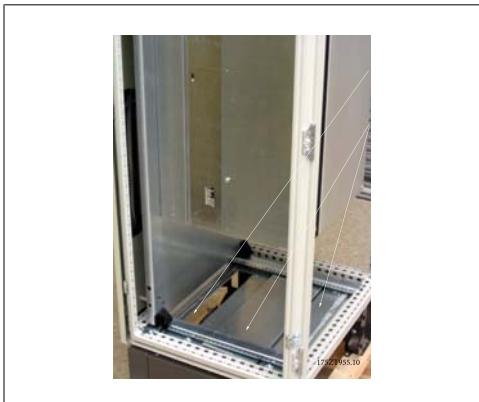


Illustration 3.55: Enclosure bottom cutout

The bottom duct work is rotated into place as shown. The bottom ductwork is a tight fit by design. The upper part of the duct fits under the bottom duct adapter and requires a tight fit which with the gasket material maintains the IP 54 and UL and NEMA 12 rating.

The cutout is made on the innermost gland plate. The remaining two gland plates must be removed for the installation of the bottom duct assembly.

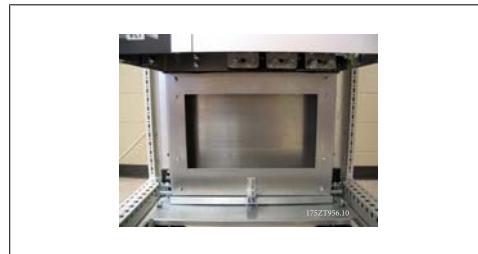


Illustration 3.56: Bottom ductwork installed

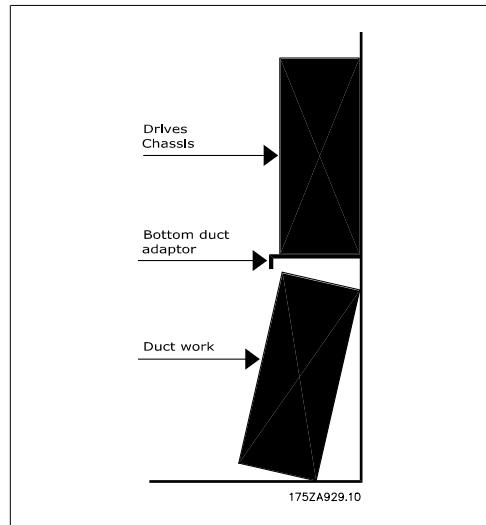


Illustration 3.57: Installation of bottom duct

After the bottom ductwork has been positioned in place, remove the three T25 screws from the outer holes in the mounting brackets on the sides and front of ductwork and move them to the inner holes of the same brackets. Tighten the three screws to the specified torque. The bottom duct work is not fastened to Rittal enclosure.

3



Illustration 3.58: Move mounting screws from the outer hole to the inner hole

Install the front cover of the duct and the cable clamp base if used. Install the two remaining gland plates.



Illustration 3.59: Bottom duct installed.

3.4.4. Installation on pedestal

The frequency converter can also be installed on the floor. A dedicated floor stand is designed for that purpose. It can only be used for units produced after week 50, 2004 (serial number XXXXG504).

This section describes the installation of a pedestal unit available for the VLT series frequency converters frames D1 and D2. This is a 200 mm high pedestal that allows these frames 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 enclosure protections.

There is one pedestal that fits both frames D1 and D2.

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 3.60: Drive on pedestal.

The kit contains a U-shaped piece, a vented front cover, 2 side covers, two front brackets and the required hardware to assemble. See the exploded view of the installation, illustration "Three front screws" (drawing 130BA647).

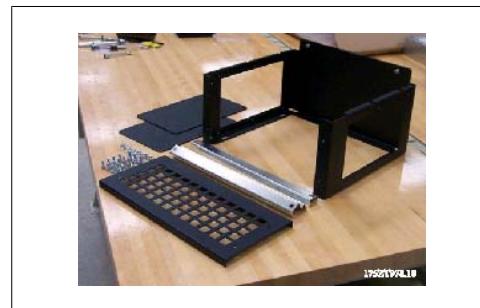


Illustration 3.61: Pedestal parts

The pedestal has been partially assembled. Before installing the drive on to the pedestal it is important to anchor the pedestal to the floor using the four pedestal mounting holes. The holes can accommodate up to M12 bolts (not included in the kit).

CAUTION: The drives are top heavy and may fall over if the pedestal is not anchored to the floor.

The entire assembly may also be supported by using the drive top mounting holes to anchor to a wall structure.

The completely assembled pedestal with vented front cover and two side covers installed. Multiple frequency converters may be mounted side by side. The interior side closing plates are left off.

NOTE: The front and side cover mounting screws are now recessed M6 Torx socket flat head screws.



Illustration 3.62: Pedestal partially assembled



Illustration 3.63: Final assembled pedestal.

Install the frequency converter by lowering on to the pedestal. The frequency converter must overhang the front of the pedestal to clear the retaining bracket on the rear of the pedestal. After the frequency converter has been placed on the pedestal, slide the frequency converter engages the retaining bracket on the pedestal and mount screws as shown.

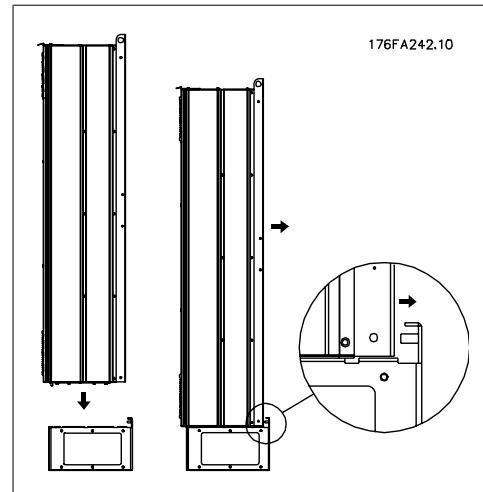


Illustration 3.64: Mounting of drive to pedestal.

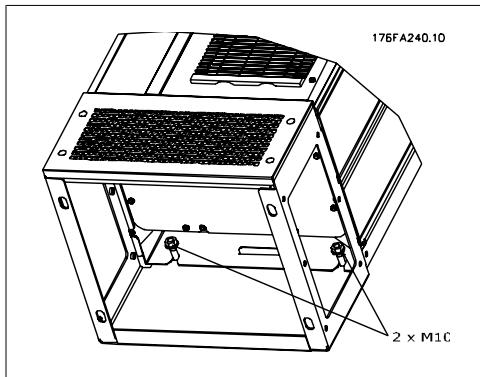


Illustration 3.65: Two nuts at rear side.

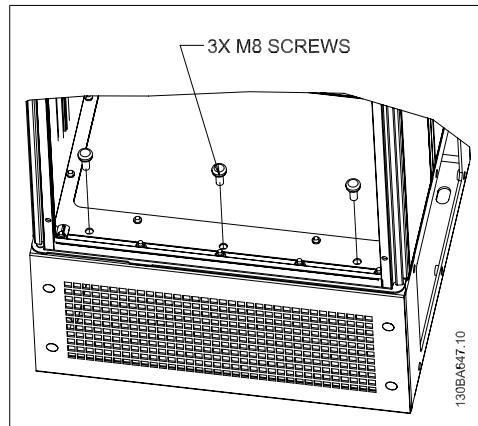


Illustration 3.66: Three front screws.



Illustration 3.67: Frame D2 with pedestal installed

3.5. Electrical Installation

3.5.1. Control Wires

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.

Control cable routing

Tie down all control wires to the designated control cable routing.

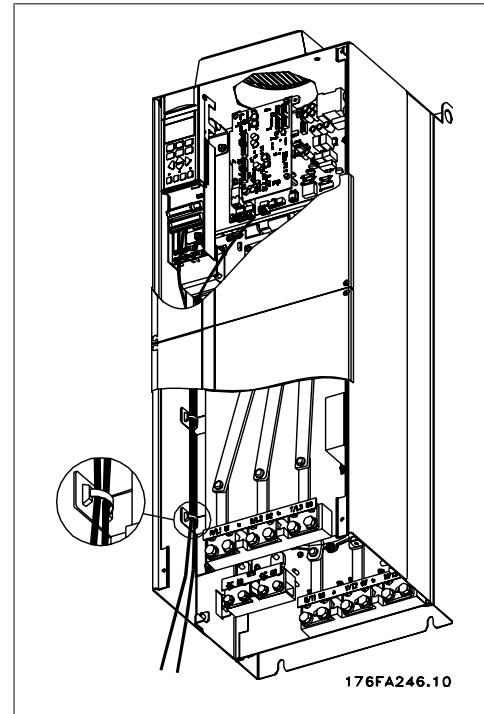


Illustration 3.68: Wire path for control wiring.

Fieldbus connection

Connections are made to the relevant options at the control card. For details see the relevant fieldbus instruction. The cable must be placed to the left inside the frequency converter and tied down together with other control wires.

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



Illustration 3.69: Top connection for fieldbus.

Installation of 24 Volt external DC Supply

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

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

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



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

3

3.5.2. Power Connections

Cabling and Fusing



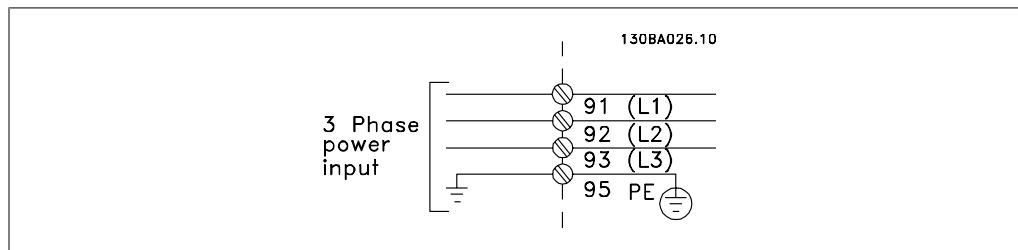
NB!
Cables General

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 of the frequency converter the recommended fuses must be used or the unit must be with built-in fuses. Recommended fuses can be seen in the tables in the fuses section. Always ensure that proper fusing is made according to local regulation.

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



NB!

Motor cable must be screened/armoured. If an unscreened/unarmoured cable is used, some EMC requirements are not complied with. Use a screened/armoured motor cable to comply with EMC emission specifications. For more information, see *EMC specifications* in the *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 in the frequency converter.

Cable-length and cross-section:

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

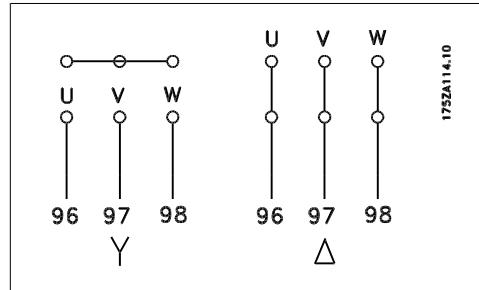
Details can be found in the relevant Design Guide.

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. 14-01.

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

¹⁾Protected Earth Connection



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

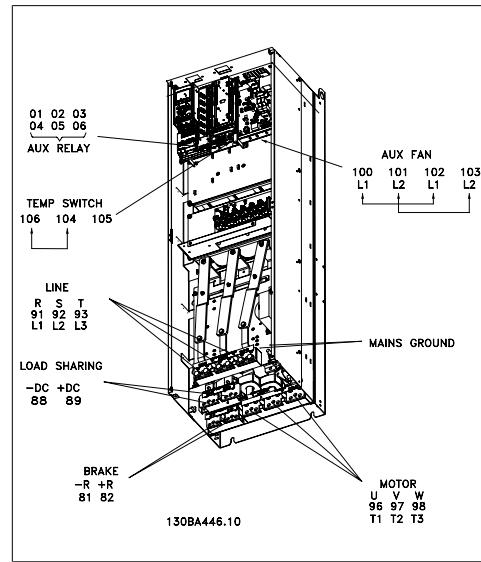


Illustration 3.70: Compact IP 00 (Chassis), enclosure D3

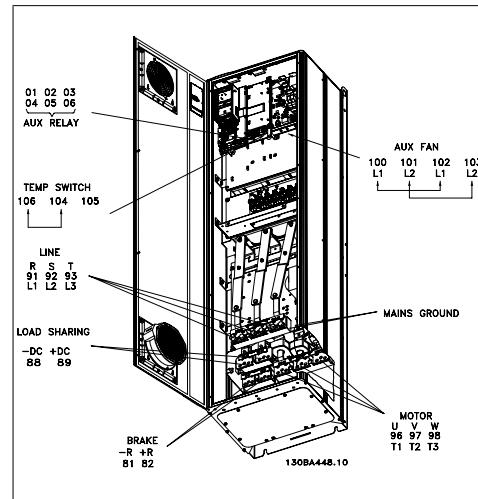


Illustration 3.71: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12), enclosure D1

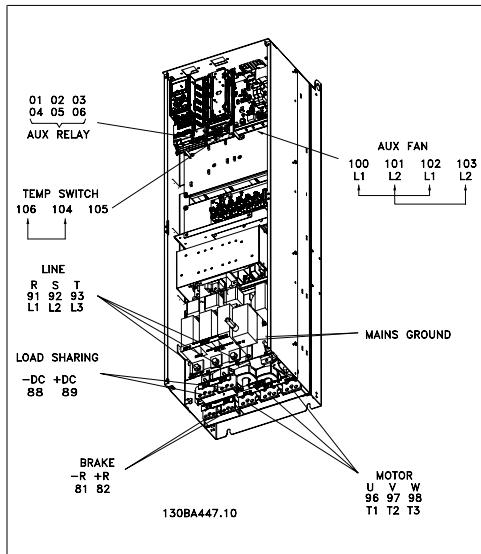


Illustration 3.72: Compact IP 00 (Chassis) with disconnect, fuse and RFI filter, enclosure D4

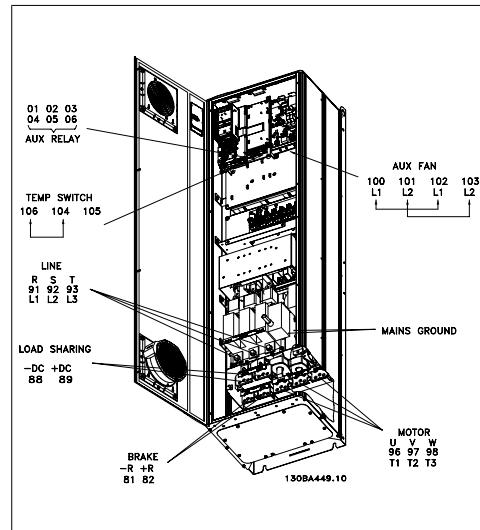


Illustration 3.74: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12) with disconnect, fuse and RFI filter, enclosure D2

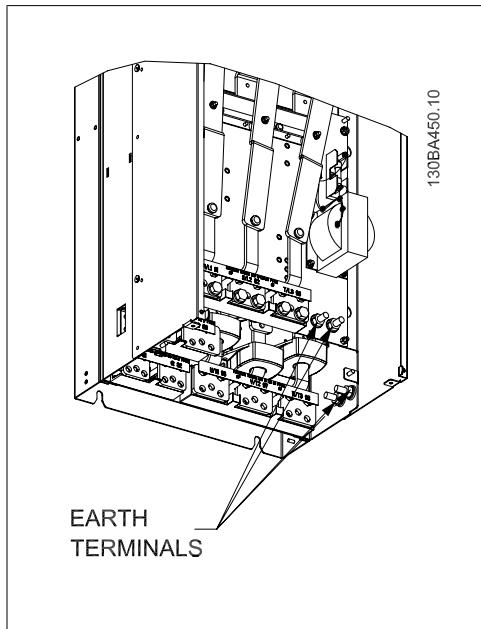


Illustration 3.73: Position of earth terminals IP00, D enclosures

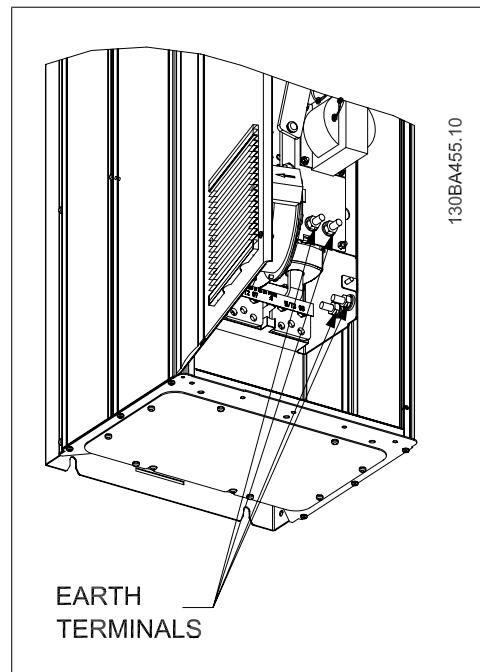


Illustration 3.75: Position of earth terminals IP21 (NEMA type 1) and IP54 (NEMA type 12)

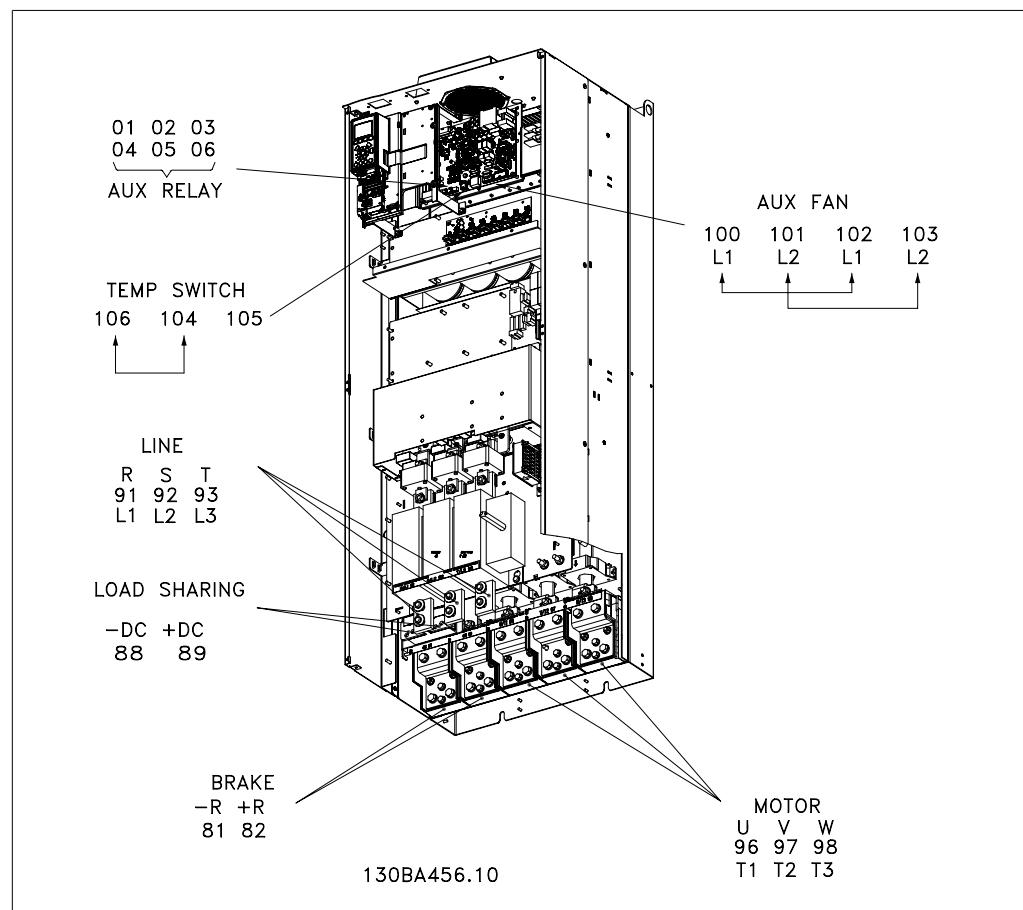


Illustration 3.76: Compact IP 00 (Chassis) with disconnect, fuse and RFI filter, enclosure E2

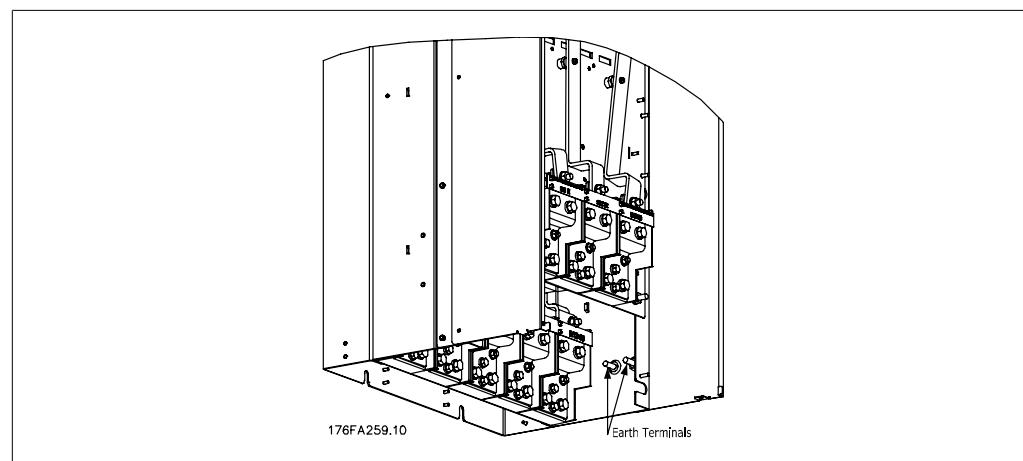


Illustration 3.77: Position of earth terminals IP00, E enclosures

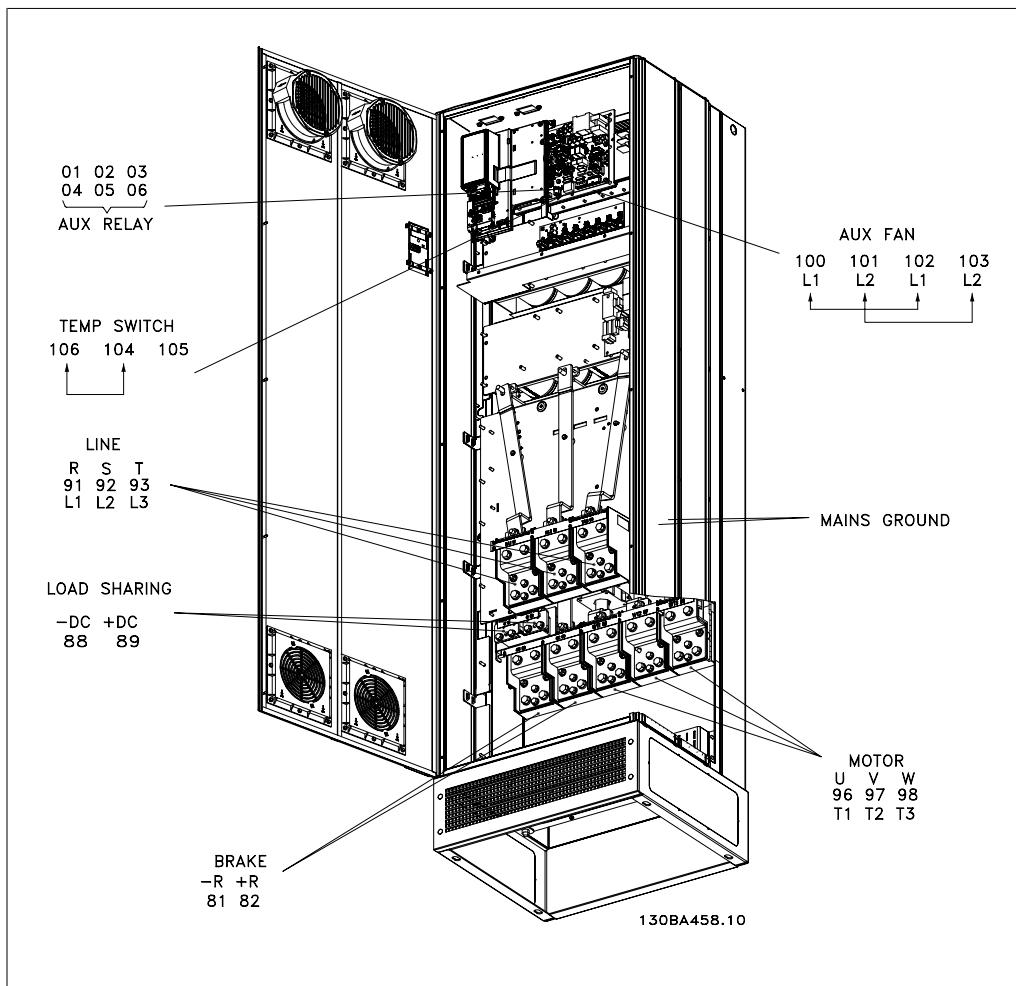


Illustration 3.78: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12) enclosure E1

3.5.3. 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.

3.5.4. 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 content may develop in the faulty 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 relevant Design Guide.

3.5.5. RFI Switch

3

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. 14-50. 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. 14-50 to [ON].

¹⁾ Not required with 525-600/690 V drives; therefore not possible.

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).

Please also refer to the application note *VLT on IT mains, MN.90.CX.02*. It is important to use isolation monitors that are capable for use together with power electronics (IEC 61557-8).

3.5.6. 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

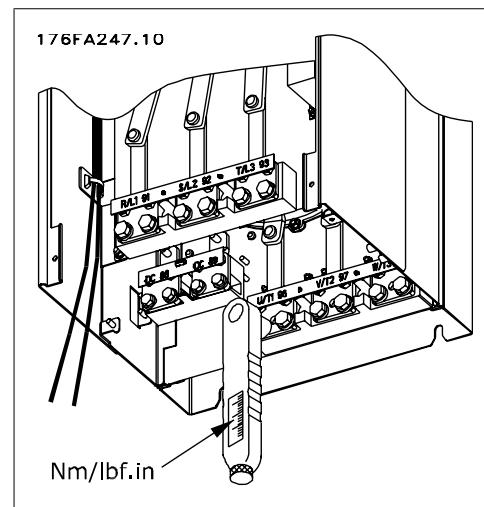


Illustration 3.79: Always use a torque wrench to tighten the bolts.

Enclosure	Terminal	Torque	Bolt size
D1, D2, D3 and D4	Mains	19 Nm (168 in-lbs)	M10
	Motor	9.5 (84 in-lbs)	M8
E1 and E2	Load sharing	19 NM (168 in-lbs)	M10
	Brake	9.5 (84 in-lbs)	M8
	Mains	19 NM (168 in-lbs)	M10
	Motor	9.5 (84 in-lbs)	M8

Table 3.4: Torque for terminals

3.5.7. 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 with either cable glands or clamps:

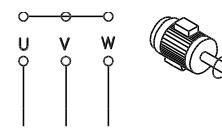
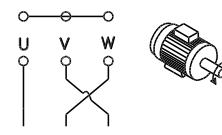
- EMC cable glands: Generally available cable glands can be used to ensure an optimum EMC connection.
- EMC cable clamp: Clamps allowing easy connection are supplied with the frequency converter.

3.5.8. 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 VLT frequency converter output connected as follows:

Terminal No.	Function
96, 97, 98, 99	Mains U/T1, V/T2, W/T3 Ground/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. 4-10.

3.5.9. Brake Cable

(Only standard with letter B in position 18 of typecode).

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. See also *Brake Instructions, MI.90.Fx.yy* and *MI.50.Sx.yy* for further information regarding safe installation.



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

3.5.10. Load Sharing

(Only extended with letter D in position 21 of the typecode).

3

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 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. For further information please contact Danfoss.

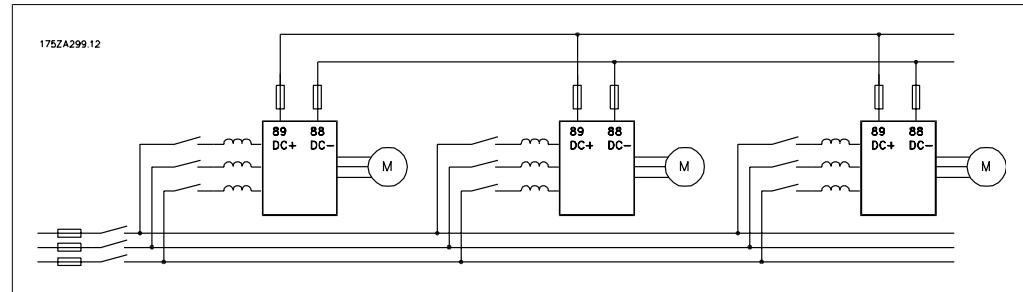


Illustration 3.80: Load sharing connection.

3.5.11. 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 an RFI filter.



Illustration 3.81: Mounting of EMC shield.

3.5.12. Mains connection

Mains must be connected to terminals 91, 92 and 93. Earth/ground 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	Ground/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.

If the unit is without built-in fuses, ensure that the appropriate fuses have the correct current rating.

3.5.13. 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 done to 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 from 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 Littelfuse KLK-5 or equivalent.

3.5.14. 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. Danfoss 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. The frequency converter is equipped with an internal over-current protection that can be used for upstream overload protection (UL-applications excluded). See par. 4-18. Moreover, 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.

Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Arms (symmetrical).

Fuse Tables

Size/ Type	Buss- mann E1958 JFHR2* *	Buss- mann E4273 T/ JDDZ**	SIBA E180276 RKI/JDDZ	LittelFuse E71611 JFHR2**	Ferraz- Shawmut E60314 JFHR2**	Buss- mann E4274 H/ JDDZ**	Bussmann E125085 JFHR2*	Internal Option Bussmann
P90K	FWH- 300	JJS- 300	2028220- 315	L50S-300	A50-P300	NOS- 300	170M3017	170M3018
P110	FWH- 350	JJS- 350	2028220- 315	L50S-350	A50-P350	NOS- 350	170M3018	170M3018
P132	FWH- 400	JJS- 400	206xx32- 400	L50S-400	A50-P400	NOS- 400	170M4012	170M4016
P160	FWH- 500	JJS- 500	206xx32- 500	L50S-500	A50-P500	NOS- 500	170M4014	170M4016
P200	FWH- 600	JJS- 600	206xx32- 600	L50S-600	A50-P600	NOS- 600	170M4016	170M4016

Table 3.5: D enclosures, 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.

Size/Type	Bussmann E125085 JFHR2	Amps	SIBA E180276 JFHR2	Ferraz-Shawmut E76491 JFHR2
P110	170M3017	315	2061032.315	6.6URD30D08A0315
P132	170M3018	350	2061032.35	6.6URD30D08A0350
P160	170M4011	350	2061032.35	6.6URD30D08A0350
P200	170M4012	400	2061032.4	6.6URD30D08A0400
P250	170M4014	500	2061032.5	6.6URD30D08A0500
P315	170M5011	550	2062032.55	6.6URD32D08A550

Table 3.6: D enclosures, 525-690 V

Size/Type	Bussmann PN*	Danfoss PN	Rating	Losses (W)
P250	170M4017	20220	700 A, 700 V	85
P315	170M6013	20221	900 A, 700 V	120
P355	170M6013	20221	900 A, 700 V	120
P400	170M6013	20221	900 A, 700 V	120

Table 3.7: E enclosures, 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.

Danfoss PN	Bussmann	Ferraz	Siba
20220	170M4017	6.9URD31D08A0700	20 610 32.700
20221	170M6013	6.9URD33D08A0900	20 630 32.900

Table 3.8: Additional Fuses for Non-UL Applications, E enclosures, 380-500 V

Size/Type	Bussmann PN*	Danfoss PN	Rating	Losses (W)
P355	170M4017	20220	700 A, 700 V	85
P400	170M4017	20220	700 A, 700 V	85
P500	170M6013	20221	900 A, 700 V	120
P560	170M6013	20221	900 A, 700 V	120

Table 3.9: E enclosures, 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.

Danfoss PN	Bussmann	Ferraz	Siba
20220	170M4017	6.9URD31D08A0700	20 610 32.700
20221	170M6013	6.9URD33D08A0900	20 630 32.900

Table 3.10: Additional Fuses for Non-UL ApplicationsE enclosures, 525-690 V

Suitable for use on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 500/600/690 Volts maximum when protected by the above fuses.

Circuit Breaker Tables

Circuit Breakers manufactured by General Electric, Cat. No. SKHA36AT0800, 600 Vac maximum, with the rating plugs listed below can be used to meet UL requirements.

Size/Type	Rating plug catalog #	Amps
P90	SRPK800A300	300
P110	SRPK800A400	400
P132	SRPK800A400	400
P160	SRPK800A500	500
P200	SRPK800A600	600

Table 3.11: D enclosures, 380-500 V

Non UL compliance

If UL/cUL is not to be complied with, we recommend using the following fuses, which will ensure compliance with EN50178:

In case of malfunction, not following the recommendation may result in unnecessary damage to the frequency converter.

P110 - P200
P250 - P400

380 - 500 V
380 - 500 V

type gG
type gR

3.5.15. Brake Resistor Temperature Switch

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

Screw size: M3

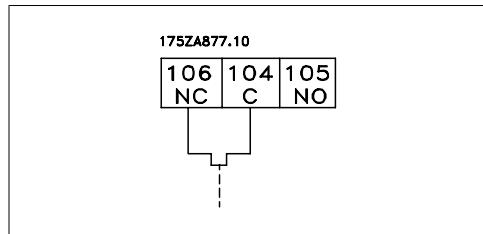
This input can be used to monitor the temperature of an externally connected brake resistor. If the input between 104 and 106 opens, the frequency converter will trip on warning / alarm 27, "Brake IGBT". If the connection is closed between 104 and 105, the frequency converter will trip on warning / alarm 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 KLIKON switch must be installed that is 'normally closed'. If this function is not used, 106 and 104 must be short-circuited together.



3.5.16. Access to Control Terminals

All terminals to the control cables are located beneath the LCP, accessed by opening the door of the IP21/ 54 version or removing the covers of the IP00 version.

3.5.17. Electrical Installation, Control Terminals

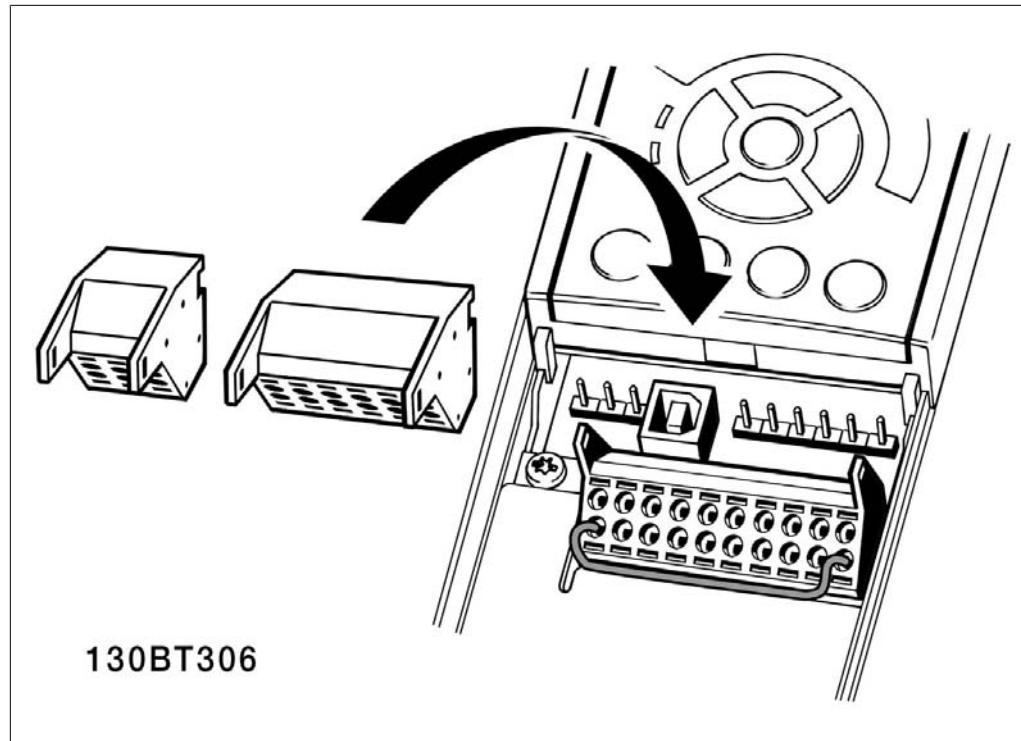
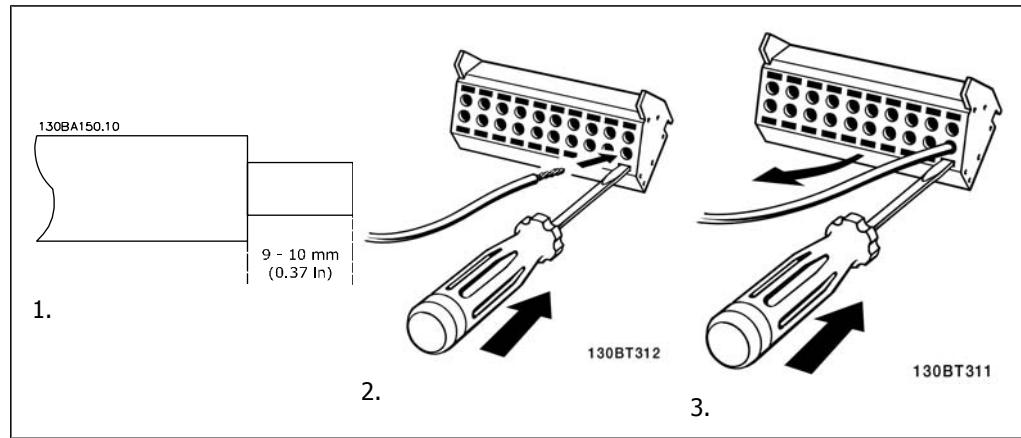
To connect the cable to the terminal:

1. Strip insulation of 9-10 mm
2. Insert a screwdriver¹⁾ in the square hole.
3. Insert the cable in the adjacent circular hole.
4. Remove the screwdriver. The cable is now mounted to the terminal.

To remove the cable from the terminal:

1. Insert a screw driver¹⁾ in the square hole.
2. Pull out the cable.

¹⁾ Max. 0.4 x 2.5 mm

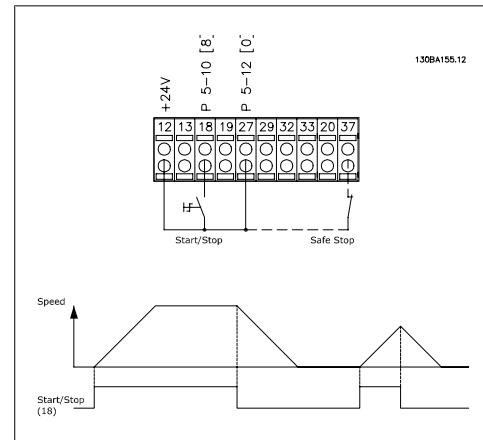


3.6. Connection Examples

3.6.1. Start/Stop

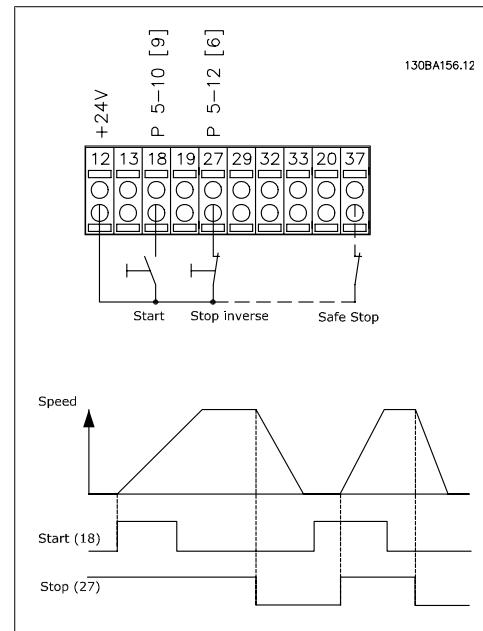
Terminal 18 = Par. 5-10 [8] *Start*
 Terminal 27 = Par. 5-12 [0] *No operation* (Default *coast inverse*)
 Terminal 37 = Safe stop (where available!)

3



3.6.2. Pulse Start/Stop

Terminal 18 = Par. 5-10 [9] *Latched start*
 Terminal 27= Par. 5-12 [6] *Stop inverse*
 Terminal 37 = Safe stop (where available!)



3.6.3. Speed Up/Down

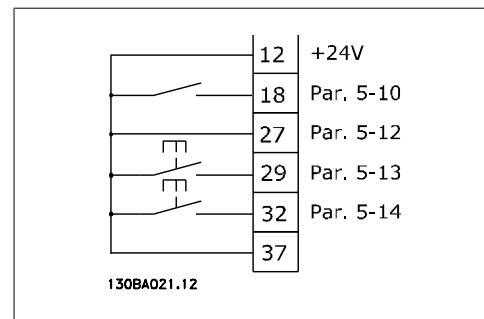
Terminals 29/32 = Speed up/down:

Terminal 18 = Par. 5-10 [9] *Start*
(default)

Terminal 27 = Par. 5-12 [19] *Freeze reference*

Terminal 29 = Par. 5-13 [21] *Speed up*

Terminal 32 = Par. 5-14 [22] *Speed down*



Note: Terminal 29 only in FC x02 (x=series type).

3.6.4. Potentiometer Reference

Voltage reference via a potentiometer:

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

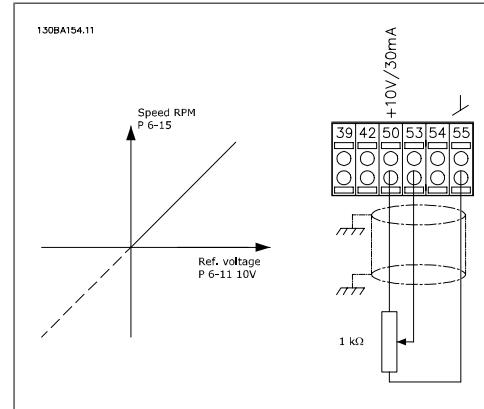
Terminal 53, Low Voltage = 0 Volt

Terminal 53, High Voltage = 10 Volt

Terminal 53, Low Ref./Feedback = 0 RPM

Terminal 53, High Ref./Feedback = 1500 RPM

Switch S201 = OFF (U)



3.7.1. Electrical Installation, Control Cables

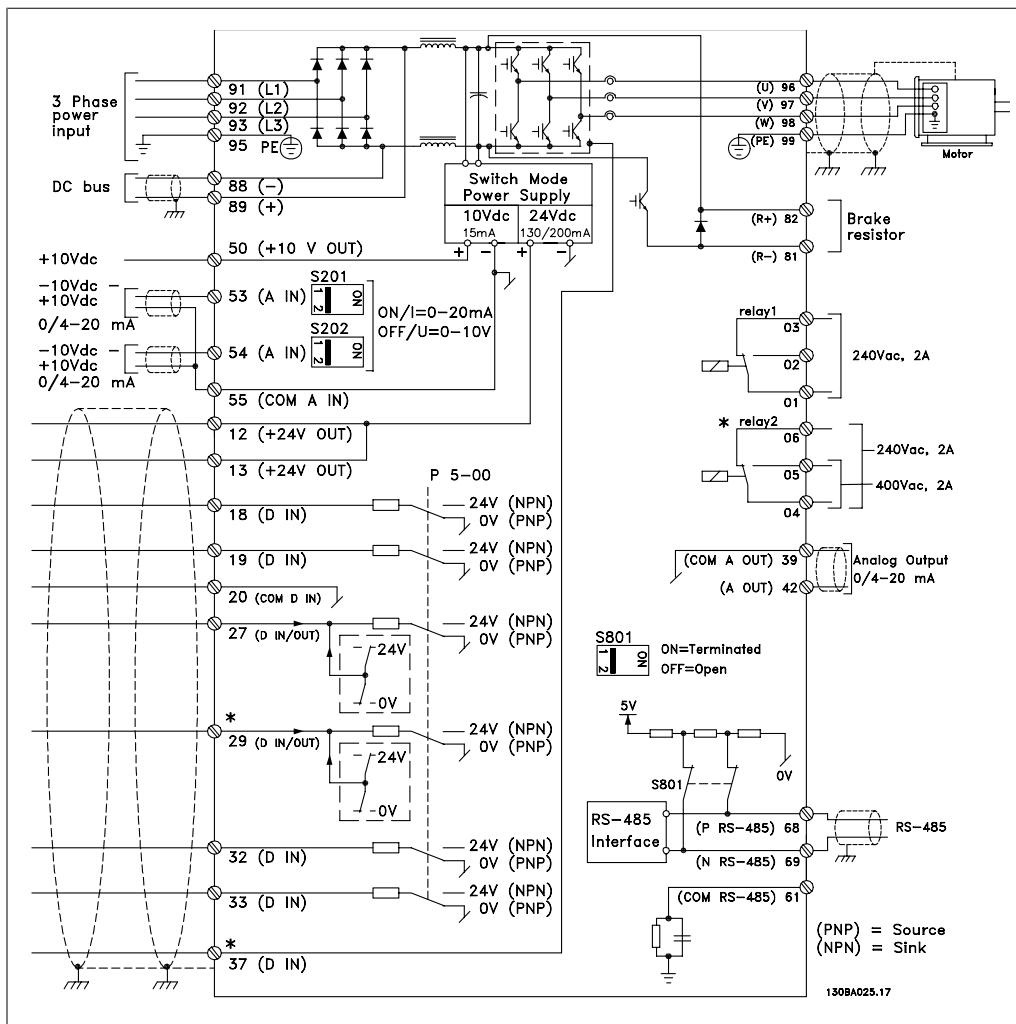


Illustration 3.82: Diagram showing all electrical terminals without options.

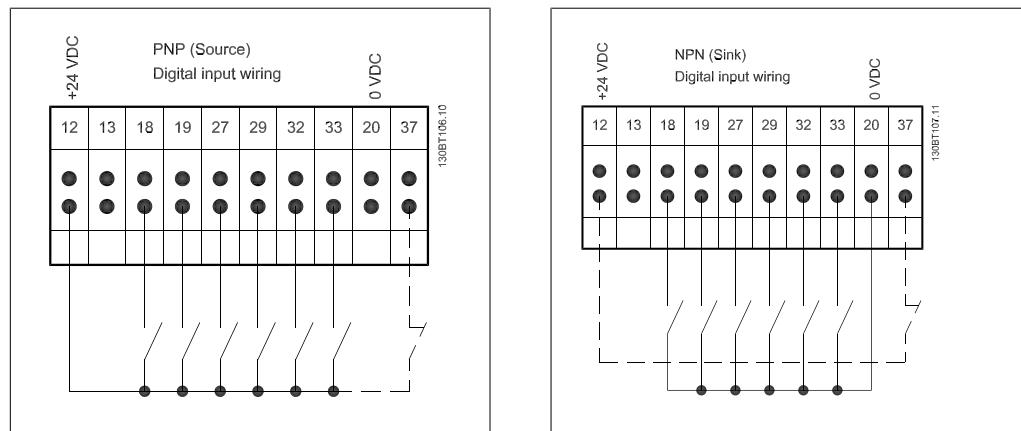
Terminal 37 is the input to be used for Safe Stop. For instructions on Safe Stop installation please refer to the section *Safe Stop Installation* in the frequency converter Design Guide. See also sections Safe Stop and Safe Stop Installation.

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.

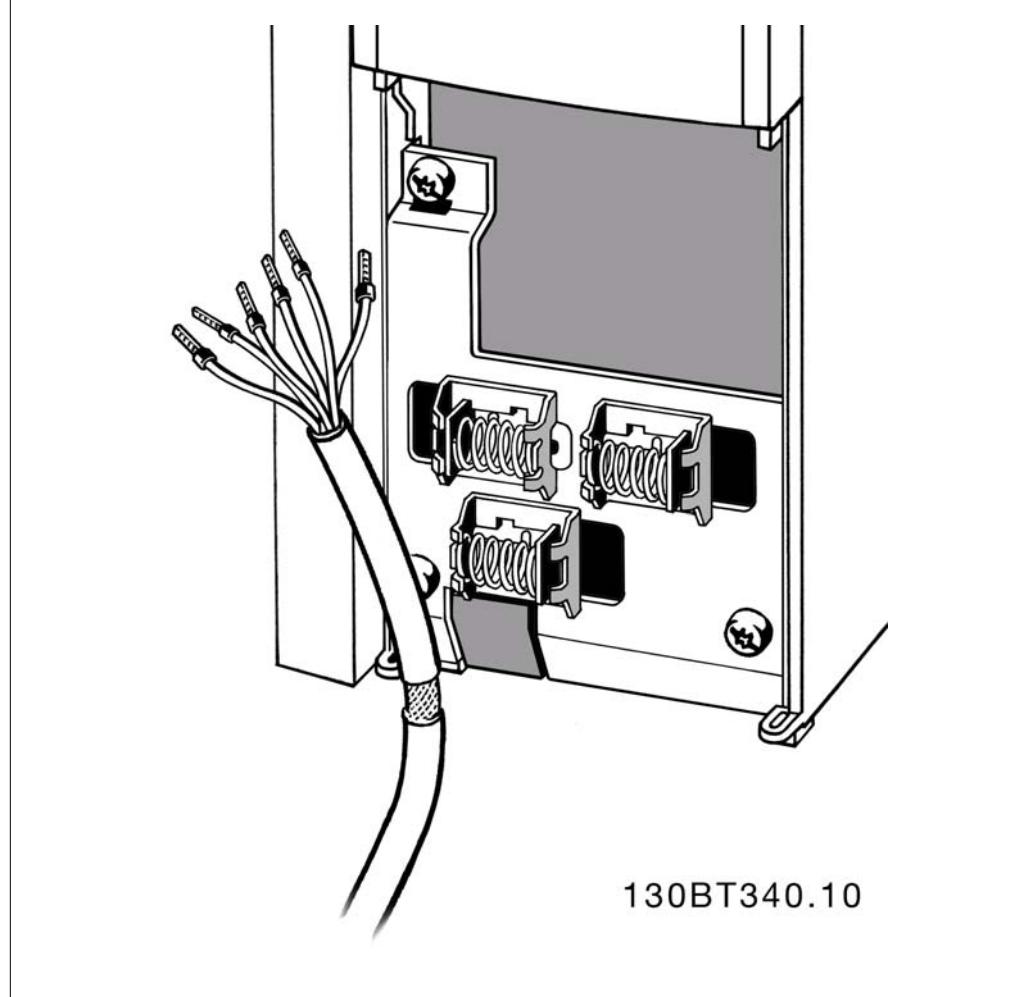
The digital and analog in- and outputs must be connected separately to the frequency converter common inputs (terminal 20, 55, 39) to avoid ground currents from both groups to affect other groups. For example, switching on the digital input may disturb the analog input signal.

Input polarity of control terminals



NB!

Control cables must be screened/armoured.



3.7.2. 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:

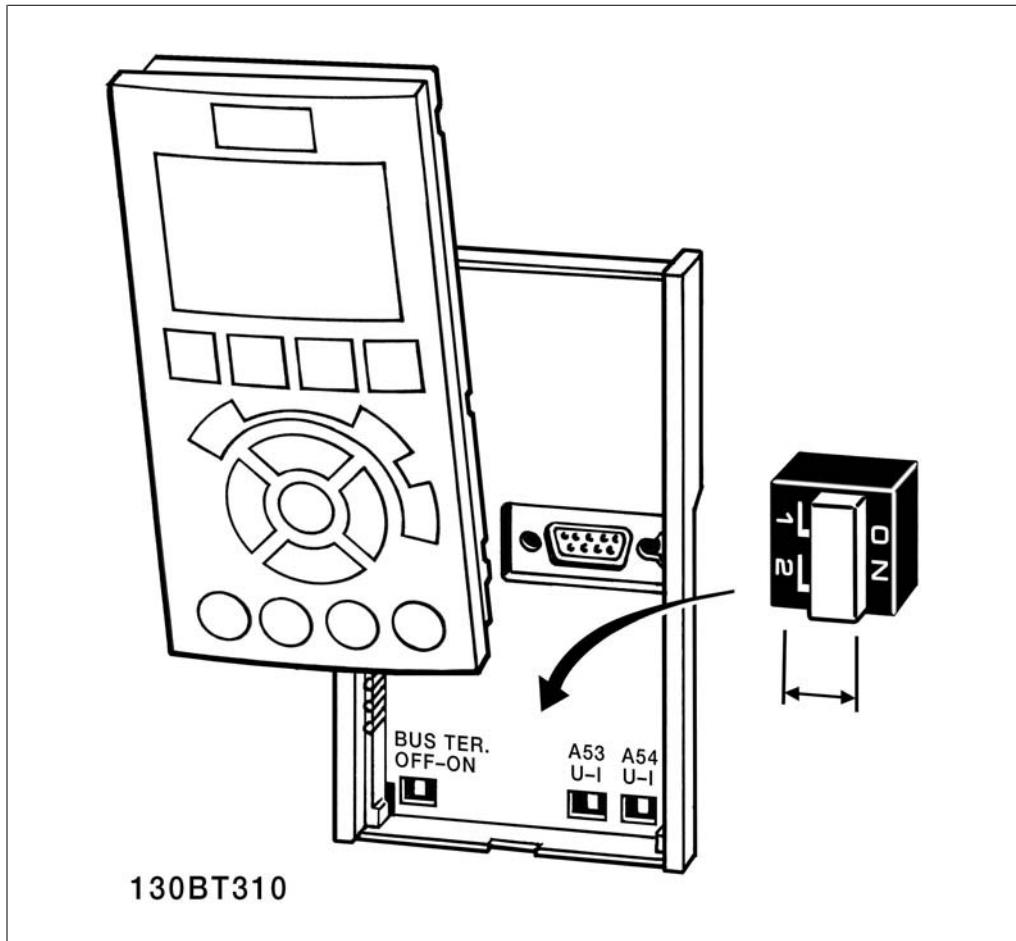
S201 (A53) = OFF (voltage input)

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 LCP fixture (cradle) when operating the switches. The switches must not be operated with power on the frequency converter.



3.8. Final Set-Up and Test

3.8.1. Final Set-Up and Test

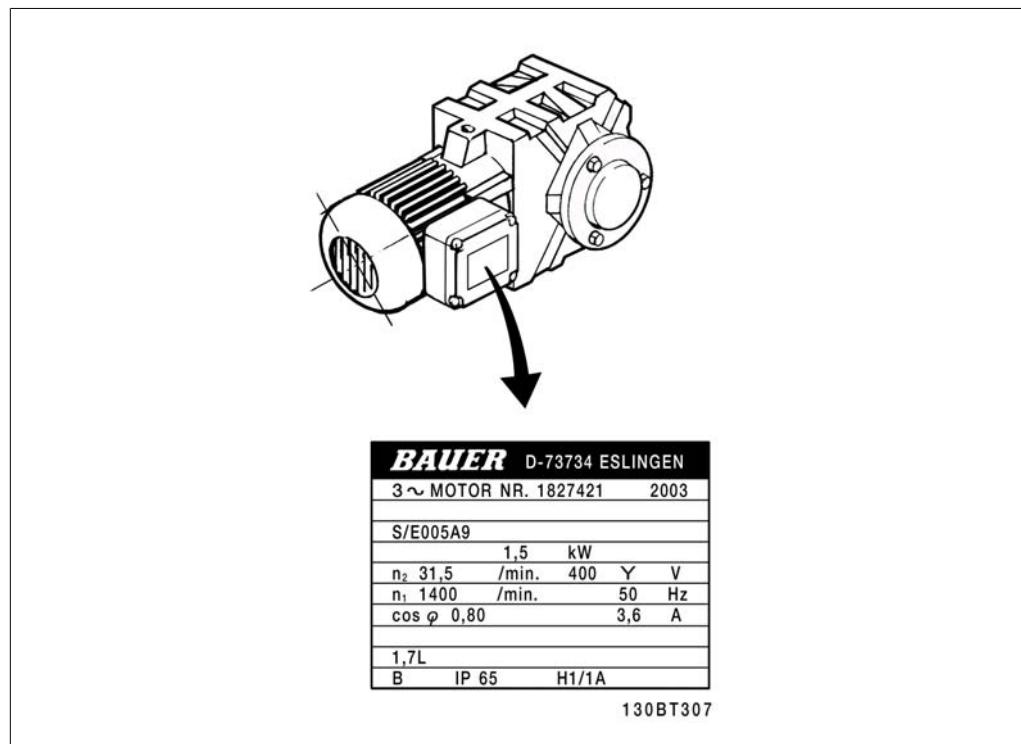
To test the set-up and ensure that the frequency converter is running, follow these steps.

Step 1. Locate the motor name plate



NB!

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



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

To access this list first press the [QUICK MENU] key then select "Q2 Quick Setup".

1.	Motor Power [kW] or Motor Power [HP]	par. 1-20 par. 1-21
2.	Motor Voltage	par. 1-22
3.	Motor Frequency	par. 1-23
4.	Motor Current	par. 1-24
5.	Motor Nominal Speed	par. 1-25

Step 3. Activate the Automatic Motor Adaptation (AMA)

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

1. Connect terminal 37 to terminal 12 (if terminal 37 is available).
2. Connect terminal 27 to terminal 12 or set par. 5-12 to 'No function' (par. 5-12 [0])
3. Activate the AMA par. 1-29.
4. Choose between complete or reduced AMA. If a Sine-wave filter is mounted, run only the reduced AMA, or remove the Sine-wave filter during the AMA procedure.
5. Press the [OK] key. The display shows "Press [Hand on] to start".

6. Press the [Hand on] key. A progress bar indicates if the AMA is in progress.

Stop the AMA during operation

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

Successful AMA

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

Unsuccessful AMA

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 AMA, before the frequency converter entered alarm mode. This number along with the description of the alarm will assist you in troubleshooting. If you contact Danfoss for service, make sure to mention number and alarm description.



NB!

Unsuccessful AMA is often caused by incorrectly registered 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 ramp time

Minimum Reference	par. 3-02
Maximum Reference	par. 3-03

Table 3.12: Set up the desired limits for speed and ramp time.

Motor Speed Low Limit	par. 4-11 or 4-12
Motor Speed High Limit	par. 4-13 or 4-14

Ramp-up Time 1 [s]	par. 3-41
Ramp-down Time 1 [s]	par. 3-42

3.9. Additional Connections

3.9.1. 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 par. 5-4* for applications with an electro-mechanical brake.
- The brake is released when the motor current exceeds the preset value in par. 2-20.
- The brake is engaged when the output frequency is less than the frequency set in par. 2-21 or 2-22, 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

3.9.2. 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.



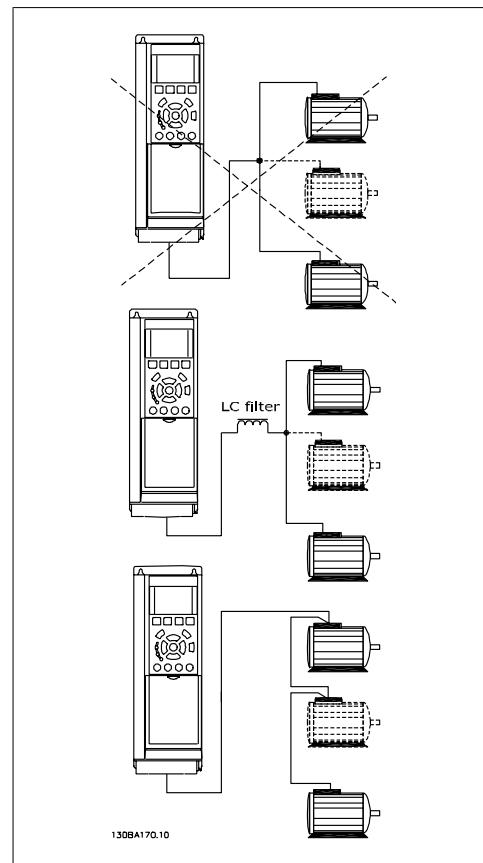
NB!

When motors are connected in parallel, par. 1-29 *Automatic Motor Adaptation (AMA)* cannot be used.



NB!

The electronic thermal relay (ETR) of the frequency converter cannot be used as motor protection for the individual motor of 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.

3.9.3. Motor Thermal Protection

The electronic thermal relay in the frequency converter has received the UL-approval for single motor protection, when par. 1-90 *Motor Thermal Protection* is set for *ETR Trip* and par. 1-24 *Motor current, $I_{M,N}$* is set to the rated motor current (see motor name plate).

For thermal motor protection it is also possible to use the MCB 112 PTC Thermistor Card option. This card provides ATEX certificate to protect motors in explosion hazardous areas, Zone 1/21 and Zone 2/22. Please refer to the *Design Guide* for further information.

4. How to Programme

4.1. The Graphical and Numerical LCP

The easiest programming of the frequency converter is performed by the Graphical Local Control Panel (LCP 102). It is necessary to consult the frequency converter Design Guide, when using the Numeric Local Control Panel (LCP 101).

4.1.1. How to Programme on the Graphical LCP

The following instructions are valid for the graphical LCP (LCP 102):

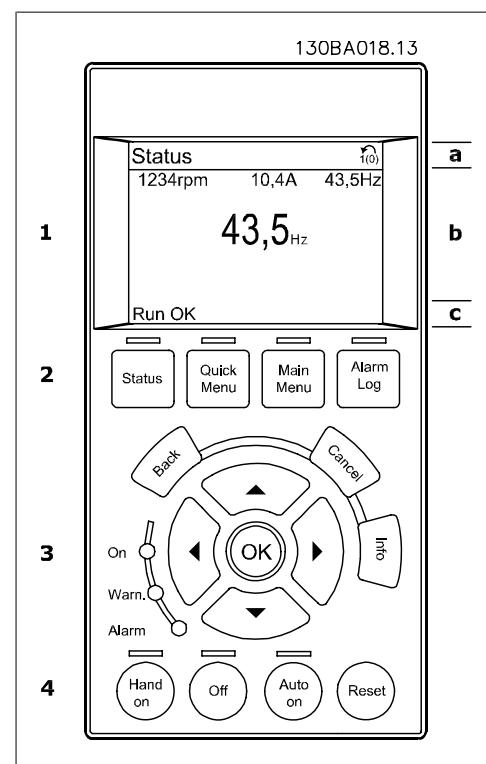
The control panel is divided into four functional groups:

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 a graphical LCP 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.1
- 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.1
- c. **Status line:** Status messages displaying text.1

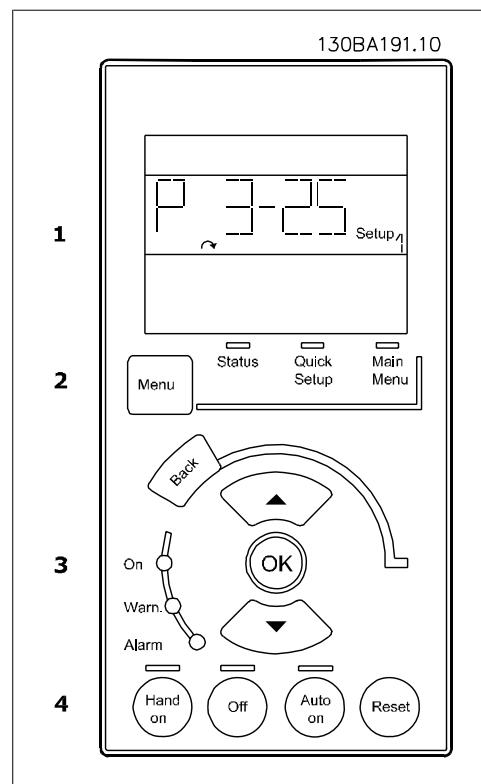


4.1.2. How to Programme on the Numerical Local Control Panel

The following instructions are valid for the numerical LCP (LCP 101):

The control panel is divided into four functional groups:

1. Numerical display.
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).



4.1.3. 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 LCP 102 (read table from left to right):

Press		
	Quick Menu	OK
0-01 Language	OK	Set language
1-20 Motor power	OK	Set Motor nameplate power
1-22 Motor voltage	OK	Set Nameplate voltage
1-23 Motor frequency	OK	Set Nameplate frequency
1-24 Motor current	OK	Set Nameplate current
1-25 Motor nominal speed	OK	Set Nameplate speed in RPM
5-12 Terminal 27 Digital Input	OK	If terminal default is <i>Coast inverse</i> it is possible to change this setting to <i>No function</i> . No connection to terminal 27 is then needed for running AMA
1-29 Automatic Motor Adaptation	OK	Set desired AMA function. Enable complete AMA is recommended
3-02 Minimum reference	OK	Set the minimum speed of the motor shaft
3-03 Maximum reference	OK	Set the maximum speed of the motor shaft
3-41 Ramp1 up time	OK	Set the ramping up time with reference to nominal motor speed (set in par. 1-25)
3-42 Ramp1 down time	OK	Set the ramping down time with reference to nominal motor speed (set in par. 1-25)
3-13 Reference site	OK	Set the site from where the reference must work

4.2. Quick Setup

0-01 Language

Option:
Function:

Defines the language to be used in the display.

The frequency converter can be delivered with 4 different language packages. English and German are included in all packages. English cannot be erased or manipulated.

[0] *	English	Part of Language packages 1 - 4
[1]	German	Part of Language packages 1 - 4
[2]	French	Part of Language package 1
[3]	Danish	Part of Language package 1
[4]	Spanish	Part of Language package 1
[5]	Italian	Part of Language package 1
[6]	Swedish	Part of Language package 1
[7]	Dutch	Part of Language package 1
[10]	Chinese	Language package 2
[20]	Finnish	Part of Language package 1
[22]	English US	Part of Language package 4
[27]	Greek	Part of Language package 4
[28]	Portuguese	Part of Language package 4
[36]	Slovenian	Part of Language package 3
[39]	Korean	Part of Language package 2
[40]	Japanese	Part of Language package 2
[41]	Turkish	Part of Language package 4
[42]	Traditional Chinese	Part of Language package 2
[43]	Bulgarian	Part of Language package 3
[44]	Serbian	Part of Language package 3
[45]	Romanian	Part of Language package 3
[46]	Hungarian	Part of Language package 3
[47]	Czech	Part of Language package 3
[48]	Polish	Part of Language package 4
[49]	Russian	Part of Language package 3
[50]	Thai	Part of Language package 2
[51]	Bahasa Indonesian	Part of Language package 2

1-20 Motor Power

Range:

Size re-[0.09 - 1200 kW]
lated*

Function:

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 LCP if par. 0-03 is *International* [0].

4

1-22 Motor Voltage

Range:

Size re-[10 - 1000 V]
lated*

Function:

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.

1-23 Motor Frequency

Option:

Function:

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. 1-50 to 1-53. For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. Adapt par. 4-13 *Motor Speed High Limit [RPM]* and par. 3-03 *Maximum Reference* to the 87 Hz application.

[50] * 50 Hz when parameter 0-03 = international

[60] 60 Hz when parameter 0-03 = US

1-24 Motor Current

Range:

Size re-[0.1 - 10000 A]
lated*

Function:

Enter the nominal motor current value from the motor nameplate data. This data is used for calculating motor torque, motor thermal protection etc.

This parameter cannot be adjusted while the motor is running.

1-25 Motor Nominal Speed

Range:

Size re-[100 - 60,000 RPM]
lated*

Function:

Enter the nominal motor speed value from the motor nameplate data. This data is used for calculating automatic motor compensations.

This parameter cannot be adjusted while the motor is running.

5-12 Terminal 27 Digital Input**Option:****Function:**

Select the function from the available digital input range.

No operation	[0]
Reset	[1]
Coast inverse	[2]
Coast and reset inverse	[3]
Quick stop inverse	[4]
DC-brake inverse	[5]
Stop inverse	[6]
Start	[8]
Latched start	[9]
Reversing	[10]
Start reversing	[11]
Enable start forward	[12]
Enable start reverse	[13]
Jog	[14]
Preset ref bit 0	[16]
Preset ref bit 1	[17]
Preset ref bit 2	[18]
Freeze reference	[19]
Freeze output	[20]
Speed up	[21]
Speed down	[22]
Set-up select bit 0	[23]
Set-up select bit 1	[24]
Catch up	[28]
Slow down	[29]
Pulse input	[32]
Ramp bit 0	[34]
Ramp bit 1	[35]
Mains failure inverse	[36]
DigiPot Increase	[55]
DigiPot Decrease	[56]
DigiPot Clear	[57]
Reset Counter A	[62]
Reset Counter B	[65]

1-29 Automatic Motor Adaptation (AMA)**Option:****Function:**

The AMA function optimizes dynamic motor performance by automatically optimizing the advanced motor parameters (par. 1-30 to par. 1-35) at motor standstill.

Activate the AMA function by pressing [Hand on] after selecting [1] or [2]. See also the section *Automatic Motor Adaptation*. After a normal sequence, the display will read: "Press [OK] to finish AMA". 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 AMA Performs AMA of the stator resistance R_s , the rotor resistance R_r , the stator leakage reactance X_1 , the rotor leakage reactance

X_2 and the main reactance X_h . Select this option if an LC filter is used between the drive and the motor.

FC 301: The complete AMA does not include X_h measurement for FC 301. Instead, the X_h value is determined from the motor database. Par. 1-35 *Main Reactance (X_h)* may be adjusted to obtain optimal start performance.

[2]	Enable reduced AMA	Performs a reduced AMA of the stator resistance R_s in the system only.
-----	--------------------	---

Note:

- For the best adaptation of the frequency converter, run AMA on a cold motor.
- AMA cannot be performed while the motor is running.
- AMA cannot be performed on permanent magnet motors.



NB!

It is important to set motor par. 1-2* Motor Data correctly, since these form part of the AMA algorithm. An AMA must 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 AMA.



NB!

If one of the settings in par. 1-2* Motor Data is changed, par. 1-30 to 1-39, the advanced motor parameters, will return to default setting.

3-02 Minimum Reference

Range:

0.000 [-100000.000 - par. Unit* 3-03] The *Minimum reference* is the minimum value obtained by the sum of all references. *Minimum reference* is only active if *Min - Max [0]* is set in par. 3-00.

Function:

3-03 Maximum Reference

Range:

1500.00 [Par. 3-02
0* 100000.000]

Function:

- Enter the Maximum Reference. The Maximum Reference is the highest value obtainable by summing all references.

The Maximum Reference unit matches:

- The choice of configuration in par. 1-00 *Configuration Mode*: for *Speed closed loop* [1], RPM; for *Torque* [2], Nm.
- The unit selected in par. 3-01 *Reference/Feedback Unit*.

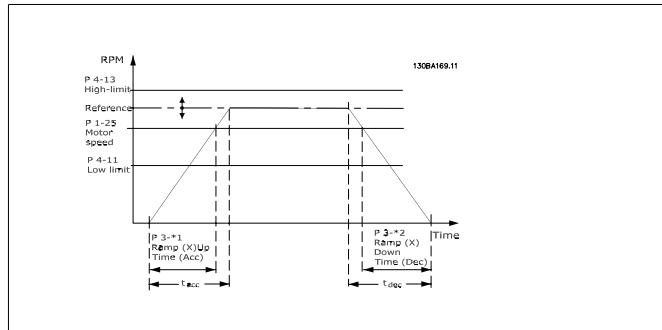
3-41 Ramp 1 Ramp Up Time**Range:**

s* [0.01 - 3600.00 s]

Function:

Enter the ramp-up time, i.e. the acceleration time from 0 RPM to the rated motor speed $n_{M,N}$ (par. 1-25). Choose a ramp-up time such that the output current does not exceed the current limit in par. 4-18 during ramping. The value 0.00 corresponds to 0.01 sec. in speed mode. See ramp-down time in par. 3-42.

$$\text{Par. 3 - 41} = \frac{t_{acc} [\text{s}] \times n_{M,N} (\text{par. 1 - 25}) [\text{RPM}]}{\Delta \text{ref} [\text{RPM}]}$$

**3-42 Ramp 1 Ramp Down Time****Range:**Size re-[0.01 - 3600.00 s]
lated**Function:**

Enter the ramp-down time, i.e. the deceleration time from the rated motor speed $n_{M,N}$ (par. 1-25) to 0 RPM. Choose a ramp-down 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. 4-18. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in par. 3-41.

$$\text{Par. 3 - 42} = \frac{t_{acc} [\text{s}] \times n_{M,N} (\text{par. 1 - 25}) [\text{RPM}]}{\Delta \text{ref} [\text{RPM}]}$$

4.3. Parameter Lists

Changes during operation

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

4-Set-up

'All set-up': the parameters 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 to and from the frequency converter.

Conv. index	100	67	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6
Conv. factor	1	1/60	100000	100000	10000	1000	100	10	1	0.1	0.01	0.00	0.0000	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

See the frequency converter *Design Guide* for further information about data types 33, 35 and 54. Parameters for the frequency converter are grouped into various parameter groups for easy selection of the correct parameters for optimized operation of the frequency converter.

4

0-xx Operation and Display parameters for basic frequency converter settings

1-xx Load and Motor parameters, includes all load and motor related parameters

2-xx Brake parameters

3-xx References and ramping parameters, includes DigiPot function

4-xx Limits Warnings, setting of limits and warning parameters

5-xx Digital inputs and outputs, includes relay controls

6-xx Analog inputs and outputs

7-xx Controls, setting parameters for speed and process controls

8-xx Communication and option parameters, setting of FC RS485 and FC USB port parameters.

9-xx Profibus parameters

10-xx DeviceNet and CAN Fieldbus parameters

13-xx Smart Logic Control parameters

14-xx Special function parameters

15-xx Drive information parameters

16-xx Read out parameters

17-xx Encoder Option parameters

32-xx MCO 305 Basic parameters

33-xx MCO 305 Advanced parameters

34-xx MCO Data Readout parameters

4.3.1. 0-** Operation/Display

Par. No. #	Parameter description	Default value (SR - Size Related)	4-set-up	FC 302 only	Change during operation	Conversion index	Type
0-0* Basic Settings							
0-01 Language	[0] English	1 set-up	TRUE	-	Uint8	-	Uint8
0-02 Motor Speed Unit	[0] RPM	2 set-ups	FALSE	-	Uint8	-	Uint8
0-03 Regional Settings	[0] International	2 set-ups	FALSE	-	Uint8	-	Uint8
0-04 Operating State at Power-up (Hand)	[1] Forced stop, ref=old	All set-ups	TRUE	-	Uint8	-	Uint8
0-1* Set-up Operations							
0-10 Active Set-up	[1] Set-up 1	1 set-up	TRUE	-	Uint8	-	Uint8
0-11 Edit Set-up	[1] Set-up 1	All set-ups	TRUE	-	Uint8	-	Uint8
0-12 This Set-up Linked to	[0] Not linked	All set-ups	FALSE	-	Uint16	0	Uint16
0-13 Readout: Linked Set-ups	0	All set-ups	FALSE	0	Int32	0	Int32
0-14 Readout: Edit Set-ups / Channel	0	All set-ups	TRUE	0	Uint8	-	Uint8
0-2* LCP Display							
0-20 Display Line 1..1 Small	1617	All set-ups	TRUE	-	Uint16	-	Uint16
0-21 Display Line 1..2 Small	1614	All set-ups	TRUE	-	Uint16	-	Uint16
0-22 Display Line 1..3 Small	1610	All set-ups	TRUE	-	Uint16	-	Uint16
0-23 Display Line 2.. Large	1613	All set-ups	TRUE	-	Uint16	-	Uint16
0-24 Display Line 3.. Large	1602	All set-ups	TRUE	-	Uint16	0	Uint16
0-25 My Personal Menu	SR	1 set-up	TRUE	0	Uint16	-	Uint16
0-3* LCP Custom Readout							
0-30 Unit for User-defined Readout	[0] None	All set-ups	TRUE	-	Uint8	-	Uint8
0-31 Min Value of User-defined Readout	0.00	All set-ups	TRUE	-2	Int32	-2	Int32
0-32 Max Value of User-defined Readout	100.00	All set-ups	TRUE	-2	Int32	-2	Int32
0-4* LCP Keypad							
0-40 [Hand on] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8	-	Uint8
0-41 [Off] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8	-	Uint8
0-42 [Auto on] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8	-	Uint8
0-43 [Reset] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8	-	Uint8
0-5* Copy/Save							
0-50 LCP Copy	[0] No copy	All set-ups	FALSE	-	Uint8	-	Uint8
0-51 Set-up Copy	[0] No copy	All set-ups	FALSE	-	Uint8	-	Uint8
0-6* Password							
0-60 Main Menu Password	100	1 set-up	TRUE	0	Uint16	-	Uint16
0-61 Access to Main Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8	-	Uint8
0-65 Quick Menu Password	200	1 set-up	TRUE	0	Uint16	-	Uint16
0-66 Access to Quick Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8	-	Uint8

4.3.2. 1-** Load/Motor

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
1-0* General Settings							
1-00 Configuration Mode	null	All set-ups	TRUE	-	Uint8	-	Uint8
1-01 Motor Control Principle	null	All set-ups	FALSE	-	Uint8	-	Uint8
1-02 Flux Motor Feedback Source	[1] 24V encoder	All set-ups	FALSE	-	Uint8	-	Uint8
1-03 Torque Characteristics	[0] Constant torque	All set-ups	TRUE	-	Uint8	-	Uint8
1-04 Overload Mode	[0] High torque	All set-ups	FALSE	-	Uint8	-	Uint8
1-05 Local Mode Configuration	[2] As mode par 1-00	All set-ups	TRUE	-	Uint8	-	Uint8
1-1* Motor Selection							
1-10 Motor Construction	[0] Asynchron	All set-ups	FALSE	-	Uint8	-	Uint8
1-2* Motor Data							
1-20 Motor Power [kW]	ExpressionLimit	All set-ups	FALSE	1	Uint32	-	Uint32
1-21 Motor Power [HP]	ExpressionLimit	All set-ups	FALSE	-2	Uint32	-	Uint16
1-22 Motor Voltage	ExpressionLimit	All set-ups	FALSE	0	Uint16	-	Uint16
1-23 Motor Frequency	ExpressionLimit	All set-ups	FALSE	0	Uint16	-	Uint32
1-24 Motor Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32	-	Uint16
1-25 Motor Nominal Speed	ExpressionLimit	All set-ups	FALSE	67	Uint16	-	Uint32
1-26 Motor Cont. Rated Torque	ExpressionLimit	All set-ups	FALSE	-1	Uint32	-	Uint8
1-29 Automatic Motor Adaptation (AMA)	[0] Off	All set-ups	FALSE	-	Uint8	-	Uint8
1-3* Adv. Motor Data							
1-30 Stator Resistance (Rs)	ExpressionLimit	All set-ups	FALSE	-4	Uint32	-	Uint32
1-31 Rotor Resistance (Rr)	ExpressionLimit	All set-ups	FALSE	-4	Uint32	-	Uint32
1-33 Stator Leakage Reactance (X1)	ExpressionLimit	All set-ups	FALSE	-4	Uint32	-	Uint32
1-34 Rotor Leakage Reactance (X2)	ExpressionLimit	All set-ups	FALSE	-4	Uint32	-	Uint32
1-35 Main Reactance (Xh)	ExpressionLimit	All set-ups	FALSE	-4	Uint32	-	Uint32
1-36 Iron Loss Resistance (Rfe)	ExpressionLimit	All set-ups	FALSE	-3	Int32	-	Int32
1-37 d-axis Inductance (Ld)	ExpressionLimit	All set-ups	FALSE	-4	Uint8	-	Uint8
1-39 Motor Poles	ExpressionLimit	All set-ups	FALSE	0	Uint16	-	Uint16
1-40 Back EMF at 1000 RPM	ExpressionLimit	All set-ups	FALSE	0	Uint16	-	Uint16
1-41 Motor Angle Offset	0 N/A	All set-ups	FALSE	0	Uint16	-	Uint16
1-5* Load Indep. Setting							
1-50 Motor Magnetisation at Zero Speed	100 %	All set-ups	TRUE	0	Uint16	-	Uint16
1-51 Min Speed Normal Magnetising [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16	-	Uint16
1-52 Min Speed Normal Magnetising [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16	-	Uint16
1-53 Model Shift Frequency	ExpressionLimit	All set-ups	FALSE	-1	Uint16	-	Uint16
1-55 U/f Characteristic - U	ExpressionLimit	All set-ups	TRUE	-1	Uint16	-	Uint16
1-56 U/f Characteristic - F	ExpressionLimit	All set-ups	TRUE	-1	Uint16	-	Uint16

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
1-6* Load Depen. Setting							
1-60	Low Speed Load Compensation	100 %	All set-ups	TRUE	0	Int16	
1-61	High Speed Load Compensation	100 %	All set-ups	TRUE	0	Int16	
1-62	Slip Compensation	ExpressionLimit	All set-ups	TRUE	0	Int16	
1-63	Slip Compensation Time Constant	ExpressionLimit	All set-ups	TRUE	-2	Uint16	
1-64	Resonance Dampening	100 %	All set-ups	TRUE	0	Uint16	
1-65	Resonance Dampening Time Constant	5 ms	All set-ups	TRUE	-3	Uint8	
1-66	Min. Current at Low Speed	100 %	All set-ups	TRUE	0	Uint8	
1-67	Load Type	[0] Passive load	All set-ups	TRUE	-	Uint32	
1-68	Minimum Inertia	ExpressionLimit	All set-ups	FALSE	-4	Uint32	
1-69	Maximum Inertia	ExpressionLimit	All set-ups	FALSE	-4	Uint32	
1-7* Start Adjustments							
1-71	Start Delay	0.0 s	All set-ups	TRUE	-1	Uint8	
1-72	Start Function	[2] Coast/delay time	All set-ups	TRUE	-	Uint8	
1-73	Flying Start	[0] Disabled	All set-ups	FALSE	-	Uint8	
1-74	Start Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16	
1-75	Start Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16	
1-76	Start Current	0.00 A	All set-ups	TRUE	-2	Uint32	
1-8* Stop Adjustments							
1-80	Function at Stop	[0] Coast	All set-ups	TRUE	-	Uint8	
1-81	Min Speed for Function at Stop [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16	
1-82	Min Speed for Function at Stop [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16	
1-83	Precise Stop Function	[0] Precise ramp stop	All set-ups	FALSE	-	Uint8	
1-84	Precise Stop Counter Value	100000 N/A	All set-ups	TRUE	0	Uint32	
1-85	Precise Stop Speed Compensation Delay	10 ms	All set-ups	TRUE	-3	Uint8	
1-9* Motor Temperature							
1-90	Motor Thermal Protection	[0] No protection	All set-ups	TRUE	-	Uint8	
1-91	Motor External Fan	[0] No	All set-ups	TRUE	-	Uint16	
1-93	Thermistor Resource	[0] None	All set-ups	TRUE	-	Uint8	
1-95	KTY Sensor Type	[0] KTY Sensor 1	All set-ups	TRUE	-	Uint8	
1-96	KTY Thermistor Resource	[0] None	All set-ups	TRUE	-	Uint8	
1-97	KTY Threshold level	80 °C	1 set-up	TRUE	100	Int16	

4.3.3. 2-** Brakes

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
2-0* DC-Brake							
2-00	DC Hold Current	50 %	All set-ups	TRUE	0	Uint8	
2-01	DC Brake Current	50 %	All set-ups	TRUE	0	Uint16	
2-02	DC Braking Time	10.0 s	All set-ups	TRUE	-1	Uint16	
2-03	DC Brake Cut In Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16	
2-04	DC Brake Cut In Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16	
2-1* Brake Energy Funct.							
2-10	Brake Function	null	All set-ups	TRUE	-	Uint8	
2-11	Brake Resistor (ohm)	ExpressionLimit	All set-ups	TRUE	0	Uint16	
2-12	Brake Power Limit (kW)	ExpressionLimit	All set-ups	TRUE	0	Uint32	
2-13	Brake Power Monitoring	[0] Off	All set-ups	TRUE	-	Uint8	
2-15	Brake Check	[0] Off	All set-ups	TRUE	-	Uint8	
2-16	AC brake Max. Current	100.0 %	All set-ups	TRUE	-1	Uint32	
2-17	Over-voltage Control	[0] Disabled	All set-ups	TRUE	-	Uint8	
2-2* Mechanical Brake							
2-20	Release Brake Current	ImaxVLT (P1637)	All set-ups	TRUE	-2	Uint32	
2-21	Activate Brake Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16	
2-22	Activate Brake Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16	
2-23	Activate Brake Delay	0.0 s	All set-ups	TRUE	-1	Uint8	
2-24	Stop Delay	0.0 s	All set-ups	TRUE	-1	Uint8	
2-25	Brake Release Time	0.20 s	All set-ups	TRUE	-2	Uint16	
2-26	Torque Ref	0.00 %	All set-ups	TRUE	-2	Int16	
2-27	Torque Ramp Time	0.2 s	All set-ups	TRUE	-1	Uint8	
2-28	Gain Boost Factor	1.00 N/A	All set-ups	TRUE	-2	Uint16	

4.3.4. 3-** Reference / Ramps

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during op- eration	Conver- sion index	Type
3-0* Reference Limits							
3-00	Reference Range	null	All set-ups	TRUE	-	Uint8	
3-01	Reference/Feedback Unit	null	All set-ups	TRUE	-	Uint8	
3-02	Minimum Reference	0 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32	
3-03	Maximum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32	
3-04	Reference Function	[0] Sum	All set-ups	TRUE	-	Uint8	
3-1* References							
3-10	Preset Reference	0.00 %	All set-ups	TRUE	-2	Int16	
3-11	Jog Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16	
3-12	Catch up/Slow Down Value	0.00 %	All set-ups	TRUE	-2	Int16	
3-13	Reference Site	[0] Linked to Hand / Auto	All set-ups	TRUE	-	Uint8	
3-14	Preset Relative Reference	0.00 %	All set-ups	TRUE	-2	Int32	
3-15	Reference Resource 1	null	All set-ups	TRUE	-	Uint8	
3-16	Reference Resource 2	null	All set-ups	TRUE	-	Uint8	
3-17	Reference Resource 3	null	All set-ups	TRUE	-	Uint8	
3-18	Relative Scaling Reference Resource	[0] No function	All set-ups	TRUE	-	Uint8	
3-19	Jog Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16	
3-4* Ramp 1							
3-40	Ramp 1 Type	[0] Linear	All set-ups	TRUE	-	Uint8	
3-41	Ramp 1 Ramp up Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32	
3-42	Ramp 1 Ramp Down Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32	
3-45	Ramp 1 S-ramp Ratio at Accel. Start	50 %	All set-ups	TRUE	0	Uint8	
3-46	Ramp 1 S-ramp Ratio at Accel. End	50 %	All set-ups	TRUE	0	Uint8	
3-47	Ramp 1 S-ramp Ratio at Decel. Start	50 %	All set-ups	TRUE	0	Uint8	
3-48	Ramp 1 S-ramp Ratio at Decel. End	50 %	All set-ups	TRUE	0	Uint8	
3-5* Ramp 2							
3-50	Ramp 2 Type	[0] Linear	All set-ups	TRUE	-	Uint8	
3-51	Ramp 2 Ramp up Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32	
3-52	Ramp 2 Ramp down Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32	
3-55	Ramp 2 S-ramp Ratio at Accel. Start	50 %	All set-ups	TRUE	0	Uint8	
3-56	Ramp 2 S-ramp Ratio at Accel. End	50 %	All set-ups	TRUE	0	Uint8	
3-57	Ramp 2 S-ramp Ratio at Decel. Start	50 %	All set-ups	TRUE	0	Uint8	
3-58	Ramp 2 S-ramp Ratio at Decel. End	50 %	All set-ups	TRUE	0	Uint8	

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
3-6* Ramp 3							
3-60	Ramp 3 Type	[0] Linear	All set-ups	TRUE	-	UInt8	
3-61	Ramp 3 Ramp up Time	ExpressionLimit	All set-ups	TRUE	-2	UInt32	
3-62	Ramp 3 Ramp down Time	ExpressionLimit	All set-ups	TRUE	-2	UInt32	
3-65	Ramp 3 S-ramp Ratio at Accel. Start	50 %	All set-ups	TRUE	0	UInt8	
3-66	Ramp 3 S-ramp Ratio at Accel. End	50 %	All set-ups	TRUE	0	UInt8	
3-67	Ramp 3 S-ramp Ratio at Decel. Start	50 %	All set-ups	TRUE	0	UInt8	
3-68	Ramp 3 S-ramp Ratio at Decel. End	50 %	All set-ups	TRUE	0	UInt8	
3-7* Ramp 4							
3-70	Ramp 4 Type	[0] Linear	All set-ups	TRUE	-	UInt8	
3-71	Ramp 4 Ramp up Time	ExpressionLimit	All set-ups	TRUE	-2	UInt32	
3-72	Ramp 4 Ramp Down Time	ExpressionLimit	All set-ups	TRUE	-2	UInt32	
3-75	Ramp 4 S-ramp Ratio at Accel. Start	50 %	All set-ups	TRUE	0	UInt8	
3-76	Ramp 4 S-ramp Ratio at Accel. End	50 %	All set-ups	TRUE	0	UInt8	
3-77	Ramp 4 S-ramp Ratio at Decel. Start	50 %	All set-ups	TRUE	0	UInt8	
3-78	Ramp 4 S-ramp Ratio at Decel. End	50 %	All set-ups	TRUE	0	UInt8	
3-8* Other Ramps							
3-80	Jog Ramp Time	ExpressionLimit	All set-ups	TRUE	-2	UInt32	
3-81	Quick Stop Ramp Time	ExpressionLimit	2 set-ups	TRUE	-2	UInt32	
3-9* Digital Pot.Meter							
3-90	Step Size	0.10 %	All set-ups	TRUE	-2	UInt16	
3-91	Ramp Time	1.00 s	All set-ups	TRUE	-2	UInt32	
3-92	Power Restore	[0] Off	All set-ups	TRUE	-	UInt8	
3-93	Maximum Limit	100 %	All set-ups	TRUE	0	Int16	
3-94	Minimum Limit	-100 %	All set-ups	TRUE	0	Int16	
3-95	Ramp Delay	1.000 N/A	All set-ups	TRUE	-3	TimD	

4.3.5. 4-** Limits / Warnings

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during op- eration	Conver- sion index	Type
4-1* Motor Limits							
4-10	Motor Speed Direction	null	All set-ups	FALSE	-	Uint8	
4-11	Motor Speed Low Limit [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16	
4-12	Motor Speed Low Limit [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16	
4-13	Motor Speed High Limit [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16	
4-14	Motor Speed High Limit [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16	
4-16	Torque Limit Motor Mode	ExpressionLimit	All set-ups	TRUE	-1	Uint16	
4-17	Torque Limit Motor Mode	100.0 %	All set-ups	TRUE	-1	Uint16	
4-18	Current Limit	ExpressionLimit	All set-ups	TRUE	-1	Uint32	
4-19	Max Output Frequency	132.0 Hz	All set-ups	FALSE	-1	Uint16	
4-2* Limit Factors							
4-20	Torque Limit Factor Source	[0] No function	All set-ups	TRUE	-	Uint8	
4-21	Speed Limit Factor Source	[0] No function	All set-ups	TRUE	-	Uint8	
4-3* Motor Fb Monitor							
4-30	Motor Feedback Loss Function	[2] Trip	All set-ups	TRUE	-	Uint8	
4-31	Motor Feedback Speed Error	300 RPM	All set-ups	TRUE	67	Uint16	
4-32	Motor Feedback Loss Timeout	0.05 s	All set-ups	TRUE	-2	Uint16	
4-5* Adj. Warnings							
4-50	Warning Current Low	0.00 A	All set-ups	TRUE	-2	Uint32	
4-51	Warning Current High	ImaxVLT (P1637)	All set-ups	TRUE	-2	Uint32	
4-52	Warning Speed Low	0 RPM	All set-ups	TRUE	67	Uint16	
4-53	Warning Speed High	outputSpeedHighLimit (P413)	All set-ups	TRUE	67	Uint16	
4-54	Warning Reference Low	-999999.999 N/A	All set-ups	TRUE	-3	Int32	
4-55	Warning Reference High	999999.999 N/A	All set-ups	TRUE	-3	Int32	
4-56	Warning Feedback Low	-999999.999 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32	
4-57	Warning Feedback High	999999.999 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32	
4-58	Missing Motor Phase Function	[1] On	All set-ups	TRUE	-	Uint8	
4-6* Speed Bypass							
4-60	Bypass Speed From [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16	
4-61	Bypass Speed From [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16	
4-62	Bypass Speed To [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16	
4-63	Bypass Speed To [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16	

4.3.6. 5-** Digital In/Out

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
5-0* Digital I/O mode							
5-00	Digital I/O Mode	[0] PNP	All set-ups	-	FALSE	-	UInt8
5-01	Terminal 27 Mode	[0] Input	All set-ups	-	TRUE	-	UInt8
5-02	Terminal 29 Mode	[0] Input	All set-ups	x	TRUE	-	UInt8
5-1* Digital Inputs							
5-10	Terminal 18 Digital Input	null	All set-ups	-	TRUE	-	UInt8
5-11	Terminal 19 Digital Input	null	All set-ups	-	TRUE	-	UInt8
5-12	Terminal 27 Digital Input	null	All set-ups	-	TRUE	-	UInt8
5-13	Terminal 29 Digital Input	null	All set-ups	x	TRUE	-	UInt8
5-14	Terminal 32 Digital Input	[0] No operation	All set-ups	-	TRUE	-	UInt8
5-15	Terminal 33 Digital Input	[0] No operation	All set-ups	-	TRUE	-	UInt8
5-16	Terminal X30/2 Digital Input	[0] No operation	All set-ups	-	TRUE	-	UInt8
5-17	Terminal X30/3 Digital Input	[0] No operation	All set-ups	-	TRUE	-	UInt8
5-18	Terminal X30/4 Digital Input	[0] No operation	All set-ups	-	TRUE	-	UInt8
5-19	Terminal 37 Safe Stop	[1] Safe Stop Alarm	1 set-up	x	TRUE	-	UInt8
5-3* Digital Outputs							
5-30	Terminal 27 Digital Output	null	All set-ups	-	TRUE	-	UInt8
5-31	Terminal 29 Digital Output	null	All set-ups	x	TRUE	-	UInt8
5-32	Term X30/6 Digi Out (MCB 101)	null	All set-ups	-	TRUE	-	UInt8
5-33	Term X30/7 Digi Out (MCB 101)	null	All set-ups	-	TRUE	-	UInt8
5-4* Relays							
5-40	Function Relay	null	All set-ups	-	TRUE	-	UInt8
5-41	On Delay, Relay	0.01 s	All set-ups	-	TRUE	-2	UInt16
5-42	Off Delay, Relay	0.01 s	All set-ups	-	TRUE	-2	UInt16
5-5* Pulse Input							
5-50	Term. 29 Low Frequency	100 Hz	All set-ups	x	TRUE	0	UInt32
5-51	Term. 29 High Frequency	100 Hz	All set-ups	x	TRUE	0	UInt32
5-52	Term. 29 Low Ref./Feedb. Value	0.000 ReferenceFeedbackUnit	All set-ups	x	TRUE	3	Int32
5-53	Term. 29 High Ref./Feedb. Value	Expression,limit	All set-ups	x	TRUE	-3	Int32
5-54	Pulse Filter Time Constant #29	100 ms	All set-ups	x	FALSE	-3	UInt16
5-55	Term. 33 Low Frequency	100 Hz	All set-ups	-	TRUE	0	UInt32
5-56	Term. 33 High Frequency	100 Hz	All set-ups	-	TRUE	0	UInt32
5-57	Term. 33 Low Ref./Feedb. Value	0.000 ReferenceFeedbackUnit	All set-ups	-	TRUE	-3	Int32
5-58	Term. 33 High Ref./Feedb. Value	Expression,limit	All set-ups	-	TRUE	-3	Int32
5-59	Pulse Filter Time Constant #33	100 ms	All set-ups	-	FALSE	-3	UInt16

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
5.6* Pulse Output							
5-60	Terminal 27 Pulse Output Variable	null	All set-ups	TRUE	-	Uint8	
5-62	Pulse Output Max Freq #27	ExpressionLimit	All set-ups	TRUE	0	Uint32	
5-63	Terminal 29 Pulse Output Variable	null	All set-ups	TRUE	-	Uint8	
5-65	Pulse Output Max Freq #29	ExpressionLimit	All set-ups	TRUE	0	Uint32	
5-66	Terminal X30/6 Pulse Output Variable	null	All set-ups	TRUE	-	Uint8	
5-68	Pulse Output Max Freq #X30/6	ExpressionLimit	All set-ups	TRUE	0	Uint32	
5.7* 24V Encoder Input							
5-70	Term 32/33 Pulses per Revolution	1024 N/A	All set-ups	FALSE	0	Uint16	
5-71	Term 32/33 Encoder Direction	[0] Clockwise	All set-ups	FALSE	-	Uint8	
5.9* Bus Controlled							
5-90	Digital & Relay Bus Control	0 N/A	All set-ups	TRUE	0	Uint32	
5-93	Pulse Out #27 Bus Control	0.00 %	All set-ups	TRUE	-2	N2	
5-94	Pulse Out #27 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16	
5-95	Pulse Out #29 Bus Control	0.00 %	All set-ups	TRUE	-2	N2	
5-96	Pulse Out #29 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16	

4.3.7. 6-** Analog In/Out

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
6-0* Analog I/O Mode							
6-00	Live Zero Timeout Time	10 s	All set-ups	TRUE	0	UInt8	
6-01	Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	UInt8	
6-1* Analog Input 1							
6-10	Terminal 53 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16	
6-11	Terminal 53 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16	
6-12	Terminal 53 Low Current	0.14 mA	All set-ups	TRUE	-5	Int16	
6-13	Terminal 53 High Current	20.00 mA	All set-ups	TRUE	-5	Int16	
6-14	Terminal 53 Low Ref./Feedb. Value	0 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32	
6-15	Terminal 53 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32	
6-16	Terminal 53 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	UInt16	
6-2* Analog Input 2							
6-20	Terminal 54 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16	
6-21	Terminal 54 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16	
6-22	Terminal 54 Low Current	0.14 mA	All set-ups	TRUE	-5	Int16	
6-23	Terminal 54 High Current	20.00 mA	All set-ups	TRUE	-5	Int16	
6-24	Terminal 54 Low Ref./Feedb. Value	0 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32	
6-25	Terminal 54 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32	
6-26	Terminal 54 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	UInt16	
6-3* Analog Input 3							
6-30	Terminal X30/11_Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16	
6-31	Terminal X30/11_High Voltage	10.00 V	All set-ups	TRUE	-2	Int16	
6-34	Term. X30/11_Low Ref./Feedb. Value	0 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32	
6-35	Term. X30/11_High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32	
6-36	Term. X30/11_Filter Time Constant	0.001 s	All set-ups	TRUE	-3	UInt16	
6-4* Analog Input 4							
6-40	Terminal X30/12_Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16	
6-41	Terminal X30/12_High Voltage	10.00 V	All set-ups	TRUE	-2	Int16	
6-44	Term. X30/12_Low Ref./Feedb. Value	0 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32	
6-45	Term. X30/12_High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32	
6-46	Term. X30/12_Filter Time Constant	0.001 s	All set-ups	TRUE	-3	UInt16	
6-5* Analog Output 1							
6-50	Terminal 42_Output	null	All set-ups	TRUE	-	UInt8	
6-51	Terminal 42_Output Min Scale	0.00 %	All set-ups	TRUE	-2	Int16	
6-52	Terminal 42_Output Max Scale	100.00 %	All set-ups	TRUE	-2	Int16	
6-53	Terminal 42_Output Bus Control	0.00 %	All set-ups	TRUE	-2	N2	
6-54	Terminal 42_Output Timeout Preset	0.00 %	1 set-up	TRUE	-2	UInt16	
6-6* Analog Output 2							
6-60	Terminal X30/8_Output	null	All set-ups	TRUE	-	UInt8	
6-61	Terminal X30/8_Min. Scale	0.00 %	All set-ups	TRUE	-2	Int16	
6-62	Terminal X30/8_Max. Scale	100.00 %	All set-ups	TRUE	-2	Int16	

4.3.8. 7-** Controllers

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during op- eration	Conver- sion index	Type
7-0* Speed PID Ctrl.							
7-00	Speed PID Feedback Source	null	All set-ups	FALSE	-	Uint8	
7-02	Speed PID Proportional Gain	ExpressionLimit	All set-ups	TRUE	-3	Uint16	
7-03	Speed PID Integral Time	ExpressionLimit	All set-ups	TRUE	-4	Uint32	
7-04	Speed PID Differentiation Time	ExpressionLimit	All set-ups	TRUE	-4	Uint16	
7-05	Speed PID Diff. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16	
7-06	Speed PID Lowpass Filter Time	10.0 ms	All set-ups	TRUE	-4	Uint16	
7-08	Speed PID Feed Forward Factor	0 %	All set-ups	FALSE	0	Uint16	
7-2* Process Ctrl. Feedb.							
7-20	Process CL Feedback 1 Resource	[0] No function	All set-ups	TRUE	-	Uint8	
7-22	Process CL Feedback 2 Resource	[0] No function	All set-ups	TRUE	-	Uint8	
7-3* Process PID Ctrl.							
7-30	Process PID Normal/ Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8	
7-31	Process PID Anti Windup	[1] On	All set-ups	TRUE	-	Uint8	
7-32	Process PID Start Speed	0 RPM	All set-ups	TRUE	67	Uint16	
7-33	Process PID Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16	
7-34	Process PID Integral Time	1.0000.00 s	All set-ups	TRUE	-2	Uint32	
7-35	Process PID Differentiation Time	0.00 s	All set-ups	TRUE	-2	Uint16	
7-36	Process PID Diff. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16	
7-38	Process PID Feed Forward Factor	0 %	All set-ups	TRUE	0	Uint16	
7-39	On Reference Bandwidth	5 %	All set-ups	TRUE	0	Uint8	

4.3.9. 8-** Comm. and Options

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
8-0* General Settings							
8-01	Control Site	[0] Digital and ctrl.word null	All set-ups	TRUE	-	Uint8	
8-02	Control Word Source	1.0 s	All set-ups	TRUE	-	Uint8	
8-03	Control Word Timeout Time	[0] Off	1 set-up	TRUE	-1	Uint32	
8-04	Control Word Timeout Function	[1] Resume set-up	1 set-up	TRUE	-	Uint8	
8-05	End-of-Timeout Function	[0] Do not reset	All set-ups	TRUE	-	Uint8	
8-06	Reset Control Word Timeout	[0] Disable	2 set-ups	TRUE	-	Uint8	
8-07	Diagnosis Trigger						
8-1* Ctrl. Word Settings							
8-10	Control Word Profile	[0] FC profile	All set-ups	TRUE	-	Uint8	
8-13	Configurable Status Word STW	[1] Profile Default	All set-ups	TRUE	-	Uint8	
8-3* FC Port Settings							
8-30	Protocol	[0] FC	1 set-up	TRUE	-	Uint8	
8-31	Address	1 N/A	1 set-up	TRUE	0	Uint8	
8-32	FC Port Baud Rate	[2] 9600 Baud	1 set-up	TRUE	-	Uint8	
8-35	Minimum Response Delay	10 ms	All set-ups	TRUE	-3	Uint16	
8-36	Max Response Delay	5000 ms	1 set-up	TRUE	-3	Uint16	
8-37	Max Inter-Char Delay	25 ms	1 set-up	TRUE	-3	Uint16	
8-4* FC MC protocol set							
8-40	Telegram selection	[1] Standard telegram 1	2 set-ups	TRUE	-	Uint8	
8-5* Digital/Bus							
8-50	Coasting Select	[3] Logic OR	All set-ups	TRUE	-	Uint8	
8-51	Quick Stop Select	[3] Logic OR	All set-ups	TRUE	-	Uint8	
8-52	DC Brake Select	[3] Logic OR	All set-ups	TRUE	-	Uint8	
8-53	Start Select	[3] Logic OR	All set-ups	TRUE	-	Uint8	
8-54	Reversing Select	[3] Logic OR	All set-ups	TRUE	-	Uint8	
8-55	Set-up Select	[3] Logic OR	All set-ups	TRUE	-	Uint8	
8-56	Preset Reference Select	[3] Logic OR	All set-ups	TRUE	-	Uint8	
8-9* Bus Jog							
8-90	Bus Jog 1 Speed	100 RPM	All set-ups	TRUE	67	Uint16	
8-91	Bus Jog 2 Speed	200 RPM	All set-ups	TRUE	67	Uint16	

4.3.10. 9-** Profibus

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during op- eration	Conver- sion index	Type
9-00	Setpoint	0 N/A	All set-ups	TRUE	0	Uint16	
9-07	Actual Value	0 N/A	All set-ups	FALSE	0	Uint16	
9-15	PCD Write Configuration	Expression/limit	2 set-ups	TRUE	-	Uint16	
9-16	PCD Read Configuration	Expression/limit	2 set-ups	TRUE	-	Uint16	
9-18	Node Address	126 N/A	1 set-up	TRUE	0	Uint8	
9-22	Telegram Selection	[108] PPO 8	1 set-up	TRUE	-	Uint8	
9-23	Parameters for Signals	0	All set-ups	TRUE	-	Uint16	
9-27	Parameter Edit	[1] Enabled	2 set-ups	FALSE	-	Uint8	
9-28	Process Control	[1] Enable cyclic master	2 set-ups	TRUE	0	Uint16	
9-31	Safe Address	0 N/A	1 set-up	TRUE	0	Uint16	
9-44	Fault Message Counter	0 N/A	All set-ups	TRUE	0	Uint16	
9-45	Fault Code	0 N/A	All set-ups	TRUE	0	Uint16	
9-47	Fault Situation Counter	0 N/A	All set-ups	TRUE	0	Uint16	
9-52	Profibus Warning Word	0 N/A	All set-ups	TRUE	0	V2	
9-53	Actual Baud Rate	[255] No baudrate found	All set-ups	TRUE	-	Uint8	
9-63	Device Identification	0 N/A	All set-ups	TRUE	0	Uint16	
9-64	Profile Number	0 N/A	All set-ups	TRUE	0	OctStr[2]	
9-65	Control Word 1	0 N/A	All set-ups	TRUE	0	V2	
9-67	Status Word 1	0 N/A	All set-ups	TRUE	0	V2	
9-68	Profibus Save Data Values	[0] Off	All set-ups	TRUE	-	Uint8	
9-71	ProfibusDriveReset	[0] No action	1 set-up	FALSE	-	Uint8	
9-72	Defined Parameters (1)	0 N/A	All set-ups	FALSE	0	Uint16	
9-80	Defined Parameters (2)	0 N/A	All set-ups	FALSE	0	Uint16	
9-81	Defined Parameters (3)	0 N/A	All set-ups	FALSE	0	Uint16	
9-82	Defined Parameters (4)	0 N/A	All set-ups	FALSE	0	Uint16	
9-83	Defined Parameters (5)	0 N/A	All set-ups	FALSE	0	Uint16	
9-84	Changed Paramètres (1)	0 N/A	All set-ups	FALSE	0	Uint16	
9-90	Changed Parameters (2)	0 N/A	All set-ups	FALSE	0	Uint16	
9-91	Changed Parameters (3)	0 N/A	All set-ups	FALSE	0	Uint16	
9-92	Changed parameters (4)	0 N/A	All set-ups	FALSE	0	Uint16	
9-93	Changed parameters (5)	0 N/A	All set-ups	FALSE	0	Uint16	
9-94	Profibus Revision Counter	0 N/A	All set-ups	TRUE	0	Uint16	
9-99							

4.3.11. 10-** CAN Fieldbus

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
10-0* Common Settings							
10-00 CAN Protocol	null	2 set-ups	2 set-ups	FALSE	-	Uint8	
10-01 Baud Rate Select	null	2 set-ups	2 set-ups	TRUE	-	Uint8	
10-02 MAC ID	ExpressionLimit	2 set-ups	All set-ups	TRUE	0	Uint8	
10-05 Readout Transmit Error Counter	0 N/A	All set-ups	All set-ups	TRUE	0	Uint8	
10-06 Readout Receive Error Counter	0 N/A	All set-ups	All set-ups	TRUE	0	Uint8	
10-07 Readout Bus Off Counter	0 N/A	All set-ups	All set-ups	TRUE	0	Uint8	
10-1* DeviceNet							
10-10 Process Data Type Selection	null	All set-ups	All set-ups	TRUE	-	Uint8	
10-11 Process Data Config Write	ExpressionLimit	2 set-ups	2 set-ups	TRUE	-	Uint16	
10-12 Process Data Config Read	ExpressionLimit	All set-ups	All set-ups	TRUE	-	Uint16	
10-13 Warning Parameter	0 N/A	All set-ups	All set-ups	TRUE	0	Uint16	
10-14 Net Reference	[0] Off	2 set-ups	2 set-ups	TRUE	-	Uint8	
10-15 Net Control	[0] Off	2 set-ups	2 set-ups	TRUE	-	Uint8	
10-2* COS Filters							
10-20 COS Filter 1	0 N/A	All set-ups	All set-ups	FALSE	0	Uint16	
10-21 COS Filter 2	0 N/A	All set-ups	All set-ups	FALSE	0	Uint16	
10-22 COS Filter 3	0 N/A	All set-ups	All set-ups	FALSE	0	Uint16	
10-23 COS Filter 4	0 N/A	All set-ups	All set-ups	FALSE	0	Uint16	
10-3* Parameter Access							
10-30 Array Index	0 N/A	2 set-ups	All set-ups	TRUE	0	Uint8	
10-31 Store Data Values	[0] Off	All set-ups	All set-ups	TRUE	-	Uint8	
10-32 Devicenet Revision	ExpressionLimit	All set-ups	All set-ups	TRUE	0	Uint16	
10-33 Store Always	[0] Off	1 set-up	1 set-up	TRUE	-	Uint8	
10-34 DeviceNet Product Code	ExpressionLimit	1 set-up	1 set-up	TRUE	0	Uint16	
10-39 Devicenet F Parameters	0 N/A	All set-ups	All set-ups	TRUE	0	Uint32	
10-5* CANopen							
10-50 Process Data Config Write.	ExpressionLimit	2 set-ups	2 set-ups	TRUE	-	Uint16	
10-51 Process Data Config Read.	ExpressionLimit	2 set-ups	2 set-ups	TRUE	-	Uint16	

4.3.12. 13-** Smart Logic

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during op- eration	Conver- sion index	Type
13-0* SLC Settings							
13-00	SL Controller Mode	null	2 set-ups	TRUE	-	Uint8	
13-01	Start Event	null	2 set-ups	TRUE	-	Uint8	
13-02	Stop Event	null	2 set-ups	TRUE	-	Uint8	
13-03	Reset SLC	[0] Do not reset SLC	All set-ups	TRUE	-	Uint8	
13-1* Comparators							
13-10	Comparator Operand	null	2 set-ups	TRUE	-	Uint8	
13-11	Comparator Operator	null	2 set-ups	TRUE	-	Uint8	
13-12	Comparator Value	ExpressionLimit	2 set-ups	TRUE	-3	Int32	
13-2* Timers							
13-20	SL Controller Timer	ExpressionLimit	1 set-up	TRUE	-3	TimD	
13-4* Logic Rules							
13-40	Logic Rule Boolean 1	null	2 set-ups	TRUE	-	Uint8	
13-41	Logic Rule Operator 1	null	2 set-ups	TRUE	-	Uint8	
13-42	Logic Rule Boolean 2	null	2 set-ups	TRUE	-	Uint8	
13-43	Logic Rule Operator 2	null	2 set-ups	TRUE	-	Uint8	
13-44	Logic Rule Boolean 3	null	2 set-ups	TRUE	-	Uint8	
13-5* States							
13-51	SL Controller Event	null	2 set-ups	TRUE	-	Uint8	
13-52	SL Controller Action	null	2 set-ups	TRUE	-	Uint8	

4.3.13. 14-** Special Functions

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
14-0* Inverter Switching							
14-00	Switching Pattern	[1] SFAVM null	All set-ups	TRUE	-	Uint8	
14-01	Switching Frequency	[1] On	All set-ups	TRUE	-	Uint8	
14-03	Overspeed Modulation	[0] Off	All set-ups	FALSE	-	Uint8	
14-04	PWM Random		All set-ups	TRUE	-	Uint8	
14-1* Mains On/Off							
14-10	Mains Failure	[0] No function Expression/limit	All set-ups	FALSE	-	Uint8	
14-11	Mains Voltage at Mains Fault	[0] Trip	All set-ups	TRUE	0	Uint16	
14-12	Function at Mains Imbalance		All set-ups	TRUE	-	Uint8	
14-2* Trip Reset							
14-20	Reset Mode	[0] Manual reset 10 s	All set-ups	TRUE	-	Uint8	
14-21	Automatic Restart Time	[0] Normal operation	All set-ups	TRUE	0	Uint16	
14-22	Operation Mode	null	All set-ups	TRUE	-	Uint8	
14-23	Typecode Setting	2 set-ups	All set-ups	FALSE	-	Uint8	
14-25	Trip Delay at Torque Limit	60 s	All set-ups	TRUE	0	Uint8	
14-26	Trip Delay at Inverter Fault	Expression/limit	All set-ups	TRUE	0	Uint8	
14-28	Production Settings	[0] No action	All set-ups	TRUE	-	Uint8	
14-29	Service Code	0 N/A	All set-ups	TRUE	0	Int32	
14-3* Current Limit Ctrl.							
14-30	Current Lim Cont, Proportional Gain	100 %	All set-ups	FALSE	0	Uint16	
14-31	Current Lim Contr, Integration Time	0.020 s	All set-ups	FALSE	-3	Uint16	
14-4* Energy Optimising							
14-40	VLT Level	66 %	All set-ups	FALSE	0	Uint8	
14-41	AEO Minimum Magnetisation	40 %	All set-ups	TRUE	0	Uint8	
14-42	Minimum AEO Frequency	10 Hz	All set-ups	TRUE	0	Uint8	
14-43	Motor Cosphi	Expression/limit	All set-ups	TRUE	-2	Uint16	
14-5* Environment							
14-50	RFI Filter	[1] On	1 set-up	x	FALSE	-	Uint8
14-52	Fan Control	[0] Auto	All set-ups	TRUE	-	Uint8	
14-53	Fan Monitor	[1] Warning	All set-ups	TRUE	-	Uint8	
14-55	Output Filter	[0] No Filter	1 set-up	FALSE	-	Uint8	
14-56	Capacitance Output Filter	2.0 uF	1 set-up	FALSE	-7	Uint16	
14-57	Inductance Output Filter	7.000 mH	1 set-up	FALSE	-6	Uint16	
14-7* Compatibility							
14-72	VLT Alarm Word	0 N/A	All set-ups	FALSE	0	Uint32	
14-73	VLT Warning Word	0 N/A	All set-ups	FALSE	0	Uint32	
14-74	VLT Ext. Status Word	0 N/A	All set-ups	FALSE	0	Uint32	

4.3.14. 15-** Drive Information

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during op- eration	Conver- sion index	Type
15-0* Operating Data							
15-00	Operating Hours	0 h	All set-ups	FALSE	74	UInt32	
15-01	Running Hours	0 h	All set-ups	FALSE	74	UInt32	
15-02	KWh Counter	0 kWh	All set-ups	FALSE	75	UInt32	
15-03	Power Ups	0 N/A	All set-ups	FALSE	0	UInt32	
15-04	Over Temp's	0 N/A	All set-ups	FALSE	0	UInt16	
15-05	Over Volts	0 N/A	All set-ups	FALSE	0	UInt16	
15-06	Reset KWh Counter	[0] Do not reset	All set-ups	TRUE	-	UInt8	
15-07	Reset Running Hours Counter	[0] Do not reset	All set-ups	TRUE	-	UInt8	
15-1* Data Log Settings							
15-10	Logging Source	0	2 set-ups	TRUE	-	UInt16	
15-11	Logging Interval	Expression/limit	2 set-ups	TRUE	-3	TimD	
15-12	Trigger Event	[0] False	1 set-up	TRUE	-	UInt8	
15-13	Logging Mode	[0] Log always	2 set-ups	TRUE	-	UInt8	
15-14	Samples Before Trigger	50 N/A	2 set-ups	TRUE	0	UInt8	
15-2* Historic Log							
15-20	Historic Log: Event	0 N/A	All set-ups	FALSE	0	UInt8	
15-21	Historic Log: Value	0 N/A	All set-ups	FALSE	0	UInt32	
15-22	Historic Log: Time	0 ms	All set-ups	FALSE	-3	UInt32	
15-3* Fault Log							
15-30	Fault Log: Error Code	0 N/A	All set-ups	FALSE	0	UInt8	
15-31	Fault Log: Value	0 N/A	All set-ups	FALSE	0	Int16	
15-32	Fault Log: Time	0 s	All set-ups	FALSE	0	UInt32	
15-4* Drive Identification							
15-40	FC Type	0 N/A	All set-ups	FALSE	0	VlsStr[6]	
15-41	Power Section	0 N/A	All set-ups	FALSE	0	VlsStr[20]	
15-42	Voltage	0 N/A	All set-ups	FALSE	0	VlsStr[20]	
15-43	Software Version	0 N/A	All set-ups	FALSE	0	VlsStr[15]	
15-44	Ordered Typecode String	0 N/A	All set-ups	FALSE	0	VlsStr[40]	
15-45	Actual Typecode String	0 N/A	All set-ups	FALSE	0	VlsStr[40]	
15-46	Frequency Converter Ordering No	0 N/A	All set-ups	FALSE	0	VlsStr[8]	
15-47	Power Card Ordering No	0 N/A	All set-ups	FALSE	0	VlsStr[8]	
15-48	LCP Id No	0 N/A	All set-ups	FALSE	0	VlsStr[20]	
15-49	SW ID Control Card	0 N/A	All set-ups	FALSE	0	VlsStr[20]	
15-50	SW ID Power Card	0 N/A	All set-ups	FALSE	0	VlsStr[20]	
15-51	Frequency Converter Serial Number	0 N/A	All set-ups	FALSE	0	VlsStr[10]	
15-53	Power Card Serial Number	0 N/A	All set-ups	FALSE	0	VlsStr[19]	

Par. No. # Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
15-6* Option Ident						
15-60 Option Mounted	0 N/A	All set-ups	FALSE	0	VisStr[30]	
15-61 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]	
15-62 Option Ordering No	0 N/A	All set-ups	FALSE	0	VisStr[8]	
15-63 Option Serial No	0 N/A	All set-ups	FALSE	0	VisStr[18]	
15-70 Option in Slot A	0 N/A	All set-ups	FALSE	0	VisStr[30]	
15-71 Slot A Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]	
15-72 Option in Slot B	0 N/A	All set-ups	FALSE	0	VisStr[30]	
15-73 Slot B Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]	
15-74 Option in Slot C0	0 N/A	All set-ups	FALSE	0	VisStr[30]	
15-75 Slot C0 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]	
15-76 Option in Slot C1	0 N/A	All set-ups	FALSE	0	VisStr[30]	
15-77 Slot C1 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]	
15-9* Parameter Info						
15-92 Defined Parameters	0 N/A	All set-ups	FALSE	0	Uint16	
15-93 Modified Parameters	0 N/A	All set-ups	FALSE	0	Uint16	
15-99 Parameter Metadata	0 N/A	All set-ups	FALSE	0	Uint16	

4.3.15. 16-** Data Readouts

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during op- eration	Conver- sion index	Type
16-0* General Status							
16-00 Control Word	0 N/A	All set-ups	FALSE	0	V2		
16-01 Reference [Unit]	0.000 ReferenceFeedbackUnit	All set-ups	FALSE	-3	Int32		
16-02 Reference %	0.0 %	All set-ups	FALSE	-1	Int16		
16-03 Status Word	0 N/A	All set-ups	FALSE	0	V2		
16-05 Main Actual Value [%]	0.00 %	All set-ups	FALSE	-2	N2		
16-09 Custom ReadoutUnit	0.00 CustomReadoutUnit	All set-ups	FALSE	-2	Int32		
16-1* Motor Status							
16-10 Power [kW]	0.00 kW	All set-ups	FALSE	1	Int32		
16-11 Power [hp]	0.00 hp	All set-ups	FALSE	-2	Int32		
16-12 Motor Voltage	0.0 V	All set-ups	FALSE	-1	Uint16		
16-13 Frequency	0.0 Hz	All set-ups	FALSE	-1	Uint16		
16-14 Motor Current	0.00 A	All set-ups	FALSE	-2	Int32		
16-15 Frequency [%]	0.00 %	All set-ups	FALSE	-2	N2		
16-16 Torque [Nm]	0.0 Nm	All set-ups	FALSE	-1	Int32		
16-17 Speed [RPM]	0 RPM	All set-ups	FALSE	67	Int32		
16-18 Motor Thermal	0 %	All set-ups	FALSE	0	Uint8		
16-19 KTY sensor temperature	0 °C	All set-ups	FALSE	100	Int16		
16-20 Motor Angle	0 N/A	All set-ups	TRUE	0	Uint16		
16-22 Torque [%]	0 %	All set-ups	FALSE	0	Int16		
16-3* Drive Status							
16-30 DC Link Voltage	0 V	All set-ups	FALSE	0	Uint16		
16-32 Brake Energy /s	0.000 kW	All set-ups	FALSE	0	Uint32		
16-33 Brake Energy /2 min	0.000 kW	All set-ups	FALSE	0	Uint32		
16-34 Heatsink Temp.	0 °C	All set-ups	FALSE	100	Uint8		
16-35 Inverter Thermal	0 %	All set-ups	FALSE	0	Uint8		
16-36 Inv. Nom. Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32		
16-37 Inv. Max. Current	0 N/A	All set-ups	FALSE	-2	Uint8		
16-38 SL Controller State	0 °C	All set-ups	FALSE	0	Uint8		
16-39 Control Card Temp.	[0] No	All set-ups	TRUE	-	Uint8		
16-5* Ref. & Feedb.							
16-50 External Reference	0.0 N/A	All set-ups	FALSE	-1	Int16		
16-51 Pulse Reference	0.0 N/A	All set-ups	FALSE	-1	Int16		
16-52 Feedback [Unit]	0.000 ReferenceFeedbackUnit	All set-ups	FALSE	-3	Int32		
16-53 Digi Pot Reference	0.00 N/A	All set-ups	FALSE	-2	Int16		

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
16-6* Inputs & Outputs							
16-60	Digital Input	0 N/A	All set-ups	FALSE	0	UInt16	
16-61	Terminal 53 Switch Setting	[0] Current	All set-ups	FALSE	-	UInt8	
16-62	Analog Input 53	0.000 N/A	All set-ups	FALSE	-3	Int32	
16-63	Terminal 54 Switch Setting	[0] Current	All set-ups	FALSE	-	UInt8	
16-64	Analog Input 54	0.000 N/A	All set-ups	FALSE	-3	Int32	
16-65	Analog Output 42 [mA]	0 N/A	All set-ups	FALSE	0	Int16	
16-66	Digital Output [bin]	0 N/A	All set-ups	FALSE	0	Int32	
16-67	Freq. Input #29 [Hz]	0 N/A	All set-ups	FALSE	0	Int32	
16-68	Freq. Input #33 [Hz]	0 N/A	All set-ups	FALSE	0	Int32	
16-69	Pulse Output #27 [Hz]	0 N/A	All set-ups	FALSE	0	Int32	
16-70	Pulse Output #29 [Hz]	0 N/A	All set-ups	FALSE	0	Int32	
16-71	Relay Output [bin]	0 N/A	All set-ups	FALSE	0	Int16	
16-72	Counter A	0 N/A	All set-ups	TRUE	0	Int32	
16-73	Counter B	0 N/A	All set-ups	TRUE	0	Int32	
16-74	Prec. Stop Counter	0 N/A	All set-ups	TRUE	0	UInt32	
16-75	Analog In X30/11	0.000 N/A	All set-ups	FALSE	-3	Int32	
16-76	Analog In X30/12	0.000 N/A	All set-ups	FALSE	-3	Int32	
16-77	Analog Out X30/8 [mA]	0.000 N/A	All set-ups	FALSE	-3	Int16	
16-8* Fieldbus & FC Port							
16-80	Fieldbus CTW 1	0 N/A	All set-ups	FALSE	0	V2	
16-82	Fieldbus REF 1	0 N/A	All set-ups	FALSE	0	N2	
16-84	Comm. Option STW	0 N/A	All set-ups	FALSE	0	V2	
16-85	FC Port CTW 1	0 N/A	All set-ups	FALSE	0	V2	
16-86	FC Port REF 1	0 N/A	All set-ups	FALSE	0	N2	
16-9* Diagnosis Readouts							
16-90	Alarm Word	0 N/A	All set-ups	FALSE	0	UInt32	
16-91	Alarm Word 2	0 N/A	All set-ups	FALSE	0	UInt32	
16-92	Warning Word	0 N/A	All set-ups	FALSE	0	UInt32	
16-93	Warning Word 2	0 N/A	All set-ups	FALSE	0	UInt32	
16-94	Ext. Status Word	0 N/A	All set-ups	FALSE	0	UInt32	

4.3.16. 17-** Motor Feedb.Option

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during op- eration	Conver- sion index	Type
17-1* Inc. Enc. Interface							
17-10 Signal Type	[1] RS422 (5V TTL)	All set-ups			FALSE	-	Uint8
17-11 Resolution (PPR)	[2] 1024 N/A	All set-ups			FALSE	0	Uint16
17-2* Abs. Enc. Interface							
17-20 Protocol Selection	[0] None	All set-ups			FALSE	-	Uint8
17-21 Resolution (Positions/Rev)	ExpressionLimit 13 N/A	All set-ups			FALSE	0	Uint32
17-24 SSI Data Length	All set-ups	All set-ups			FALSE	0	Uint8
17-25 Clock Rate	ExpressionLimit [0] Gray code [4] 9600	All set-ups	All set-ups		FALSE	3	Uint16
17-26 SSI Data Format	All set-ups	All set-ups			FALSE	-	Uint8
17-34 HIPERFACE Baudrate	All set-ups	All set-ups			FALSE	-	Uint8
17-5* Resolver Interface							
17-50 Poles	2 N/A	1 set-up			FALSE	0	Uint8
17-51 Input Voltage	7.0 V	1 set-up			FALSE	-1	Uint8
17-52 Input Frequency	10.0 kHz	1 set-up			FALSE	2	Uint8
17-53 Transformation Ratio	0.5 N/A	1 set-up			FALSE	-1	Uint8
17-59 Resolver Interface	[0] Disabled	All set-ups			FALSE	-	Uint8
17-6* Monitoring and App.							
17-60 Feedback Direction	[0] Clockwise	All set-ups			FALSE	-	Uint8
17-61 Feedback Signal Monitoring	[1] Warning	All set-ups			TRUE	-	Uint8

4.3.17. 32-** MCO Basic Settings

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
32-0* Encoder 2							
32-00	Incremental Signal Type	[1] RS422 (5V TTL) 1024 N/A	2 set-ups	2 set-ups	TRUE	-	Uint8
32-01	Incremental Resolution	[0] None	2 set-ups	2 set-ups	TRUE	0	Uint32
32-02	Absolute Protocol	8192 N/A	2 set-ups	2 set-ups	TRUE	-	Uint8
32-03	Absolute Resolution	25 N/A	2 set-ups	2 set-ups	TRUE	0	Uint32
32-05	Absolute Encoder Data Length	262,000 kHz	2 set-ups	2 set-ups	TRUE	0	Uint8
32-06	Absolute Encoder Clock Frequency	[1] On	2 set-ups	2 set-ups	TRUE	-	Uint32
32-07	Absolute Encoder Clock Generation	0 m	2 set-ups	2 set-ups	TRUE	0	Uint16
32-08	Absolute Encoder Cable Length	[0] Off	2 set-ups	2 set-ups	TRUE	-	Uint8
32-09	Encoder Monitoring	[1] No action	2 set-ups	2 set-ups	TRUE	-	Uint8
32-10	Rotational Direction	1 N/A	2 set-ups	2 set-ups	TRUE	0	Uint32
32-11	User Unit Denominator	1 N/A	2 set-ups	2 set-ups	TRUE	0	Uint32
32-12	User Unit Numerator						
32-3* Encoder 1							
32-30	Incremental Signal Type	[1] RS422 (5V TTL)	2 set-ups	2 set-ups	TRUE	-	Uint8
32-31	Incremental Resolution	1024 N/A	2 set-ups	2 set-ups	TRUE	0	Uint32
32-32	Absolute Protocol	[0] None	2 set-ups	2 set-ups	TRUE	-	Uint8
32-33	Absolute Resolution	8192 N/A	2 set-ups	2 set-ups	TRUE	0	Uint32
32-35	Absolute Encoder Data Length	25 N/A	2 set-ups	2 set-ups	TRUE	0	Uint8
32-36	Absolute Encoder Clock Frequency	262,000 kHz	2 set-ups	2 set-ups	TRUE	0	Uint32
32-37	Absolute Encoder Clock Generation	[1] On	2 set-ups	2 set-ups	TRUE	-	Uint8
32-38	Absolute Encoder Cable Length	0 m	2 set-ups	2 set-ups	TRUE	0	Uint16
32-39	Encoder Monitoring	[0] Off	2 set-ups	2 set-ups	TRUE	-	Uint8
32-40	Encoder Termination	[1] On	2 set-ups	2 set-ups	TRUE	-	Uint8
32-50	Feedback Source	[2] Encoder 2	2 set-ups	2 set-ups	TRUE	-	Uint8
32-51	Source Slave						

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
32-6* PID Controller							
32-60	Proportional factor	30 N/A	2 set-ups	TRUE	0	Uint32	
32-61	Derivative factor	0 N/A	2 set-ups	TRUE	0	Uint32	
32-62	Integral factor	0 N/A	2 set-ups	TRUE	0	Uint32	
32-63	Limit Value for Integral Sum	1000 N/A	2 set-ups	TRUE	0	Uint16	
32-64	PID Bandwidth	1000 N/A	2 set-ups	TRUE	0	Uint32	
32-65	Velocity Feed-Forward	0 N/A	2 set-ups	TRUE	0	Uint32	
32-66	Acceleration Feed-Forward	0 N/A	2 set-ups	TRUE	0	Uint32	
32-67	Max. Tolerated Position Error	20000 N/A	2 set-ups	TRUE	0	Uint32	
32-68	Reverse Behavior for Slave	[0] Reversing allowed	2 set-ups	TRUE	-	Uint8	
32-69	Sampling Time for PID Control	1 ms	2 set-ups	TRUE	-3	Uint16	
32-70	Scan Time for Profile Generator	1 ms	2 set-ups	TRUE	-3	Uint8	
32-71	Size of the Control Window (Activation)	0 N/A	2 set-ups	TRUE	0	Uint32	
32-72	Size of the Control Window (Deactiv.)	0 N/A	2 set-ups	TRUE	0	Uint32	
32-8* Velocity & Accel.							
32-80	Maximum Velocity (Encoder)	1500 RPM	2 set-ups	TRUE	67	Uint32	
32-81	Shortest Ramp	1.000 s	2 set-ups	TRUE	-3	Uint32	
32-82	Ramp Type	[0] Linear	2 set-ups	TRUE	-	Uint8	
32-83	Velocity Resolution	100 N/A	2 set-ups	TRUE	0	Uint32	
32-84	Default Velocity	50 N/A	2 set-ups	TRUE	0	Uint32	
32-85	Default Acceleration	50 N/A	2 set-ups	TRUE	0	Uint32	

4.3.18. 33-** MCO Adv. Settings

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
33-0* Home Motion							
33-00	Force HOME	[0] Home not forced 0 N/A	2 set-ups	2 set-ups	TRUE	-	UInt8
33-01	Zero Point Offset from Home Pos.	10 N/A	2 set-ups	2 set-ups	TRUE	0	Int32
33-02	Ramp for Home Motion	10 N/A	2 set-ups	2 set-ups	TRUE	0	Int32
33-03	Velocity of Home Motion	[0] Revers and index	2 set-ups	2 set-ups	TRUE	-	UInt8
33-1* Synchronization							
33-10	Synchronization Factor Master (M:S)	1 N/A	2 set-ups	2 set-ups	TRUE	0	Int32
33-11	Synchronization Factor Slave (M:S)	1 N/A	2 set-ups	2 set-ups	TRUE	0	Int32
33-12	Position Offset for Synchronization	0 N/A	2 set-ups	2 set-ups	TRUE	0	Int32
33-13	Accuracy Window for Position Sync.	1000 N/A	2 set-ups	2 set-ups	TRUE	0	Int32
33-14	Relative Slave Velocity Limit	0 %	2 set-ups	2 set-ups	TRUE	0	UInt8
33-15	Marker Number for Master	1 N/A	2 set-ups	2 set-ups	TRUE	0	UInt16
33-16	Marker Number for Slave	1 N/A	2 set-ups	2 set-ups	TRUE	0	UInt16
33-17	Master Marker Distance	4096 N/A	2 set-ups	2 set-ups	TRUE	0	UInt32
33-18	Slave Marker Distance	4096 N/A	2 set-ups	2 set-ups	TRUE	0	UInt32
33-19	Master Marker Type	[0] Encoder Z positive	2 set-ups	2 set-ups	TRUE	0	UInt8
33-20	Slave Marker Type	[0] Encoder Z positive	2 set-ups	2 set-ups	TRUE	-	UInt8
33-21	Master Marker Tolerance Window	0 N/A	2 set-ups	2 set-ups	TRUE	0	UInt32
33-22	Slave Marker Tolerance Window	0 N/A	2 set-ups	2 set-ups	TRUE	0	UInt32
33-23	Start Behaviour for Marker Sync	[0] Start Function 1	2 set-ups	2 set-ups	TRUE	-	UInt16
33-24	Marker Number for Fault	10 N/A	2 set-ups	2 set-ups	TRUE	0	UInt16
33-25	Marker Number for Ready	1 N/A	2 set-ups	2 set-ups	TRUE	0	UInt16
33-26	Velocity Filter	0 us	2 set-ups	2 set-ups	TRUE	-6	Int32
33-27	Offset Filter Time	0 ms	2 set-ups	2 set-ups	TRUE	-3	Int32
33-28	Marker Filter Configuration	[0] Marker filter 1	2 set-ups	2 set-ups	TRUE	-3	UInt8
33-29	Filter Time for Marker Filter	0 ms	2 set-ups	2 set-ups	TRUE	-3	Int32
33-30	Maximum Marker Correction	0 N/A	2 set-ups	2 set-ups	TRUE	0	UInt32
33-31	Synchronisation Type	[0] Standard	2 set-ups	2 set-ups	TRUE	-	UInt8
33-4* Limit Handling							
33-40	Behaviour atEnd Limit Switch	[0] Call error handler	2 set-ups	2 set-ups	TRUE	-	UInt8
33-41	Negative Software End Limit	-500000 N/A	2 set-ups	2 set-ups	TRUE	0	Int32
33-42	Positive Software End Limit	500000 N/A	2 set-ups	2 set-ups	TRUE	0	Int32
33-43	Negative Software End Limit Active	[0] Inactive	2 set-ups	2 set-ups	TRUE	-	UInt8
33-44	Positive Software End Limit Active	[0] Inactive	2 set-ups	2 set-ups	TRUE	-	UInt8
33-45	Time in Target Window	0 ms	2 set-ups	2 set-ups	TRUE	-3	UInt8
33-46	Target Window LimitValue	1 N/A	2 set-ups	2 set-ups	TRUE	0	UInt16
33-47	Size of Target Window	0 N/A	2 set-ups	2 set-ups	TRUE	0	UInt16

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
33-5* I/O Configuration							
33-50	Terminal X57/1 Digital Input	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-51	Terminal X57/2 Digital Input	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-52	Terminal X57/3 Digital Input	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-53	Terminal X57/4 Digital Input	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-54	Terminal X57/5 Digital Input	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-55	Terminal X57/6 Digital Input	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-56	Terminal X57/7 Digital Input	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-57	Terminal X57/8 Digital Input	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-58	Terminal X57/9 Digital Input	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-59	Terminal X57/10 Digital Input	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-60	Terminal X59/1 and X59/2 Mode	[1] Output	2 set-ups	2	FALSE	-	UInt8
33-61	Terminal X59/1 Digital Input	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-62	Terminal X59/2 Digital Input	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-63	Terminal X59/1 Digital Output	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-64	Terminal X59/2 Digital Output	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-65	Terminal X59/3 Digital Output	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-66	Terminal X59/4 Digital Output	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-67	Terminal X59/5 Digital Output	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-68	Terminal X59/6 Digital Output	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-69	Terminal X59/7 Digital Output	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-70	Terminal X59/8 Digital Output	[0] No function	2 set-ups	2	TRUE	-	UInt8
33-8* Global Parameters							
33-80	Activated Program Number	-1 N/A	2 set-ups	0	TRUE	-	Int8
33-81	Power-up State	[1] Motor on	2 set-ups	2	TRUE	-	UInt8
33-82	Drive Status Monitoring	[1] On	2 set-ups	2	TRUE	-	UInt8
33-83	Behaviour afterError	[0] Coast	2 set-ups	2	TRUE	-	UInt8
33-84	Behaviour afterEsc.	[0] Controlled stop	2 set-ups	2	TRUE	-	UInt8
33-85	MCO Supplied by External 24VDC	[0] No	2 set-ups	2	TRUE	-	UInt8

4.3.19. 34-** MCO Data Readouts

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
34-0* PCD Write Par.							
34-01	PCD 1 Write to MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-02	PCD 2 Write to MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-03	PCD 3 Write to MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-04	PCD 4 Write to MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-05	PCD 5 Write to MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-06	PCD 6 Write to MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-07	PCD 7 Write to MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-08	PCD 8 Write to MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-09	PCD 9 Write to MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-10	PCD 10 Write to MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-2* PCD Read Par.							
34-21	PCD 1 Read from MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-22	PCD 2 Read from MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-23	PCD 3 Read from MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-24	PCD 4 Read from MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-25	PCD 5 Read from MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-26	PCD 6 Read from MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-27	PCD 7 Read from MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-28	PCD 8 Read from MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-29	PCD 9 Read from MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-30	PCD 10 Read from MCO	0 N/A	All set-ups	TRUE	0	Uint16	
34-4* Inputs & Outputs							
34-40	Digital Inputs	0 N/A	All set-ups	TRUE	0	Uint16	
34-41	Digital Outputs	0 N/A	All set-ups	TRUE	0	Uint16	
34-5* Process Data							
34-50	Actual Position	0 N/A	All set-ups	TRUE	0	Int32	
34-51	Commanded Position	0 N/A	All set-ups	TRUE	0	Int32	
34-52	Actual Master Position	0 N/A	All set-ups	TRUE	0	Int32	
34-53	Slave Index Position	0 N/A	All set-ups	TRUE	0	Int32	
34-54	Master Index Position	0 N/A	All set-ups	TRUE	0	Int32	
34-55	Curve Position	0 N/A	All set-ups	TRUE	0	Int32	
34-56	Track Error	0 N/A	All set-ups	TRUE	0	Int32	
34-57	Synchronizing Error	0 N/A	All set-ups	TRUE	0	Int32	
34-58	Actual Velocity	0 N/A	All set-ups	TRUE	0	Int32	
34-59	Actual Master Velocity	0 N/A	All set-ups	TRUE	0	Int32	
34-60	Synchronizing Status	0 N/A	All set-ups	TRUE	0	Int32	
34-61	Axis Status	0 N/A	All set-ups	TRUE	0	Int32	
34-62	Program Status	0 N/A	All set-ups	TRUE	0	Int32	
34-7* Diagnosis readouts							
34-70	MCO Alarm Word 1	0 N/A	All set-ups	FALSE	0	Uint32	
34-71	MCO Alarm Word 2	0 N/A	All set-ups	FALSE	0	Uint32	

5. General Specifications

Mains supply (L1, L2, L3):

Supply voltage	FC 302: 380-500 V $\pm 10\%$
Supply voltage	FC 302: 525-690 V $\pm 10\%$
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 (> 0.98)
Displacement Power Factor ($\cos \phi$) near unity	
Switching on input supply L1, L2, L3 (power-ups) ≥ 11 kW	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.

5

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.

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 k Ω

Safe stop Terminal 37³⁾ (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.

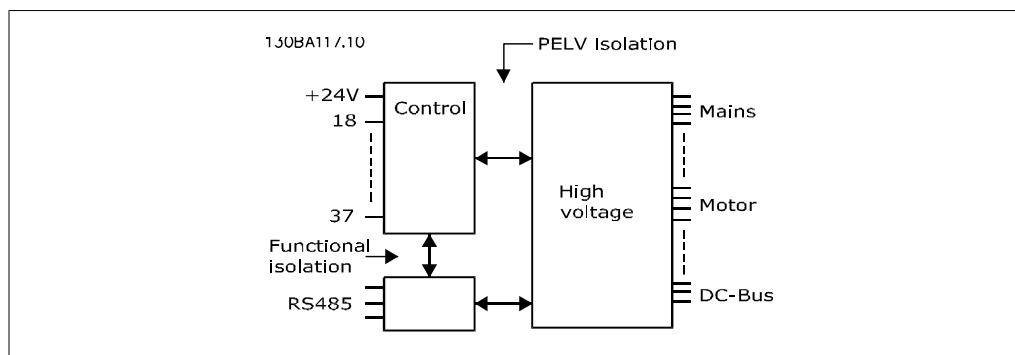
2) Except safe stop input Terminal 37.

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 Design Guide.

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 ¹ , 33 ²) / 32 ³ , 33 ³)
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) FC 302 only

2) Pulse inputs are 29 and 33

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

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.

5

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 analogue 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 (FC 302 only) 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 <i>Precise start/stop</i> (terminals 18, 19)	$\leq \pm 0.1$ 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 feed-back device	0 - 6000 rpm: error ± 0.15 rpm

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

Surroundings:

Enclosure	IP 21/ Type 1, IP 54/ Type 12
Vibration test	1.0 g
Max. relative humidity	5% - 95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43)	class H ₂ S
Ambient temperature ¹⁾	Max. 50 °C (24-hour average maximum 45 °C)

1) For high ambient temperature, see special conditions in the Design Guide

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

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

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

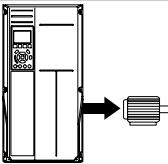
See section on special conditions in the Design Guide

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, enclosures 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.

5.1.1. Electrical Data:

380 - 500 Volt

VLT Type	P110	P132	P160	P200	
					
Output current	[VAC]	HO NO HO NO HO NO HO NO			
Continuous (100/ 100%) [A]	400	212 260 260 315 315 395 395 480			
Intermittent (150/ 110%) [A]	400	318 286 390 347 473 435 593 528			
Continuous (100/ 100%) [A]	460/ 500	190 240 240 302 302 361 361 443			
Intermittent (150/ 110%) [A]	460/ 500	285 264 360 332 453 397 542 487			
Output kVA					
Continuous (100/ 100%) [kVA]	400	147 180 180 218 218 274 274 333			
Intermittent (150/ 110%) [kVA]	400	220 198 270 240 327 301 410 366			
Continuous (100/ 100%) [kVA]	460	151 191 191 241 241 288 288 353			
Intermittent (150/ 110%) [kVA]	460	227 210 287 265 361 316 431 388			
Continuous (100/ 100%) [kVA]	500	165 208 208 262 262 313 313 384			
Intermittent (150/ 110%) [kVA]	500	247 229 312 288 392 344 469 422			
Typical Shaft Output					
High Overload (150%) [kW]	400	110	132	160	200
Normal Overload (110%) [kW]	400	132	160	200	250
High Overload (150%) [HP]	460	150	200	250	300
Normal Overload (110%) [HP]	460	200	250	300	350
High Overload (150%) [kW]	500	132	160	200	250
Normal Overload (110%) [kW]	500	160	200	250	315
Max. Motor Cable Length		500 feet (150 m) shielded, 1000 feet (300 m)			
		unshielded			
Output Voltage [%]		0-100% of the AC line voltage			
Output Frequency [Hz]		0-450			
Rated Motor Voltage [V]		400/460/500			
Rated Motor Frequency [Hz]		50/60			
Thermal protection during operation			ETR for motor (Class 20)		
Thermal protection during operation	Deg C.	VLT trip 90	VLT trip 105	VLT trip 105	VLT trip 115
Switching on the Output			Unlimited		
Ramp times [sec]			0.01 - 3600		

VLT Type	380 - 500 Volt				
	P110	P132	P160	P200	
Max. Input Current [A]	400	204	251	251	304
Max. Input Current [A]	460 / 500	183	231	231	291
Max. external pre-fuses¹⁾ [A]		350		400	500
Soft Charge Fuses²⁾ AC [A] (qty)				20 (3)	
SMPS fuse³⁾ [A]				4	
AC Fan fuse³⁾ [A]				4	
Supply Voltage [V]		3 Phase, 380-500 ± 10%			
Supply Frequency [Hz]		50/ 60			
Power Factor		greater than 0.90			
Efficiency		0.98			
Power loss at rated max. load (400V)					
High Overload (150%) [W]	2995	3425	3910	4625	
Normal Overload (110%) [W]	3782	4213	5119	5893	
Enclosure	IP00, IP21/ NEMA 1 & IP54/ NEMA 12				
Vibration Test [g]	0.7				
Relative Humidity [%]	93%, +2%, -3% (IEC 68-2-3)				
Ambient Temperature [de- grees C]	-10 Deg C to 40 Deg C continuously, periodically at +45 degrees C -25 Deg C to +65/ 70 Deg C for storage/ transport				
Adjustable Frequency Drive Protection	Ground and short-circuit protection				
Weight⁵⁾					
IP00/ Chassis [kg]	90.5	111.8	122.9	137.7	
IP21/ NEMA 1 [kg]	104.1	125.4	136.3	151.3	
IP54/ NEMA 12 [kg]	104.1	125.4	136.3	151.3	

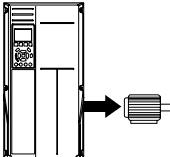
1) Bussmann 170M6000 series. See fuse chart

2) Bussmann FWH-20A6F or exact equivalent, 3 per unit

3) Bussmann KTK-4 or exact equivalent, 1 per unit

4) Littlefuse KLK-15 or exact equivalent, 1 per unit

5) VLT with standard input option, no brake, no loadshare

380 - 500 Volt																													
VLT Type	P250		P315		P355		P400																						
																													
Output current	[VAC]	HO	NO	HO	NO	HO	NO	HO	NO																				
Continuous (100/ 100%) [A]	400	480	600	600	658	658	745	695	800																				
Intermittent (150/ 110%) [A]	400	720	660	900	724	987	820	1043	880																				
Continuous (100/ 100%) [A]	460/ 500	443	540	540	590	590	678	678	730																				
Intermittent (150/ 110%) [A]	460/ 500	665	594	810	649	885	746	1017	803																				
Output kVA																													
Continuous (100/ 100%) [kVA]	400	333	416	416	456	456	516	482	554																				
Intermittent (150/ 110%) [kVA]	400	499	457	624	501	684	568	723	610																				
Continuous (100/ 100%) [kVA]	460	353	430	430	470	470	540	540	582																				
Intermittent (150/ 110%) [kVA]	460	529	473	645	517	705	594	810	640																				
Continuous (100/ 100%) [kVA]	500	384	468	468	511	511	587	587	632																				
Intermittent (150/ 110%) [kVA]	500	575	514	701	562	766	646	881	695																				
Typical Shaft Output																													
High Overload (150%) [kW]	400	250		315		355		400																					
Normal Overload (110%) [kW]	400	315		355		400		450																					
High Overload (150%) [HP]	460	350		450		500		550																					
Normal Overload (110%) [HP]	460	450		500		600		600																					
High Overload (150%) [kW]	500	315		355		400		500																					
Normal Overload (110%) [kW]	500	355		400		500		530																					
Max. Motor Cable Length	500 feet (150 m) shielded, 1000 feet (300 m) unshielded																												
Output Voltage [%]	0-100% of the AC line voltage																												
Output Frequency [Hz]	0-300					0-200																							
Rated Motor Voltage [V]	400/460/500																												
Rated Motor Frequency [Hz]	50/60																												
Thermal protection during operation	ETR for motor (Class 20)																												
Thermal protection during operation	Deg C.	VLT trip at 95 Deg C																											
Switching on the Output	Unlimited																												
Ramp times [sec]	0.01 - 3600																												

VLT Type	380 - 500 Volt					
	P250	P315	P355	P400		
Max. Input Current [A]	400	472	590	590	647	733
Max. Input Current [A]	460/ 500	436	531	531	580	667
Max. external pre-fuses¹⁾ [A]		700		900		900
Soft Charge Fuses²⁾ AC [A] (qty)				20 (3)		
SMPS fuse³⁾ [A]				4		
AC Fan fuse³⁾ [A]		4		15		
Supply Voltage [V]				3 Phase, 380-500 ± 10%		
Supply Frequency [Hz]				50/ 60		
Power Factor				greater than 0.90		
Efficiency				0.98		
Power loss at rated max. load (400V)						
High Overload (150%) [W]	6005	6960	7691	7964		
Normal Overload (110%) [W]	7630	7701	8879	9428		
Enclosure				IP00, IP21/ NEMA 1 & IP54/ NEMA 12		
Vibration Test [g]				0.7		
Relative Humidity [%]				93%, +2%, -3% (IEC 68-2-3)		
Ambient Temperature [degrees C]				-10 Deg C to 40 Deg C continuously, periodically at +45 degrees C		
				-25 Deg C to +65/ 70 Deg C for storage/ transport		
Adjustable Frequency Drive Protection				Ground and short-circuit protection		
Weight⁵⁾						
IP00/ Chassis [kg]	221.4	234.1	236.4	277.3		
IP21/ NEMA 1 [kg]	263.2	270.0	272.3	313.2		
IP54/ NEMA 12 [kg]	263.2	270.0	272.3	313.2		

1) Bussmann 170M6000 series. See fuse chart

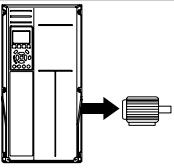
2) Bussmann FWH-20A6F or exact equivalent, 3 per unit

3) Bussmann KTK-4 or exact equivalent, 1 per unit

4) Littlefuse KLK-15 or exact equivalent, 1 per unit

5) VLT with standard input option, no brake, no loadsharing

525 - 690 Volt

VLT Type	P110	P132	P160
			
Output current	[VAC]	HO NO HO NO HO NO	
Continuous (100/ 100%) [A]	550	137 162 162 201 201 253	
Intermittent (150/ 110%) [A]	550	206 178 243 221 302 278	
Continuous (100/ 100%) [A]	575/ 690	131 155 155 192 192 242	
Intermittent (150/ 110%) [A]	575/ 690	197 171 233 211 288 266	
Output kVA			
Continuous (100/ 100%) [kVA]	550	131 154 154 191 191 241	
Intermittent (150/ 110%) [kVA]	550	196 170 231 211 287 265	
Continuous (100/ 100%) [kVA]	575	130 154 154 191 191 241	
Intermittent (150/ 110%) [kVA]	575	196 170 232 210 287 265	
Continuous (100/ 100%) [kVA]	690	157 185 185 229 229 289	
Intermittent (150/ 110%) [kVA]	690	235 204 278 252 344 318	
Typical Shaft Output			
High Overload (150%) [kW]	550	90 110	132
Normal Overload (110%) [kW]	550	110 132	160
High Overload (150%) [HP]	575	125 150	200
Normal Overload (110%) [HP]	575	150 200	250
High Overload (150%) [kW]	690	110 132	160
Normal Overload (110%) [kW]	690	132 160	200
Max. Motor Cable Length	500 feet (150 m) shielded, 1000 feet (300 m) unshielded		
Output Voltage [%]	0-100% of the AC line voltage		
Output Frequency [Hz]	0-200		
Rated Motor Voltage [V]	550/ 575/ 690		
Rated Motor Frequency [Hz]	50/60		
Thermal protection during operation	ETR for motor (Class 20)		
Thermal protection during operation	85	90	110
Switching on the Output	Unlimited		
Ramp times [sec]	0.01 - 3600		

VLT Type	525 - 690 Volt						
	P110	P132	P160				
Max. Input Current [A]	550	130	158	158	198	198	245
Max. Input Current [A]	575	124	151	151	189	189	234
Max. Input Current [A]	690	128	155	155	197	197	240
Max. external pre-fuses¹⁾ [A]		225		250		350	
Soft Charge Fuses²⁾ AC [A] (qty)				20 (3)			
SMPS fuse³⁾ [A]				4			
AC Fan fuse³⁾ [A]				4			
Supply Voltage [V]				3 Phase, 525-690 ± 10%			
Supply Frequency [Hz]				50/ 60			
Power Factor				>0.90 for 525 V, >0.85 for 690 V			
Efficiency				0.98			
Power loss at rated max. load (690 V)							
High Overload (150%) [W]		2665		2953		3451	
Normal Overload (110%) [W]		3114		3612		4293	
Enclosure				IP00, IP21/ NEMA 1 & IP54/ NEMA 12			
Vibration Test [g]				0.7			
Relative Humidity [%]				93%, +2%, -3% (IEC 68-2-3)			
Ambient Temperature [degrees C]				-10 Deg C to 40 Deg C continuously, periodically at +45 degrees C			
				-25 Deg C to +65/ 70 Deg C for storage/ transport			
Adjustable Frequency Drive Protection				Ground and short-circuit protection			
Weight⁵⁾							
IP00/ Chassis [kg]		81.9		90.5		111.8	
IP21/ NEMA 1 [kg]		95.5		104.1		125.4	
IP54/ NEMA 12 [kg]		95.5		104.1		125.4	

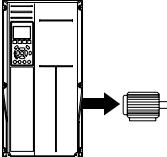
1) Bussmann 170M6000 series. See fuse chart

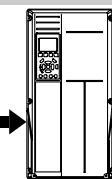
2) Bussmann FWH-20A6F or exact equivalent, 3 per unit

3) Bussmann KTK-4 or exact equivalent, 1 per unit

4) Littlefuse KLK-15 or exact equivalent, 1 per unit

5) VLT with standard input option, no brake, no loadsharing

525 - 690 Volt															
VLT Type	P200		P250		P315		P355								
															
Output current	[VAC]	HO	NO	HO	NO	HO	NO	HO	NO						
Continuous (100/ 100%) [A]	550	253	303	303	360	360	418	395	470						
Intermittent (150/ 110%) [A]	550	380	333	455	396	540	460	593	517						
Continuous (100/ 100%) [A]	575/ 690	242	290	290	344	344	400	380	450						
Intermittent (150/ 110%) [A]	575/ 690	363	319	435	378	516	440	570	495						
Output kVA															
Continuous (100/ 100%) [kVA]	550	241	289	289	343	343	398	376	448						
Intermittent (150/ 110%) [kVA]	550	362	318	433	377	514	438	564	493						
Continuous (100/ 100%) [kVA]	575	241	289	289	343	343	398	378	448						
Intermittent (150/ 110%) [kVA]	575	362	318	433	377	514	438	568	493						
Continuous (100/ 100%) [kVA]	690	289	347	347	411	411	478	454	538						
Intermittent (150/ 110%) [kVA]	690	434	381	520	452	617	526	681	592						
Typical Shaft Output															
High Overload (150%) [kW]	550	160	200	200	250	250	315	315	315						
Normal Overload (110%) [kW]	550	200	250	250	315	315	355	355	355						
High Overload (150%) [HP]	575	250	300	300	350	350	400	400	400						
Normal Overload (110%) [HP]	575	300	350	350	400	400	450	450	450						
High Overload (150%) [kW]	690	200	250	250	315	315	355	355	355						
Normal Overload (110%) [kW]	690	250	315	315	400	400	450	450	450						
Max. Motor Cable Length	500 feet (150 m) shielded, 1000 feet (300 m) unshielded														
Output Voltage [%]	0-100% of the AC line voltage														
Output Frequency [Hz]	0-200					0-150									
Rated Motor Voltage [V]	550/ 575/ 690														
Rated Motor Frequency [Hz]	50/60														
Thermal protection during operation	ETR for motor (Class 20)														
Thermal protection during operation	110	110	110	110	110	110	110	110	85						
Switching on the Output	Unlimited														
Ramp times [sec]	0.01 - 3600														

VLT Type	525 - 690 Volt							
	P200	P250	P315	P355				
								
Max. Input Current [A]	550	245	299	299	355	355	408	381
Max. Input Current [A]	575	234	286	286	339	339	390	366
Max. Input Current [A]	690	240	296	296	352	352	400	366
Max. external pre-fuses¹⁾ [A]		400		500		600		700
Soft Charge Fuses²⁾ AC [A] (qty)					20 (3)			
SMPS fuse³⁾ [A]					4			
AC Fan fuse³⁾ [A]					4			
Supply Voltage [V]					3 Phase, 525-690 ± 10%			
Supply Frequency [Hz]					50/ 60			
Power Factor					>0.90 for 525 V, >0.85 for 690 V			
Efficiency					0.98			
Power loss at rated max. load (690 V)								
High Overload (150%) [W]		4275		4875		5185		5383
Normal Overload (110%) [W]		5156		5821		6149		6449
Enclosure					IP00, IP21/ NEMA 1 & IP54/ NEMA 12			
Vibration Test [g]					0.7			
Relative Humidity [%]					93%, +2%, -3% (IEC 68-2-3)			
Ambient Temperature [degrees C]					-10 Deg C to 40 Deg C continuously, periodically at +45 degrees C			
					-25 Deg C to +65/ 70 Deg C for storage/ transport			
Adjustable Frequency Drive Protection					Ground and short-circuit protection			
Weight⁵⁾								
IP00/ Chassis [kg]		122.9		137.7		151.3		221
IP21/ NEMA 1 [kg]		136.3		151.3		164.9		263
IP54/ NEMA 12 [kg]		136.3		151.3		164.9		263

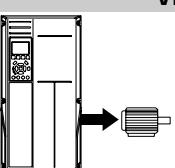
1) Bussmann 170M6000 series. See fuse chart

2) Bussmann FWH-20A6F or exact equivalent, 3 per unit

3) Bussmann KTK-4 or exact equivalent, 1 per unit

4) Littlefuse KLK-15 or exact equivalent, 1 per unit

5) VLT with standard input option, no brake, no loadsharing

525 - 690 Volt							
VLT Type	P400	P500		P560			
							
Output current	[VAC]	HO	NO	HO	NO	HO	NO
Continuous (100/ 100%) [A]	550	429	523	523	596	596	630
Intermittent (150/ 110%) [A]	550	644	575	785	656	894	693
Continuous (100/ 100%) [A]	575/ 690	410	500	500	570	570	630
Intermittent (150/ 110%) [A]	575/ 690	615	550	750	627	855	693
Output kVA							
Continuous (100/ 100%) [kVA]	550	409	498	498	568	568	600
Intermittent (150/ 110%) [kVA]	550	613	548	747	625	852	660
Continuous (100/ 100%) [kVA]	575	408	498	498	568	568	627
Intermittent (150/ 110%) [kVA]	575	612	548	747	624	852	690
Continuous (100/ 100%) [kVA]	690	490	598	598	681	681	753
Intermittent (150/ 110%) [kVA]	690	735	657	896	749	1022	828
Typical Shaft Output							
High Overload (150%) [kW]	550	315		400		450	
Normal Overload (110%) [kW]	550	400		450		500	
High Overload (150%) [HP]	575	400		500		600	
Normal Overload (110%) [HP]	575	500		600		650	
High Overload (150%) [kW]	690	400		500		560	
Normal Overload (110%) [kW]	690	500		560		630	
Max. Motor Cable Length	500 feet (150 m) shielded, 1000 feet (300 m) unshielded						
Output Voltage [%]	0-100% of the AC line voltage						
Output Frequency [Hz]	0-150						
Rated Motor Voltage [V]	550/ 575/ 690						
Rated Motor Frequency [Hz]	50/60						
Thermal protection during operation	ETR for motor (Class 20)						
Thermal protection during operation	85		85		85		
Switching on the Output	Unlimited						
Ramp times [sec]	0.01 - 3600						

VLT Type	525 - 690 Volt						
	P400	P500	P560				
Max. Input Current [A]	550	413	504	504	574	574	607
Max. Input Current [A]	575	395	482	482	549	549	607
Max. Input Current [A]	690	395	482	482	549	549	607
Max. external pre-fuses¹⁾ [A]		700		900		900	
Soft Charge Fuses²⁾ AC [A] (qty)				20 (3)			
SMPS fuse³⁾ [A]				4			
AC Fan fuse³⁾ [A]		4			15		
Supply Voltage [V]				3 Phase, 525-690 ± 10%			
Supply Frequency [Hz]				50/ 60			
Power Factor				>0.90 for 525 V			
Efficiency				0.98			
Power loss at rated max. load (690 V)							
High Overload (150%) [W]		5818		7671		8715	
Normal Overload (110%) [W]		7249		8727		9673	
Enclosure				IP00, IP21/ NEMA 1 & IP54/ NEMA 12			
Vibration Test [g]				0.7			
Relative Humidity [%]				93%, +2%, -3% (IEC 68-2-3)			
Ambient Temperature [de- grees C]				-10 Deg C to 40 Deg C continuously, periodically at +45 degrees C			
				-25 Deg C to +65/ 70 Deg C for storage/ transport			
Adjustable Frequency Drive Protection				Ground and short-circuit protection			
Weight⁵⁾							
IP00/ Chassis [kg]		221		236		277	
IP21/ NEMA 1 [kg]		263		272		313	
IP54/ NEMA 12 [kg]		263		272		313	

1) Bussmann 170M6000 series. See fuse chart

2) Bussmann FWH-20A6F or exact equivalent, 3 per unit

3) Bussmann KTK-4 or exact equivalent, 1 per unit

4) Littlefuse KLK-15 or exact equivalent, 1 per unit

5) VLT with standard input option, no brake, no loadsharing

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.

6

This may be done in three ways:

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



NB!

After a manual reset using the [RESET] button on the LCP, the [AUTO ON] 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 parameters 14-20 (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 parameters 1-90 *Motor Thermal Protection*. 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)		6-01
3	No motor	(X)			1-80
4	Mains phase loss	(X)	(X)	(X)	14-12
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 ETR over temperature	(X)	(X)		1-90
11	Motor thermistor over temperature	(X)	(X)		1-90
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)		8-04
23	Internal Fan Fault	X			
24	External Fan Fault	X			14-53
25	Brake resistor short-circuited	X			
26	Brake resistor power limit	(X)	(X)		2-13
27	Brake chopper short-circuited	X	X		
28	Brake check	(X)	(X)		2-15
29	Power board over temp	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	4-58
31	Motor phase V missing	(X)	(X)	(X)	4-58
32	Motor phase W missing	(X)	(X)	(X)	4-58
33	Inrush Fault	X		X	
34	Fieldbus communication fault	X	X		
36	Mains failure	X	X		
38	Internal Fault	X		X	
40	Overload of Digital Output Terminal 27	(X)			5-00, 5-01
41	Overload of Digital Output Terminal 29	(X)			5-00, 5-02
42	Overload of Digital Output On X30/6	(X)			5-32
42	Overload of Digital Output On X30/7	(X)			5-33
47	24 V supply low	X	X	X	
48	1.8 V supply low	X		X	
49	Speed limit	X			
50	AMA calibration failed		X		
51	AMA check U_{nom} and I_{nom}		X		
52	AMA low I_{nom}		X		
53	AMA motor too big		X		
54	AMA motor too small		X		
55	AMA parameter out of range		X		
56	AMA interrupted by user		X		
57	AMA time-out		X		
58	AMA internal fault	X	X		
59	Current limit	X			

Table 6.1: Alarm/Warning code list

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
61	Tracking Error	(X)	(X)		4-30
62	Output Frequency at Maximum Limit	X			
63	Mechanical Brake Low		(X)		2-20
64	Voltage Limit	X			
65	Control Board Over-temperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Configuration has Changed		X		
68	Safe Stop	(X)	(X) ¹⁾		5-19
70	Illegal FC configuration			X	
71	PTC 1 Safe Stop	X	X ¹⁾		5-19
72	Dangerous Failure			X ¹⁾	5-19
80	Drive Initialized to Default Value		X		
90	Encoder Loss	(X)	(X)	X	17-61 S202
91	Analogue input 54 wrong settings				
100-	See Operating Instructions for MCO				
199	305				
250	New spare part			X	14-23
251	New Type Code	X	X		

Table 6.2: Alarm/Warning code list

(X) Dependent on parameter

1) Can not be Auto reset via Par 14-20

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. 5-1* [1]). The origin event that caused an alarm cannot damage the drive or cause dangerous conditions. A trip lock is an action when an alarm occurs, which may cause damage to drive 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, (reserved)	Pwr. Card Temp		AMA Running
2	00000004	4	Earth Fault	ServiceTrip, Typecode/ Sparepart	Earth Fault		Start CW/CCW
3	00000008	8	Ctrl.Card Temp	ServiceTrip, (reserved)	Ctrl.Card Temp		Slow Down
4	00000010	16	Ctrl. Word TO	ServiceTrip, (reserved)	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 ETR Over		Motor ETR Over		Output Current Low
9	00000200	512	Inverter Overld.		Inverter Overld.		Output Freq High
10	00000400	1024	DC under Volt		DC under Volt		Output Freq Low
11	00000800	2048	DC over Volt		DC over Volt		Brake Check OK
12	00001000	4096	Short Circuit		DC Voltage Low		Braking Max
13	00002000	8192	Inrush Fault		DC Voltage High		Braking
14	00004000	16384	Mains ph. Loss		Mains ph. Loss		Out of Speed Range
15	00008000	32768	AMA 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 Time-lock
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	Fieldbus Fault		Fieldbus Fault		Unused
23	00800000	8388608	24 V Supply Low		24V Supply Low		Unused
24	01000000	16777216	Mains Failure		Mains Failure		Unused
25	02000000	33554432	1.8V Supply Low		Current Limit		Unused
26	04000000	67108864	Brake Resistor		Low Temp		Unused
27	08000000	134217728	Brake IGBT		Voltage Limit		Unused
28	10000000	268435456	Option Change		Encoder loss		Unused
29	20000000	536870912	Drive Initialized		Output freq. lim.		Unused
30	40000000	1073741824	Safe Stop (A68)	PTC 1 Safe Stop (A71)	Safe Stop (W68)	PTC Safe Stop (W71)	1 Unused
31	80000000	2147483648	Mech. brake low	Dangerous Failure (A72)	Extended Word	Status	Unused

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

The alarm words, warning words and extended status words can be read out via serial bus or optional fieldbus for diagnose. See also par. 16-90 - 16-94.

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. 6-10, 6-12, 6-20, or 6-22 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. 2-10

Increase par. 14-26

Alarm/warning limits:

Frequency con-	3 x 380 -	3 x 525 -
verter:	500 V	690 V
	[VDC]	[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 $\pm 5\%$. 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 ETR over temperature:

According to the electronic thermal protection (ETR), 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. 1-90. The fault is that the motor is overloaded by more than 100% for too long. Check that the motor par. 1-24 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. 1-90. 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 sensor is used, check for correct connection between terminal 54 and 55.

WARNING/ALARM 12, Torque limit:

The torque is higher than the value in par. 4-16 (in motor operation) or the torque is higher than the value in par. 4-17 (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. 8-04 is NOT set to *OFF*.

If par. 8-04 is set to *Stop* and *Trip*, a warning appears and the frequency converter ramps down until it trips, while giving an alarm. par. 8-03 *Control word Time-out Time* could possibly be increased.

WARNING 23, Internal fan fault:

The fan warning function is an extra protection function that checks if the fan is running / mounted. The fan warning can be disabled in *Fan Monitor*, par. 14-53, (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 *Fan Monitor*, par. 14-53, (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. 2-15 *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. 2-11) 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. 2-13, the frequency converter cuts out and issues this alarm, when the dissipated braking power is higher than 100%.

ALARM/ WARNING 27, Brake chopper fault:

The brake transistor is monitored during operation and if it short-circuits, the brake function disconnects and the warning comes up. The frequency converter is still able to run, but since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.

Turn off the frequency converter and remove the brake resistor.

This alarm/ warning could also occur should the brake resistor overheat. Terminal 104 to 106 are available as brake resistor. Klixon inputs, see section *Brake Resistor Temperature Switch*.



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

ALARM/WARNING 28, Brake check failed:

Brake resistor fault: the brake resistor is not connected/working.

ALARM 29, Drive over temperature:

If the enclosure is IP 20 or IP 21/Type 1, the cutout temperature of the heatsink is 95 °C ±5 °C. The temperature fault cannot be reset, until the temperature of the heatsink is below 70 °C ±5 °C.

The fault could be:

- Ambient temperature too high
- Too long motor cable

ALARM 30, Motor phase U missing:

Motor phase U between the frequency converter and the 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 occurred within a short time period. See the chapter *General Specifications* for the allowed number of power-ups within one minute.

WARNING/ALARM 34, Fieldbus communication fault:

The fieldbus 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 parameter 14-10 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 Danfoss 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 LCP
- 1792 DSP watchdog is active. Debugging of power part data Motor Orientated Control data not transferred correctly
- 2049 Power data restarted
- 2315 Missing SW version from power unit
- 2816 Stack overflow Control board module
- 2817 Scheduler slow tasks
- 2818 Fast tasks
- 2819 Parameter thread
- 2820 LCP stack overflow
- 2821 Serial port overflow
- 2822 USB port overflow
- 3072- 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
- 5122 Option in slot A: Hardware incompatible with Control board hardware
- 5123 Option in slot B: Hardware incompatible with Control board hardware
- 5124 Option in slot C0: Hardware incompatible with Control board hardware
- 5125 Option in slot C1: Hardware incompatible with Control board hardware
- 5126 Option in slot C1: Hardware incompatible with Control board hardware
- 5376- Out of memory
- 6231

WARNING 40, Overload of Digital Output Terminal 27:

Check the load connected to terminal 27 or remove short-circuit connection. Check parameters 5-00 and 5-01.

WARNING 41, Overload of Digital Output Terminal 29:

Check the load connected to terminal 29 or remove short-circuit connection. Check parameters 5-00 and 5-02.

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

Check the load connected to X30/6 or remove short-circuit connection. Check parameter 5-32.

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

Check the load connected to X30/7 or remove short-circuit connection. Check parameter 5-33.

WARNING 47, 24 V supply low:

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

WARNING 48, 1.8 V supply low:

Contact your Danfoss supplier.

WARNING 49, Speed limit:

The speed is not within the specified range in par. 4-11 and par. 4-13.

ALARM 50, AMA calibration failed:

Contact your Danfoss supplier.

ALARM 51, AMA check Unom and Inom:

The setting of motor voltage, motor current, and motor power is presumably wrong. Check the settings.

ALARM 52, AMA low Inom:

The motor current is too low. Check the settings.

ALARM 53, AMA motor too big:

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

ALARM 54, AMA motor too small:

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

ALARM 55, AMA par. out of range:

The par. values found from the motor are outside acceptable range.

ALARM 56, AMA interrupted by user:

The AMA has been interrupted by the user.

ALARM 57, AMA time-out:

Try to start the AMA again a number of times, until the AMA 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, AMA internal fault:

Contact your Danfoss supplier.

WARNING 59, Current limit:

Contact your Danfoss supplier.

WARNING 61, Encoder loss:

Contact your Danfoss supplier.

WARNING 62, Output Frequency at Maximum Limit:

The output frequency is higher than the value set in par. 4-19

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

ALARM 67, Option Configuration has Changed:

One or more options has 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 Design Guide

ALARM 70, Illegal FC Configuration:

Actual combination of control board and power board is illegal.

ALARM 80, Drive Initialized to Default Value:

Parameter settings are initialized to default setting after a manual (three-finger) reset.

ALARM 91, Analogue Input 54 Wrong Settings:

Switch S202 has to be set in position OFF (voltage input) when a KTY sensor is connected to analogue input terminal 54.

ALARM 250, New Spare Part:

The power or Switch Mode Power Supply has been exchanged. The frequency converter type code must be restored in the EEPROM. Select the correct type code in Par 14-23 according to the label on unit. Remember to select 'Save to EEPROM' to complete.

ALARM 251, New Type Code:

The Frequency Converter has got a new type code.

Index

2

24 V Dc Backup	3
----------------	---

A

Abbreviations	5
Access To Control Terminals	60
Airflow	28
Alarm Messages	123
Ama	67
Analog Inputs	108
Analog Output	109
Approvals	4
Automatic Motor Adaptation (ama)	67, 76

B

Back Cooling	29
Brake Cable	54
Brake Control	127
Brake Resistor Temperature Switch	60

C

Cable Lengths And Cross Sections	110
Cable Positions	23
Cable-length And Cross-section:	49
Cabling	48
Communication Option	128
Control Cable Routing	47
Control Cables	65
Control Cables	64
Control Card Performance	110
Control Card, +10 V Dc Output	109
Control Card, 24 V Dc Output	109
Control Card, Rs 485 Serial Communication	109
Control Card, Usb Serial Communication	109
Control Characteristics	110
Control Terminals	60
Cooling	28

D

Dc Link	126
Default Settings	78
Devicenet	3
Digital Inputs:	107
Digital Output	109
Disposal Instruction	7
Drip Shield Installation	34
Duct Cooling	29
Duct Kit Ordering Numbers	29
Duct Work Cooling Kits	34

E

Earth Leakage Current	8
Earthing	52
Elcb Relays	52
Electrical Data	112
Electrical Installation	60, 64
Etr	127
External Fan Supply	56

F

Fieldbus Connection	47
Floor Mounting	31
Fuses	57
Fusing	48

G

General Considerations	20
General Warning	8
Graphical Display	71

I

Input Polarity Of Control Terminals	65
Installation Of 24 Volt External Dc Supply	47
Installation Of Rittal Enclosures	35
Installation On Pedestal	44
Installation On The Wall - Ip21 (nema 1) And Ip54 (nema 12) Units	30
Intermediate Circuit	126
It Mains	53

K

Kit Contents	35
Kty Sensor	127

L

Language	74
Language Package 1	74
Language Package 2	74
Language Package 3	74
Language Package 4	74
Lcp	71
Lcp 101	72
Lcp 102	71
Leakage Current	8
Leds	71, 72
Lifting	13
Load Sharing	55
Local Control Panel	72

M

Main Reactance	77
Mains Connection	56
Mains Supply (I1, L2, L3)	107
Maximum Reference	77
Mct 10	3
Mechanical Brake Control	69
Mechanical Dimensions	18
Mechanical Dimensions	14
Mechanical Installation	19
Minimum Reference	77
Motor Cable	54
Motor Current	75
Motor Frequency	75
Motor Name Plate	67
Motor Nominal Speed, 1-25	75
Motor Output	107
Motor Overload Protection	8
Motor Power	75
Motor Protection	111
Motor Thermal Protection	70
Motor Voltage	75

Motor Voltage, 1-22	75
N	
Name Plate Data	67
Non UI Compliance	58
Numerical Display	72
O	
Ordering	34
Output Performance (u, V, W)	107
P	
Parallel Connection Of Motors	69
Pedestal Installation	31
Planning The Installation Site	12
Potentiometer Reference	63
Power Connections	48
Profibus	3
Protection	57
Protection And Features	111
Pulse Start/stop	62
Pulse/encoder Inputs	108
R	
Ramp 1 Ramp Down Time	78
Ramp 1 Ramp Up Time	78
Rated Power	19
Receiving The Frequency Converter	12
Relay Outputs	110
Repair Work	8
Required Tools:	44
Residual Current Device	8
Rfi Switch	53
S	
Safe Stop	9
Safe Stop Installation	10
Safety Category 3 (en 954-1)	10
Safety Instructions	8
Screened/armoured	65
Screening Of Cables:	48
Serial Communication	109
Shielded Cables	54
Sine-wave Filter	49
Space	20
Speed Up/down	63
Start/stop	62
Stator Leakage Reactance	76
Status Messages	71
Stopping Category 0 (en 60204-1)	10
Surroundings	110
Switches S201, S202, And S801	66
Switching Frequency:	49
Symbols	4
T	
Terminal Locations	22, 24
Torque	53
Torque Characteristics	107
Torque For Terminals	53

U

Unintended Start.....	9
Unpacking.....	12

V

Voltage Level.....	107
Voltage Reference Via A Potentiometer.....	63

W

Warnings.....	123
Wire Access.....	22