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# 1 How to Read these Operating Instructions

# 1

## 1.1.1 Copyright, Limitation of Liability and Revision Rights

This publication contains information proprietary to Danfoss. By accepting and using this manual the user agrees that the information contained herein will be used solely for operating equipment from Danfoss or equipment from other vendors provided that such equipment is intended for communication with Danfoss equipment over a serial communication link. This publication is protected under the Copyright laws of Denmark and most other countries.

Danfoss does not warrant that a software program produced according to the guidelines provided in this manual will function properly in every physical, hardware or software environment.

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Danfoss reserves the right to revise this publication at any time and to make changes to its contents without prior notice or any obligation to notify former or present users of such revisions or changes.

These Operating Instructions will introduce all aspects of your VLT AQUA Drive.

1

**Available literature for VLT AQUA Drive:**

- Operating Instructions MG.20.MX.YY provide the necessary information for getting the drive up and running.
- Design Guide MG.20.NX.YY entails technical information about the drive design and customer applications.
- Programming Guide MG.20.OX.YY provides information on how to programme and includes complete parameter descriptions.

X = Revision number

YY = Language code

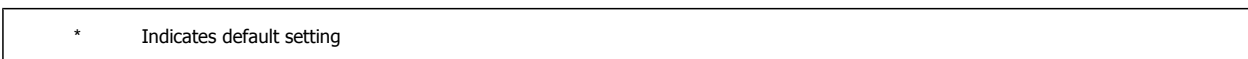
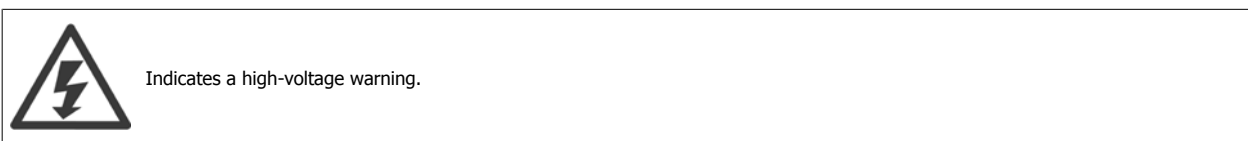
Danfoss Drives technical literature is also available online at [www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation](http://www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation).

### 1.1.2 Approvals



### 1.1.3 Symbols

Symbols used in these Operating Instructions.



## 2 Safety

2

### 2.1.1 Safety note



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

#### Safety Regulations

1. The frequency converter must be disconnected from mains if repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
2. The [STOP/RESET] key on the control panel of the frequency converter does not disconnect the equipment from mains and is thus not to be used as a safety switch.
3. Correct protective earthing of the equipment must be established, the user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The earth leakage currents are higher than 3.5 mA.
5. Protection against motor overload is set by par. 1-90 *Motor Thermal Protection*. If this function is desired, set par. 1-90 to data value [ETR trip] (default value) or data value [ETR warning]. Note: The function is initialised at 1.16 x rated motor current and rated motor frequency. For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.
6. Do not remove the plugs for the motor and mains supply while the frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
7. Please note that the frequency converter has voltage inputs other than L1, L2 and L3, when load sharing (linking of DC intermediate circuit) and external 24 V DC have been installed. Check that all voltage inputs have been disconnected and that the necessary time has passed before commencing repair work.

#### Installation at High Altitudes



##### Installation at high altitude:

380 - 480 V: At altitudes above 3 km, please contact Danfoss Drives regarding PELV.  
 525 - 690 V: At altitudes above 2 km, please contact Danfoss Drives regarding PELV.

#### Warning against Unintended Start

1. The motor can be brought to a stop by means of digital commands, bus commands, references or a local stop, while the frequency converter is connected to mains. If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.
2. While parameters are being changed, the motor may start. Consequently, the stop key [STOP/RESET] must always be activated; following which data can be modified.
3. A motor that has been stopped may start if faults occur in the electronics of the frequency converter, or if a temporary overload or a fault in the supply mains or the motor connection ceases.



##### 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 external 24 V DC, load sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic back up.

### 2.1.2 General Warning



**Warning:**

Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.

Also make sure that other voltage inputs have been disconnected, (linkage of DC intermediate circuit), as well as the motor connection for kinetic back-up.

Before touching any potentially live parts of the frequency converter, wait at least as follows:

380 - 480 V, 110 - 250 kW, wait at least 20 minutes.

380 - 480 V, 315- 1000 kW, wait at least 40 minutes.

525 - 690 V, 45 - 400 kW, wait at least 20 minutes.

525 - 690 V, 450 - 1200 kW, wait at least 30 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. According to IEC 61800-5-1 a reinforced Protective Earth connection must be ensured by means of: a min. 10mm<sup>2</sup> Cu or 16mm<sup>2</sup> Al PE-wire or an additional PE wire - with the same cable cross section as the Mains wiring - must be 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.

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

### 2.1.3 Before commencing repair work

1. Disconnect the frequency converter from mains
2. Disconnect DC bus terminals 88 and 89
3. Wait at least the time mentioned in section General Warning above
4. Remove motor cable

### 2.1.4 Special conditions

**Electrical ratings:**

The rating indicated on the nameplate of the frequency converter is based on a typical 3-phase mains power supply, within the specified voltage, current and temperature range, which is expected to be used in most applications.

**The frequency converters also support other special applications, which affect the electrical ratings of the frequency converter. Special conditions which affect the electrical ratings might be:**

- Single phase applications
- High temperature applications which require derating of the electrical ratings
- Marine applications with more severe environmental conditions.

Consult the relevant clauses in these instructions and in the **VLT® AQUA Drive Design Guide** for information about the electrical ratings.

**Installation requirements:**

**The overall electrical safety of the frequency converter requires special installation considerations regarding:**

- Fuses and circuit breakers for over-current and short-circuit protection
- Selection of power cables (mains, motor, brake, loadsharing and relay)
- Grid configuration (IT, TN, grounded leg, etc.)
- Safety of low-voltage ports (PELV conditions).

Consult the relevant clauses in these instructions and in the **VLT® AQUA Drive Design Guide** for information about the installation requirements.

**2.1.5 Caution**

**!** The frequency converter's DC link capacitors remain charged after power has been disconnected. To avoid an 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:

| Voltage     | Power size    | Min. Waiting Time |
|-------------|---------------|-------------------|
| 380 - 480 V | 110 - 250 kW  | 20 minutes        |
|             | 315 - 1000 kW | 40 minutes        |
| 525 - 690 V | 45 - 400 kW   | 20 minutes        |
|             | 450- 1200 kW  | 30 minutes        |

Be aware that there may be high voltage on the DC link even when the LEDs are turned off.

**2.1.6 Avoid unintended start**

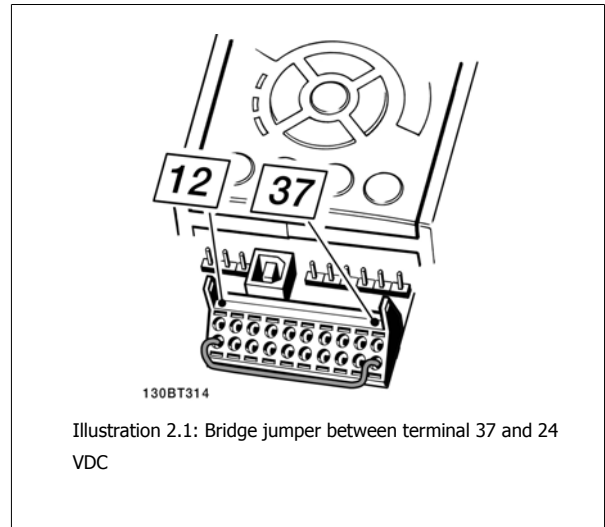
While the frequency converter is connected to mains, the motor can be started/stopped using digital commands, bus commands, references or via the Local Control Panel.

- 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.
- Unless terminal 37 is turned off, an electronic fault, temporary overload, a fault in the mains supply, or lost motor connection may cause a stopped motor to start.

**2.1.7 Safe Stop Installation**

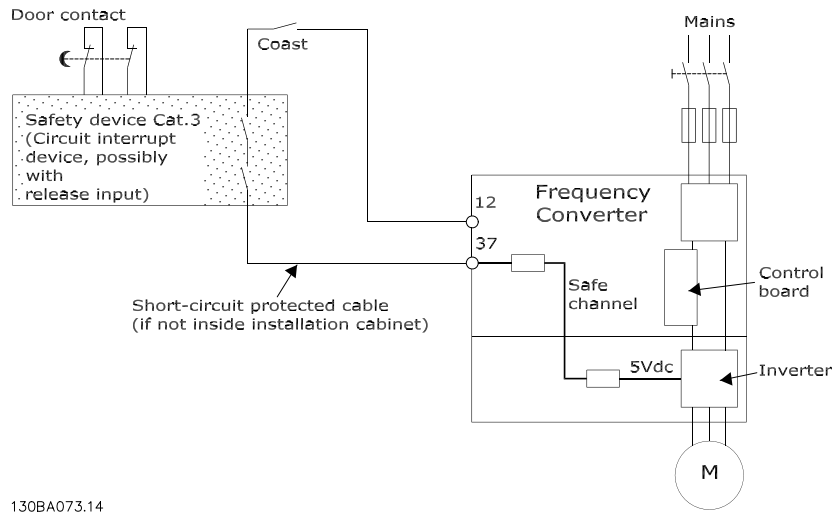
To carry out an installation of a Category 0 Stop (EN60204) in conformity with Safety Category 3 (EN954-1), follow these instructions:

1. The bridge (jumper) between Terminal 37 and 24 V DC must be removed. Cutting or breaking the jumper is not sufficient. Remove it entirely to avoid short-circuiting. See jumper on illustration.
2. Connect terminal 37 to 24 V DC by a short-circuit protected cable. The 24 V DC voltage supply must be interruptible by an EN954-1 Category 3 circuit interrupt device. If the interrupt device and the frequency converter are placed in the same installation panel, you can use an unscreened cable instead of a screened one.



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.

2



130BA073.14

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

### 2.1.8 Safe Stop of the Frequency Converter

For versions fitted with a Safe Stop terminal 37 input, the frequency converter 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 VLT AQUA Drive Design Guide MG.20.NX.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!



### 2.1.9 IT mains



#### IT Mains

Do not connect frequency converters with RFI-filters to mains supplies with a voltage between phase and earth of more than 440 V for 400 V converters and 760 V for 690 V converters.

For 400 V IT mains and delta earth (grounded leg), mains voltage may exceed 440 V between phase and earth.

For 690 V IT mains and delta earth (grounded leg), mains voltage may exceed 760 V between phase and earth.

par. 14-50 *RFI Filter* can be used to disconnect the internal RFI capacitors from the RFI filter to ground.

### 2.1.10 Software Version and Approvals

VLT AQUA Drive  
Software version: 1.24



This manual can be used with all VLT AQUA Drive frequency converters with software version 1.24.

The software version number can be found in parameter 15-43.

### 2.1.11 Disposal instruction



Equipment containing electrical components must 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.



## 3 How to Install

### 3.1 How to Get Started

#### 3.1.1 About How to Install

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

#### 3.1.2 How to Get Started

The frequency converter is designed to achieve a quick and EMC-correct installation by following the steps described below.



Read the safety instructions before installing the unit.

#### Mechanical Installation

- Mechanical mounting

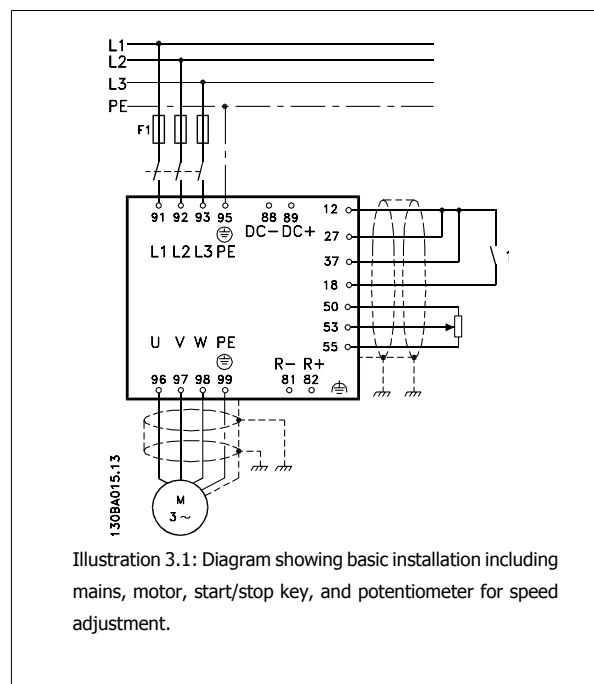
#### Electrical Installation

- 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



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



**NB!**

The card box cover contains a drilling master for the mounting holes in the D frames. For the E size, please refer to section *Mechanical Dimensions* later in this chapter.

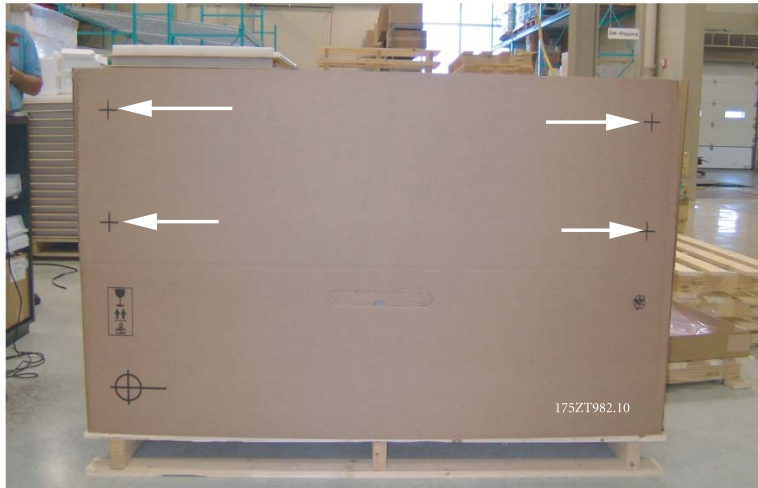
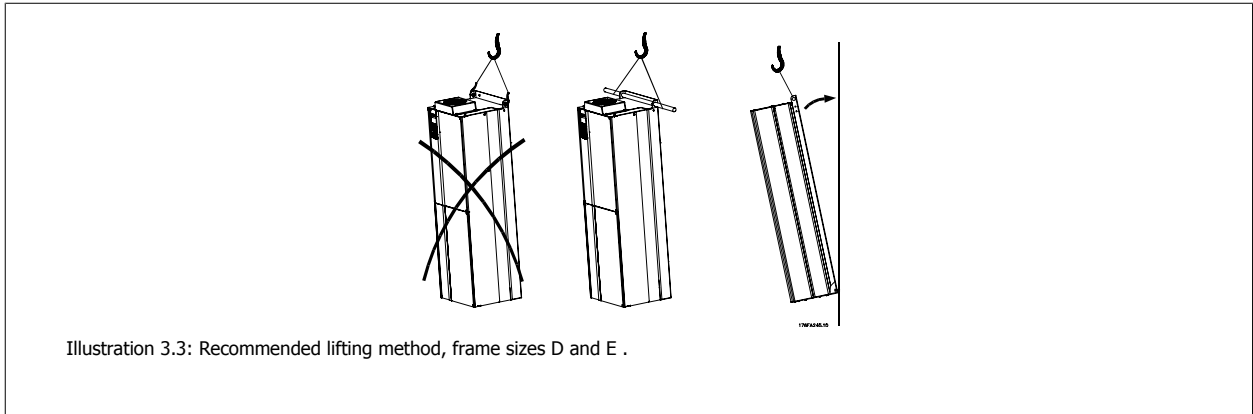


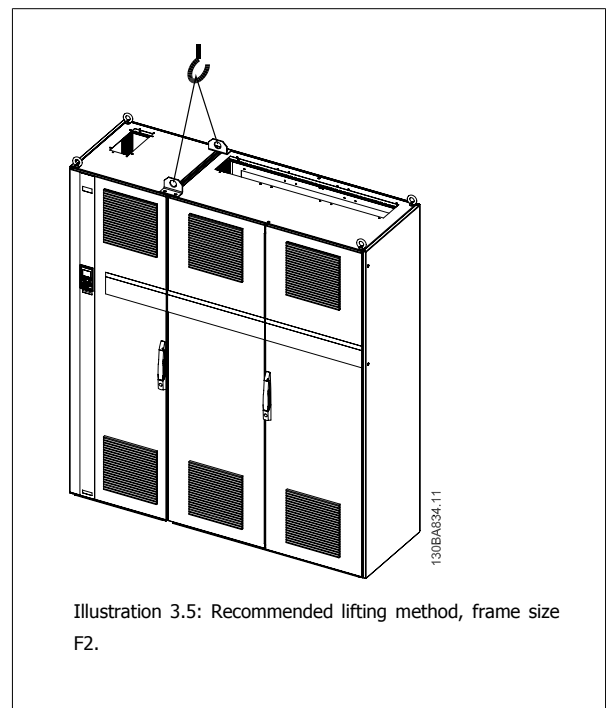
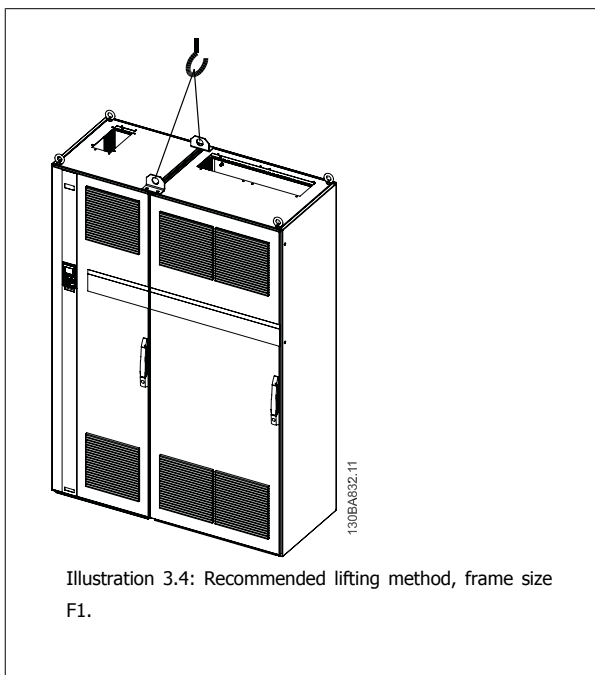
Illustration 3.2: Mounting Template

### 3.2.4 Lifting

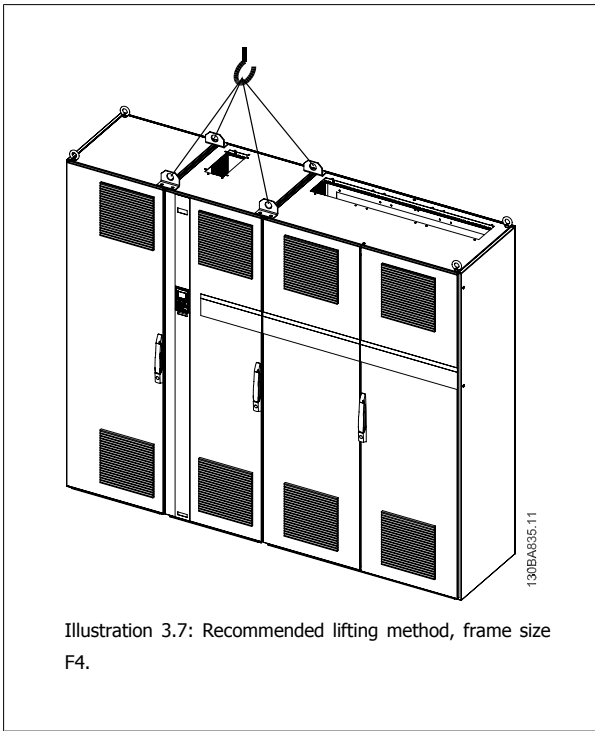
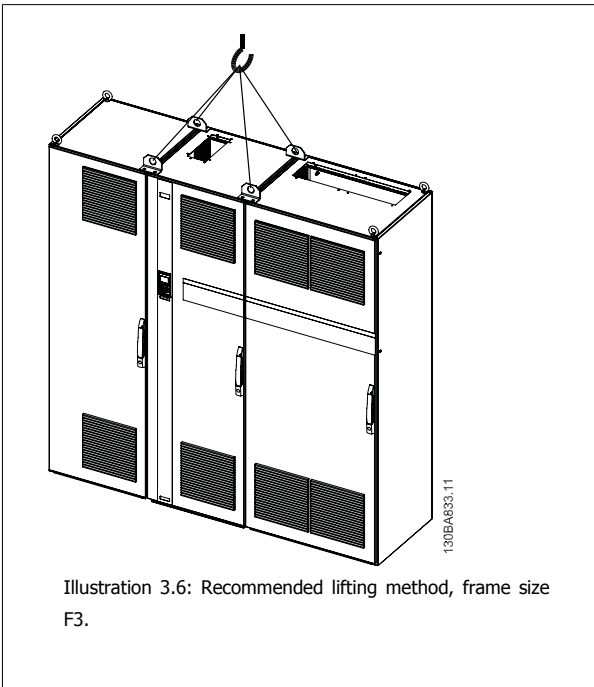
Always lift the frequency converter in the dedicated lifting eyes. For all D and E2 (IP00) frames, use a bar to avoid bending the lifting holes of the frequency converter.



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



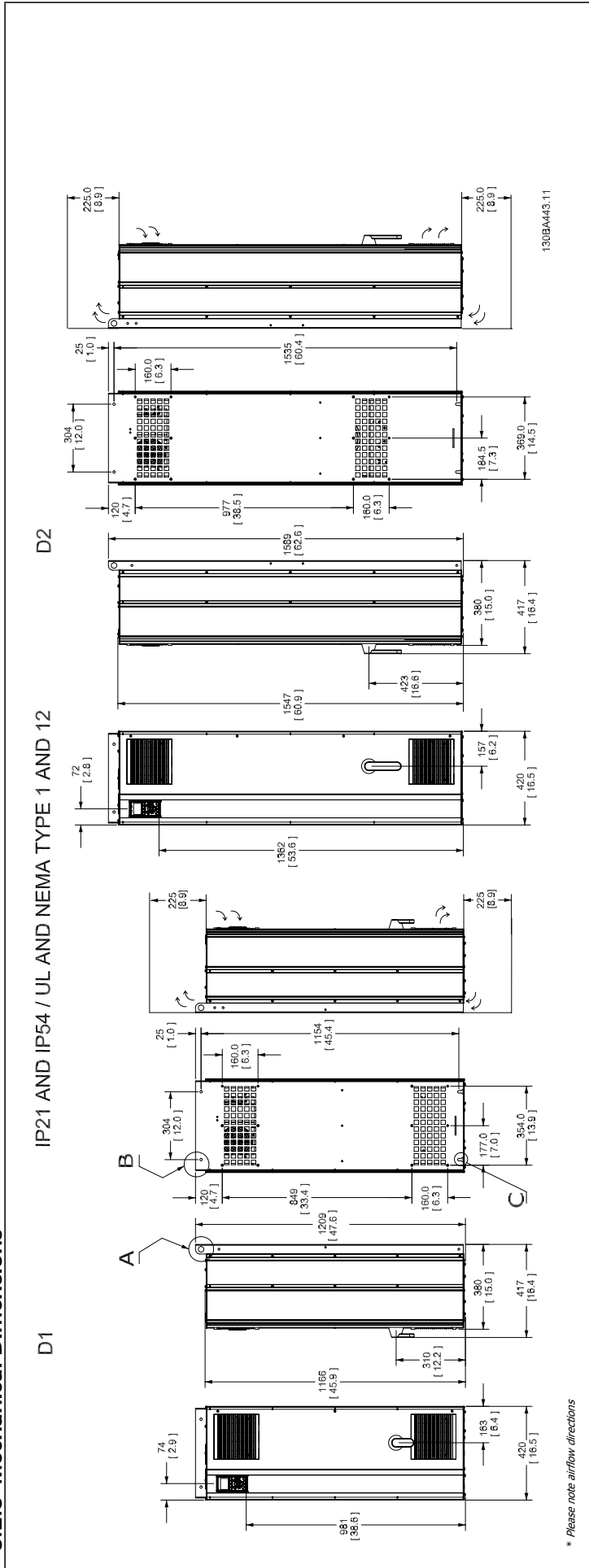
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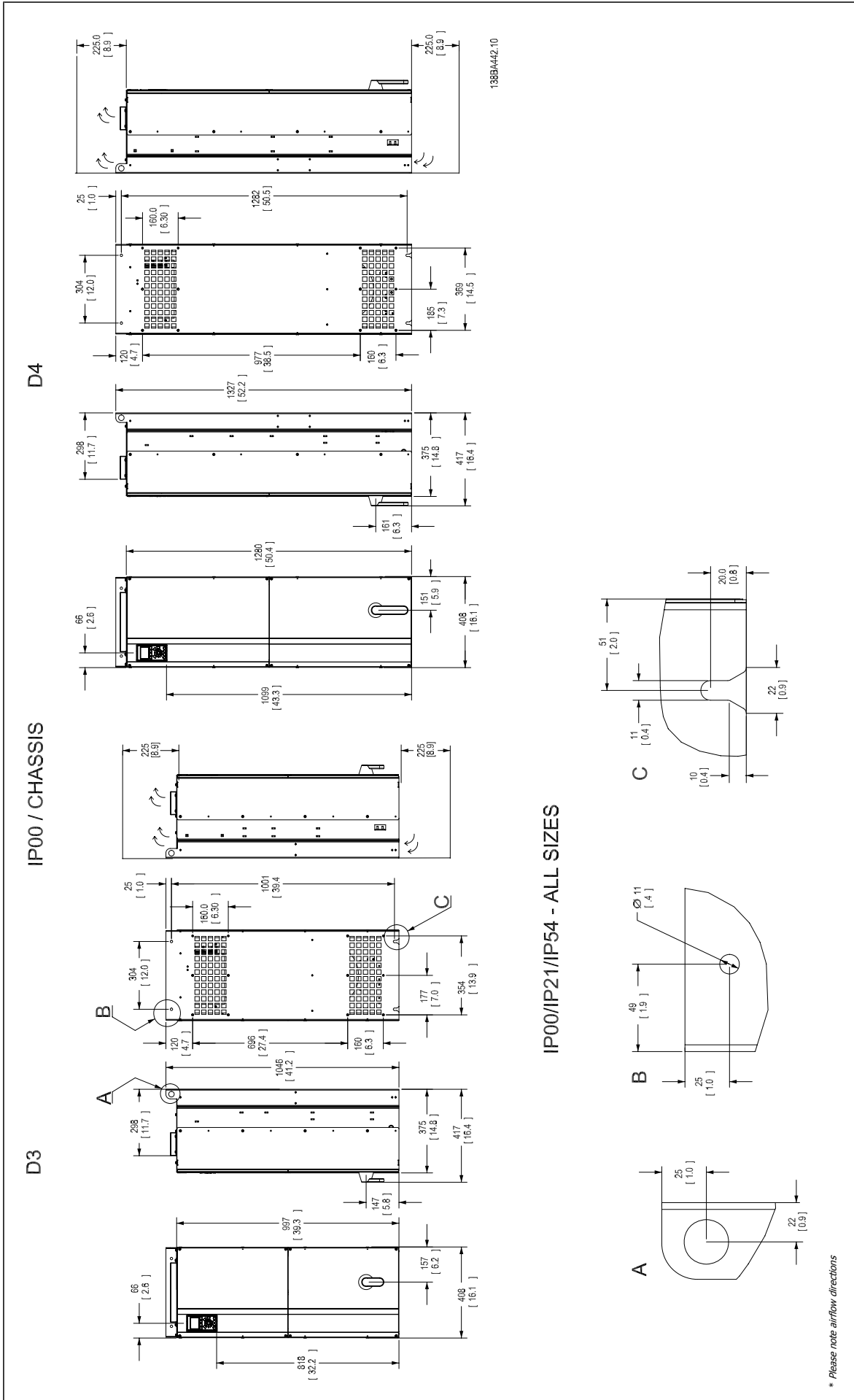
**NB!**

Note the plinth is provided in the same packaging as the frequency converter but is not attached to F1-F4 frames during shipment. The plinth is required to allow airflow to the drive to provide proper cooling. The F frames should be positioned on top of the plinth in the final installation location. The angle from the top of the drive to the lifting cable should be 60 degrees or greater.

3.2.5 Mechanical Dimensions

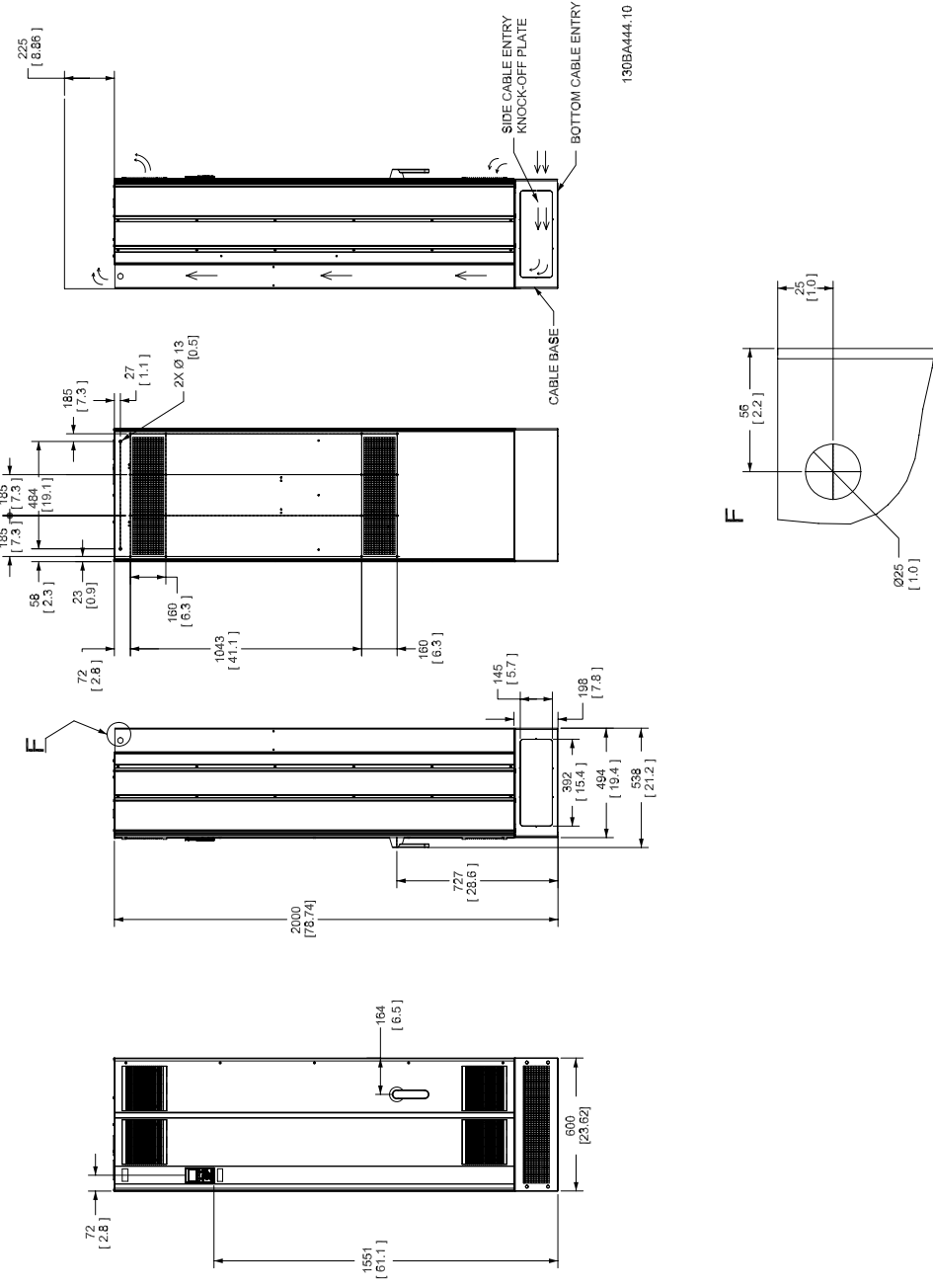


3



IP21 AND IP54 / UL AND NEMA TYPE 1 AND 12

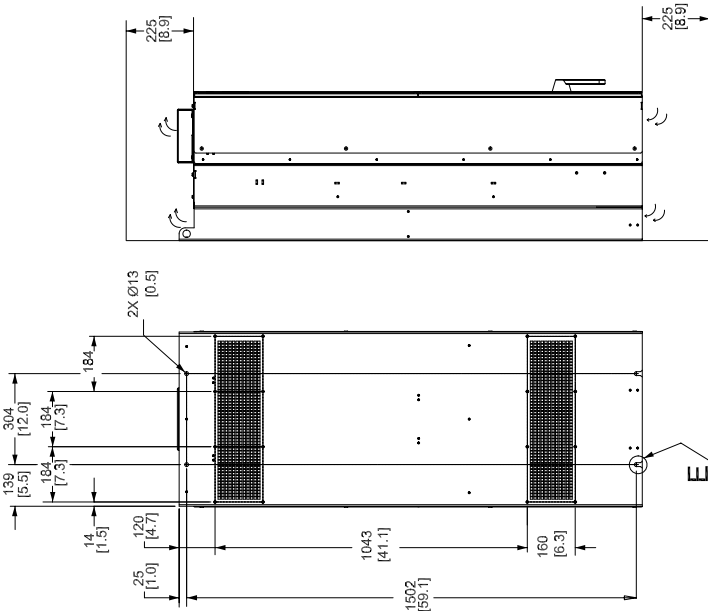
E1



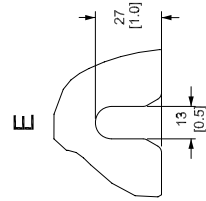
\* Please note airflow directions

**3**

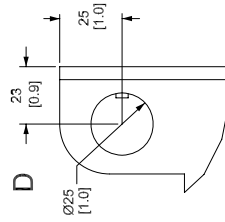
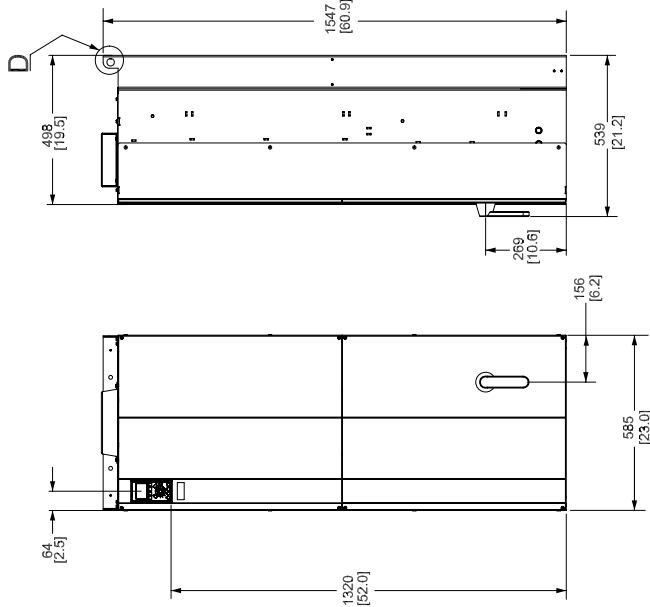
IP00 / CHASSIS



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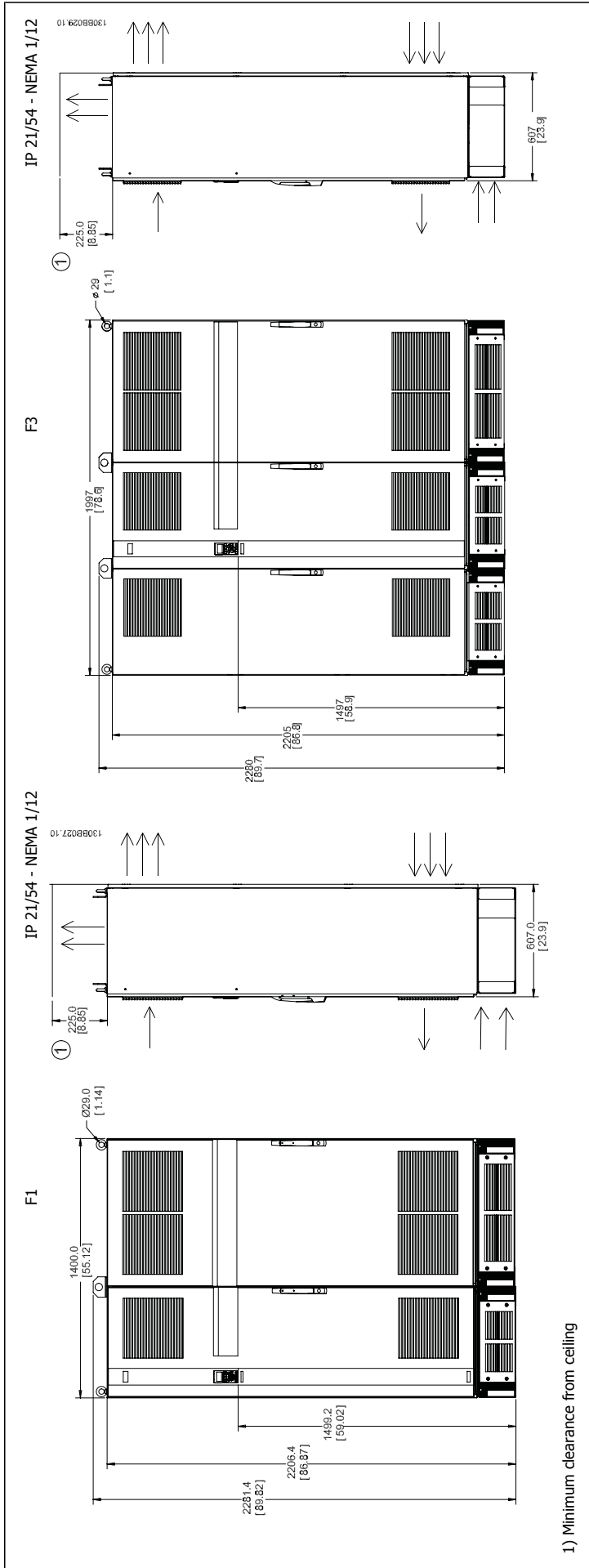


E2



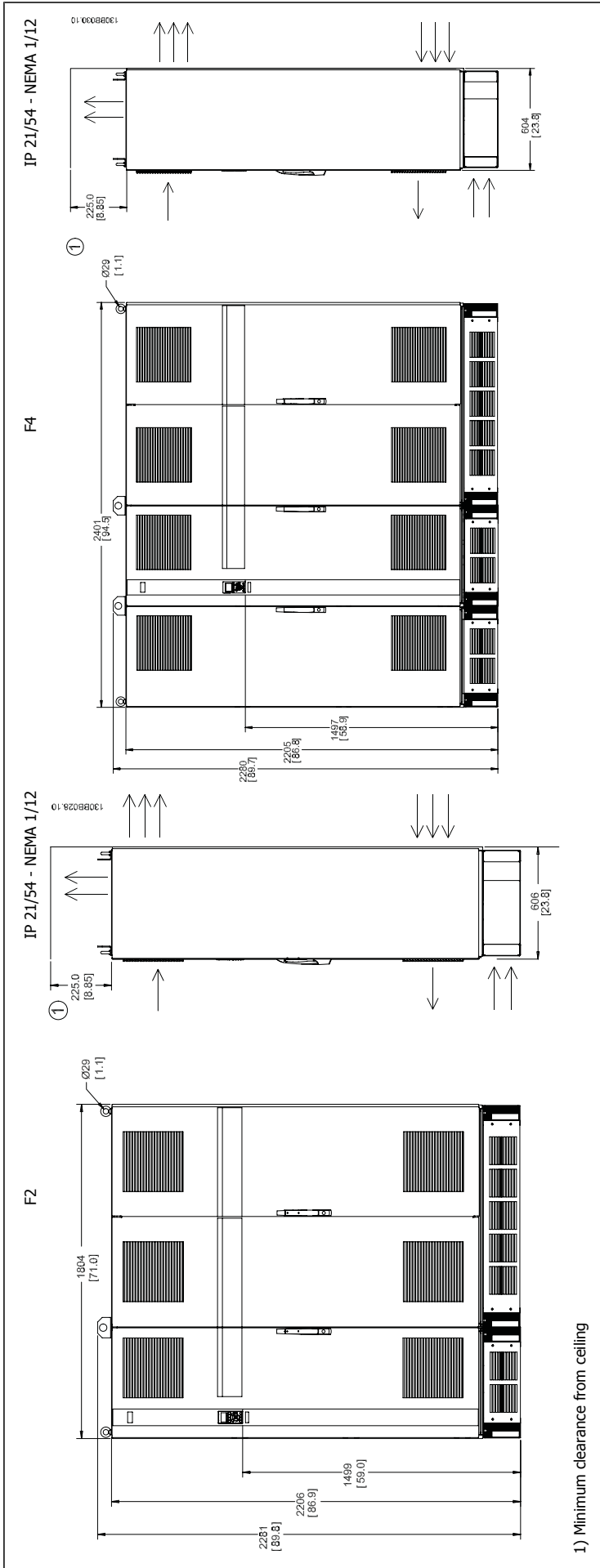
\* Please note airflow directions





1) Minimum clearance from ceiling

3

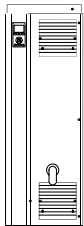

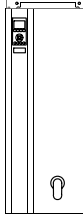
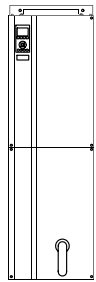


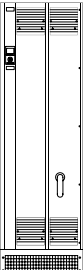
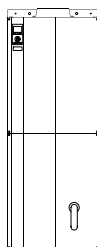
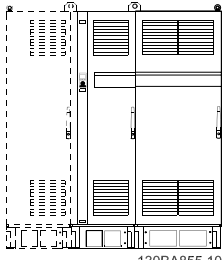
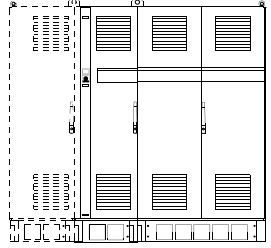
| Mechanical dimensions , Frame size D |  |   |  |  |  |   |  |  |
|--------------------------------------|--|---|--|--|--|---|--|--|
| Frame Size                           |  | D1  |  | D2   |  | D3  |  | D4   |
|                                      |  | 110 - 132 kW at 400 V<br>(380 - 480 V)<br>45 - 160 kW at 690 V<br>(525-690 V) |  | 160 - 250 kW at 400 V<br>(380 - 480 V)<br>200 - 400 kW at 690 V<br>(525-690 V) |  | 110 - 132 kW at 400 V<br>(380 - 480 V)<br>45 - 160 kW at 690 V<br>(525-690 V) |  | 160 - 250 kW at 400 V<br>(380 - 480 V)<br>200 - 400 kW at 690 V<br>(525-690 V) |
| IP NEMA                              |  | 21<br>Type 1  |  | 54<br>Type 12  |  | 21<br>Type 1  |  | 54<br>Type 12  |
| Shipping di-<br>mensions             |  | Height  |  | 650 mm   |  | 650 mm  |  | 650 mm   |
|                                      |  | Width   |  | 1730 mm  |  | 1730 mm   |  | 1730 mm  |
|                                      |  | Depth   |  | 570 mm   |  | 570 mm  |  | 570 mm   |
| Drive dimen-<br>sions                |  | Height  |  | 1209 mm  |  | 1209 mm   |  | 1589 mm  |
|                                      |  | Width   |  | 420 mm   |  | 420 mm  |  | 420 mm   |
|                                      |  | Depth   |  | 380 mm   |  | 380 mm  |  | 380 mm   |
|                                      |  | Max weight  |  | 104 kg   |  | 104 kg  |  | 151 kg   |

| Mechanical dimensions, frame size E and F |  |  |  |  |  |  |  |   |  |
|---|--|--|--|--|--|--|--|---|--|
| Frame Size                                |  | E1   |  | E2   |  | F1   |  | F2  |  |
|   |  | 315 - 450 kW at<br>400 V<br>(380 - 480 V)<br>450 - 630 kW at<br>690 V<br>(525-690 V) |  | 315 - 450 kW at<br>400 V<br>(380 - 480 V)<br>450 - 630 kW at<br>690 V<br>(525-690 V) |  | 500 - 710 kW at<br>400 V<br>(380 - 480 V)<br>710 - 900 kW at<br>690 V<br>(525-690 V) |  | 800 - 1000 kW at<br>400 V<br>(380 - 480 V)<br>1000 - 1200 kW<br>at 690 V<br>(525-690 V) |  |
| IP NEMA                                   |  | 21, 54<br>Type 1/ Type 12  |  | 00<br>Chassis  |  | 21, 54<br>Type 1/ Type 12  |  | 21, 54<br>Type 1/ Type 12   |  |
| Shipping di-<br>mensions                  |  | Height   |  | 840 mm   |  | 831 mm   |  | 2324 mm   |  |
|   |  | Width  |  | 2197 mm  |  | 1705 mm  |  | 1569 mm   |  |
|   |  | Depth  |  | 736 mm   |  | 736 mm   |  | 927 mm  |  |
| Drive dimen-<br>sions                     |  | Height   |  | 2000 mm  |  | 1547 mm  |  | 2204  |  |
|   |  | Width  |  | 600 mm   |  | 585 mm   |  | 1400  |  |
|   |  | Depth  |  | 494 mm   |  | 498 mm   |  | 606   |  |
|   |  | Max weight   |  | 313 kg   |  | 277 kg   |  | 1004  |  |

3

3.2.6 Rated Power

| Frame size   |      | D1   | D2   | D3  | D4   |
|--|------|--|--|---|--|
|  |      | <br>130BA481.10 | <br>130BA482.10 | <br>130BA478.10 | <br>130BA479.10 |
| Enclosure protection                               | IP   | 21/54  | 21/54  | 00  | 00   |
|  | NEMA | Type 1/ Type 12  | Type 1/ Type 12  | Chassis   | Chassis  |
| Normal overload rated power - 110% overload torque |      | 110 - 132 kW at 400 V<br>(380 - 480 V)<br>45 - 160 kW at 690 V<br>(525-690 V)                    | 150 - 250 kW at 400 V<br>(380 - 480 V)<br>200 - 400 kW at 690 V<br>(525-690 V)                   | 110 - 132 kW at 400 V<br>(380 - 480 V)<br>45 - 160 kW at 690 V<br>(525-690 V)                     | 150 - 250 kW at 400 V<br>(380 - 480 V)<br>200 - 400 kW at 690 V<br>(525-690 V)                     |

| Frame size   |      | E1  | E2  | F1/F3  | F2/F4   |
|--|------|---|---|--|---|
|  |      | <br>130BA483.10 | <br>130BA480.10 | <br>130BA855.10 | <br>130BA854.10 |
| Enclosure protection                               | IP   | 21/54   | 00  | 21/54  | 21/54   |
|  | NEMA | Type 1/ Type 12   | Chassis   | Type 1/ Type 12  | Type 1/ Type 12   |
| Normal overload rated power - 110% overload torque |      | 315 - 450 kW at 400 V<br>(380 - 480 V)<br>450 - 630 kW at 690 V<br>(525-690 V)                    | 315 - 450 kW at 400 V<br>(380 - 480 V)<br>450 - 630 kW at 690 V<br>(525-690 V)                    | 500 - 710 kW at 400 V<br>(380 - 480 V)<br>710 - 900 kW at 690 V<br>(525-690 V)                     | 800 - 1000 kW at 400 V<br>(380 - 480 V)<br>1000 - 1200 kW at 690 V<br>(525-690 V)                   |

**NB!** The F frames have four different sizes, F1, F2, F3 and F4. The F1 and F2 consist of an inverter cabinet on the right and rectifier cabinet on the left. The F3 and F4 have an additional options cabinet left of the rectifier cabinet. The F3 is an F1 with an additional options cabinet. The F4 is an F2 with an additional options cabinet.

### 3.3 Mechanical Installation

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

#### 3.3.1 Tools Needed

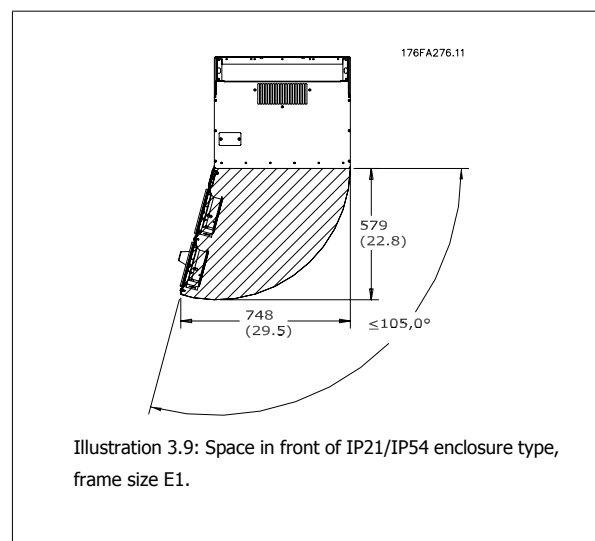
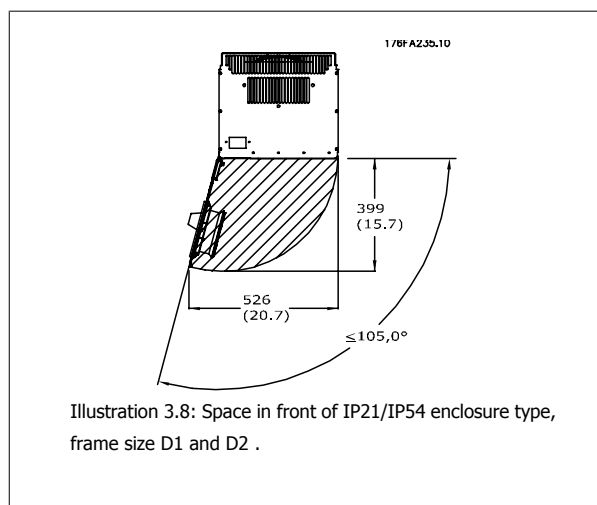
To perform the mechanical installation the following tools are needed:

- Drill with 10 or 12 mm drill
- Tape measure
- Wrench with relevant metric sockets (7-17 mm)
- Extensions to wrench
- Sheet metal punch for conduits or cable glands in IP 21/Nema 1 and IP 54 units
- Lifting bar to lift the unit (rod or tube max. Ø 25 mm (1 inch), able to lift minimum 400 kg (880 lbs)).
- Crane or other lifting aid to place the frequency converter in position
- A Torx T50 tool is needed to install the E1 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.



##### 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.



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

**3.3.3 Terminal locations - frame size D**

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

**3**

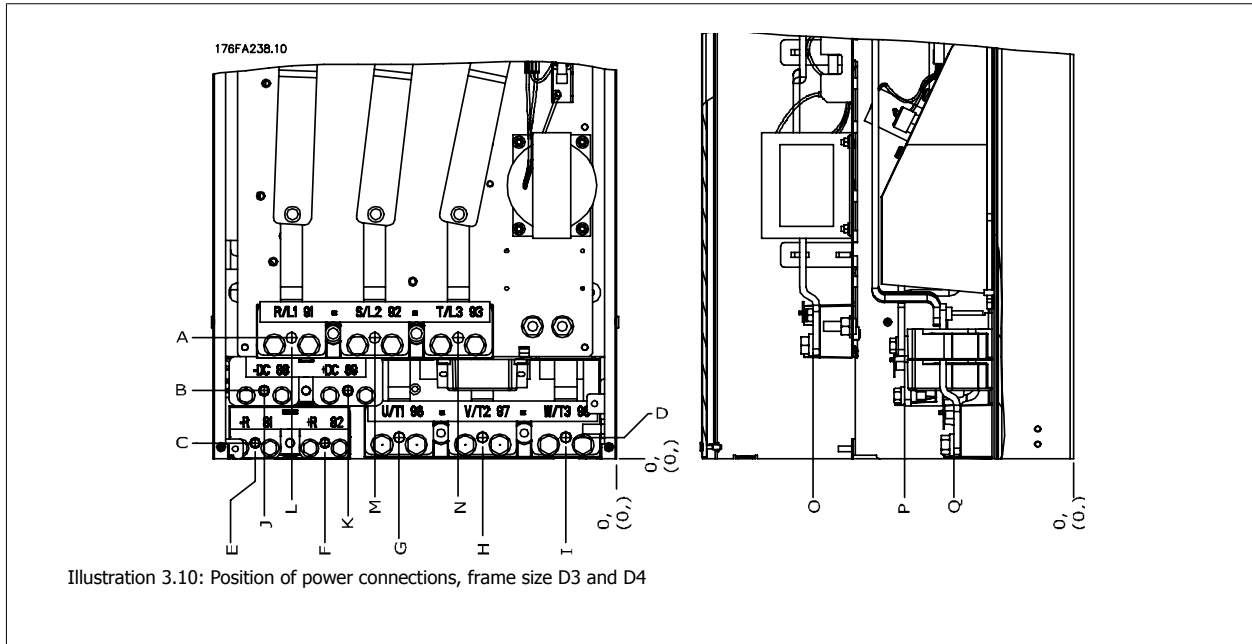


Illustration 3.10: Position of power connections, frame size D3 and D4

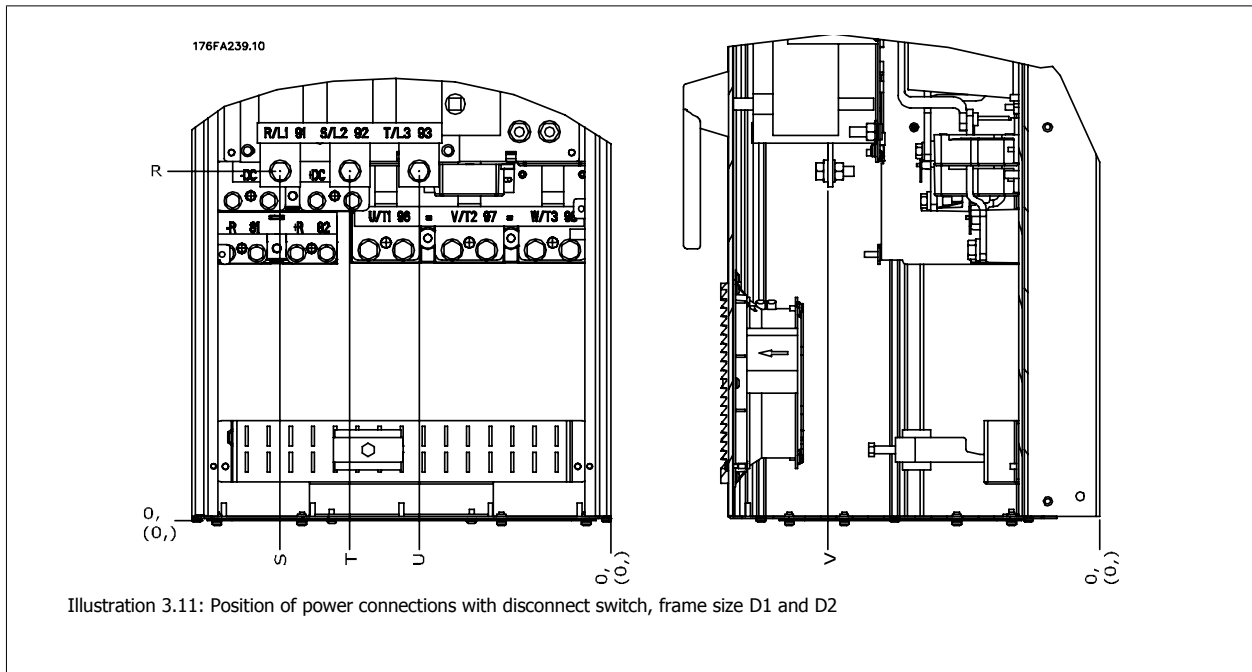


Illustration 3.11: Position of power connections with disconnect switch, frame size D1 and D2

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

**NB!**  
 All D frames are available with standard input terminals or disconnect switch. All terminal dimensions can be found in table on next page.

**3**

|   | IP 21 (NEMA 1) / IP 54 (NEMA 12) |               | IP 00 / Chassis |               |
|---|----------------------------------|---------------|-----------------|---------------|
|   | Frame size D1                    | Frame size D2 | Frame size D3   | Frame size 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).

**3.3.4 Terminal Locations - frame size E**

**Terminal locations - E1**

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

**3**

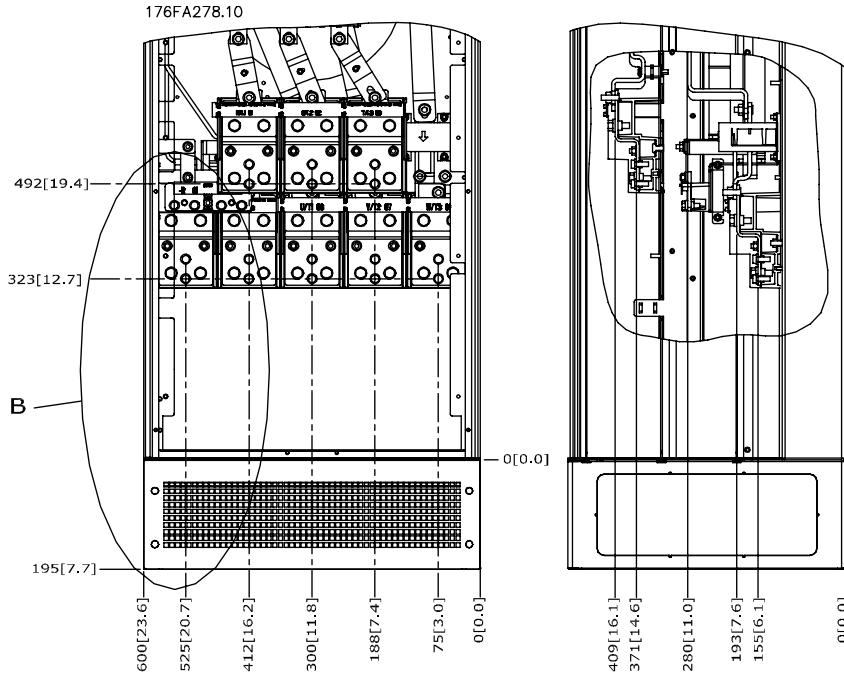


Illustration 3.12: IP21 (NEMA Type 1) and IP54 (NEMA Type 12) enclosure power connection positions

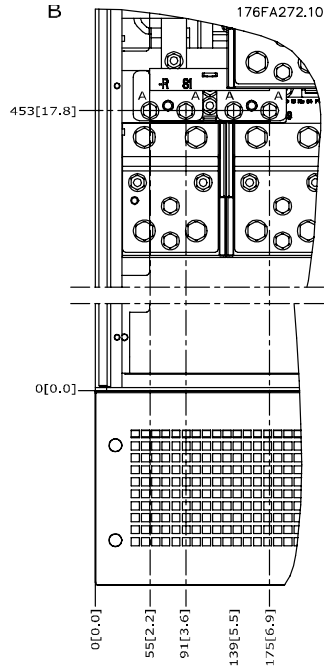
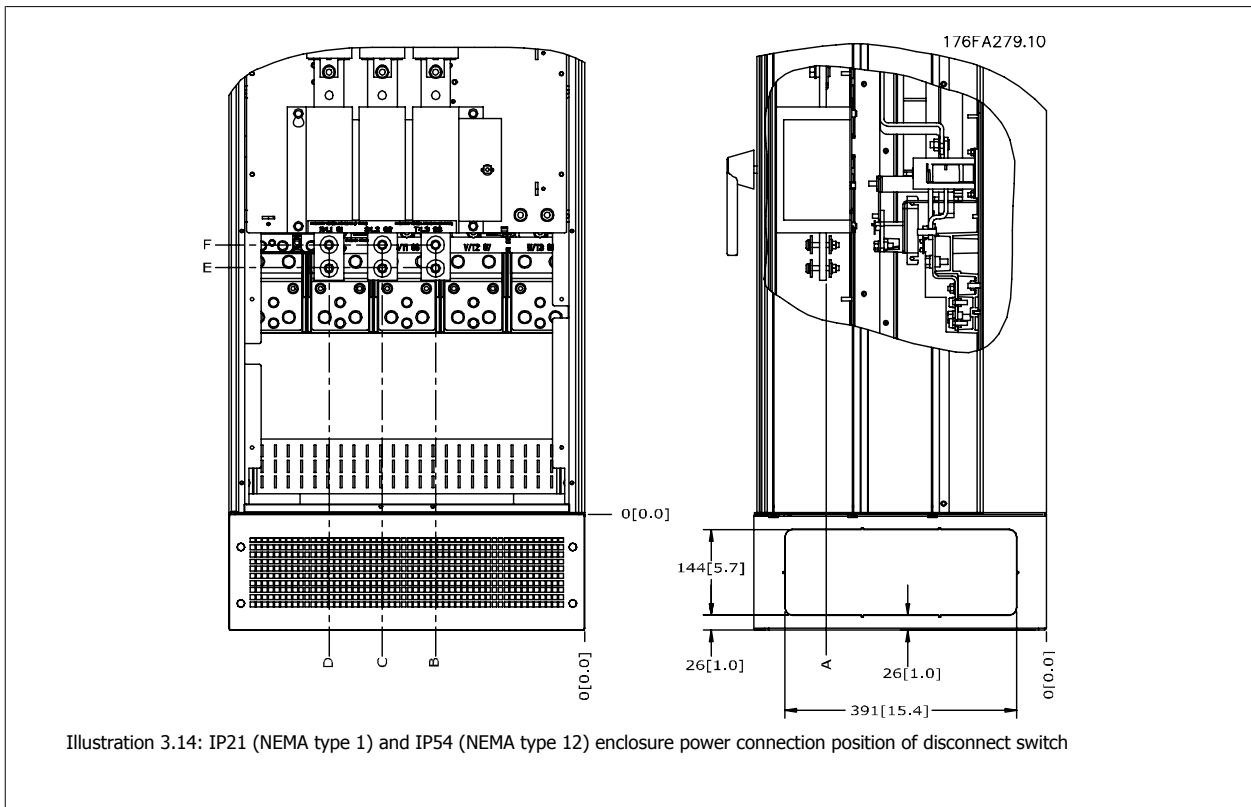


Illustration 3.13: IP21 (NEMA type 1) and IP54 (NEMA type 12) enclosure power connection positions (detail B)



3

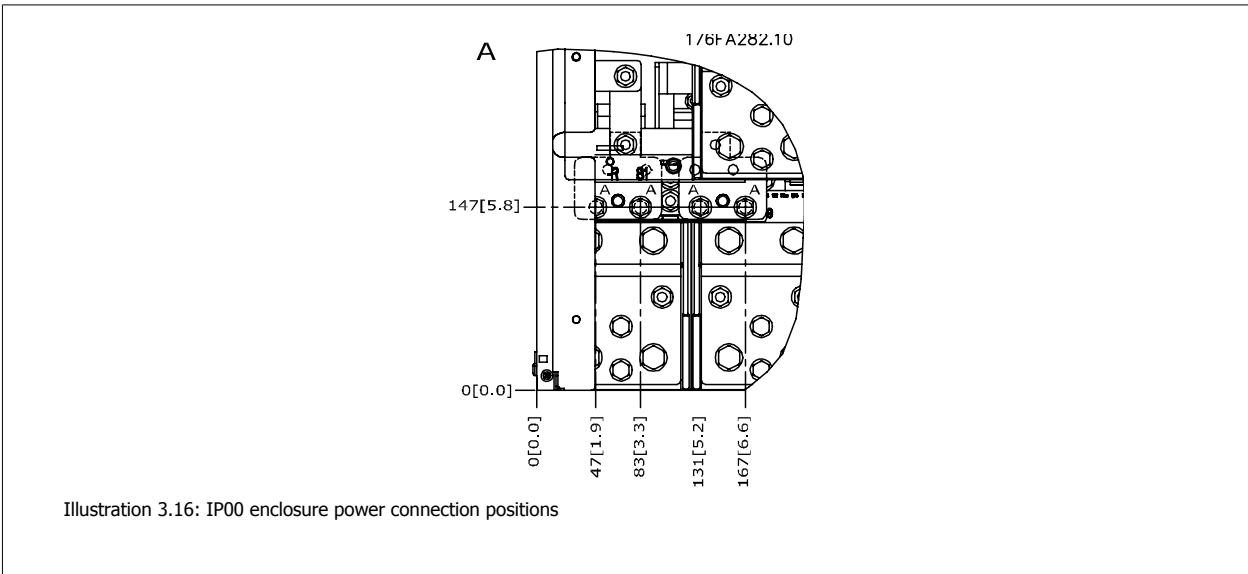
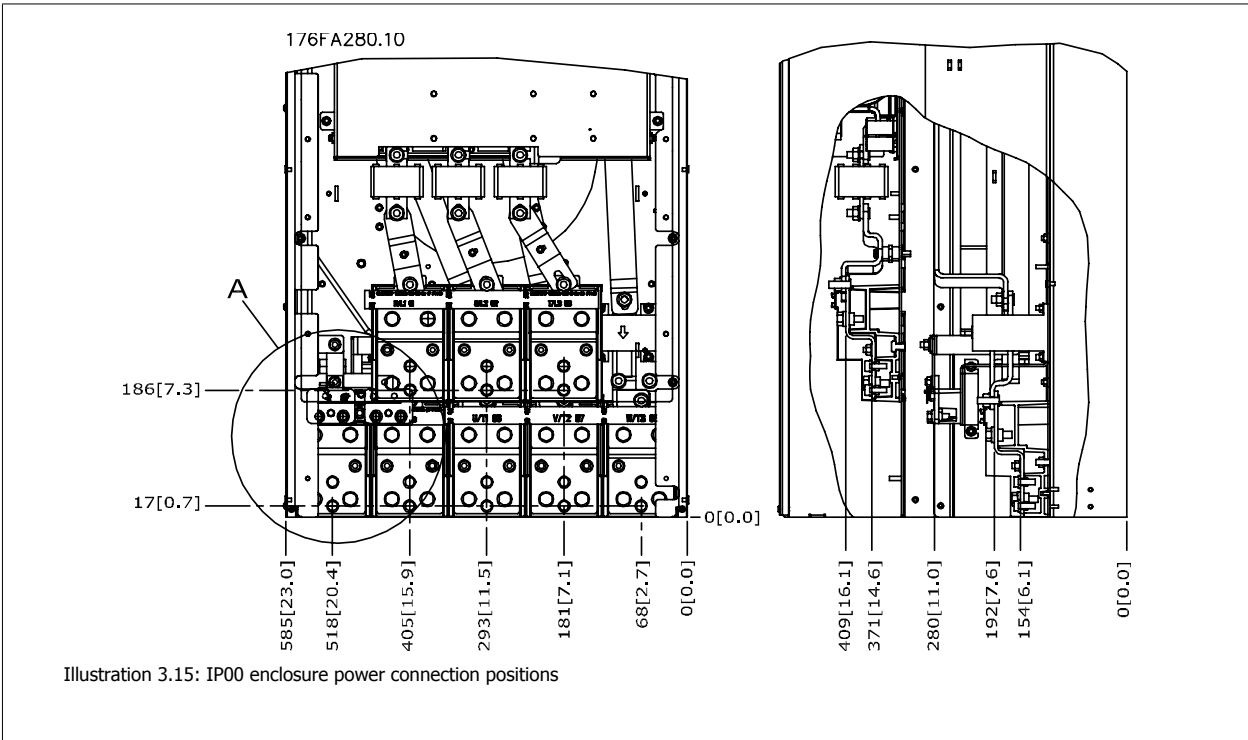


| Frame size | UNIT TYPE  | DIMENSION FOR DISCONNECT TERMINAL |            |            |            |            |            |
|------------|--|-----------------------------------|------------|------------|------------|------------|------------|
|            | IP54/IP21 UL AND NEMA1/NEMA12                    |                                   |            |            |            |            |            |
| E1         | 250/315 kW (400V) AND 355/450-500/630 KW (690 V) | 381 (15.0)                        | 253 (9.9)  | 253 (9.9)  | 431 (17.0) | 562 (22.1) | N/A        |
|            | 315/355-400/450 kW (400V)                        | 371 (14.6)                        | 371 (14.6) | 341 (13.4) | 431 (17.0) | 431 (17.0) | 455 (17.9) |

**Terminal locations - E2**

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

3



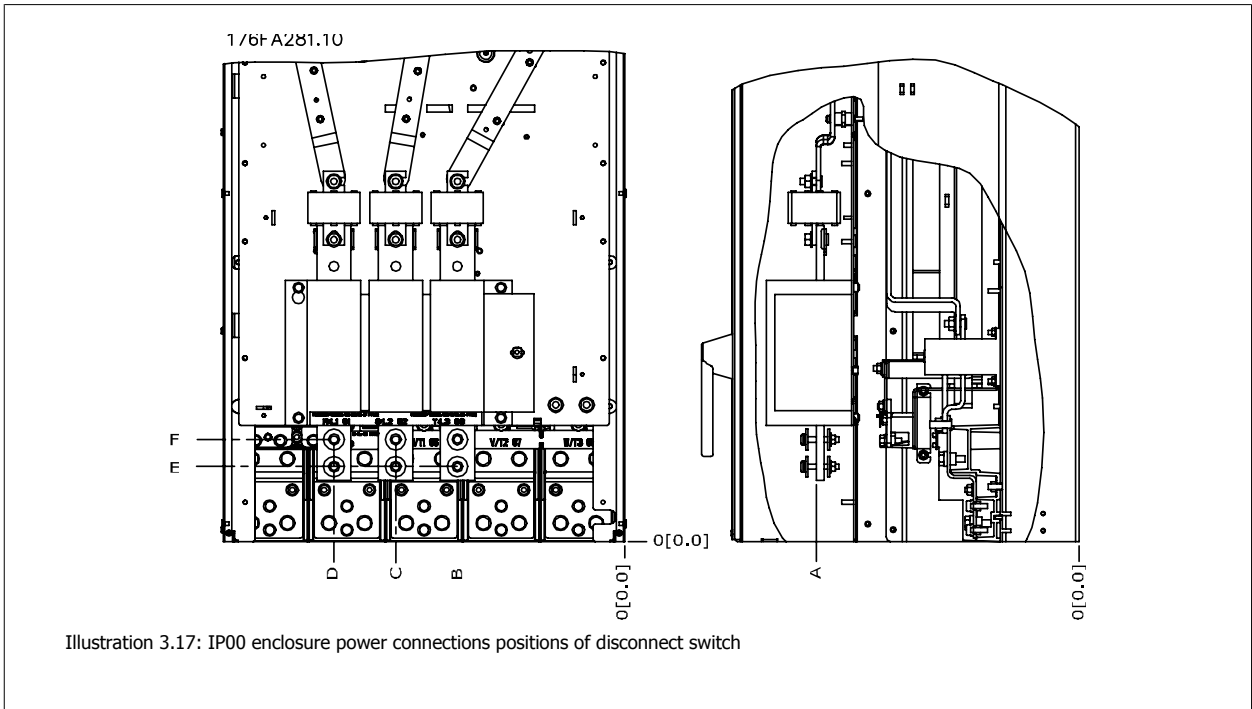


Illustration 3.17: IP00 enclosure power connections positions of disconnect switch

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.

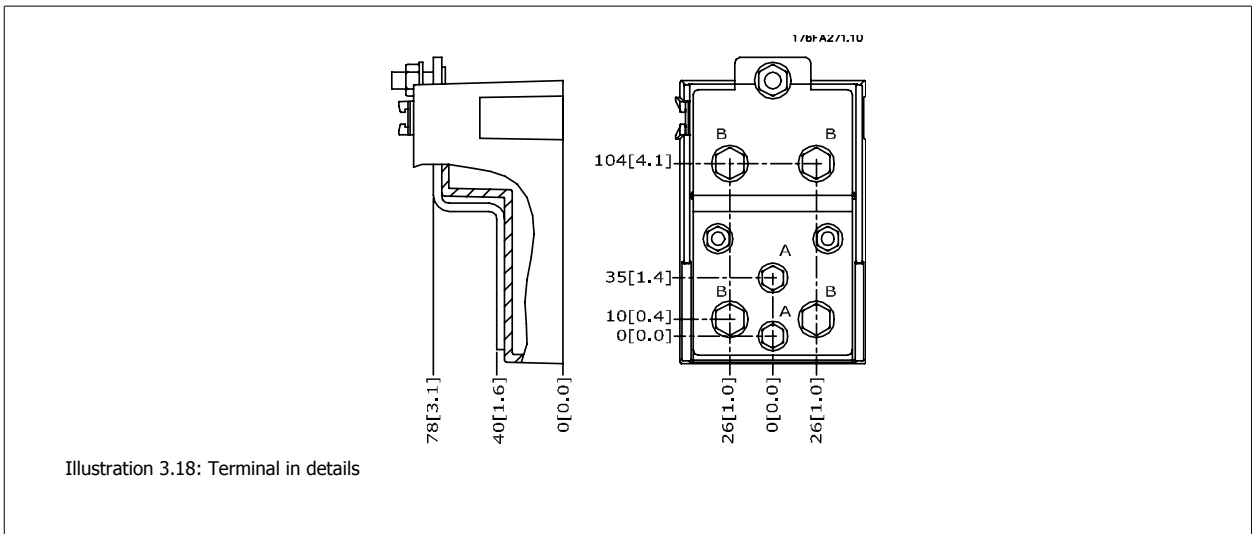


Illustration 3.18: Terminal in details



**NB!**

Power connections can be made to positions A or B

| Frame size | UNIT TYPE  | DIMENSION FOR DISCONNECT TERMINAL |           |            |            |            |           |
|------------|--|-----------------------------------|-----------|------------|------------|------------|-----------|
|            |  | A                                 | B         | C          | D          | E          | F         |
| E2         | IPOO/CHASSIS                                     |                                   |           |            |            |            |           |
|            | 250/315 kW (400V) AND 355/450-500/630 kW (690 V) | 381 (15.0)                        | 245 (9.6) | 334 (13.1) | 423 (16.7) | 256 (10.1) | N/A       |
|            | 315/355-400/450 kW (400V)                        | 383 (15.1)                        | 244 (9.6) | 334 (13.1) | 424 (16.7) | 109 (4.3)  | 149 (5.8) |

**3.3.5 Terminal Locations - frame size F**



**NB!**

The F frames have four different sizes, F1, F2, F3 and F4. The F1 and F2 consist of an inverter cabinet on the right and rectifier cabinet on the left. The F3 and F4 have an additional options cabinet left of the rectifier cabinet. The F3 is an F1 with an additional options cabinet. The F4 is an F2 with an additional options cabinet.

**3**

**Terminal locations - frame size F1 and F3**

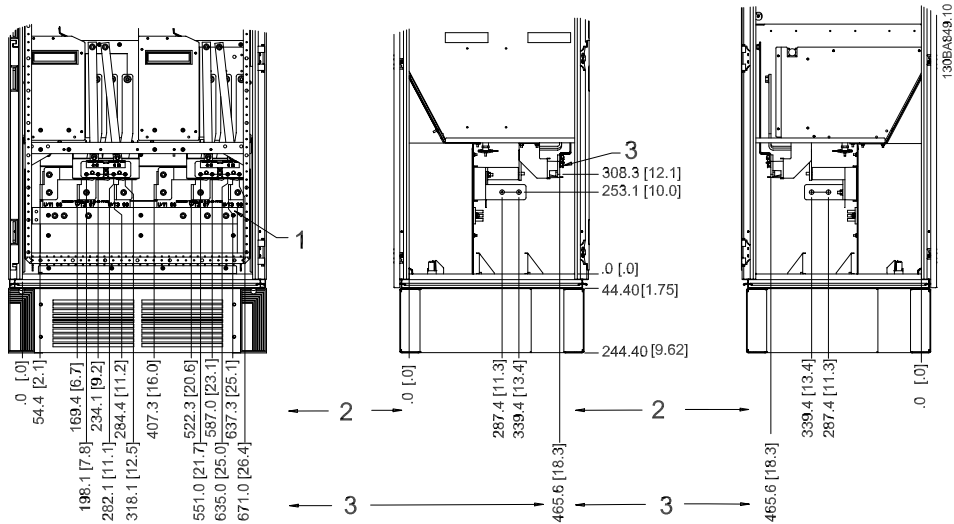


Illustration 3.19: Terminal locations - Inverter Cabinet - F1 and F3 (front, left and right side view)

- 1) Earth ground bar
- 2) Motor terminals
- 3) Brake terminals

**Terminal locations - frame size F2 and F4**

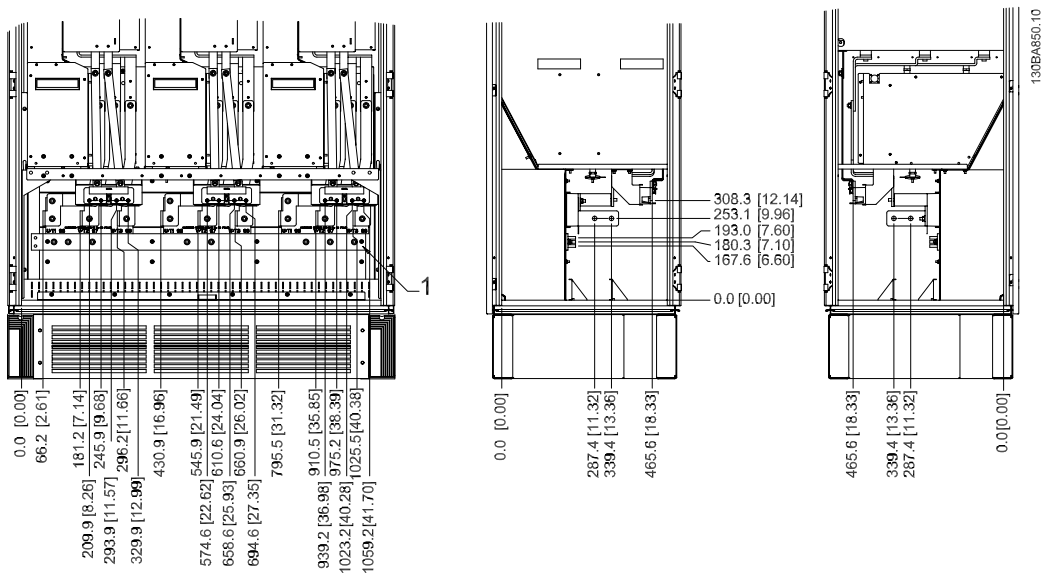


Illustration 3.20: Terminal locations - Inverter Cabinet - F2 and F4 (front, left and right side view)

- 1) Earth ground bar

**Terminal locations - Rectifier (F1, F2, F3 and F4)**

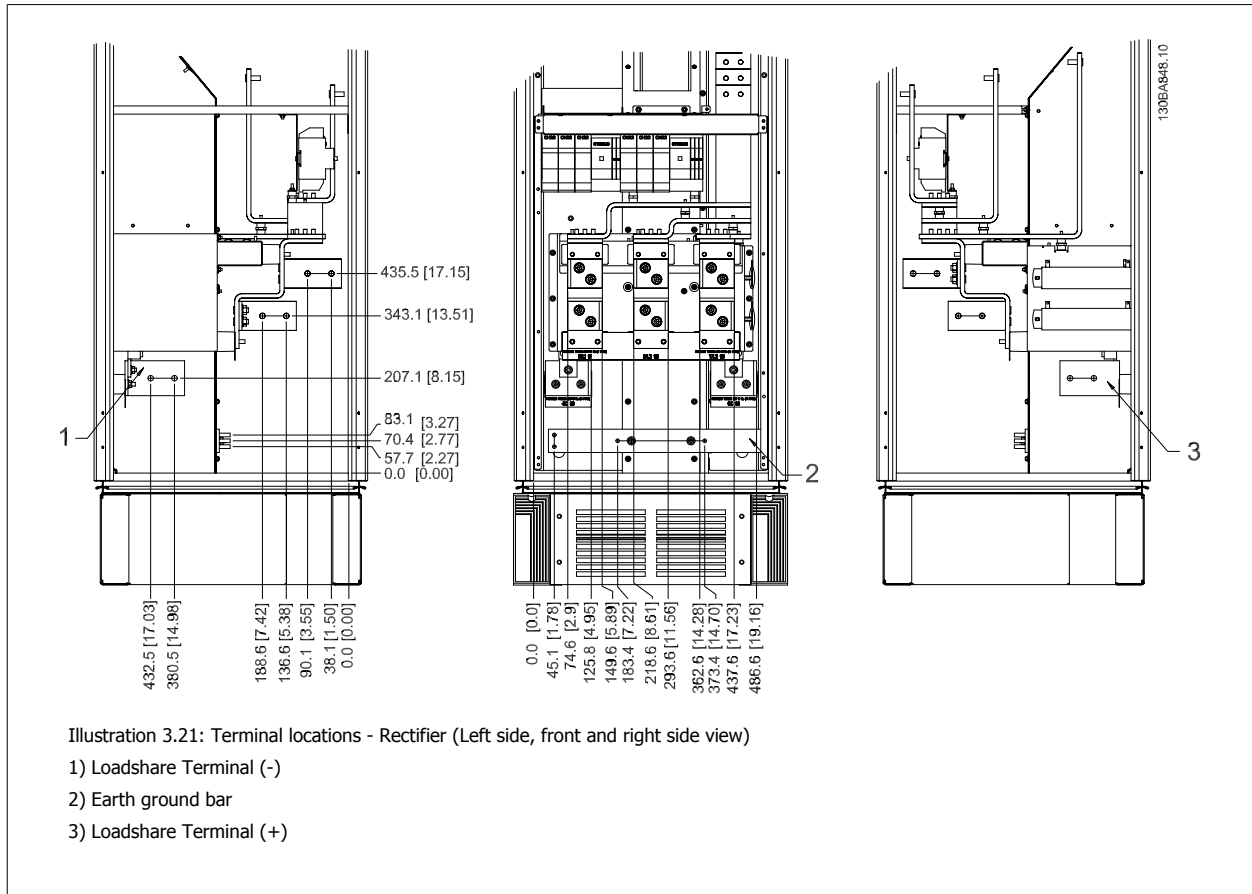


Illustration 3.21: Terminal locations - Rectifier (Left side, front and right side view)

- 1) Loadshare Terminal (-)
- 2) Earth ground bar
- 3) Loadshare Terminal (+)

**Terminal locations - Options Cabinet (F3 and F4)**

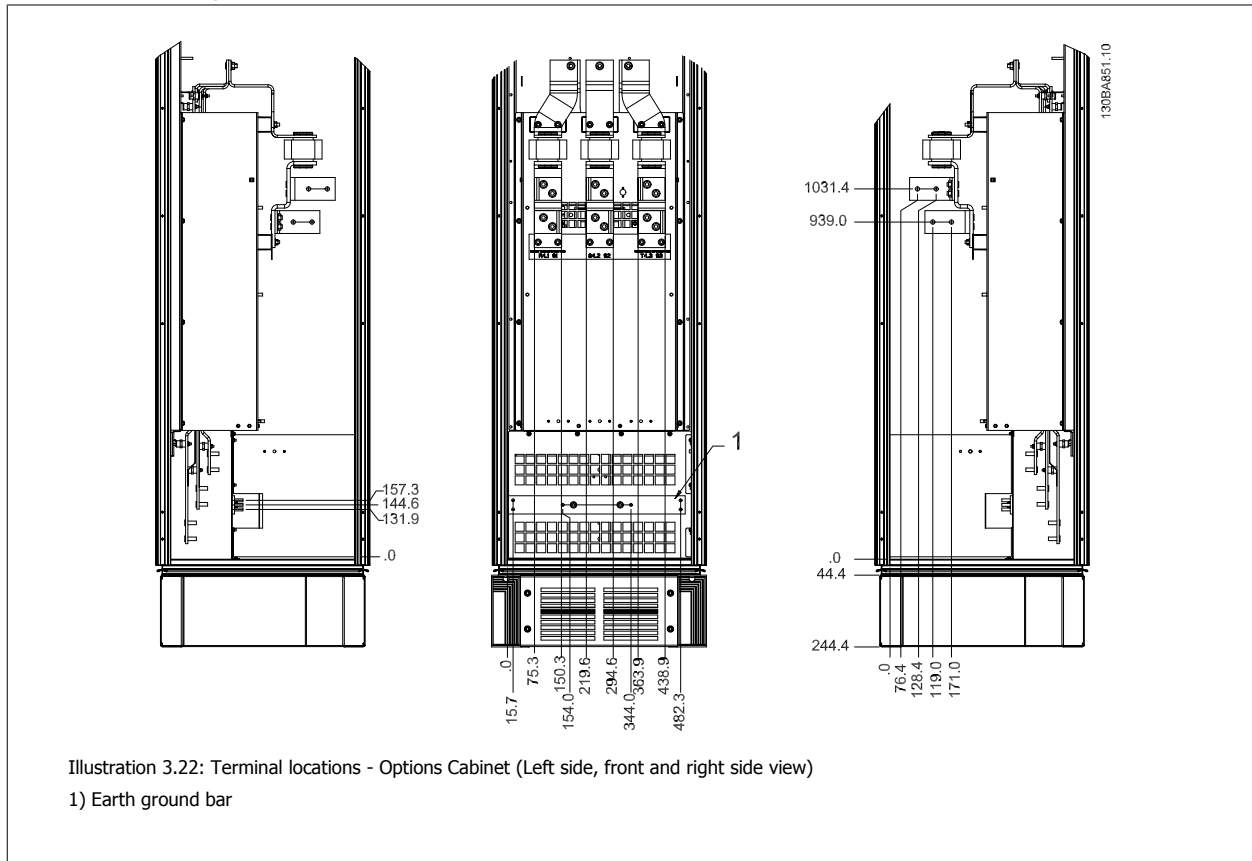
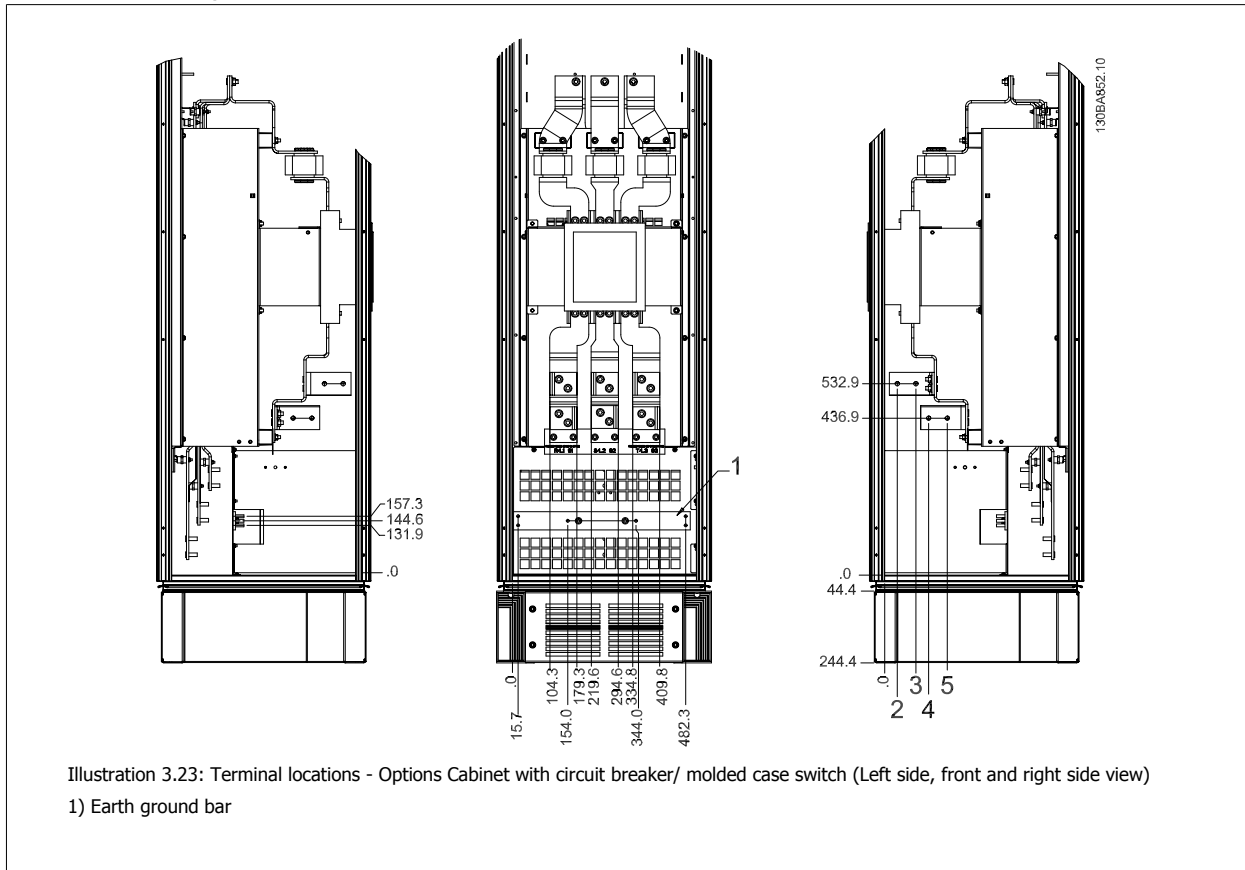


Illustration 3.22: Terminal locations - Options Cabinet (Left side, front and right side view)

- 1) Earth ground bar

3

Terminal locations - Options Cabinet with circuit breaker/ molded case switch (F3 and F4)



3.3.6 Cooling and Airflow

Cooling

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

Duct cooling

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

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

Back cooling

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



NB!

A doorfan(s) is required on the Rittal cabinet to remove the loses not contained in the backchannel of the drive. The minimum doorfan(s) airflow required at the drive maximum ambient for the D3 and D4 is 391 m<sup>3</sup>/h (230 cfm). The minimum doorfan(s) airflow required at the drive maximum ambient for the E2 is 782 m<sup>3</sup>/h (460 cfm). If the ambient is below maximum or if additional components, heat loses, are added within the enclosure a calculation must be made to ensure the proper airflow is provided to cool the inside of the Rittal enclosure.


Airflow

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

| Enclosure protection | Frame size        | Door fan / Top fan airflow       | Airflow over heatsink            |
|----------------------|-------------------|----------------------------------|----------------------------------|
| IP21 / NEMA 1        | D1 and D2         | 170 m <sup>3</sup> /h (100 cfm)  | 765 m <sup>3</sup> /h (450 cfm)  |
| IP54 / NEMA 12       | E1                | 340 m <sup>3</sup> /h (200 cfm)  | 1444 m <sup>3</sup> /h (850 cfm) |
| IP21 / NEMA 1        | F1, F2, F3 and F4 | 700 m <sup>3</sup> /h (412 cfm)* | 985 m <sup>3</sup> /h (580 cfm)  |
| IP54 / NEMA 12       | F1, F2, F3 and F4 | 525 m <sup>3</sup> /h (309 cfm)* | 985 m <sup>3</sup> /h (580 cfm)  |
| IP00 / Chassis       | D3 and D4         | 255 m <sup>3</sup> /h (150 cfm)  | 765 m <sup>3</sup> /h (450 cfm)  |
|                      | E2                | 255 m <sup>3</sup> /h (150 cfm)  | 1444 m <sup>3</sup> /h (850 cfm) |

\* Airflow per fan. Frame size F contain multiple fans.

Table 3.2: Heatsink Air Flow



**NB!**  
The fan runs for the following reasons:

1. AMA
2. DC Hold
3. Pre-Mag
4. DC Brake
5. 60% of nominal current is exceeded
6. Specific heatsink temperature exceeded (power size dependent).

Once the fan is started it will run for minimum 10 minutes.

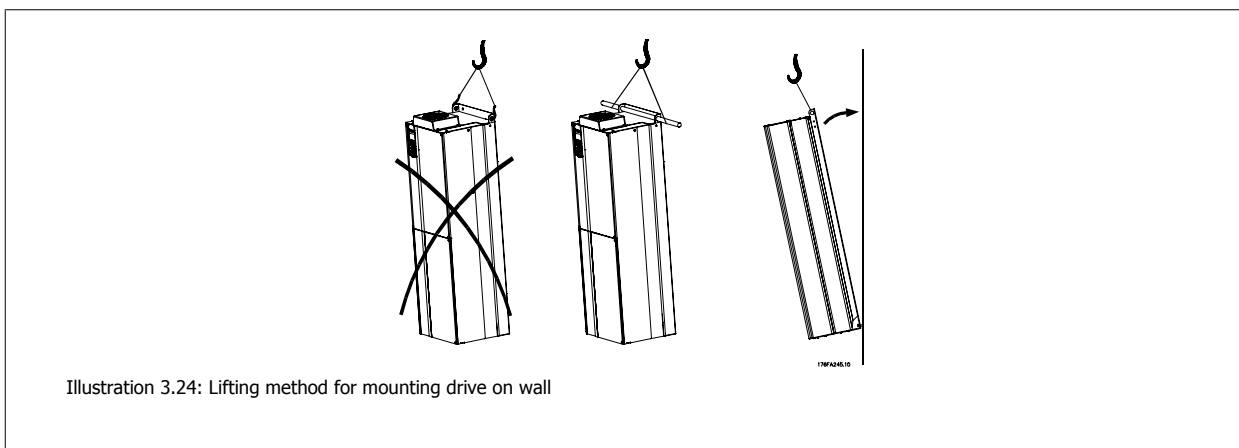
### 3.3.7 Installation on the Wall - IP21 (NEMA 1) and IP54 (NEMA 12) Units

This only applies to frame sizes D1 and D2 . 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.



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

Cables are connected through the gland plate from the bottom. Remove the plate and plan where to place the entry for the glands or conduits. Prepare holes in the marked area on the drawing.

**3**



**NB!**

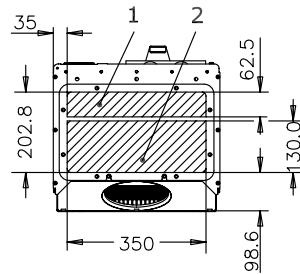
The gland plate must be fitted to the frequency converter to ensure the specified protection degree, as well as ensuring proper cooling of the unit. If the gland plate is not mounted, the frequency converter may trip on Alarm 69, Pwr. Card Temp



130BB073.10

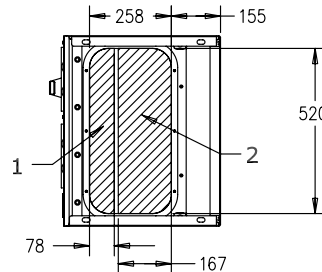
Illustration 3.25: Example of proper installation of the gland plate.

**Frame size D1 + D2**



176FA289.11

**Frame size E1**

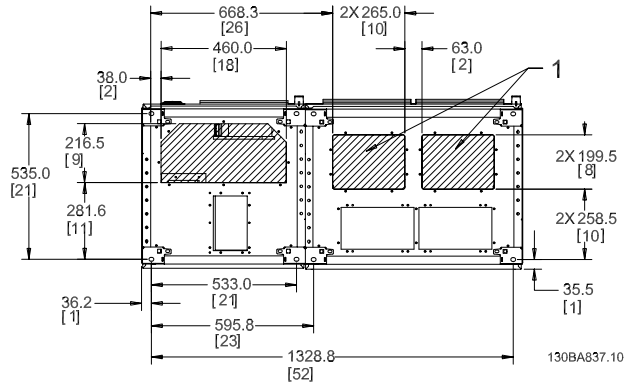


176FA290.11

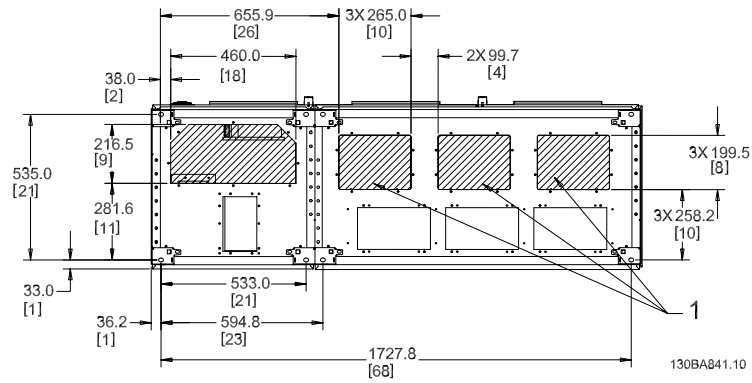
Cable entries viewed from the bottom of the frequency converter - 1) Mains side 2) Motor side



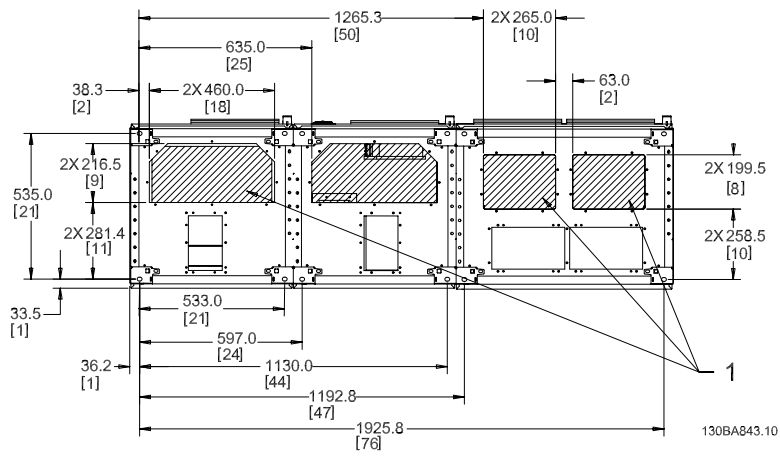
**Frame size F1**



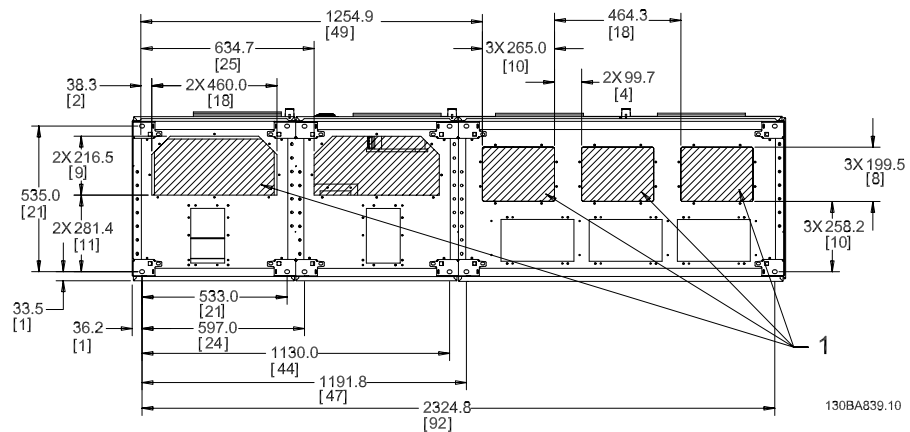
**Frame size F2**



**Frame size F3**



**Frame size F4**



F1-F4: Cable entries viewed from the bottom of the frequency converter - 1) Place conduits in marked areas

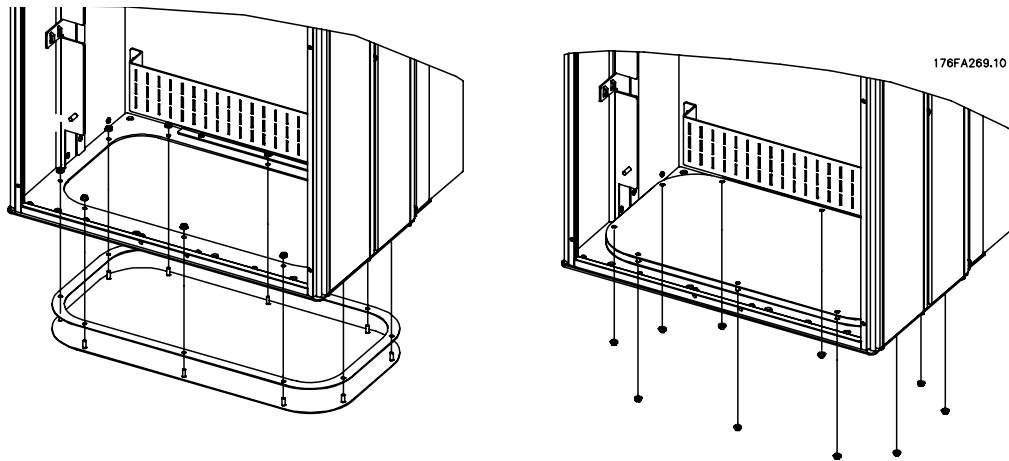


Illustration 3.26: Mounting of bottom plate, Frame size E1.

The bottom plate of the E1 frame 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.

### 3.3.9 IP21 Drip shield installation (frame size D1 and D2 )

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)

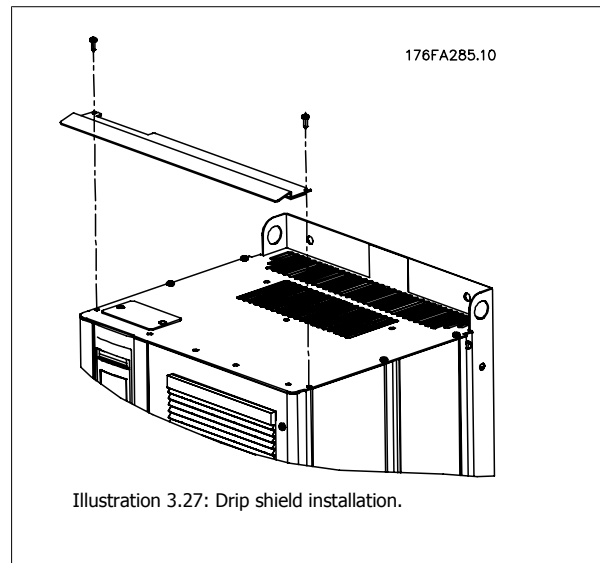
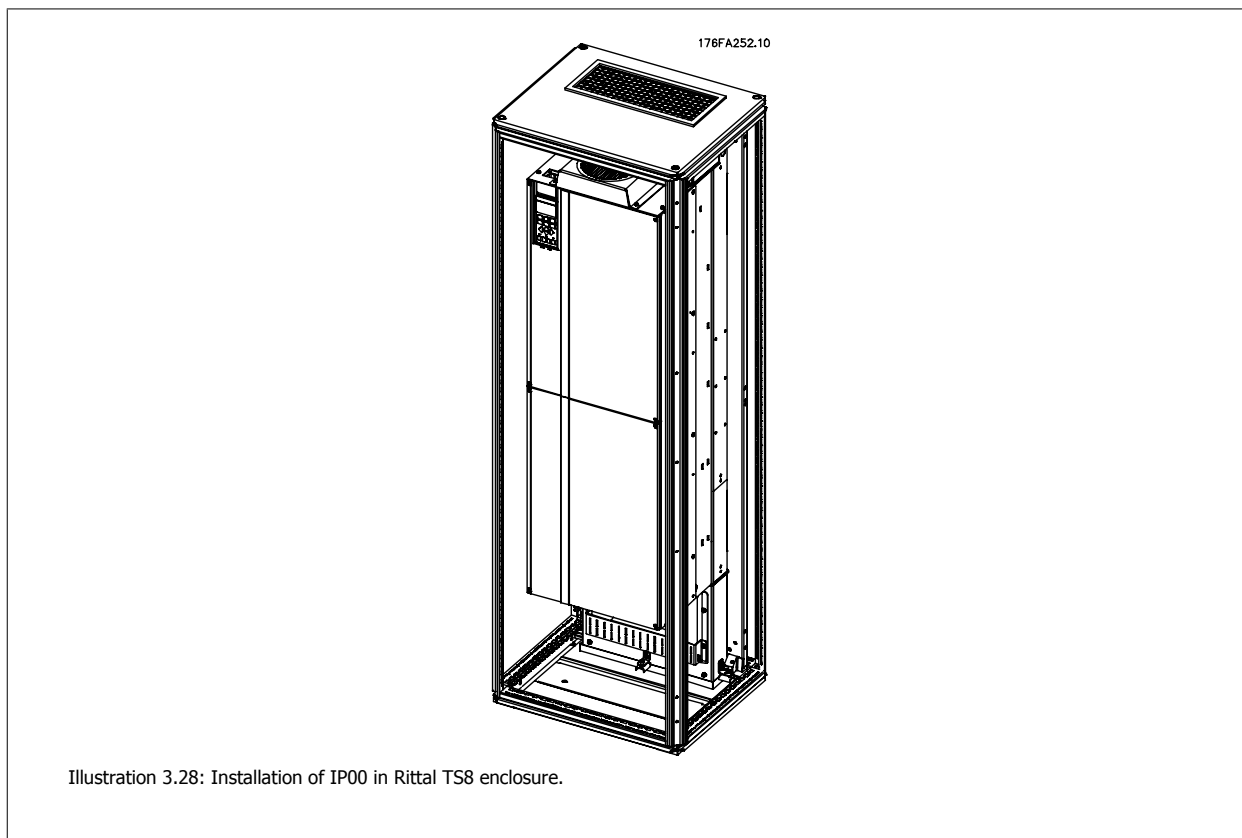


Illustration 3.27: Drip shield installation.

## 3.4 Field Installation of Options

### 3.4.1 Installation of Duct Cooling Kit in Rittal Enclosures

This section deals with the installation of IP00 / chassis enclosed frequency converters with duct work cooling kits in Rittal enclosures. In addition to the enclosure a 200 mm base/plinth is required.



**The minimum enclosure dimension is:**

- D3 and D4 frame: Depth 500 mm and width 600 mm.
- E2 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.



For the E2 frames it is important to mount the plate at the absolute rear of the Rittal enclosure due to the weight of the frequency converter.



**NB!**

A doorfan(s) is required on the Rittal cabinet to remove the losses not contained in the backchannel of the drive. The minimum doorfan(s) airflow required at the drive maximum ambient for the D3 and D4 is 391 m<sup>3</sup>/h (230 cfm). The minimum doorfan(s) airflow required at the drive maximum ambient for the E2 is 782 m<sup>3</sup>/h (460 cfm). If the ambient is below maximum or if additional components, heat losses, are added within the enclosure a calculation must be made to ensure the proper airflow is provided to cool the inside of the Rittal enclosure.

**3**

**Ordering Information**

| Rittal TS-8 Enclosure | Frame D3 Kit Part No. | Frame D4Kit 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 D3 and D4 frame kits:
  - 175R5639 - Mounting templates and top/bottom cut out for Rittal enclosure.
- Delivered with E2 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)

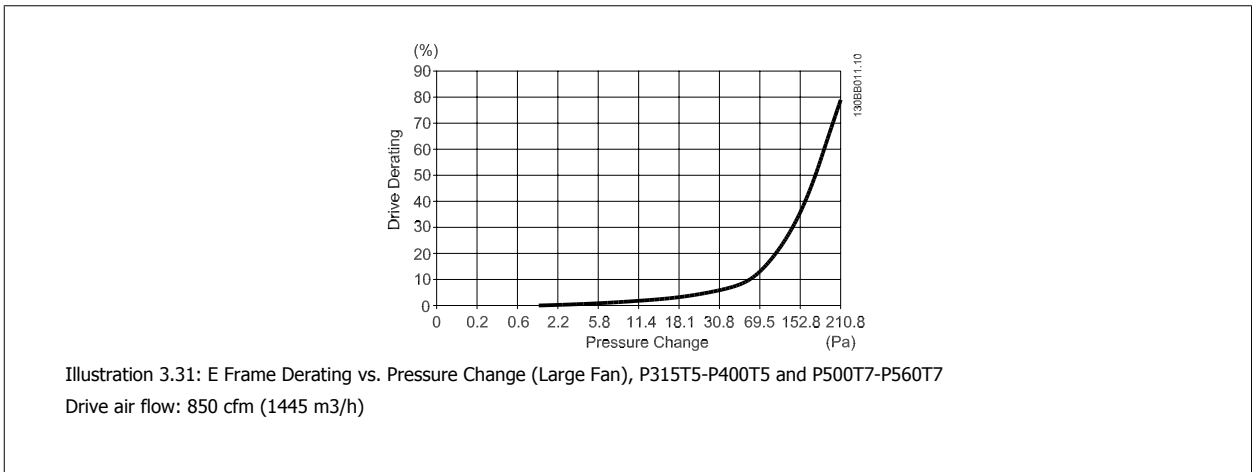
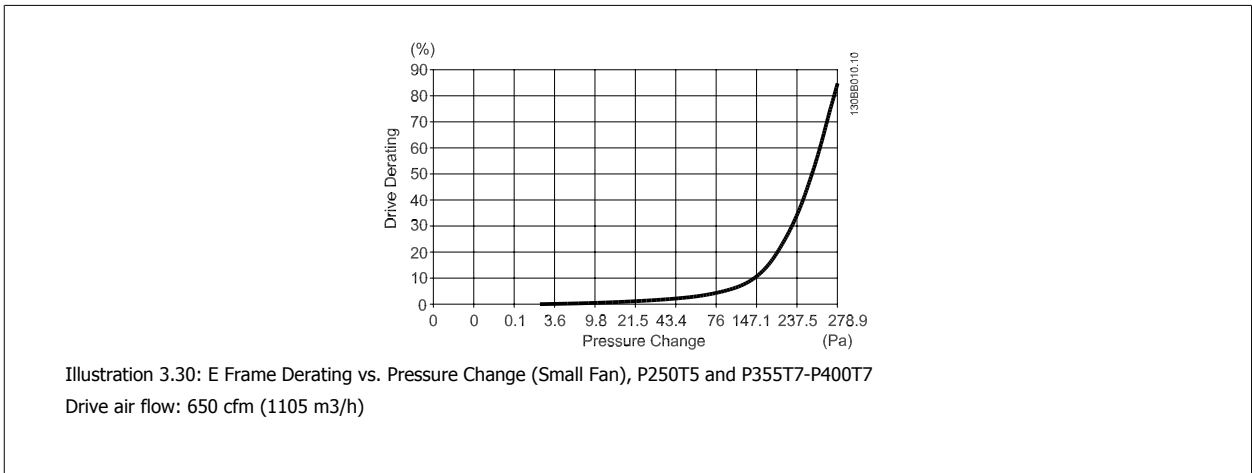
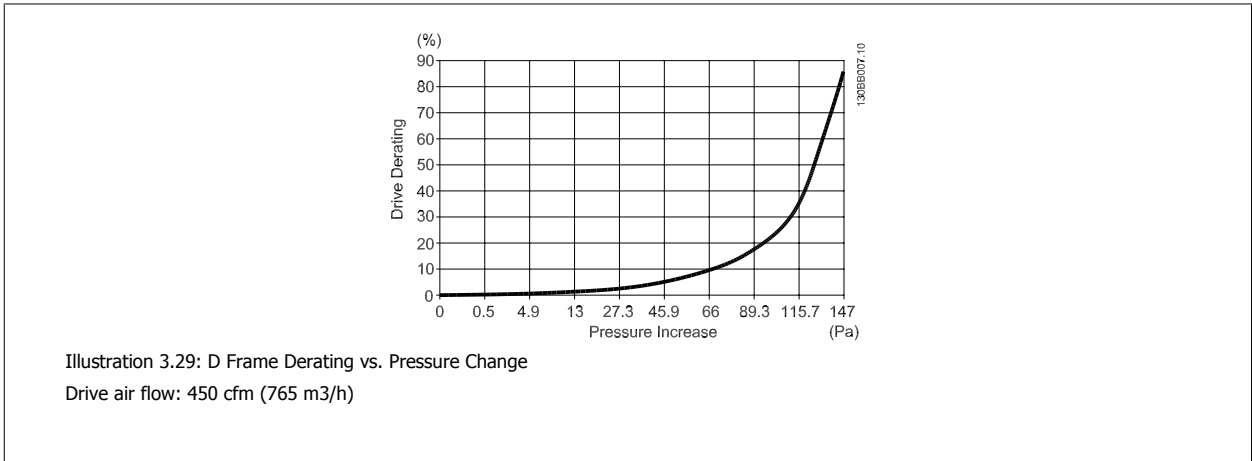


**NB!**

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

**External ducts**

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



### 3.4.2 Outside installation/ NEMA 3R kit for Rittal enclosures



This section is for the installation of NEMA 3R kits available for the frequency converter frames D3, D4 and E2. These kits are designed and tested to be used with IP00/ Chassis versions of these frames in Rittal TS8 NEMA 3R or NEMA 4 enclosures. The NEMA-3R enclosure is an outdoor enclosure that provides a degree of protection against rain and ice. The NEMA-4 enclosure is an outdoor enclosure that provides a greater degree of protection against weather and hosed water.

The minimum enclosure depth is 500 mm (600 mm for E2 frame) and the kit is designed for a 600 mm (800 mm for E2 frame) wide enclosure. Other enclosure widths are possible, however additional Rittal hardware is required. The maximum depth and width are as required by the installation.



**NB!**

The current rating of drives in D3 and D4 frames are de-rated by 3%, when adding the NEMA 3R kit. Drives in E2 frames require no derating



**NB!**

A doorfan(s) is required on the Rittal cabinet to remove the losses not contained in the backchannel of the drive. The minimum doorfan(s) airflow required at the drive maximum ambient for the D3 and D4 is 391 m<sup>3</sup>/h (230 cfm). The minimum doorfan(s) airflow required at the drive maximum ambient for the E2 is 782 m<sup>3</sup>/h (460 cfm). If the ambient is below maximum or if additional components, heat losses, are added within the enclosure a calculation must be made to ensure the proper airflow is provided to cool the inside of the Rittal enclosure.

**Ordering information**

Frame size D3: 176F4600

Frame size D4: 176F4601

Frame size E2: 176F1852

**Kit contents:**

- Ductwork components
- Mounting hardware
- 16 mm, M5 torx screws for top vent cover
- 10 mm, M5 for attaching drive mounting plate to enclosure
- M10 nuts to attach drive to mounting plate
- Gasket material

**Torque requirements:**

1. M5 screws/ nuts torque to 20 in-lbs (2.3 N-M)
2. M6 screws/ nuts torque to 35 in-lbs (3.9 N-M)
3. M10 nuts torque to 170 in-lbs (20 N-M)
4. T25 Torx screws torque to 20 in-lbs (2.3 N-M)



**NB!**  
Please see the instructions 175R5922 for further information

### 3.4.3 Installation on pedestal

This section describes the installation of a pedestal unit available for the 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.

**3**



Illustration 3.32: Drive on pedestal

There is one pedestal that fits both frames D1 and D2. Its ordering number is 176F1827. The pedestal is standard for E1 frame.

**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

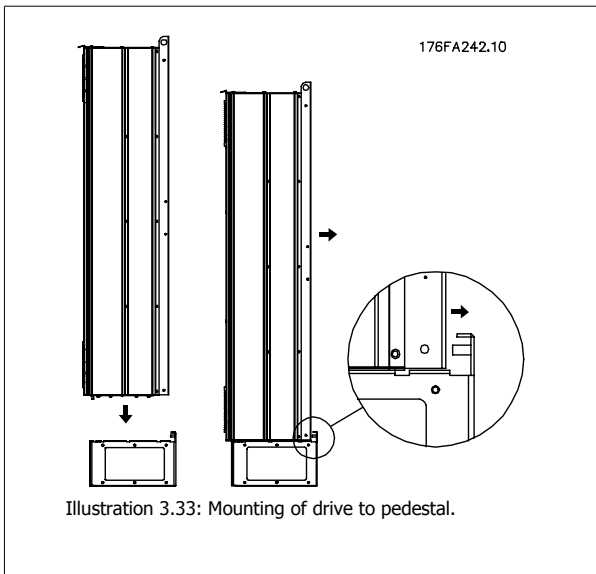
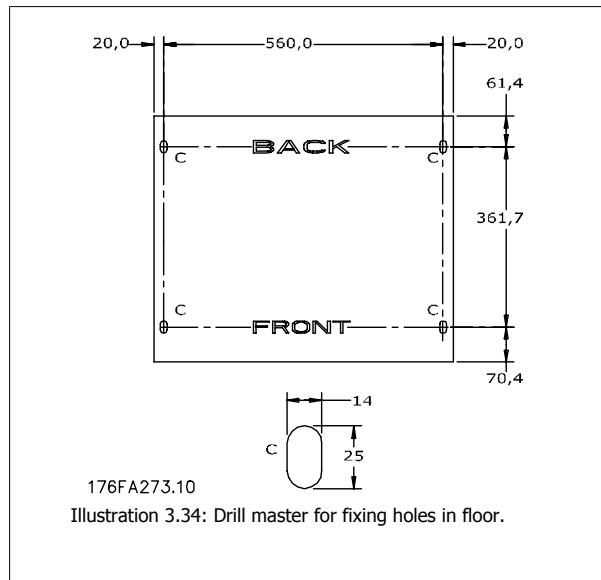


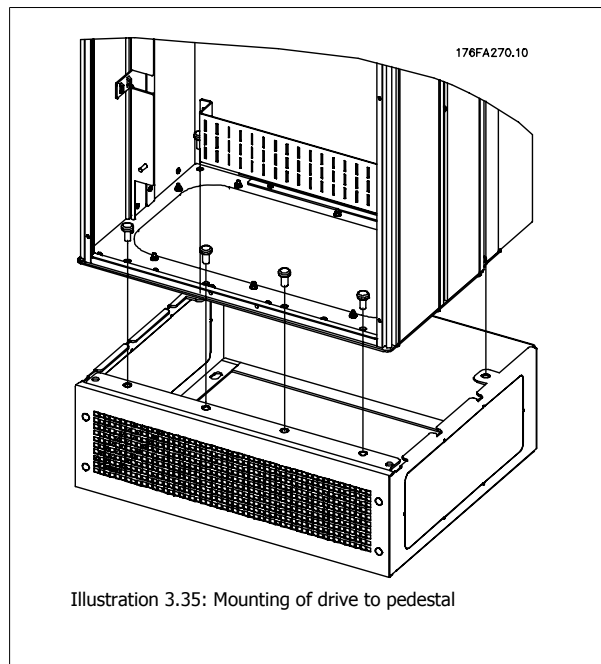
Illustration 3.33: Mounting of drive to pedestal.

**3**

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



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




**NB!**

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



### 3.4.4 Input plate option

This section is for the field installation of input option kits available for frequency converters in all D and E frames. Do not attempt to remove RFI filters from input plates. Damage may occur to RFI filters if they are removed from the input plate.


 **NB!**  
Where RFI filters are available, there are two different type of RFI filters depending on the input plate combination and the RFI filters interchangeable. Field installable kits in certain cases are the same for all voltages.

|    | 380 - 480 V<br>380 - 500 V                       | Fuses    | Disconnect Fuses | RFI      | RFI Fuses | RFI Disconnect Fuses |
|----|--|----------|------------------|----------|-----------|----------------------|
| D1 | All D1 power sizes                               | 176F8442 | 176F8450         | 176F8444 | 176F8448  | 176F8446             |
| D2 | All D2 power sizes                               | 176F8443 | 176F8441         | 176F8445 | 176F8449  | 176F8447             |
| E1 | FC102/ 202: 315 kW<br>FC 302: 250 kW             | 176F0253 | 176F0255         | 176F0257 | 176F0258  | 176F0260             |
|    | FC102/ 202: 355 - 450 kW<br>FC 302: 315 - 400 kW | 176F0254 | 176F0256         | 176F0257 | 176F0259  | 176F0262             |


|    | 525 - 690 V                                | Fuses    | Disconnect Fuses | RFI      | RFI Fuses | RFI Disconnect Fuses |
|----|--|----------|------------------|----------|-----------|----------------------|
| D1 | FC102/ 202: 45-90 kW<br>FC302: 37-75 kW    | 175L8829 | 175L8828         | 175L8777 | NA        | NA                   |
|    | FC102/202: 110-160 kW<br>FC302: 90-132 kW  | 175L8442 | 175L8445         | 175L8777 | NA        | NA                   |
|    | All D2 power sizes                         | 175L8827 | 175L8826         | 175L8825 | NA        | NA                   |
| E1 | FC102/202: 450-500 kW<br>FC302: 355-400 kW | 176F0253 | 176F0255         | NA       | NA        | NA                   |
|    | FC102/202: 560-630 kW<br>FC302: 500-560 kW | 176F0254 | 176F0258         | NA       | NA        | NA                   |

**Kit contents**

- Input plate assembled
- Instruction sheet 175R5795
- Modification Label
- Disconnect handle template (units w/ mains disconnect)

 **Cautions**

- Frequency converter contains dangerous voltages when connected to line voltage. No disassembly should be attempted with power applied
- Electrical parts of the frequency converter may contain dangerous voltages even after the mains have been disconnected. Wait the minimum time listed on the drive label after disconnecting the mains before touching any internal components to ensure that capacitors have fully discharged
- The input plates contain metal parts with sharp edges. Use hand protection when removing and reinstalling.
- E frames input plates are heavy (20-35 kg depending on configuration). It is recommended that the disconnect switch be removed from input plate for easier installation and be reinstalled on the input plate after the input plate has been installed on the drive

 **NB!**  
For further information, please see the Instruction Sheet, *175R5795*

### 3.4.5 Installation of Mains Shield for frequency converters

This section is for the installation of a mains shield for the frequency converter series with D1, D2 and E1 frames. It is not possible to install in the IP00/Chassis versions as these have included as standard a metal cover. These shields satisfy VBG-4 requirements.

#### Ordering numbers:

Frames D1 and D2 : 176F0799

Frame E1: 176F1851

#### Torque requirements

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

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

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



#### NB!

For further information, please see the Instruction Sheet, *175R5923*

## 3.5 Frame size F Panel Options

### 3.5.1 Frame size F Panel Options

#### Space Heaters and Thermostat

Mounted on the cabinet interior of frame size F frequency converters, space heaters controlled via automatic thermostat help control humidity inside the enclosure, extending the lifetime of drive components in damp environments.

#### Cabinet Light with Power Outlet

A light mounted on the cabinet interior of frame size F frequency converters increase visibility during servicing and maintenance. The housing the light includes a power outlet for temporarily powering tools or other devices, available in two voltages:

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

#### Transformer Tap Setup

If the Cabinet Light & Outlet and/or the Space Heaters & Thermostat are installed Transformer T1 requires it taps to be set to the proper input voltage. A 380-480/ 500 V380-480 V drive will initially be set to the 525 V tap and a 525-690 V drive will be set to the 690 V tap to insure no overvoltage of secondary equipment occurs if the tap is not changed prior to power being applied. See the table below to set the proper tap at terminal T1 located in the rectifier cabinet. For location in the drive, see illustration of rectifier in the *Power Connections* section.

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

#### NAMUR Terminals

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

#### RCD (Residual Current Device)

Uses the core balance method to monitor ground fault currents in grounded and high-resistance grounded systems (TN and TT systems in IEC terminology). There is a pre-warning (50% of main alarm setpoint) and a main alarm setpoint. Associated with each setpoint is an SPDT alarm relay for external use. Requires an external "window-type" current transformer (supplied and installed by customer).

- Integrated into the drive's safe-stop circuit

- IEC 60755 Type B device monitors AC, pulsed DC, and pure DC ground fault currents
- LED bar graph indicator of the ground fault current level from 10–100% of the setpoint
- Fault memory
- TEST / RESET button

**Insulation Resistance Monitor (IRM)**

Monitors the insulation resistance in ungrounded systems (IT systems in IEC terminology) between the system phase conductors and ground. There is an ohmic pre-warning and a main alarm setpoint for the insulation level. Associated with each setpoint is an SPDT alarm relay for external use. Note: only one insulation resistance monitor can be connected to each ungrounded (IT) system.

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

**IEC Emergency Stop with Pilz Safety Relay**

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

**Manual Motor Starters**

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

Unit features include:

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

**30-Amp, Fuse-Protected Terminals**

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

**24 VDC Power Supply**

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

**External Temperature Monitoring**

Designed for monitoring temperatures of external system components, such as the motor windings and/or bearings. Includes eight universal input modules plus two dedicated thermistor input modules. All ten modules are integrated into the drive's safe-stop circuit and can be monitored via a fieldbus network (requires the purchase of a separate module/bus coupler).

**Universal inputs (8)**

Signal types:

- RTD inputs (including Pt100), 3-wire or 4-wire
- Thermocouple
- Analog current or analog voltage

Additional features:

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

### **Dedicated thermistor inputs (2)**


Features:

- Each module capable of monitoring up to six thermistors in series
- Fault diagnostics for wire breakage or short-circuits of sensor leads
- ATEX/UL/CSA certification
- A third thermistor input can be provided by the PTC Thermistor Option Card MCB 112, if necessary

### 3.6 Electrical Installation

#### 3.6.1 Power Connections

##### Cabling and Fusing



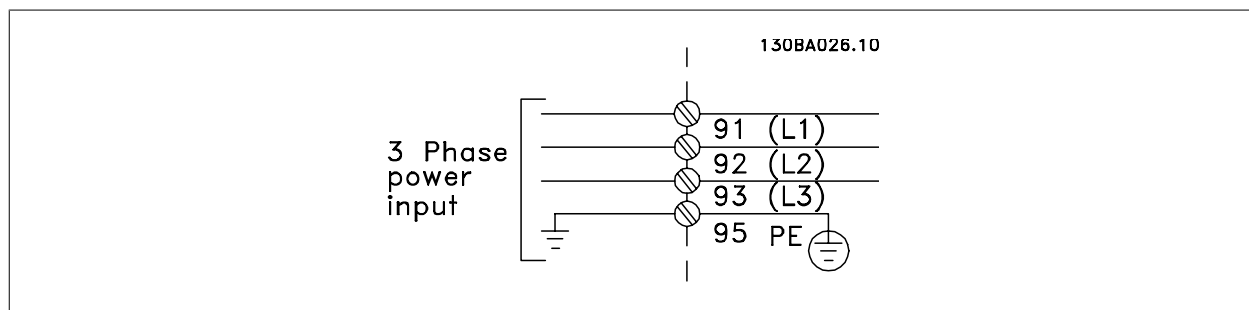
**NB!**  
**Cables General**  
 All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. Copper (75°C) conductors are recommended.


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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 of the fuse 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!**  
 The 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.

**3**

**Screening of cables:**

Avoid installation with twisted screen ends (pigtails). They spoil the screening effect at higher frequencies. If it is necessary to break the screen to install a motor isolator or motor contactor, the screen must be continued at the lowest possible HF impedance.

Connect the motor cable screen to both the de-coupling plate of the frequency converter and to the metal housing of the motor.

Make the screen connections with the largest possible surface area (cable clamp). This is done by using the supplied installation devices within the frequency converter.

**Cable-length and cross-section:**

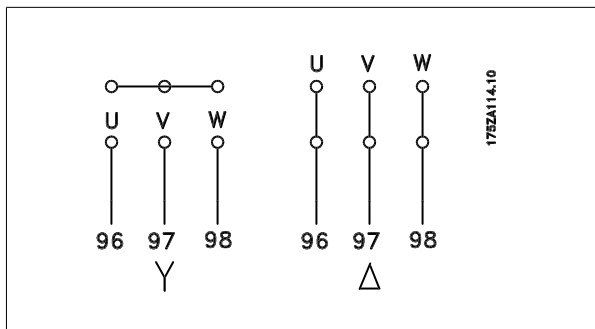
The frequency converter has been EMC tested with a given length of cable. Keep the motor cable as short as possible to reduce the noise level and leakage currents.

**Switching frequency:**

When frequency converters are used together with Sine-wave filters to reduce the acoustic noise from a motor, the switching frequency must be set according to the instruction in par. 14-01 *Switching Frequency*.

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

<sup>1)</sup>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.

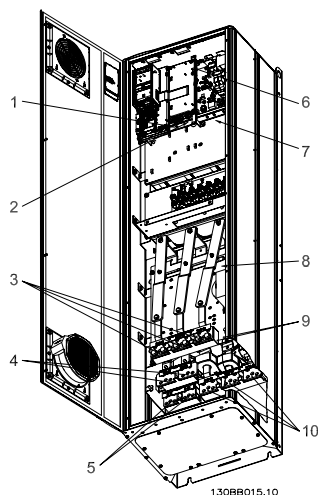


Illustration 3.36: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12), frame size D1

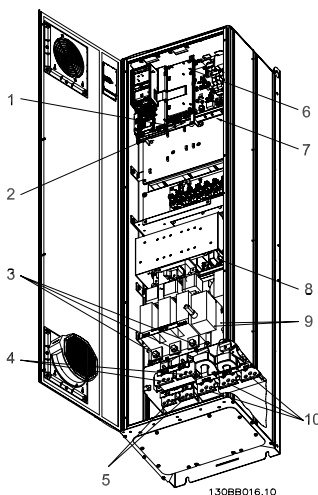


Illustration 3.37: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12) with disconnect, fuse and RFI filter, frame size D2

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

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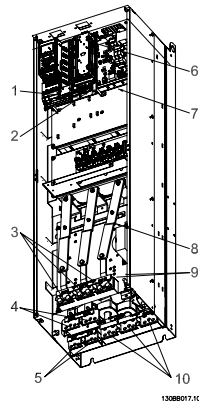


Illustration 3.38: Compact IP 00 (Chassis), frame size D3

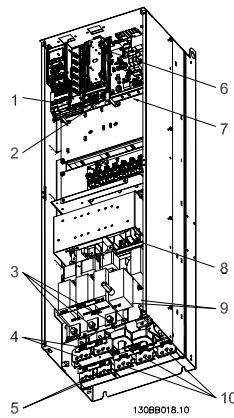
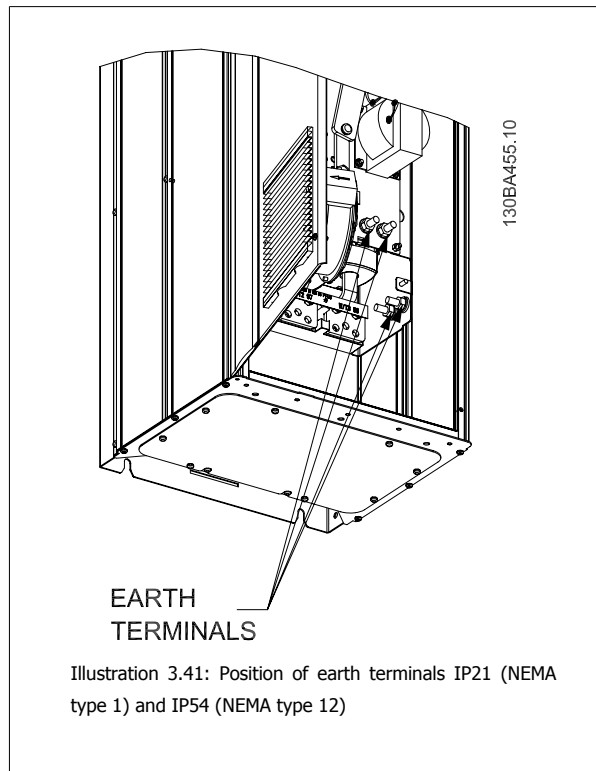
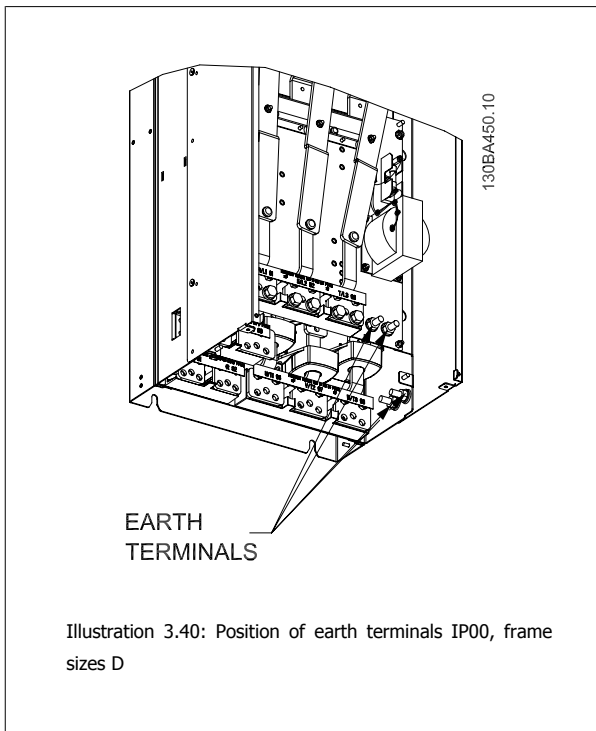



Illustration 3.39: Compact IP 00 (Chassis) with disconnect, fuse and RFI filter, frame size D4

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





 **NB!**  
D2 and D4 shown as examples. D1 and D3 are equivalent.

3

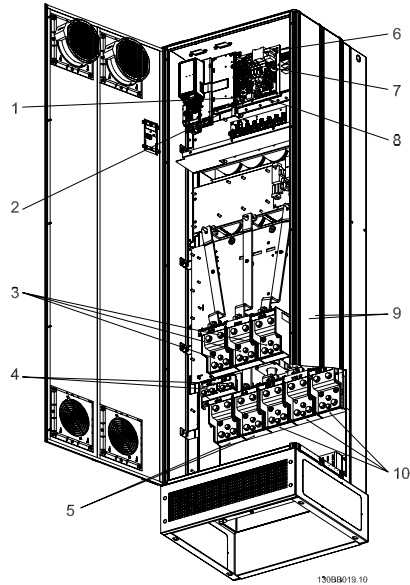


Illustration 3.42: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12) frame size E1

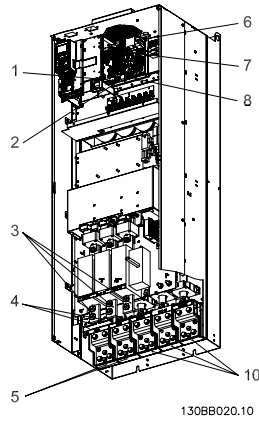
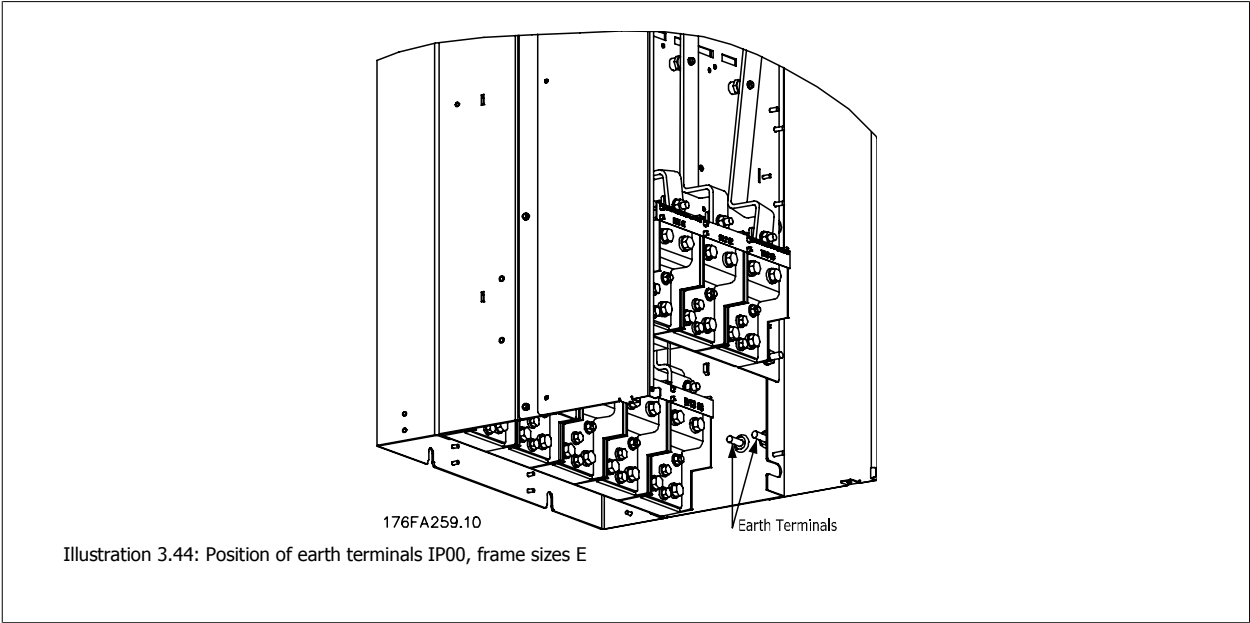


Illustration 3.43: Compact IP 00 (Chassis) with disconnect, fuse and RFI filter, frame size E2

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

3



**3**

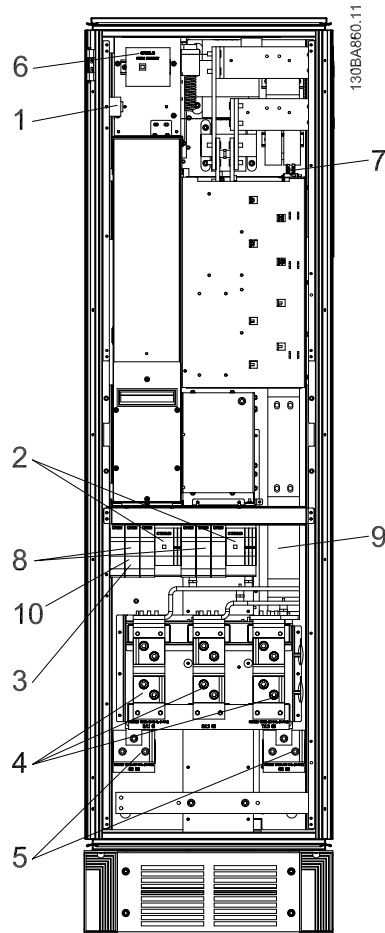


Illustration 3.45: Rectifier Cabinet, frame size F1, F2, F3 and F4

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

**3**

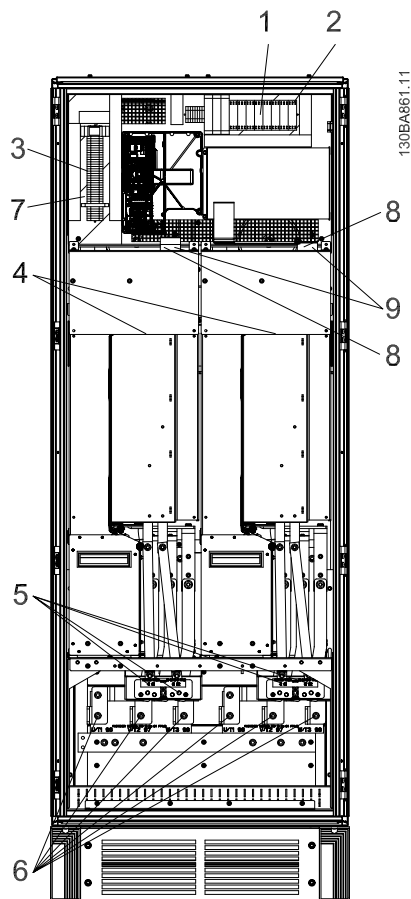


Illustration 3.46: Inverter Cabinet, frame size F1 and F3

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

3

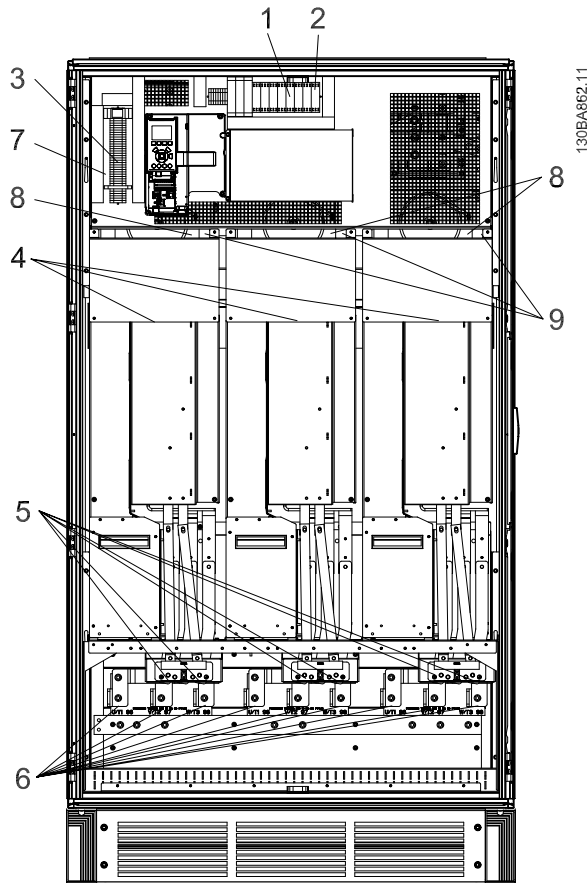


Illustration 3.47: Inverter Cabinet, frame size F2 and F4

1) External Temperature Monitoring

2) AUX Relay

01 02 03  
04 05 06

3) NAMUR

4) AUX Fan

100 101 102 103  
L1 L2 L1 L2

5) Brake

-R +R  
81 82

6) Motor

U V W

96 97 98

T1 T2 T3

7) NAMUR Fuse. See fuse tables for part numbers

8) Fan Fuses. See fuse tables for part numbers

9) SMPS Fuses. See fuse tables for part numbers

**3**

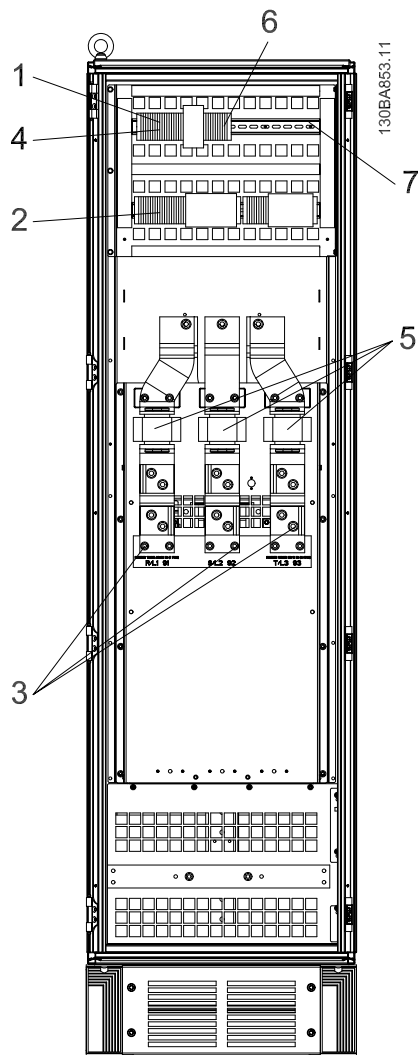


Illustration 3.48: Options Cabinet, frame size F3 and F4

- |  |  |
|--|--|
| <p>1) Pilz Relay Terminal</p> <p>2) RCD or IRM Terminal</p> <p>3) Mains</p> <p style="padding-left: 20px;">R   S   T</p> <p style="padding-left: 20px;">91  92  93</p> <p style="padding-left: 20px;">L1  L2  L3</p> | <p>4) Safety Relay Coil Fuse with PILS Relay<br/>See fuse tables for part numbers</p> <p>5) Line Fuses, F3 and F4 (3 pieces)<br/>See fuse tables for part numbers</p> <p>6) Contactor Relay Coil (230 VAC). N/C and N/O Aux Contacts</p> <p>7) Circuit Breaker Shunt Trip Control Terminals (230 VAC or 230 VDC)</p> |
|--|--|

### 3.6.2 Earthing

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

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

Connect the different earth systems at the lowest possible conductor impedance. The lowest possible conductor impedance is obtained by keeping the conductor as short as possible and by using the greatest possible surface area.

The metal cabinets of the different devices are mounted on the cabinet rear plate using the lowest possible HF impedance. This avoids having different HF voltages for the individual devices and avoids the risk of radio interference currents running in connection cables that may be used between the devices. The radio interference will have been reduced.

In order to obtain a low HF impedance, use the fastening bolts of the devices as HF connection to the rear plate. It is necessary to remove insulating paint or similar from the fastening points.

### 3.6.3 Extra Protection (RCD)

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

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

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

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

### 3.6.4 RFI Switch

#### 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)<sup>1)</sup> via par. 14-50 *RFI Filter*. For further reference, see IEC 364-3. In case optimum EMC performance is needed, parallel motors are connected or the motor cable length is above 25 m, it is recommended to set par. 14-50 *RFI Filter* to [ON].

<sup>1)</sup> Not available for 525-600/690 V frequency converters.

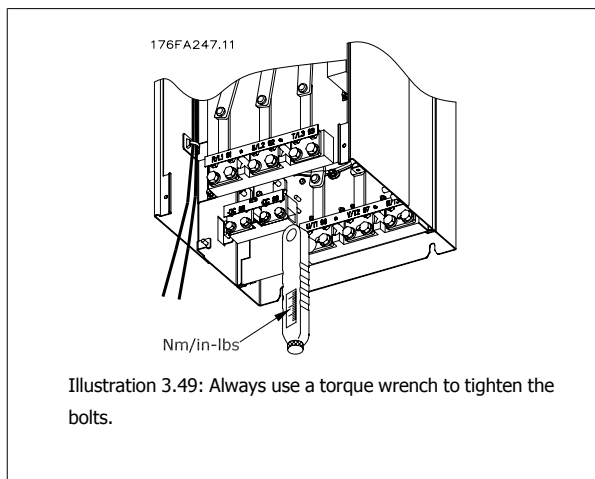
In OFF, the internal RFI capacities (filter capacitors) between the chassis and the intermediate circuit are cut off to avoid damage to the intermediate circuit and to reduce the earth capacity currents (according to IEC 61800-3).

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).

### 3.6.5 Torque

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





| Frame size        | Terminal     | Torque             | Bolt size |
|-------------------|--------------|--------------------|-----------|
| D1, D2, D3 and D4 | Mains        | 19 Nm (168 in-lbs) | M10       |
|                   | Motor        |                    |           |
|                   | Load sharing | 9.5 Nm (84 in-lbs) | M8        |
|                   | Brake        |                    |           |
| E1 and E2         | Mains        | 19 NM (168 in-lbs) | M10       |
|                   | Motor        |                    |           |
|                   | Load sharing | 9.5 Nm (84 in-lbs) | M8        |
|                   | Brake        |                    |           |
| F1, F2, F3 and F4 | Mains        | 19 Nm (168 in-lbs) | M10       |
|                   | Motor        |                    |           |
|                   | Load sharing | 19 Nm (168 in-lbs) | M10       |
|                   | Brake        | 9.5 Nm (84 in-lbs) | M8        |
|                   | Regen        | 19 Nm (168 in-lbs) | M10       |

Table 3.3: Torque for terminals

### 3.6.6 Shielded Cables

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

**Connection can be made using either cable glands or clamps:**

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

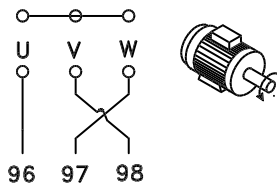
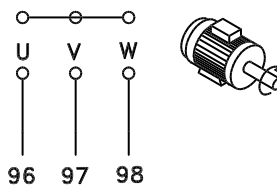
### 3.6.7 Motor cable

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

| Terminal No.   | Function                        |
|----------------|---------------------------------|
| 96, 97, 98, 99 | Mains U/T1, V/T2, W/T3<br>Earth |

**3**

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



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The direction of rotation can be changed by switching two phases in the motor cable or by changing the setting of par. 4-10 *Motor Speed Direction*. Motor rotation check can be performed using par. 1-28 *Motor Rotation Check* and following the steps shown in the display.

**F frame Requirements**

**F1/F3 requirements:** Motor phase cable quantities must be 2, 4, 6, or 8 (multiples of 2, 1 cable is not allowed) to obtain equal amount of wires attached to both inverter module terminals. The cables are required to be equal length within 10% between the inverter module terminals and the first common point of a phase. The recommended common point is the motor terminals.

**F2/F4 requirements:** Motor phase cable quantities must be 3, 6, 9, or 12 (multiples of 3, 2 cables are not allowed) to obtain equal amount of wires attached to each inverter module terminal. The wires are required to be equal length within 10% between the inverter module terminals and the first common point of a phase. The recommended common point is the motor terminals.

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



**NB!**

If a retrofit applications requires unequal amount of wires per phase please consult the factory for requirements.

**3.6.8 Brake Cable Drives with factory installed Brake Chopper option**


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

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

| Terminal No. | Function                 |
|--------------|--------------------------|
| 81, 82       | Brake resistor terminals |

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

Size the brake cable cross-section to match the brake torque. 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.

**F Frame Requirements**

The brake resistor(s) must be connected to the brake terminals in each inverter module.

**3.6.9 Brake Resistor Temperature Switch**

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


Screw size: M3

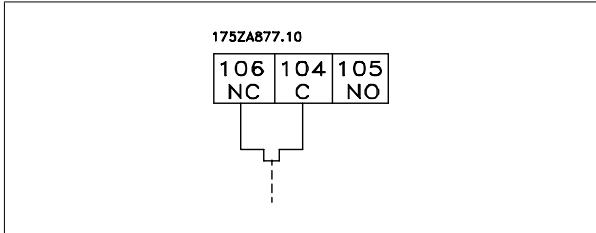
This input can be used to monitor the temperature of an externally connected brake resistor. If the input between 104 and 106 is established, the frequency converter will trip on warning / alarm 27, "Brake IGBT". If the connection is closed between 104 and 105, the frequency converter will trip on warning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

Normally closed: 104-106 (factory installed jumper)

Normally open: 104-105

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

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





**3.6.10 Load Sharing**

| Terminal No. | Function    |
|--------------|-------------|
| 88, 89       | Loadsharing |

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

Load sharing enables linking of the DC intermediate circuits of several frequency converters.

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

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

### 3.6.11 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 3.50: Mounting of EMC shield.

3

### 3.6.12 Mains connection

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

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



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

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

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

### 3.6.13 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 made on the power card.

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

The connector located on the power card provides the connection of line voltage for the cooling fans. The fans are connected from factory to be supplied 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 LittleFuse KLK-5 or equivalent.

### 3.6.14 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 *Current Limit*. 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.

**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 - P250 | 380 - 480 V | type gG |
| P315 - P450 | 380 - 480 V | type gR |

**380-480 V, frame sizes D, E and F**

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

| Size/Type | Bussmann E1958 JFHR2** | Bussmann E4273 T/JDDZ** | SIBA E180276 RKI/JDDZ | Littelfuse E71611 JFHR2** | Ferraz-Shawmut E60314 JFHR2** | Bussmann E4274 H/JDDZ** | Bussmann E125085 JFHR2* | Internal Option Bussmann |
|-----------|------------------------|-------------------------|-----------------------|---------------------------|-------------------------------|-------------------------|-------------------------|--------------------------|
| P110      | FWH-300                | JJS-300                 | 2028220-315           | L50S-300                  | A50-P300                      | NOS-300                 | 170M3017                | 170M3018                 |
| P132      | FWH-350                | JJS-350                 | 2028220-315           | L50S-350                  | A50-P350                      | NOS-350                 | 170M3018                | 170M3018                 |
| P160      | FWH-400                | JJS-400                 | 206xx32-400           | L50S-400                  | A50-P400                      | NOS-400                 | 170M4012                | 170M4016                 |
| P200      | FWH-500                | JJS-500                 | 206xx32-500           | L50S-500                  | A50-P500                      | NOS-500                 | 170M4014                | 170M4016                 |
| P250      | FWH-600                | JJS-600                 | 206xx32-600           | L50S-600                  | A50-P600                      | NOS-600                 | 170M4016                | 170M4016                 |

Table 3.4: Frame size D, Line fuses, 380-480 V

| Size/Type | Bussmann PN* | Rating       | Ferraz           | Siba          |
|-----------|--------------|--------------|------------------|---------------|
| P315      | 170M4017     | 700 A, 700 V | 6.9URD31D08A0700 | 20 610 32.700 |
| P355      | 170M6013     | 900 A, 700 V | 6.9URD33D08A0900 | 20 630 32.900 |
| P400      | 170M6013     | 900 A, 700 V | 6.9URD33D08A0900 | 20 630 32.900 |
| P450      | 170M6013     | 900 A, 700 V | 6.9URD33D08A0900 | 20 630 32.900 |

Table 3.5: Frame size E, Line fuses, 380-480 V

| Size/Type | Bussmann PN* | Rating        | Siba           | Internal Bussmann Option |
|-----------|--------------|---------------|----------------|--------------------------|
| P500      | 170M7081     | 1600 A, 700 V | 20 695 32.1600 | 170M7082                 |
| P560      | 170M7081     | 1600 A, 700 V | 20 695 32.1600 | 170M7082                 |
| P630      | 170M7082     | 2000 A, 700 V | 20 695 32.2000 | 170M7082                 |
| P710      | 170M7082     | 2000 A, 700 V | 20 695 32.2000 | 170M7082                 |
| P800      | 170M7083     | 2500 A, 700 V | 20 695 32.2500 | 170M7083                 |
| P1M0      | 170M7083     | 2500 A, 700 V | 20 695 32.2500 | 170M7083                 |

Table 3.6: Frame size F, Line fuses, 380-480 V

| Size/Type | Bussmann PN* | Rating         | Siba           |
|-----------|--------------|----------------|----------------|
| P500      | 170M8611     | 1100 A, 1000 V | 20 781 32.1000 |
| P560      | 170M8611     | 1100 A, 1000 V | 20 781 32.1000 |
| P630      | 170M6467     | 1400 A, 700 V  | 20 681 32.1400 |
| P710      | 170M6467     | 1400 A, 700 V  | 20 681 32.1400 |
| P800      | 170M8611     | 1100 A, 1000 V | 20 781 32.1000 |
| P1M0      | 170M6467     | 1400 A, 700 V  | 20 681 32.1400 |

Table 3.7: Frame size F, Inverter module DC Link Fuses, 380-480 V

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

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

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

| Size/Type | Bussmann<br>E125085<br>JFHR2 | Amps | SIBA<br>E180276<br>JFHR2 | Ferraz-Shawmut<br>E76491<br>JFHR2 | Internal<br>Option<br>Bussmann |
|-----------|------------------------------|------|--------------------------|-----------------------------------|--------------------------------|
| P45K      | 170M3013                     | 125  | 2061032.125              | 6.6URD30D08A0125                  | 170M3015                       |
| P55K      | 170M3014                     | 160  | 2061032.16               | 6.6URD30D08A0160                  | 170M3015                       |
| P75K      | 170M3015                     | 200  | 2061032.2                | 6.6URD30D08A0200                  | 170M3015                       |
| P90K      | 170M3015                     | 200  | 2061032.2                | 6.6URD30D08A0200                  | 170M3015                       |
| P110      | 170M3016                     | 250  | 2061032.25               | 6.6URD30D08A0250                  | 170M3018                       |
| P132      | 170M3017                     | 315  | 2061032.315              | 6.6URD30D08A0315                  | 170M3018                       |
| P160      | 170M3018                     | 350  | 2061032.35               | 6.6URD30D08A0350                  | 170M3018                       |
| P200      | 170M4011                     | 350  | 2061032.35               | 6.6URD30D08A0350                  | 170M5011                       |
| P250      | 170M4012                     | 400  | 2061032.4                | 6.6URD30D08A0400                  | 170M5011                       |
| P315      | 170M4014                     | 500  | 2061032.5                | 6.6URD30D08A0500                  | 170M5011                       |
| P400      | 170M5011                     | 550  | 2062032.55               | 6.6URD32D08A550                   | 170M5011                       |

Table 3.8: Frame size D, 525-690 V

| Size/Type | Bussmann PN* | Rating       | Ferraz           | Siba          |
|-----------|--------------|--------------|------------------|---------------|
| P450      | 170M4017     | 700 A, 700 V | 6.9URD31D08A0700 | 20 610 32.700 |
| P500      | 170M4017     | 700 A, 700 V | 6.9URD31D08A0700 | 20 610 32.700 |
| P560      | 170M6013     | 900 A, 700 V | 6.9URD33D08A0900 | 20 630 32.900 |
| P630      | 170M6013     | 900 A, 700 V | 6.9URD33D08A0900 | 20 630 32.900 |

Table 3.9: Frame size E, 525-690 V

| Size/Type | Bussmann PN* | Rating        | Siba           | Internal Bussmann Option |
|-----------|--------------|---------------|----------------|--------------------------|
| P710      | 170M7081     | 1600 A, 700 V | 20 695 32.1600 | 170M7082                 |
| P800      | 170M7081     | 1600 A, 700 V | 20 695 32.1600 | 170M7082                 |
| P900      | 170M7081     | 1600 A, 700 V | 20 695 32.1600 | 170M7082                 |
| P1M0      | 170M7081     | 1600 A, 700 V | 20 695 32.1600 | 170M7082                 |
| P1M2      | 170M7082     | 2000 A, 700 V | 20 695 32.2000 | 170M7082                 |

Table 3.10: Frame size F, Line fuses, 525-690 V

| Size/Type | Bussmann PN* | Rating         | Siba            |
|-----------|--------------|----------------|-----------------|
| P710      | 170M8611     | 1100 A, 1000 V | 20 781 32. 1000 |
| P800      | 170M8611     | 1100 A, 1000 V | 20 781 32. 1000 |
| P900      | 170M8611     | 1100 A, 1000 V | 20 781 32. 1000 |
| P1M0      | 170M8611     | 1100 A, 1000 V | 20 781 32. 1000 |
| P1M2      | 170M8611     | 1100 A, 1000 V | 20 781 32. 1000 |

Table 3.11: Frame size F, Inverter module DC Link Fuses, 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.

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.

Supplementary fuses

| Frame size | Bussmann PN* | Rating     |
|------------|--------------|------------|
| D, E and F | KTK-4        | 4 A, 600 V |

Table 3.12: SMPS Fuse

| Size/Type            | Bussmann PN* | Littelfuse | Rating     |
|----------------------|--------------|------------|------------|
| P110-P315, 380-480 V | KTK-4        |            | 4 A, 600 V |
| P45K-P500, 525-690 V | KTK-4        |            | 4 A, 600 V |
| P355-P1M0, 380-480 V |              | KLK-15     | 15A, 600 V |
| P560-P1M2, 525-690 V |              | KLK-15     | 15A, 600 V |

Table 3.13: Fan Fuses

|                        | Size/Type            | Bussmann PN*     | Rating      | Alternative Fuses                                 |
|------------------------|----------------------|------------------|-------------|---|
| <b>2.5-4.0 A Fuse</b>  | P500-P1M0, 380-480 V | LPJ-6 SP or SPI  | 6 A, 600 V  | Any listed Class J Dual Element, Time Delay, 6A   |
|                        | P710-P1M2, 525-690 V | LPJ-10 SP or SPI | 10 A, 600 V | Any listed Class J Dual Element, Time Delay, 10 A |
| <b>4.0-6.3 A Fuse</b>  | P500-P1M0, 380-480 V | LPJ-10 SP or SPI | 10 A, 600 V | Any listed Class J Dual Element, Time Delay, 10 A |
|                        | P710-P1M2, 525-690 V | LPJ-15 SP or SPI | 15 A, 600 V | Any listed Class J Dual Element, Time Delay, 15 A |
| <b>6.3 - 10 A Fuse</b> | P500-P1M0, 380-480 V | LPJ-15 SP or SPI | 15 A, 600 V | Any listed Class J Dual Element, Time Delay, 15 A |
|                        | P710-P1M2, 525-690 V | LPJ-20 SP or SPI | 20 A, 600 V | Any listed Class J Dual Element, Time Delay, 20A  |
| <b>10 - 16 A Fuse</b>  | P500-P1M0, 380-480 V | LPJ-25 SP or SPI | 25 A, 600 V | Any listed Class J Dual Element, Time Delay, 25 A |
|                        | P710-P1M2, 525-690 V | LPJ-20 SP or SPI | 20 A, 600 V | Any listed Class J Dual Element, Time Delay, 20 A |

Table 3.14: Manual Motor Controller Fuses

| Frame size | Bussmann PN*     | Rating      | Alternative Fuses                                 |
|------------|------------------|-------------|---|
| F          | LPJ-30 SP or SPI | 30 A, 600 V | Any listed Class J Dual Element, Time Delay, 30 A |

Table 3.15: 30 A Fuse Protected Terminal Fuse

| Frame size | Bussmann PN*    | Rating     | Alternative Fuses                                |
|------------|-----------------|------------|--|
| F          | LPJ-6 SP or SPI | 6 A, 600 V | Any listed Class J Dual Element, Time Delay, 6 A |

Table 3.16: Control Transformer Fuse

| Frame size | Bussmann PN* | Rating        |
|------------|--------------|---------------|
| F          | GMC-800MA    | 800 mA, 250 V |

Table 3.17: NAMUR Fuse

| Frame size | Bussmann PN* | Rating     | Alternative Fuses        |
|------------|--------------|------------|--------------------------|
| F          | LP-CC-6      | 6 A, 600 V | Any listed Class CC, 6 A |

Table 3.18: Safety Relay Coil Fuse with PILS Relay

### 3.6.15 Mains disconnectors - frame size D, E and F

| Frame size | Power & Voltage                         | Type                          |
|------------|---|-------------------------------|
| D1/D3      | P110-P132 380-480V & P110-P160 525-690V | ABB OETL-NF200A               |
| D2/D4      | P160-P250 380-480V & P200-P400 525-690V | ABB OETL-NF400A               |
| E1/E2      | P315 380-480V & P450-P630 525-690V      | ABB OETL-NF600A               |
| E1/E2      | P355-P450 380-480V                      | ABB OETL-NF800A               |
| F3         | P500 380-480V & P710-P800 525-690V      | Merlin Gerin NPJF36000S12AAYP |
| F3         | P560-P710 380-480V & P900 525-690V      | Merlin Gerin NRK36000S20AAYP  |
| F4         | P800-P1M0 380-480V & P1M0-P1M2 525-690V | Merlin Gerin NRK36000S20AAYP  |

### 3.6.16 F frame circuit breakers

| Frame size | Power & Voltage                    | Type                             |
|------------|------------------------------------|----------------------------------|
| F3         | P500 380-480V & P710-P800 525-690V | Merlin Gerin NPJF36120U31AABSCYP |
| F3         | P630-P710 380-480V & P900 525-690V | Merlin Gerin NRJF36200U31AABSCYP |
| F4         | P800 380-480V & P1M0-P1M2 525-690V | Merlin Gerin NRJF36200U31AABSCYP |
| F4         | P1M0 380-480V                      | Merlin Gerin NRJF36250U31AABSCYP |

### 3.6.17 F frame mains contactors

| Frame size | Power & Voltage                         | Type              |
|------------|---|-------------------|
| F3         | P500-P560 380-480V & P710-P900 525-690V | Eaton XTCE650N22A |
| F3         | P630 380-480V                           | Eaton XTCE820N22A |
| F3         | P710 380-480V                           | Eaton XTCEC14P22B |
| F4         | P1M0 525-690V                           | Eaton XTCE820N22A |
| F4         | P800-P1M0 380-480V & P1M2 525-690V      | Eaton XTCEC14P22B |

### 3.6.18 Motor Insulation

For motor cable lengths  $\leq$  the maximum cable length listed in the General Specifications tables the following motor insulation ratings are recommended because the peak voltage can be up to twice the DC link voltage, 2.8 times the mains voltage, due to transmission line effects in the motor cable. If a motor has lower insulation rating it recommended to use a du/dt or sine wave filter.

| Nominal Mains Voltage      | Motor Insulation             |
|----------------------------|------------------------------|
| $U_N \leq 420$ V           | Standard $U_{LL} = 1300$ V   |
| $420$ V $< U_N \leq 500$ V | Reinforced $U_{LL} = 1600$ V |
| $500$ V $< U_N \leq 600$ V | Reinforced $U_{LL} = 1800$ V |
| $600$ V $< U_N \leq 690$ V | Reinforced $U_{LL} = 2000$ V |

### 3.6.19 Motor Bearing Currents

All motors installed with 110 kW or higher power drives should have NDE (Non-Drive End) insulated bearings installed to eliminate circulating bearing currents. To minimize DE (Drive End) bearing and shaft currents proper grounding of the drive, motor, driven machine, and motor to the driven machine is required.

#### Standard Mitigation Strategies:

1. Use an insulated bearing
2. Apply rigorous installation procedures
  - Strictly follow the EMC Installation guideline



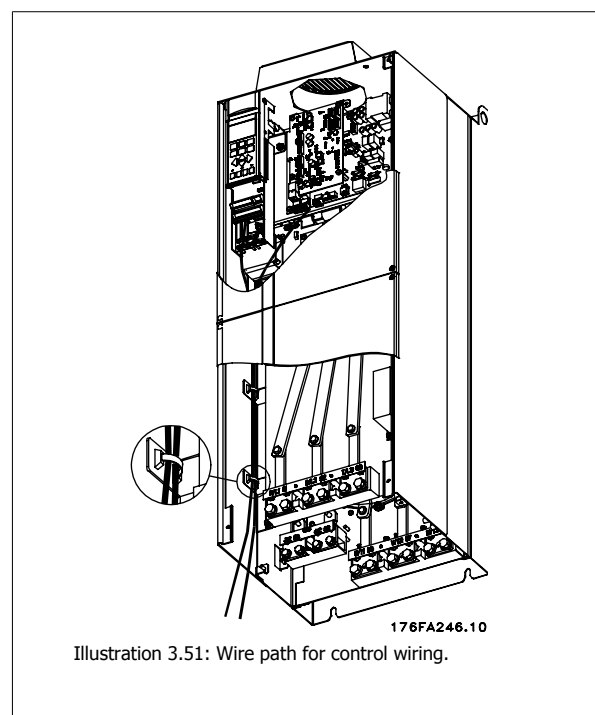
- Provide a good high frequency connection between the motor and the frequency converter for instance by screened cable which has a 360° connection in the motor and the frequency converter
  - Provide a low impedance path from frequency converter to building ground/earth and from the motor to building ground/earth. This can be difficult for pumps
  - Make a direct earth connection between the motor and load machine
  - Reinforce the PE so the high frequency impedance is lower in the PE
  - Ensure the motor and load motor are aligned
3. Lower the IGBT switching frequency
  4. Modify the inverter waveform, 60° AVM vs. SFAVM
  5. Install a shaft grounding system or use an isolating coupling between motor and load
  6. Apply conductive lubrication
  7. If the application allows, avoid running at low motor speeds by using the minimum speed settings of the drive .
  8. Try to ensure the line voltage is balanced to ground. This can be difficult for IT, TT, TN-CS or Grounded leg systems
  9. Use a dU/dt or sinus filter

### 3.6.20 Control cable routing

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

#### Fieldbus connection

Connections are made to the relevant options on 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 (see picture).



176FA246.10  
Illustration 3.51: Wire path for control wiring.

In the Chassis (IP00) and NEMA 1 units it is also possible to connect the fieldbus from the top of the unit as shown on the picture to the right. On the NEMA 1 unit a cover plate must be removed.  
Kit number for fieldbus top connection: 176F1742



Illustration 3.52: 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 VDC external supply can be used as low-voltage supply to the control card and any option cards installed. This enables full operation of the LCP (including parameter setting) without connection to mains. Please note that a warning of low voltage will be given when 24 VDC has been connected; however, there will be no tripping.



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

### 3.6.21 Access to Control Terminals

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

### 3.6.22 Electrical Installation, Control Terminals

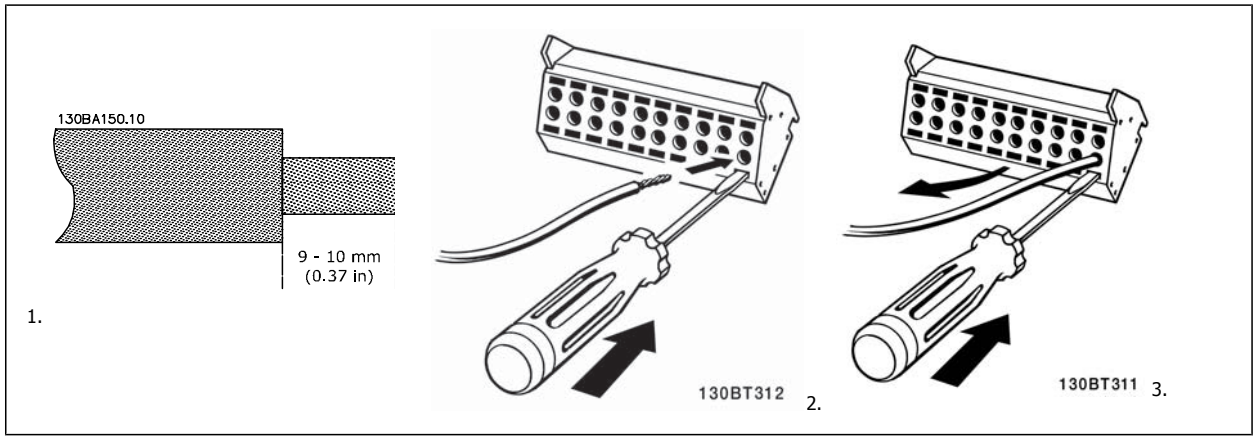
#### To connect the cable to the terminal:

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

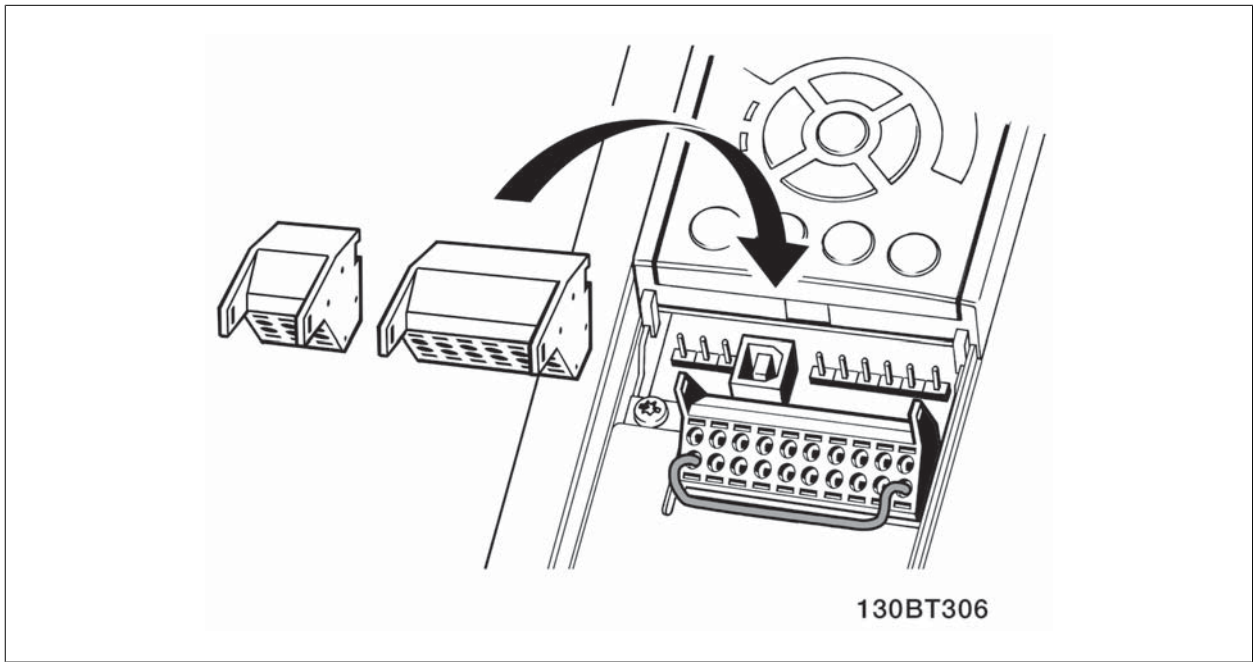
#### To remove the cable from the terminal:

1. Insert a screw driver<sup>1)</sup> in the square hole.
2. Pull out the cable.

<sup>1)</sup> Max. 0.4 x 2.5 mm



**3**



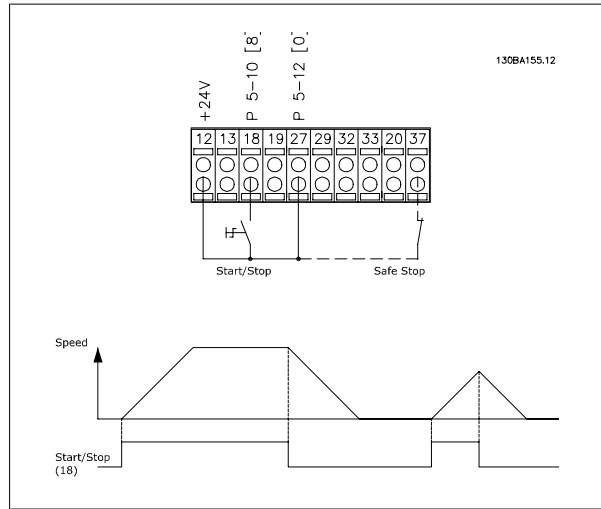
### 3.7 Connection Examples

#### 3.7.1 Start/Stop

Terminal 18 = par. 5-10 *Terminal 18 Digital Input [8] Start*  
 Terminal 27 = par. 5-12 *Terminal 27 Digital Input [0] No operation (Default coast inverse)*

Terminal 37 = Safe stop

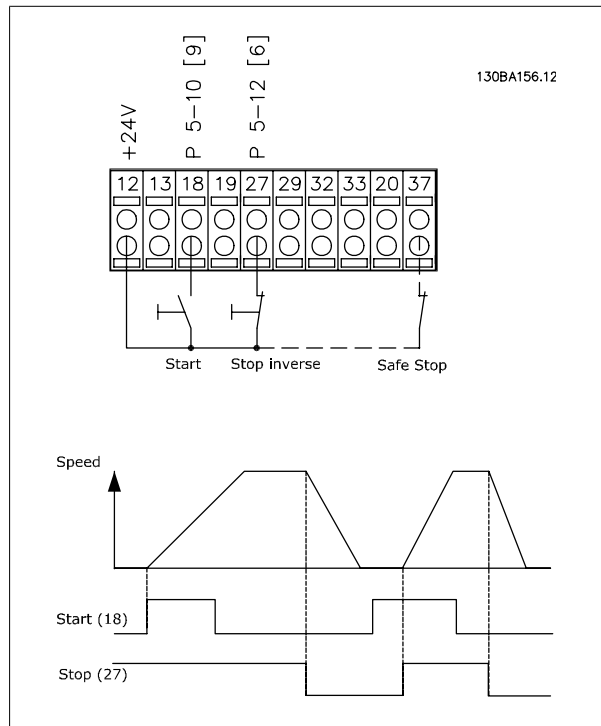
**3**



#### 3.7.2 Pulse Start/Stop

Terminal 18 = par. 5-10 *Terminal 18 Digital Input [9] Latched start*  
 Terminal 27 = par. 5-12 *Terminal 27 Digital Input [6] Stop inverse*

Terminal 37 = Safe stop



### 3.7.3 Speed Up/Down

**Terminals 29/32 = Speed up/down:**

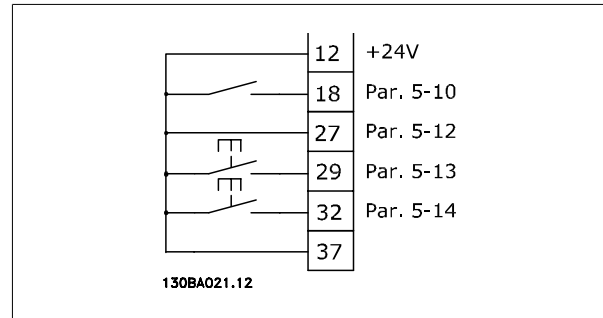
Terminal 18 = par. 5-10 *Terminal 18 Digital Input* Start [9] (default)

Terminal 27 = par. 5-12 *Terminal 27 Digital Input* Freeze reference [19]

Terminal 29 = par. 5-13 *Terminal 29 Digital Input* Speed up [21]

Terminal 32 = par. 5-14 *Terminal 32 Digital Input* Speed down [22]

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



**3**

### 3.7.4 Potentiometer Reference

**Voltage reference via a potentiometer:**

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

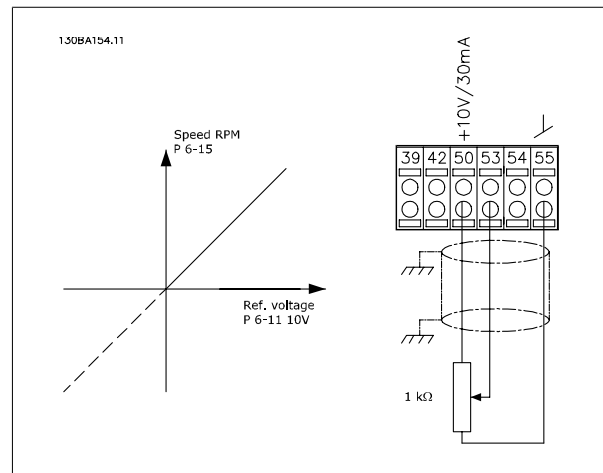
Terminal 53, Low Voltage = 0 Volt

Terminal 53, High Voltage = 10 Volt

Terminal 53, Low Ref./Feedback = 0 RPM

Terminal 53, High Ref./Feedback = 1500 RPM

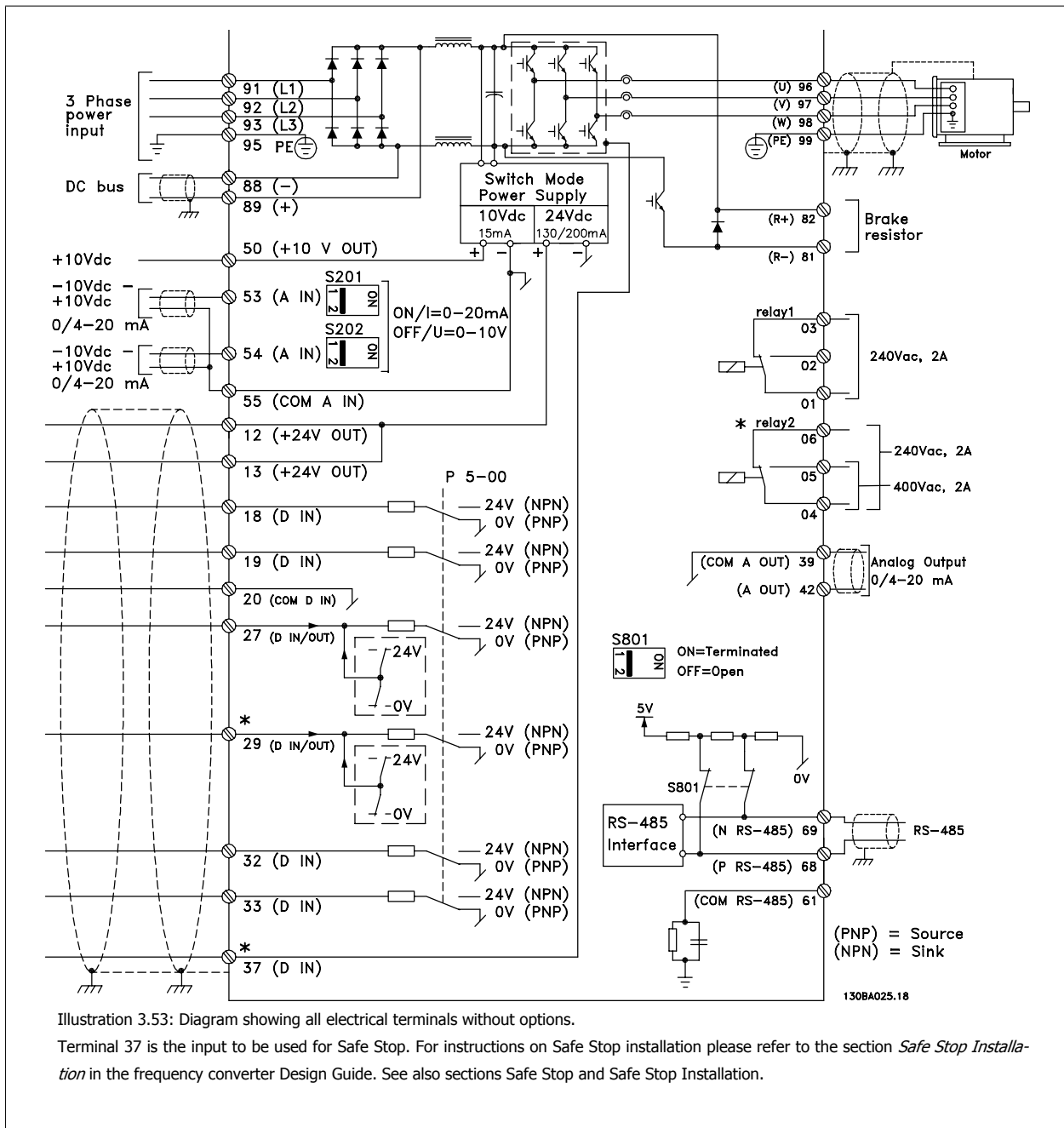
Switch S201 = OFF (U)



### 3.8 Electrical Installation - additional

#### 3.8.1 Electrical Installation, Control Cables

3

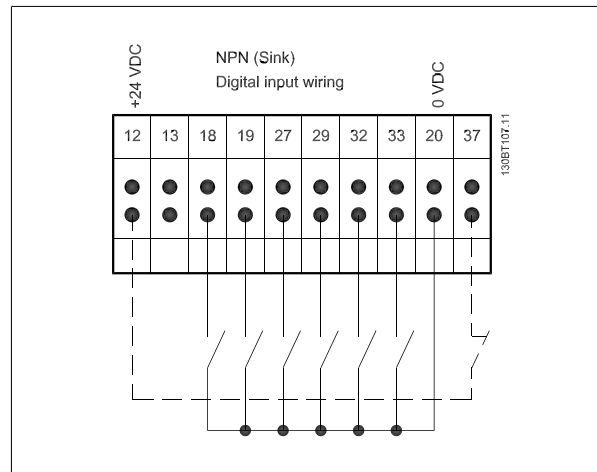
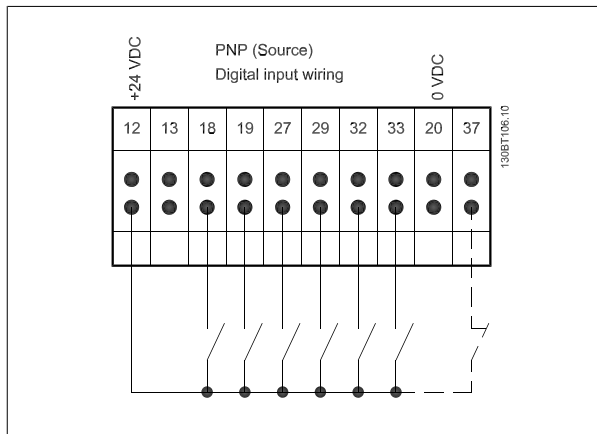


Very long control cables and analogue signals may in rare cases and depending on installation result in 50/60 Hz earth loops due to noise from mains supply cables.

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

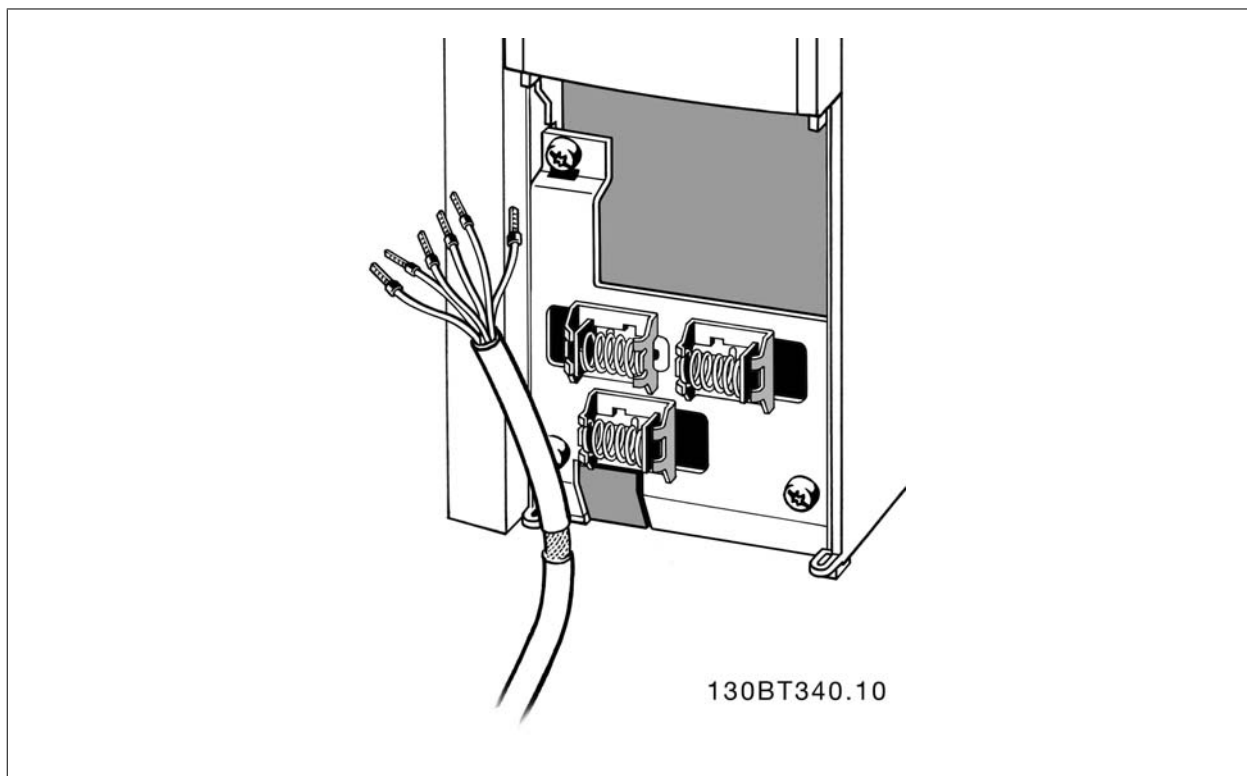
The digital and analog inputs and outputs must be connected separately to the frequency converter common inputs (terminal 20, 55, 39) to avoid earth currents from both groups to affect other groups. For example, switching on the digital input may disturb the analog input signal.

**Input polarity of control terminals**



**3**

 **NB!**  
Control cables must be screened/armoured.



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

### 3.8.2 Switches S201, S202, and S801

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

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

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

# 3

#### Default setting:

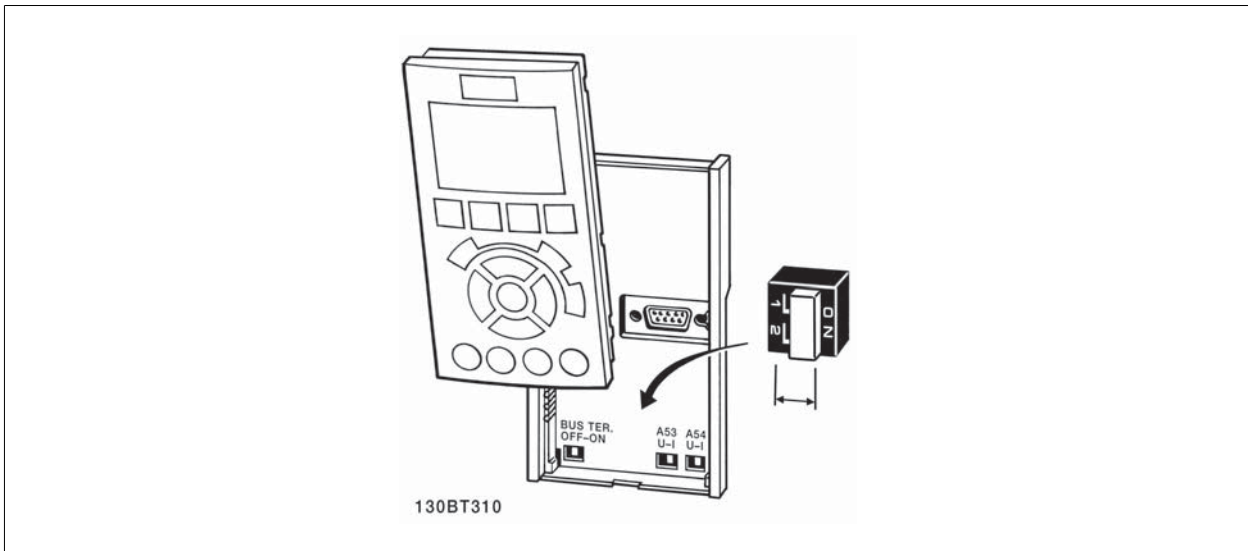
S201 (A53) = OFF (voltage input)

S202 (A54) = OFF (voltage input)

S801 (Bus termination) = OFF



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






### 3.9 Final Set-up and Test

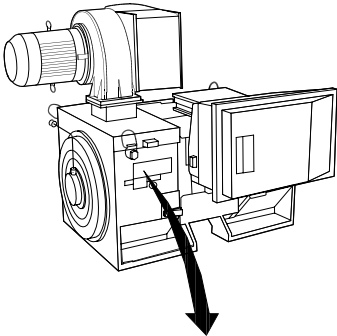
To test the set-up and ensure that the frequency converter is running, follow these steps.

#### Step 1. Locate the motor name plate



**NB!**  
The motor is either star- (Y) or delta- connected ( $\Delta$ ). This information is located on the motor name plate data.

3



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

130BA767.10

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

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

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

#### 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 *Terminal 27 Digital Input* to 'No function' (par. 5-12 *Terminal 27 Digital Input [0]*)
3. Activate the AMA par. 1-29 *Automatic Motor Adaptation (AMA)*.
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.

3

**Step 4. Set speed limit and ramp time**

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

Table 3.19: Set up the desired limits for speed and ramp time.

par. 4-11 *Motor Speed Low Limit [RPM]* or par. 4-12 *Motor Speed Low Limit [Hz]*  
par. 4-13 *Motor Speed High Limit [RPM]* or par. 4-14 *Motor Speed High Limit [Hz]*

par. 3-41 *Ramp 1 Ramp up Time*  
par. 3-42 *Ramp 1 Ramp Down Time*

### 3.10 Additional Connections

#### 3.10.1 Mechanical Brake Control

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

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

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

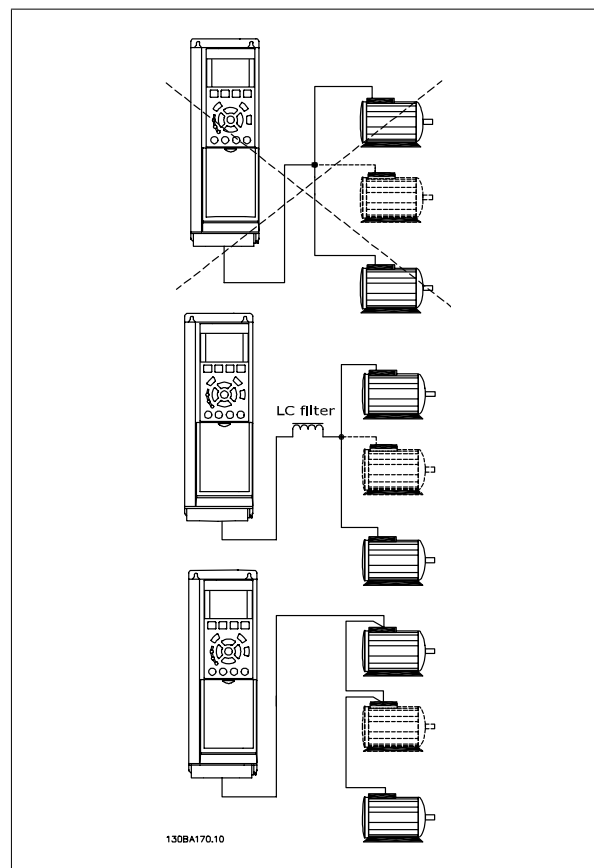
#### 3.10.2 Parallel Connection of Motors

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

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

**NB!**  
When motors are connected in parallel, par. 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 in systems with parallel-connected motors. Provide further motor protection by e.g. thermistors in each motor or individual thermal relays (circuit breakers are not suitable as protection).



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

#### 3.10.3 Motor Thermal Protection

The electronic thermal relay in the frequency converter has received UL-approval for single motor protection, when par. 1-90 *Motor Thermal Protection* is set for *ETR Trip* and par. 1-24 *Motor Current* 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

## 4 How to operate the frequency converter

### 4.1 Ways of Operation

#### 4.1.1 Ways of Operation

The frequency converter can be operated in 3 ways:

1. Graphical Local Control Panel (GLCP), see 6.1.2
2. Numeric Local Control Panel (NLCP), see 6.1.3
3. RS-485 serial communication or USB, both for PC connection, see 6.1.4

If the frequency converter is fitted with fieldbus option, please refer to relevant documentation.

4

#### 4.1.2 How to operate graphical LCP (GLCP)

The following instructions are valid for the GLCP (LCP 102).

The GLCP is divided into four functional groups:

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

##### Graphical display:

The LCD-display is back-lit with a total of 6 alpha-numeric lines. All data is displayed on the LCP which can show up to five operating variables while in [Status] mode.

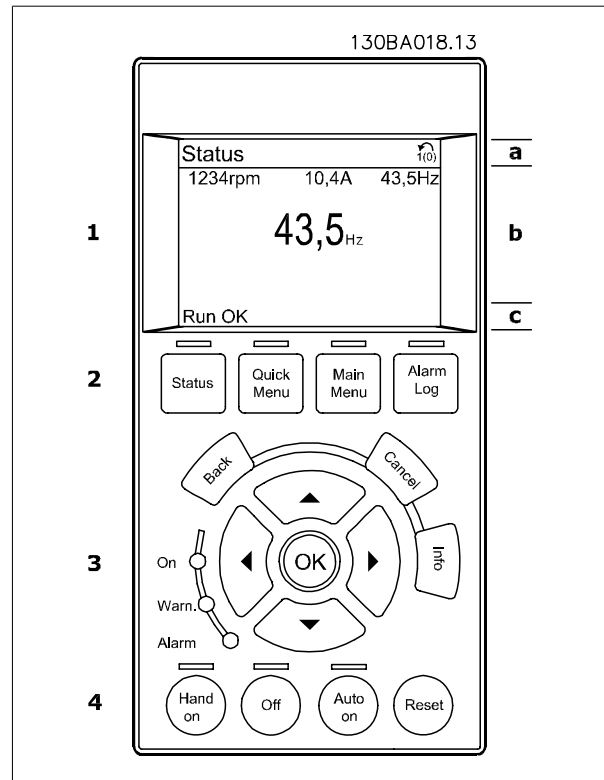
##### Display lines:

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

The display is divided into 3 sections:

##### Top section (a)

shows the status when in status mode or up to 2 variables when not in status mode and in the case of Alarm/Warning.



The number of the Active Set-up (selected as the Active Set-up in par. 0-10) is shown. When programming in another Set-up than the Active Set-up, the number of the Set-up being programmed appears to the right in brackets.

**Middle section (b)**

shows up to 5 variables with related unit, regardless of status. In case of alarm/warning, the warning is shown instead of the variables.

It is possible to toggle between three status read-out displays by pressing the [Status] key.

Operating variables with different formatting are shown in each status screen - see below.

Several values or measurements can be linked to each of the displayed operating variables. The values / measurements to be displayed can be defined via par. 0-20, 0-21, 0-22, 0-23, and 0-24, which can be accessed via [QUICK MENU], "Q3 Function Setups", "Q3-1 General Settings", "Q3-11 Display Settings".

Each value / measurement readout parameter selected in par. 0-20 to par. 0-24 has its own scale and number of digits after a possible decimal point. Larger numeric values are displayed with few digits after the decimal point.

Ex.: Current readout

5.25 A; 15.2 A 105 A.

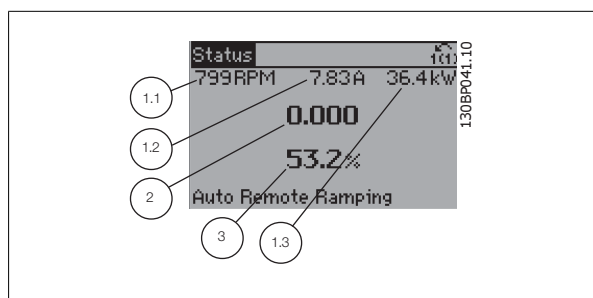
4

**Status display I**

This read-out state is standard after start-up or initialization.

Use [INFO] to obtain information about the value/measurement linked to the displayed operating variables (1.1, 1.2, 1.3, 2, and 3).

See the operating variables shown in the display in this illustration. 1.1, 1.2 and 1.3 are shown in small size. 2 and 3 are shown in medium size.

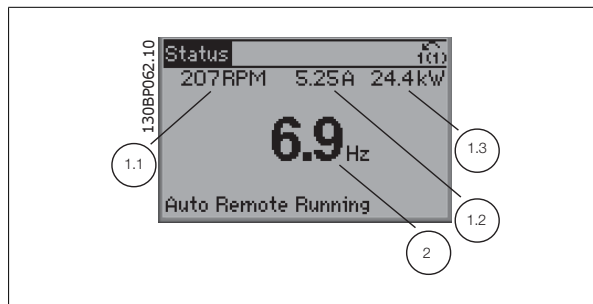


**Status display II**

See the operating variables (1.1, 1.2, 1.3, and 2) shown in the display in this illustration.

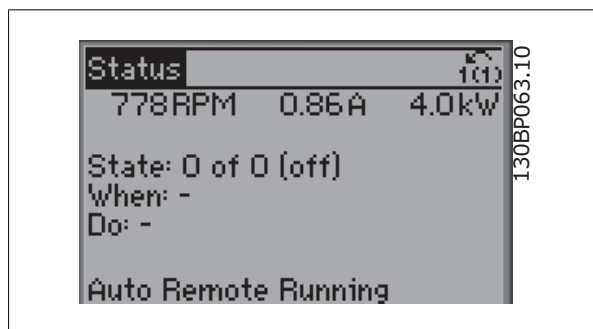
In the example, Speed, Motor current, Motor power and Frequency are selected as variables in the first and second lines.

1.1, 1.2 and 1.3 are shown in small size. 2 is shown in large size.



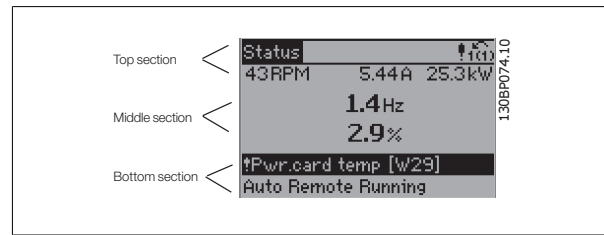
**Status display III:**

This state displays the event and action of the Smart Logic Control. For further information, see section *Smart Logic Control*.



**Bottom section**

always shows the state of the frequency converter in Status mode.



**Display Contrast Adjustment**

Press [status] and [▲] for darker display

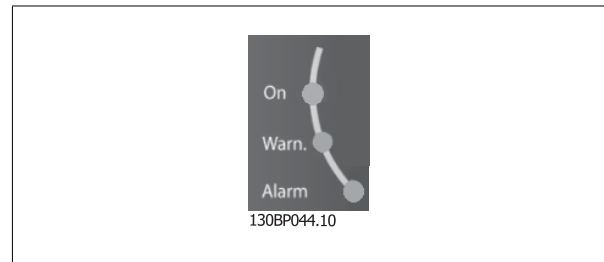
Press [status] and [▼] for brighter display

**Indicator lights (LEDs):**

If certain threshold values are exceeded, the alarm and/or warning LED lights up. A status and alarm text appear on the control panel.

The On LED is activated when the frequency converter receives power from mains voltage, a DC bus terminal, or an external 24 V supply. At the same time, the back light is on.

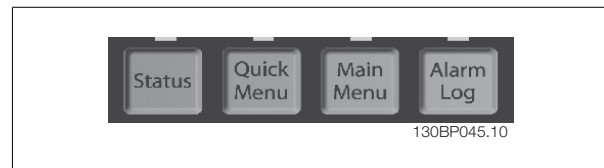
- Green LED/On: Control section is working.
- Yellow LED/Warn.: Indicates a warning.
- Flashing Red LED/Alarm: Indicates an alarm.



**GLCP keys**

**Menu keys**

The menu keys are divided into functions. The keys below the display and indicator lamps are used for parameter set-up, including choice of display indication during normal operation.



**[Status]**

Indicates the status of the frequency converter and/or the motor. 3 different readouts can be chosen by pressing the [Status] key: 5 line readouts, 4 line readouts or Smart Logic Control.

Use [Status] for selecting the mode of display or for changing back to Display mode from either the Quick Menu mode, the Main Menu mode or Alarm mode. Also use the [Status] key to toggle single or double read-out mode.

**[Quick Menu]**

Allows quick set-up of the frequency converter. **The most common functions can be programmed here.**

**The [Quick Menu] consists of:**

- Q1: My Personal Menu
- Q2: Quick Setup
- Q3: Function Setups
- Q5: Changes Made
- Q6: Loggings

The Function set-up provides quick and easy access to all parameters required for the majority of water and wastewater applications including variable torque, constant torque, pumps, dosing pumps, well pumps, booster pumps, mixer pumps, aeration blowers and other pump and fan applications. Amongst other features it also includes parameters for selecting which variables to display on the LCP, digital preset speeds, scaling of analog references, closed loop single zone and multi-zone applications and specific functions related to water and wastewater applications.

The Quick Menu parameters can be accessed immediately unless a password has been created via par. 0-60, 0-61, 0-65 or 0-66.

It is possible to switch directly between Quick Menu mode and Main Menu mode.

**[Main Menu]**

is used for programming all parameters.

The Main Menu parameters can be accessed immediately unless a password has been created via par. 0-60, 0-61, 0-65 or 0-66. For the majority of water and wastewater applications it is not necessary to access the Main Menu parameters but instead the Quick Menu, Quick Setup and Function Setups provides the simplest and quickest access to the typical required parameters.

It is possible to switch directly between Main Menu mode and Quick Menu mode.

Parameter shortcut can be carried out by pressing down the [Main Menu] key for 3 seconds. The parameter shortcut allows direct access to any parameter.

#### [Alarm Log]

displays an Alarm list of the five latest alarms (numbered A1-A5). To obtain additional details about an alarm, use the arrow keys to manoeuvre to the alarm number and press [OK]. Information is displayed about the condition of the frequency converter before it enters the alarm mode.

#### [Back]

reverts to the previous step or layer in the navigation structure.

#### [Cancel]

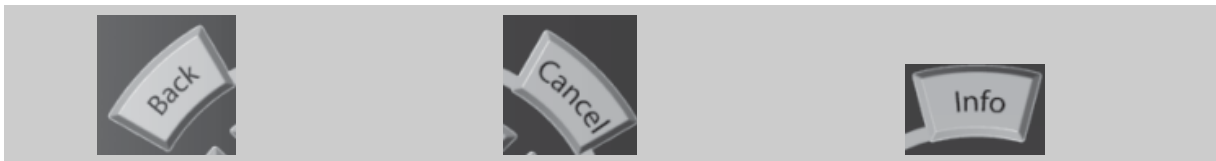
last change or command will be cancelled as long as the display has not been changed.

#### [Info]

displays information about a command, parameter, or function in any display window. [Info] provides detailed information when needed.

Exit Info mode by pressing either [Info], [Back], or [Cancel].

4



#### Navigation Keys

The four navigation arrows are used to navigate between the different choices available in [Quick Menu], [Main Menu] and [Alarm Log]. Use the keys to move the cursor.

#### [OK]

is used for choosing a parameter marked by the cursor and for enabling the change of a parameter.



#### Operation Keys

for local control are found at the bottom of the control panel.



#### [Hand On]

enables control of the frequency converter via the GLCP. [Hand on] also starts the motor, and it is now possible to give the motor speed reference by means of the arrow keys. The key can be *Enabled* [1] or *Disabled* [0] via par. 0-40 [Hand on] Key on LCP.

The following control signals will still be active when [Hand on] is activated:

- [Hand on] - [Off] - [Auto on]
- Reset
- Coasting stop inverse (motor coasting to stop)
- Reversing
- Set-up select lsb - Set-up select msb
- Stop command from serial communication



- Quick stop
- DC brake

**NB!**

External stop signals activated by means of control signals or a serial bus will override a "start" command via the LCP.

**[Off]**

stops the connected motor. The key can be *Enabled* [1] or *Disabled* [0] via par. 0-41 [Off] key on LCP. If no external stop function is selected and the [Off] key is inactive the motor can only be stopped by disconnecting the mains supply.

**[Auto On]**

enables the frequency converter to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or the bus, the frequency converter will start. The key can be *Enabled* [1] or *Disabled* [0] via par. 0-42 [Auto on] key on LCP.

**NB!**

An active HAND-OFF-AUTO signal via the digital inputs has higher priority than the control keys [Hand on] – [Auto on].

**[Reset]**

is used for resetting the frequency converter after an alarm (trip). The key can be *Enabled* [1] or *Disabled* [0] via par. 0-43 Reset Keys on LCP.

**The parameter shortcut**

can be carried out by holding down the [Main Menu] key for 3 seconds. The parameter shortcut allows direct access to any parameter.

### 4.1.3 How to operate numeric LCP (NLCP)

The following instructions are valid for the NLCP (LCP 101).

**The control panel is divided into four functional groups:**

1. Numeric display.
2. Menu key and indicator lights (LEDs) - changing parameters and switching between display functions.
3. Navigation keys and indicator lights (LEDs).
4. Operation keys and indicator lights (LEDs).



**NB!**

Parameter copy is not possible with Numeric Local Control Panel (LCP101).

**Select one of the following modes:**

**Status Mode:** Displays the status of the frequency converter or the motor.

If an alarm occurs, the NLCP automatically switches to status mode.

A number of alarms can be displayed.

**Quick Setup or Main Menu Mode:** Display parameters and parameter settings.

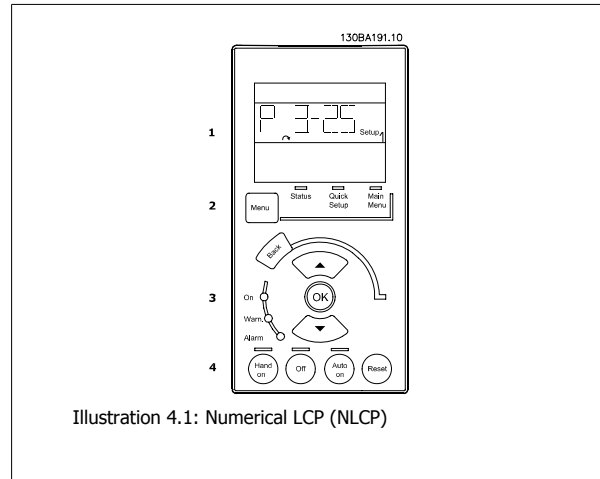


Illustration 4.1: Numerical LCP (NLCP)



Illustration 4.2: Status display example



Illustration 4.3: Alarm display example

**Indicator lights (LEDs):**

- Green LED/On: Indicates if control section is on.
- Yellow LED/Wrn.: Indicates a warning.
- Flashing red LED/Alarm: Indicates an alarm.

**Menu key**

**[Menu]** Select one of the following modes:

- Status
- Quick Setup
- Main Menu

**Main Menu**

is used for programming all parameters.

The parameters can be accessed immediately unless a password has been created via par. 0-60 *Main Menu Password*, par. 0-61 *Access to Main Menu w/o Password*, par. 0-65 *Personal Menu Password* or par. 0-66 *Access to Personal Menu w/o Password*.

**Quick Setup** is used to set up the frequency converter using only the most essential parameters.

The parameter values can be changed using the up/down arrows when the value is flashing.

Select Main Menu by pressing the [Menu] key a number of times until the Main Menu LED is lit.

Select the parameter group [xx-\_\_] and press [OK]

Select the parameter [\_\_-xx] and press [OK]

If the parameter is an array parameter select the array number and press [OK]

Select the wanted data value and press [OK]

**Navigation Keys**

**[Back]**

for stepping backwards

**Arrow [▲] [▼]**

keys are used for manoeuvring between parameter groups, parameters and within parameters

**[OK]**

is used for choosing a parameter marked by the cursor and for enabling the change of a parameter.

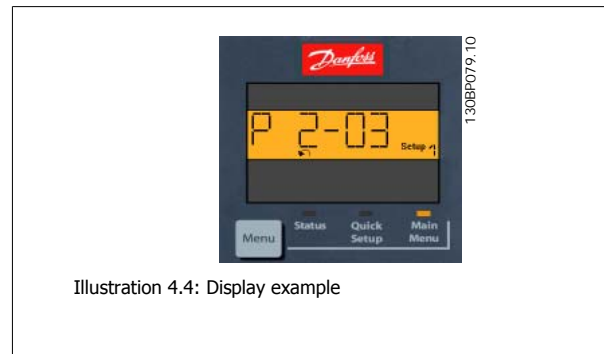


Illustration 4.4: Display example

**Operation Keys**

Keys for local control are found at the bottom of the control panel.

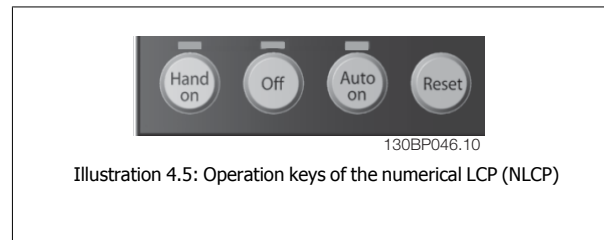


Illustration 4.5: Operation keys of the numerical LCP (NLCP)

**[Hand on]**

enables control of the frequency converter via the LCP. [Hand on] also starts the motor and it is now possible to enter the motor speed data by means of the arrow keys. The key can be *Enabled* [1] or *Disabled* [0] via par. 0-40 *[Hand on] Key on LCP*.

External stop signals activated by means of control signals or a serial bus will override a 'start' command via the LCP.

**The following control signals will still be active when [Hand on] is activated:**

- [Hand on] - [Off] - [Auto on]
- Reset
- Coasting stop inverse
- Reversing
- Set-up select lsb - Set-up select msb
- Stop command from serial communication
- Quick stop
- DC brake

**[Off]**

stops the connected motor. The key can be *Enabled* [1] or *Disabled* [0] via par. 0-41 *[Off] Key on LCP*.

If no external stop function is selected and the [Off] key is inactive the motor can be stopped by disconnecting the mains supply.

**[Auto on]**

enables the frequency converter to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or the bus, the frequency converter will start. The key can be *Enabled* [1] or *Disabled* [0] via par. 0-42 *[Auto on] Key on LCP*.

**NB!**  
An active HAND-OFF-AUTO signal via the digital inputs has higher priority than the control keys [Hand on] [Auto on].

**[Reset]**

is used for resetting the frequency converter after an alarm (trip). The key can be *Enabled* [1] or *Disabled* [0] via par. 0-43 *[Reset] Key on LCP*.

**4.1.4 Changing Data**

1. Press [Quick Menu] or [Main Menu] key.
2. Use [▲] and [▼] keys keys to find parameter group to edit.

3. Press [OK] key.
4. Use [▲] and [▼] keys to find parameter to edit.
5. Press [OK] key.
6. Use [▲] and [▼] keys to select correct parameter setting. Or, to move to digits within a number, use keys. Cursor indicates digit selected to change. [▲] key increases the value, [▼] key decreases the value.
7. Press [Cancel] key to disregard change, or press [OK] key to accept change and enter new setting.

#### 4.1.5 Changing a Text Value

4

If the selected parameter is a text value, change the text value by means of the up/down navigation keys.

The up key increases the value, and the down key decreases the value. Place the cursor on the value to be saved and press [OK].

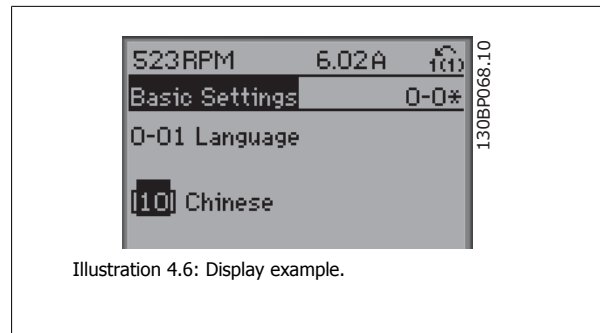


Illustration 4.6: Display example.

#### 4.1.6 Changing a Group of Numeric Data Values

If the chosen parameter represents a numeric data value, change the chosen data value by means of the <> navigation keys as well as the up/down navigation keys. Use the <> navigation keys to move the cursor horizontally.

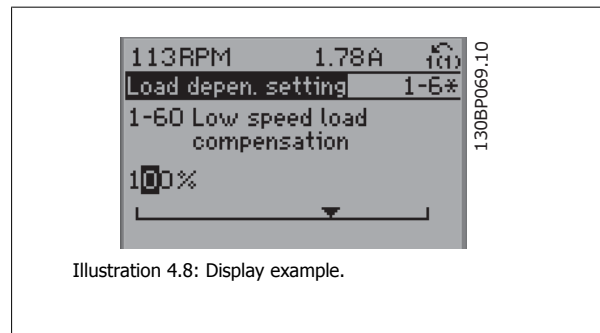


Illustration 4.8: Display example.

Use the up/down navigation keys to change the data value. The up key enlarges the data value, and the down key reduces the data value. Place the cursor on the value to be saved and press [OK].

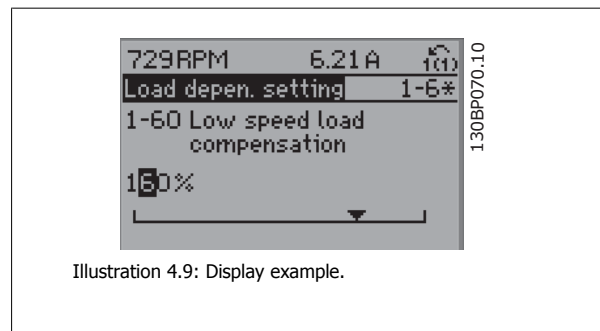


Illustration 4.9: Display example.

#### 4.1.7 Changing of Data Value, Step-by-Step

Certain parameters can be changed step by step or infinitely variably. This applies to par. 1-20 *Motor Power [kW]*, par. 1-22 *Motor Voltage* and par. 1-23 *Motor Frequency*.

The parameters are changed both as a group of numeric data values and as numeric data values infinitely variably.

### 4.1.8 Read-out and Programming of Indexed Parameters

Parameters are indexed when placed in a rolling stack.

par. 15-30 *Alarm Log: Error Code* to par. 15-32 *Alarm Log: Time* contain a fault log which can be read out. Choose a parameter, press [OK], and use the up/down navigation keys to scroll through the value log.

Use par. 3-10 *Preset Reference* as another example:

Choose the parameter, press [OK], and use the up/down navigation keys to scroll through the indexed values. To change the parameter value, select the indexed value and press [OK]. Change the value by using the up/down keys. Press [OK] to accept the new setting. Press [Cancel] to abort. Press [Back] to leave the parameter.


### 4.1.9 Tips and tricks

|   |   |
|---|---|
| * | For the majority of water and wastewater applications the Quick Menu, Quick Setup and Function Setups provides the simplest and quickest access to all the typical parameters required. |
| * | Whenever possible, performing an AMA, will ensure best shaft performance  |
| * | Contrast of the display can be adjusted by pressing [Status] and [▲] for darker display or by pressing [Status] and [▼] for brighter display  |
| * | Under [Quick Menu] and [Changes Made] all parameters that have been changed from factory settings are displayed   |
| * | Press and hold [Main Menu] key for 3 seconds for access to any parameter  |
| * | For service purposes it is recommended to copy all parameters to the LCP, see par 0-50 for further information  |

Table 4.1: Tips and tricks

### 4.1.10 Quick Transfer of Parameter Settings when using GLCP

Once the set-up of a frequency converter is complete, it is recommended to store (backup) the parameter settings in the GLCP or on a PC via MCT 10 Set-up Software Tool.



**NB!**  
Stop the motor before performing any of these operations.

**Data storage in LCP:**

1. Go to par. 0-50 *LCP Copy*
2. Press the [OK] key
3. Select "All to LCP"
4. Press the [OK] key

All parameter settings are now stored in the GLCP indicated by the progress bar. When 100% is reached, press [OK].

The GLCP can now be connected to another frequency converter and the parameter settings copied to this frequency converter.

**Data transfer from LCP to Frequency converter:**

1. Go to par. 0-50 *LCP Copy*
2. Press the [OK] key
3. Select "All from LCP"
4. Press the [OK] key

The parameter settings stored in the GLCP are now transferred to the frequency converter indicated by the progress bar. When 100% is reached, press [OK].

### 4.1.11 Initialisation to Default Settings

There are two ways to initialise the frequency converter to default: Recommended initialisation and manual initialisation. Please be aware that they have different impact according to the below description.

#### Recommended initialisation (via par. 14-22 *Operation Mode*)

1. Select par. 14-22 *Operation Mode*
2. Press [OK]
3. Select "Initialisation" (for NLCP select "2")
4. Press [OK]
5. Remove power to unit and wait for display to turn off.
6. Reconnect power and the frequency converter is reset. Note that first start-up takes a few more seconds.
7. Press [Reset]

par. 14-22 *Operation Mode* initialises all except:

- par. 14-50 *RFI Filter*
- par. 8-30 *Protocol*
- par. 8-31 *Address*
- par. 8-32 *Baud Rate*
- par. 8-35 *Minimum Response Delay*
- par. 8-36 *Max Response Delay*
- par. 8-37 *Maximum Inter-Char Delay*
- par. 15-00 *Operating Hours* to par. 15-05 *Over Volt's*
- par. 15-20 *Historic Log: Event* to par. 15-22 *Historic Log: Time*
- par. 15-30 *Alarm Log: Error Code* to par. 15-32 *Alarm Log: Time*

**NB!**  
Parameters selected in par. 0-25 *My Personal Menu*, will stay present, with default factory setting.

#### Manual initialisation

**NB!**  
When carrying out manual initialisation, serial communication, RFI filter settings and fault log settings are reset.  
Removes parameters selected in par. 0-25 *My Personal Menu*

1. Disconnect from mains and wait until the display turns off.
- 2a. Press [Status] - [Main Menu] - [OK] at the same time while power up for Graphical LCP (GLCP).
- 2b. Press [Menu] while power up for LCP 101, Numerical Display
3. Release the keys after 5 s.
4. The frequency converter is now programmed according to default settings.

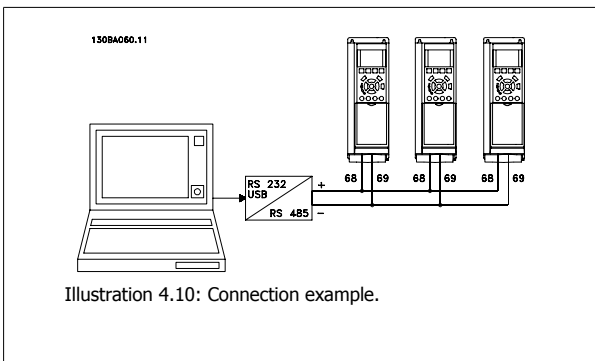
This parameter initialises all except:

- par. 15-00 *Operating Hours*
- par. 15-03 *Power Up's*
- par. 15-04 *Over Temp's*
- par. 15-05 *Over Volt's*

### 4.1.12 RS-485 Bus Connection

One or more frequency converters can be connected to a controller (or master) using the RS-485 standard interface. Terminal 68 is connected to the P signal (TX+, RX+), while terminal 69 is connected to the N signal (TX-,RX-).

If more than one frequency converter is connected to a master, use parallel connections.



In order to avoid potential equalizing currents in the screen, earth the cable screen via terminal 61, which is connected to the frame via an RC-link.

#### Bus termination

The RS-485 bus must be terminated by a resistor network at both ends. If the drive is the first or the last device in the RS-485 loop, set the switch S801 on the control card for ON.

For more information, see the paragraph *Switches S201, S202, and S801*.

#### 4.1.13 How to Connect a PC to the frequency converter

To control or program the frequency converter from a PC, install the PC-based Configuration Tool MCT 10.

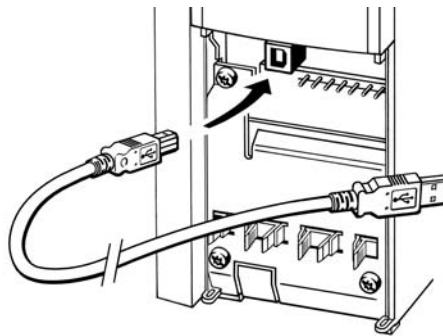
The PC is connected via a standard (host/device) USB cable, or via the RS-485 interface as shown in the *Design Guide, chapter How to Install > Installation of misc. connections*.



**NB!**

The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. The USB connection is connected to protection earth on the frequency converter. Use only isolated laptop as PC connection to the USB connector on the frequency converter.

4



130BT308

Illustration 4.11: For control cable connections, see section on *Control Terminals*.

#### 4.1.14 PC Software tools

##### PC-based Configuration Tool MCT 10

All Frequency converters are equipped with a serial communication port. Danfoss provides a PC tool for communication between PC and frequency converter, PC-based Configuration Tool MCT 10. Please check the section on *Available Literature* for detailed information on this tool.

##### MCT 10 Set-up Software

MCT 10 has been designed as an easy to use interactive tool for setting parameters in our frequency converters. The software can be downloaded from the Danfoss internet site <http://www.Danfoss.com/BusinessAreas/DrivesSolutions/SoftwareDownload/DDPC+Software+Program.htm>.

The xMCT 10 Set-up software will be useful for:

- Planning a communication network off-line. MCT 10 contains a complete frequency converter database
- Commissioning frequency converters on line
- Saving settings for all frequency converters
- Replacing a frequency converter in a network
- Simple and accurate documentation of frequency converter settings after commissioning.
- Expanding an existing network
- Future developed frequency converters will be supported

MCT 10 set-up software supports Profibus DP-V1 via a Master class 2 connection. It makes it possible to on line read/write parameters in a frequency converter via the Profibus network. This will eliminate the need for an extra communication network.

**Save Frequency Converter Settings:**

1. Connect a PC to the unit via USB com port. (Note: Use a PC, which is isolated from the mains, in conjunction with the USB port. Failure to do so may damage equipment.)
2. Open MCT 10 Set-up Software
3. Choose "Read from drive"
4. Choose "Save as"

All parameters are now stored in the PC.

**Load Frequency Converter Settings:**


1. Connect a PC to the frequency converter via USB com port
2. Open MCT 10 Set-up software
3. Choose "Open"– stored files will be shown
4. Open the appropriate file
5. Choose "Write to drive"

All parameter settings are now transferred to the frequency converter.

A separate manual for MCT 10 Set-up Software is available: *MG.10.Rx.yy*.

**The MCT 10 Set-up Software Modules**

The following modules are included in the software package:

|  |  |
|--|--|
|  | <b>MCT Set-up 10 Software</b><br>Setting parameters<br>Copy to and from frequency converters<br>Documentation and print out of parameter settings incl. diagrams |
|  | <b>Ext. User Interface</b><br>Preventive Maintenance Schedule<br>Clock settings<br>Timed Action Programming<br>Smart Logic Controller Set-up                     |

**Ordering number:**

Please order the CD containing MCT 10 Set-up Software using code number 130B1000.

MCT 10 can also be downloaded from the Danfoss Internet: [WWW.DANFOSS.COM](http://WWW.DANFOSS.COM), Business Area: Motion Controls.



## 5 How to programme the frequency converter

### 5.1 How to programme

#### 5.1.1 Parameter Set-Up

##### Overview of parameter groups

| Group | Title                              | Function   |
|-------|------------------------------------|--|
| 0-    | Operation / Display                | Parameters related to the fundamental functions of the frequency converter, function of the LCP buttons and configuration of the LCP display.      |
| 1-    | Load / Motor                       | Parameter group for motor settings.  |
| 2-    | Brakes                             | Parameter group for setting brake features in the frequency converter.   |
| 3-    | Reference / Ramps                  | Parameters for reference handling, definitions of limitations, and configuration of the reaction of the frequency converter to changes.            |
| 4-    | Limits / Warnings                  | Parameter group for configuring limits and warnings.   |
| 5-    | Digital In/Out                     | Parameter group for configuring the digital inputs and outputs.  |
| 6-    | Analog In/Out                      | Parameter group for configuration of the analog inputs and outputs.  |
| 8-    | Communication and Options          | Parameter group for configuring communications and options.  |
| 9-    | Profibus                           | Parameter group for Profibus-specific parameters.  |
| 10-   | DeviceNet Fieldbus                 | Parameter group for DeviceNet-specific parameters.   |
| 11-   | LonWorks                           | Parameter group for LonWorks parameters  |
| 13-   | Smart Logic                        | Parameter group for Smart Logic Control  |
| 14-   | Special Functions                  | Parameter group for configuring special frequency converter functions.   |
| 15-   | Drive Information                  | Parameter group containing frequency converter information such as operating data, hardware configuration and software versions.                   |
| 16-   | Data Readouts                      | Parameter group for data read-outs, e.g. actual references, voltages, control, alarm, warning and status words.                                    |
| 18-   | Info and Readouts                  | This parameter group contains the last 10 Preventive Maintenance logs.   |
| 20-   | Drive Closed Loop                  | This parameter group is used for configuring the closed loop PID Controller that controls the output frequency of the unit.                        |
| 21-   | Extended Closed Loop               | Parameters for configuring the three Extended Closed Loop PID Controllers.   |
| 22-   | Application Functions              | These parameters monitor water applications.   |
| 23-   | Time-based Functions               | These parameters are for actions needed to be performed on a daily or weekly basis, e.g. different references for working hours/non-working hours. |
| 25-   | Basic Cascade Controller Functions | Parameters for configuring the Basic Cascade Controller for sequence control of multiple pumps.  |
| 26-   | Analog I/O Option MCB 109          | Parameters for configuring the Analog I/O Option MCB 109.  |
| 27-   | Extended Cascade Control           | Parameters for configuring the Extended Cascade Control.   |
| 29-   | Water Application Functions        | Parameters for setting water specific functions.   |
| 31-   | Bypass Option                      | Parameters for configuring the Bypass Option   |

Table 5.1: Parameter Groups

Parameter descriptions and selections are displayed on the graphic (GLCP) or numeric (NLCP) in the display area. (See Section 5 for details.) Access the parameters by pressing the [Quick Menu] or [Main Menu] key on the control panel. The quick menu is used primarily for commissioning the unit at start-up by providing those parameters necessary to start operation. The main menu provides access to all parameters for detailed application programming.

All digital input/output and analog input/output terminals are multifunctional. All terminals have factory default functions suitable for the majority of water applications but if other special functions are required, they must be programmed in parameter group 5 or 6.

#### 5.1.2 Quick Menu Mode

The GLCP provides access to all parameters listed under the Quick Menu. To set parameters using the [Quick Menu] button:

Pressing [Quick Menu] the list indicates the different areas contained in the Quick menu.

##### Efficient Parameter Set-up for Water Applications

The parameters can easily be set up for the vast majority of the water and wastewater applications only by using the [Quick Menu].

**The optimum way to set parameters through the [Quick Menu] is by following the below steps:**

1. Press [Quick Setup] for selecting basic motor settings, ramp times, etc.
2. Press [Function Setups] for setting up the required functionality of the frequency converter - if not already covered by the settings in [Quick Setup].
3. Choose between *General Settings*, *Open Loop Settings* and *Closed Loop Settings*.

It is recommended to do the set-up in the order listed.

**5**

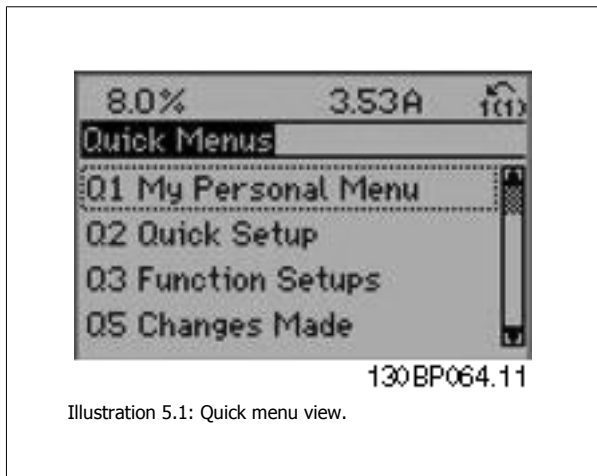


Illustration 5.1: Quick menu view.

| Par. | Designation                      | [Units] |
|------|----------------------------------|---------|
| 0-01 | Language                         |         |
| 1-20 | Motor Power                      | [kW]    |
| 1-22 | Motor Voltage                    | [V]     |
| 1-23 | Motor Frequency                  | [Hz]    |
| 1-24 | Motor Current                    | [A]     |
| 1-25 | Motor Nominal Speed              | [RPM]   |
| 3-41 | Ramp 1 Ramp up Time              | [s]     |
| 3-42 | Ramp 1 Ramp down Time            | [s]     |
| 4-11 | Motor Speed Low Limit            | [RPM]   |
| 4-13 | Motor Speed High Limit           | [RPM]   |
| 1-29 | Automatic Motor Adaptation (AMA) |         |

Table 5.2: Quick Setup parameters

If *No Operation* is selected in terminal 27 no connection to +24 V on terminal 27 is necessary to enable start.

If *Coast Inverse* (factory default value) is selected in Terminal 27, a connection to +24V is necessary to enable start.

**NB!**

For detailed parameter descriptions, please see the following section on *Commonly Used Parameters - Explanations*.

### 5.1.3 Q1 My Personal Menu

Parameters defined by the user can be stored in Q1 My Personal Menu.

Select *My Personal Menu* to display only the parameters, which have been pre-selected and programmed as personal parameters. For example, a pump or equipment OEM may have pre-programmed these to be in My Personal Menu during factory commissioning to make on site commissioning / fine tuning simpler.. These parameters are selected in par. 0-25 *My Personal Menu*. Up to 20 different parameters can be defined in this menu.

| Q1 My Personal Menu |                       |
|---------------------|-----------------------|
| 20-21               | Setpoint 1            |
| 20-93               | PID Proportional Gain |
| 20-94               | PID Integral Time     |

### 5.1.4 Q2 Quick Setup

The parameters in Q2 Quick Setup are the basic parameters which are always needed to set-up the frequency converter to operation.

| Q2 Quick Setup            |                                  |
|---------------------------|----------------------------------|
| Parameter number and name | Unit                             |
| 0-01                      | Language                         |
| 1-20                      | Motor Power                      |
| 1-22                      | Motor Voltage                    |
| 1-23                      | Motor Frequency                  |
| 1-24                      | Motor Current                    |
| 1-25                      | Motor Nominal Speed              |
| 3-41                      | Ramp 1 Ramp Up Time              |
| 3-42                      | Ramp 1 Ramp Down Time            |
| 4-11                      | Motor Speed Low Limit            |
| 4-13                      | Motor Speed High Limit           |
| 1-29                      | Automatic Motor Adaptation (AMA) |

### 5.1.5 Q3 Function Setups

The Function Setup provides quick and easy access to all parameters required for the majority of water and wastewater applications including variable torque, constant torque, pumps, dosing pumps, well pumps, booster pumps, mixer pumps, aeration blowers and other pump and fan applications. Amongst other features it also includes parameters for selecting which variables to display on the LCP, digital preset speeds, scaling of analog references, closed loop single zone and multi-zone applications and specific functions related to water and wastewater applications.

How to access Function Set-up - example




Illustration 5.2: Step 1: Turn on the frequency converter (On LED lights)

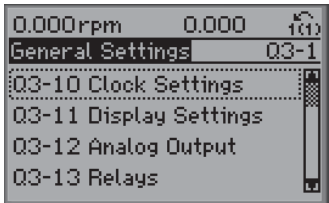


Illustration 5.6: Step 5: Use the up/down navigation keys to scroll down to i.e. 03-12 *Analog Outputs*. Press [OK].




Illustration 5.3: Step 2: Press the [Quick Menus] button (Quick Menu choices appear).

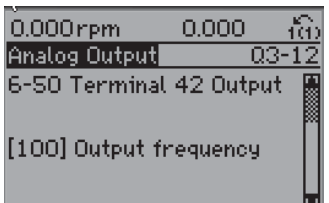


Illustration 5.7: Step 6: Choose parameter 6-50 *Terminal 42 Output*. Press [OK].




Illustration 5.4: Step 3: Use the up/down navigation keys to scroll down to Function Setups. Press [OK].

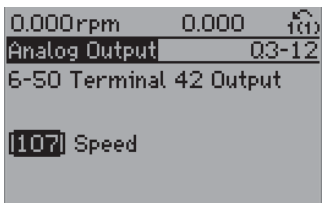


Illustration 5.8: Step 7: Use the up/down navigation keys to select between the different choices. Press [OK].

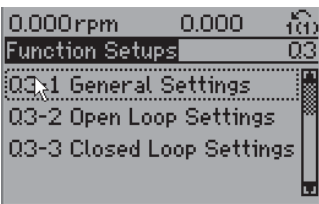


Illustration 5.5: Step 4: Function Setups choices appear. Choose 03-1 *General Settings*. Press [OK].

The Function Setup parameters are grouped in the following way:

| Q3-1 General Settings     |                             |                                   |                                      |
|---------------------------|-----------------------------|-----------------------------------|--------------------------------------|
| Q3-10 Clock Settings      | Q3-11 Display Settings      | Q3-12 Analog Output               | Q3-13 Relays                         |
| 0-70 Set Date and Time    | 0-20 Display Line 1.1 Small | 6-50 Terminal 42 Output           | Relay 1 ⇒ 5-40 Function Relay        |
| 0-71 Date Format          | 0-21 Display Line 1.2 Small | 6-51 Terminal 42 Output Min Scale | Relay 2 ⇒ 5-40 Function Relay        |
| 0-72 Time Format          | 0-22 Display Line 1.3 Small | 6-52 Terminal 42 Output Max Scale | Option relay 7 ⇒ 5-40 Function Relay |
| 0-74 DST/Summertime       | 0-23 Display Line 2 Large   |                                   | Option relay 8 ⇒ 5-40 Function Relay |
| 0-76 DST/Summertime Start | 0-24 Display Line 3 Large   |                                   | Option relay 9 ⇒ 5-40 Function Relay |
| 0-77 DST/Summertime End   | 0-37 Display Text 1         |                                   |                                      |
|                           | 0-38 Display Text 2         |                                   |                                      |
|                           | 0-39 Display Text 3         |                                   |                                      |

5

| Q3-2 Open Loop Settings        |  |
|--------------------------------|--|
| Q3-20 Digital Reference        | Q3-21 Analog Reference                 |
| 3-02 Minimum Reference         | 3-02 Minimum Reference                 |
| 3-03 Maximum Reference         | 3-03 Maximum Reference                 |
| 3-10 Preset Reference          | 6-10 Terminal 53 Low Voltage           |
| 5-13 Terminal 29 Digital Input | 6-11 Terminal 53 High Voltage          |
| 5-14 Terminal 32 Digital Input | 6-14 Terminal 53 Low Ref/Feedb. Value  |
| 5-15 Terminal 33 Digital Input | 6-15 Terminal 53 High Ref/Feedb. Value |

| Q3-3 Closed Loop Settings             |                                  |
|---------------------------------------|----------------------------------|
| Q3-30 Feedback Settings               | Q3-31 PID Settings               |
| 1-00 Configuration Mode               | 20-81 PID Normal/Inverse Control |
| 20-12 Reference/Feedb.Unit            | 20-82 PID Start Speed [RPM]      |
| 3-02 Minimum Reference                | 20-21 Setpoint 1                 |
| 3-03 Maximum Reference                | 20-93 PID Proportional Gain      |
| 6-20 Terminal 54 Low Voltage          | 20-94 PID Integral Time          |
| 6-21 Terminal 54 High Voltage         |                                  |
| 6-24 Terminal 54 Low Ref/Feedb Value  |                                  |
| 6-25 Terminal 54 High Ref/Feedb Value |                                  |
| 6-00 Live Zero Timeout Time           |                                  |
| 6-01 Live Zero Timeout Function       |                                  |

### 5.1.6 Q5 Changes Made

Q5 Changes Made can be used for fault finding.

Select **Changes made to get information about:**

- the last 10 changes. Use the up/down navigation keys to scroll between the last 10 changed parameters.
- the changes made since default setting.

Select **Loggings** to get information about the display line read-outs. The information is shown as graphs.

Only display parameters selected in par. 0-20 and par. 0-24 can be viewed. It is possible to store up to 120 samples in the memory for later reference.

Please notice that the parameters listed in the below tables for Q5 only serve as examples as they will vary depending on the programming of the particular frequency converter.

| Q5-1 Last 10 Changes        |
|-----------------------------|
| 20-94 PID Integral Time     |
| 20-93 PID Proportional Gain |

| Q5-2 Since Factory Setting  |
|-----------------------------|
| 20-93 PID Proportional Gain |
| 20-94 PID Integral Time     |

| Q5-3 Input Assignments |
|------------------------|
| Analog Input 53        |
| Analog Input 54        |

### 5.1.7 Q6 Loggings

Q6 Loggings can be used for fault finding.

Please notice that the parameters listed in the below table for Q6 only serve as examples as they will vary depending on the programming of the particular frequency converter.

| <b>Q6 Loggings</b>  |  |
|---------------------|--|
| Reference           |  |
| Analog Input 53     |  |
| Motor Current       |  |
| Frequency           |  |
| Feedback            |  |
| Energy Log          |  |
| Trending Cont Bin   |  |
| Trending Timed Bin  |  |
| Trending Comparison |  |

### 5.1.8 Main Menu Mode

Both the GLCP and NLCP provide access to the main menu mode. Select the Main Menu mode by pressing the [Main Menu] key. Illustration 6.2 shows the resulting read-out, which appears on the display of the GLCP. Lines 2 through 5 on the display show a list of parameter groups which can be chosen by toggling the up and down buttons.

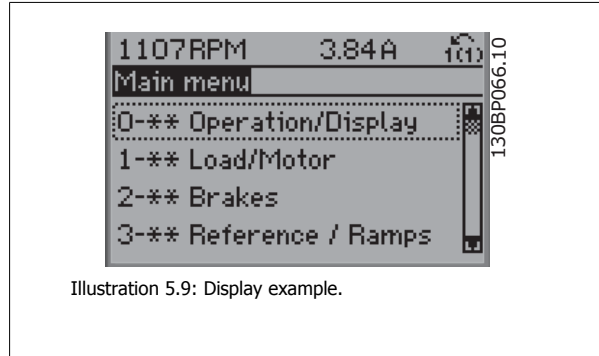


Illustration 5.9: Display example.

## 5

Each parameter has a name and number which remain the same regardless of the programming mode. In the Main Menu mode, the parameters are divided into groups. The first digit of the parameter number (from the left) indicates the parameter group number.

All parameters can be changed in the Main Menu. The configuration of the unit (par. 1-00 *Configuration Mode*) will determine other parameters available for programming. For example, selecting Closed Loop enables additional parameters related to closed loop operation. Option cards added to the unit enable additional parameters associated with the option device.

### 5.1.9 Parameter Selection

In the Main Menu mode, the parameters are divided into groups. Select a parameter group by means of the navigation keys.

The following parameter groups are accessible:

| Group no. | Parameter group:          |
|-----------|---------------------------|
| 0         | Operation/Display         |
| 1         | Load/Motor                |
| 2         | Brakes                    |
| 3         | References/Ramps          |
| 4         | Limits/Warnings           |
| 5         | Digital In/Out            |
| 6         | Analog In/Out             |
| 8         | Comm. and Options         |
| 9         | Profibus                  |
| 10        | CAN Fieldbus              |
| 11        | LonWorks                  |
| 13        | Smart Logic               |
| 14        | Special Functions         |
| 15        | Drive Information         |
| 16        | Data Readouts             |
| 18        | Data Readouts 2           |
| 20        | Drive Closed Loop         |
| 21        | Ext. Closed Loop          |
| 22        | Application Functions     |
| 23        | Time-based Functions      |
| 24        | Fire Mode                 |
| 25        | Cascade Controller        |
| 26        | Analog I/O Option MCB 109 |

Table 5.3: Parameter groups.

After selecting a parameter group, choose a parameter by means of the navigation keys.

The middle section on the GLCP display shows the parameter number and name as well as the selected parameter value.

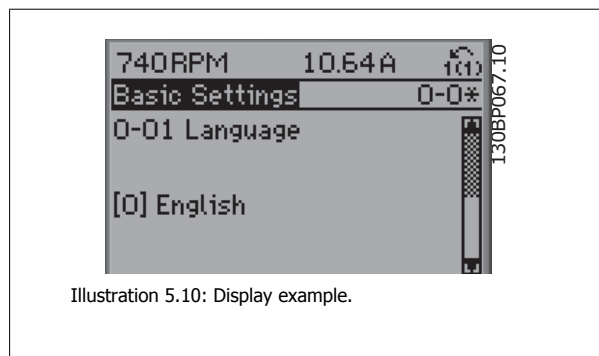


Illustration 5.10: Display example.

## 5.2 Commonly Used Parameters - Explanations

### 5.2.1 Main Menu

The Main Menu includes all available parameters in the VLT® AQUA Drive FC 200 frequency converter.

All parameters are grouped in a logic way with a group name indicating the function of the parameter group.

All parameters are listed by name and number in the section *Parameter Options* in these Operating Instructions.

All parameters included in the Quick Menus (Q1, Q2, Q3, Q5 and Q6) can be found in the following.

Some of the most used parameters for VLT® AQUA Drive applications are also explained in the following section.

For a detailed explanation of all parameters, please refer to the VLT® AQUA Drive Programming Guide MG.20.OX.YY which is available on [www.danfoss.com](http://www.danfoss.com) or by ordering at the local Danfoss office.

## 5.2.2 0-\*\*\* Operation / Display

Parameters related to the fundamental functions of the frequency converter, function of the LCP buttons and configuration of the LCP display.

### 0-01 Language

| <b>Option:</b> |                     | <b>Function:</b>  |
|----------------|---------------------|---|
|                |                     | Defines the language to be used in the display.<br>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  |

### 0-20 Display Line 1.1 Small


| <b>Option:</b> |                                | <b>Function:</b>  |
|----------------|--------------------------------|---|
|                |                                | Select a variable for display in line 1, left position.   |
| [0]            | None                           | No display value selected   |
| [37]           | Display Text 1                 | Present control word  |
| [38]           | Display Text 2                 | Enables an individual text string to be written, for display in the LCP or to be read via serial communication. |
| [39]           | Display Text 3                 | Enables an individual text string to be written, for display in the LCP or to be read via serial communication. |
| [89]           | Date and Time Readout          | Displays the current date and time.   |
| [953]          | Profibus Warning Word          | Displays Profibus communication warnings.   |
| [1005]         | Readout Transmit Error Counter | View the number of CAN control transmission errors since the last power-up.                                     |



|          |                               |  |
|----------|-------------------------------|--|
| [1006]   | Readout Receive Error Counter | View the number of CAN control receipt errors since the last power-up.   |
| [1007]   | Readout Bus Off Counter       | View the number of Bus Off events since the last power-up.   |
| [1013]   | Warning Parameter             | View a DeviceNet-specific warning word. One separate bit is assigned to every warning.   |
| [1115]   | LON Warning Word              | Shows the LON-specific warnings.   |
| [1117]   | XIF Revision                  | Shows the version of the external interface file of the Neuron C chip on the LON option.   |
| [1118]   | LON Works Revision            | Shows the software version of the application program of the Neuron C chip on the LON option.  |
| [1500]   | Operating Hours               | View the number of running hours of the frequency converter.   |
| [1501]   | Running Hours                 | View the number of running hours of the motor.   |
| [1502]   | kWh Counter                   | View the mains power consumption in kWh.   |
| [1600]   | Control Word                  | View the Control Word sent from the frequency converter via the serial communication port in hex code.   |
| [1601] * | Reference [Unit]              | Total reference (sum of digital/analog/preset/bus/freeze ref./catch up and slow-down) in selected unit.  |
| [1602]   | Reference %                   | Total reference (sum of digital/analog/preset/bus/freeze ref./catch up and slow-down) in percent.  |
| [1603]   | Status Word                   | Present status word  |
| [1605]   | Main Actual Value [%]         | One or more warnings in a Hex code   |
| [1609]   | Custom Readout                | View the user-defined readouts as defined in par. 0-30, 0-31 and 0-32.   |
| [1610]   | Power [kW]                    | Actual power consumed by the motor in kW.  |
| [1611]   | Power [hp]                    | Actual power consumed by the motor in HP.  |
| [1612]   | Motor Voltage                 | Voltage supplied to the motor.   |
| [1613]   | Motor Frequency               | Motor frequency, i.e. the output frequency from the frequency converter in Hz.   |
| [1614]   | Motor Current                 | Phase current of the motor measured as effective value.  |
| [1615]   | Frequency [%]                 | Motor frequency, i.e. the output frequency from the frequency converter in percent.  |
| [1616]   | Torque [Nm]                   | Present motor load as a percentage of the rated motor torque.  |
| [1617]   | Speed [RPM]                   | Speed in RPM (revolutions per minute) i.e. the motor shaft speed in closed loop based on the entered motor nameplate data, the output frequency and the load on the frequency converter. |
| [1618]   | Motor Thermal                 | Thermal load on the motor, calculated by the ETR function. See also parameter group 1-9* Motor Temperature.  |
| [1622]   | Torque [%]                    | Shows the actual torque produced, in percentage.   |
| [1630]   | DC Link Voltage               | Intermediate circuit voltage in the frequency converter.   |
| [1632]   | BrakeEnergy/s                 | Present brake power transferred to an external brake resistor.<br>Stated as an instantaneous value.  |
| [1633]   | BrakeEnergy/2 min             | Brake power transferred to an external brake resistor. The mean power is calculated continuously for the most recent 120 seconds.  |
| [1634]   | Heatsink Temp.                | Present heat sink temperature of the frequency converter. The cut-out limit is 95 ±5 °C; cutting back in occurs at 70 ±5° C.   |
| [1635]   | Thermal Drive Load            | Percentage load of the inverters   |
| [1636]   | Inv. Nom. Current             | Nominal current of the frequency converter   |
| [1637]   | Inv. Max. Current             | Maximum current of the frequency converter   |
| [1638]   | SL Control State              | State of the event executed by the control   |
| [1639]   | Control Card Temp.            | Temperature of the control card.   |
| [1650]   | External Reference            | Sum of the external reference as a percentage, i.e. the sum of analog/pulse/bus.   |
| [1652]   | Feedback [Unit]               | Signal value in units from the programmed digital input(s).  |
| [1653]   | Digi Pot Reference            | View the contribution of the digital potentiometer to the actual reference Feedback.   |
| [1654]   | Feedback 1 [Unit]             | View the value of Feedback 1. See also par. 20-0*.   |
| [1655]   | Feedback 2 [Unit]             | View the value of Feedback 2. See also par. 20-0*.   |
| [1656]   | Feedback 3 [Unit]             | View the value of Feedback 3. See also par. 20-0*.   |
| [1658]   | PID Output [%]                | Returns the Drive Closed Loop PID controller output value in percent.  |

|        |                            |   |
|--------|----------------------------|---|
| [1659] | Adjusted Setpoint          | Displays the actual operating set-point after it is modified by flow compensation. See parameters 22-8*.                                    |
| [1660] | Digital Input              | Displays the status of the digital inputs. Signal low = 0; Signal high = 1. Regarding order, see par. 16-60. Bit 0 is at the extreme right. |
| [1661] | Terminal 53 Switch Setting | Setting of input terminal 53. Current = 0; Voltage = 1.   |
| [1662] | Analog Input 53            | Actual value at input 53 either as a reference or protection value.   |
| [1663] | Terminal 54 Switch Setting | Setting of input terminal 54. Current = 0; Voltage = 1.   |
| [1664] | Analog Input 54            | Actual value at input 54 either as reference or protection value.   |
| [1665] | Analog Output 42 [mA]      | Actual value at output 42 in mA. Use par. 6-50 to select the variable to be represented by output 42.                                       |
| [1666] | Digital Output [bin]       | Binary value of all digital outputs.  |
| [1667] | Freq. Input #29 [Hz]       | Actual value of the frequency applied at terminal 29 as a pulse input.  |
| [1668] | Freq. Input #33 [Hz]       | Actual value of the frequency applied at terminal 33 as a pulse input.  |
| [1669] | Pulse Output #27 [Hz]      | Actual value of pulses applied to terminal 27 in digital output mode.   |
| [1670] | Pulse Output #29 [Hz]      | Actual value of pulses applied to terminal 29 in digital output mode.   |
| [1671] | Relay Output [bin]         | View the setting of all relays.   |
| [1672] | Counter A                  | View the present value of Counter A.  |
| [1673] | Counter B                  | View the present value of Counter B.  |
| [1675] | Analog input X30/11        | Actual value of the signal on input X30/11 (General Purpose I/O Card. Option)   |
| [1676] | Analog input X30/12        | Actual value of the signal on input X30/12 (General Purpose I/O Card. Optional)   |
| [1677] | Analog output X30/8 [mA]   | Actual value at output X30/8 (General Purpose I/O Card. Optional) Use Par. 6-60 to select the variable to be shown.                         |
| [1680] | Fieldbus CTW 1             | Control word (CTW) received from the Bus Master.  |
| [1682] | Fieldbus REF 1             | Main reference value sent with control word via the serial communications network e.g. from the BMS, PLC or other master controller.        |
| [1684] | Comm. Option STW           | Extended fieldbus communication option status word.   |
| [1685] | FC Port CTW 1              | Control word (CTW) received from the Bus Master.  |
| [1686] | FC Port REF 1              | Status word (STW) sent to the Bus Master.   |
| [1690] | Alarm Word                 | One or more alarms in a Hex code (used for serial communications)   |
| [1691] | Alarm Word 2               | One or more alarms in a Hex code (used for serial communications)   |
| [1692] | Warning Word               | One or more warnings in a Hex code (used for serial communications)   |
| [1693] | Warning Word 2             | One or more warnings in a Hex code (used for serial communications)   |
| [1694] | Ext. Status Word           | One or more status conditions in a Hex code (used for serial communications)  |
| [1695] | Ext. Status Word 2         | One or more status conditions in a Hex code (used for serial communications)  |
| [1696] | Maintenance Word           | The bits reflect the status for the programmed Preventive Maintenance Events in parameter group 23-1*                                       |
| [1830] | Analog Input X42/1         | Shows the value of the signal applied to terminal X42/1 on the Analog I/O card.   |
| [1831] | Analog Input X42/3         | Shows the value of the signal applied to terminal X42/3 on the Analog I/O card.   |
| [1832] | Analog Input X42/5         | Shows the value of the signal applied to terminal X42/5 on the Analog I/O card.   |
| [1833] | Analog Out X42/7 [V]       | Shows the value of the signal applied to terminal X42/7 on the Analog I/O card.   |
| [1834] | Analog Out X42/9 [V]       | Shows the value of the signal applied to terminal X42/9 on the Analog I/O card.   |
| [1835] | Analog Out X42/11 [V]      | Shows the value of the signal applied to terminal X42/11 on the Analog I/O card.  |
| [2117] | Ext. 1 Reference [Unit]    | The value of the reference for extended Closed Loop Controller 1  |
| [2118] | Ext. 1 Feedback [Unit]     | The value of the feedback signal for extended Closed Loop Controller 1  |
| [2119] | Ext. 1 Output [%]          | The value of the output from extended Closed Loop Controller 1  |
| [2137] | Ext. 2 Reference [Unit]    | The value of the reference for extended Closed Loop Controller 2  |
| [2138] | Ext. 2 Feedback [Unit]     | The value of the feedback signal for extended Closed Loop Controller 2  |
| [2139] | Ext. 2 Output [%]          | The value of the output from extended Closed Loop Controller 2  |

|        |                         |  |
|--------|-------------------------|--|
| [2157] | Ext. 3 Reference [Unit] | The value of the reference for extended Closed Loop Controller 3                               |
| [2158] | Ext. 3 Feedback [Unit]  | The value of the feedback signal for extended Closed Loop Controller 3                         |
| [2159] | Ext. Output [%]         | The value of the output from extended Closed Loop Controller 3                                 |
| [2230] | No-Flow Power           | The calculated No Flow Power for the actual operating speed                                    |
| [2580] | Cascade Status          | Status for the operation of the Cascade Controller   |
| [2581] | Pump Status             | Status for the operation of each individual pump controlled by the Cascade Controller          |
| [2791] | Cascade Reference       | Reference output for use with follower drives.   |
| [2792] | % Of Total Capacity     | Readout parameter to show the system operating point as a % capacity of total system capacity. |
| [2793] | Cascade Option Status   | Readout parameter to show the status of the cascade system.                                    |



**NB!**  
Please consult the VLT® AQUA Drive Programming Guide, MG.20.OX.YY for detailed information.

**0-21 Display Line 1.2 Small**

**Option:** **Function:**  
Select a variable for display in line 1, middle position.

|          |                 |  |
|----------|-----------------|--|
| [1662] * | Analog input 53 | The options are the same as those listed for par. 0-20 <i>Display Line 1.1 Small</i> . |
|----------|-----------------|--|

**0-22 Display Line 1.3 Small**

**Option:** **Function:**  
Select a variable for display in line 1, right position.

|          |               |  |
|----------|---------------|--|
| [1614] * | Motor Current | The options are the same as those listed for par. 0-20 <i>Display Line 1.1 Small</i> . |
|----------|---------------|--|

**0-23 Display Line 2 Large**

**Option:** **Function:**  
Select a variable for display in line 2. The options are the same as those listed for par. 0-20 *Display Line 1.1 Small*.

|          |           |  |
|----------|-----------|--|
| [1615] * | Frequency |  |
|----------|-----------|--|

**0-24 Display Line 3 Large**

**Option:** **Function:**  
Select a variable for display in line 2. The options are the same as those listed for par. 0-20 *Display Line 1.1 Small*.

|          |                 |  |
|----------|-----------------|--|
| [1652] * | Feedback [Unit] |  |
|----------|-----------------|--|

**0-37 Display Text 1**

**Range:** **Function:**  
In this parameter it is possible to write an individual text string for display in the LCP or to be read via serial communication. If to be displayed permanently select Display Text 1 in par. 0-20 *Display Line 1.1 Small*, par. 0-21 *Display Line 1.2 Small*, par. 0-22 *Display Line 1.3 Small*, par. 0-23 *Display Line 2 Large* or par. 0-24 *Display Line 3 Large*. Use the ▲ or ▼ buttons on the LCP to change a character. Use the ◀ and ▶ buttons to move the cursor. When a character is highlighted by the cursor, it can be changed. Use the ▲ or ▼ buttons on the LCP to change a character. A character can be inserted by placing the cursor between two characters and pressing ▲ or ▼.

|        |             |  |
|--------|-------------|--|
| 0 N/A* | [0 - 0 N/A] |  |
|--------|-------------|--|

**0-38 Display Text 2**

**Range:** 0 N/A\* [0 - 0 N/A]

**Function:** In this parameter it is possible to write an individual text string for display in the LCP or to be read via serial communication. If to be displayed permanently select Display Text 2 in par. 0-20 *Display Line 1.1 Small*, par. 0-21 *Display Line 1.2 Small*, par. 0-22 *Display Line 1.3 Small*, par. 0-23 *Display Line 2 Large* or par. 0-24 *Display Line 3 Large*. Use the ▲ or ▼ buttons on the LCP to change a character. Use the ◀ and ▶ buttons to move the cursor. When a character is highlighted by the cursor, this character can be changed. A character can be inserted by placing the cursor between two characters and pressing ▲ or ▼.

**0-39 Display Text 3**


**Range:** 0 N/A\* [0 - 0 N/A]

**Function:** In this parameter it is possible to write an individual text string for display in the LCP or to be read via serial communication. If to be displayed permanently select Display Text 3 in par. 0-20 *Display Line 1.1 Small*, par. 0-21 *Display Line 1.2 Small*, par. 0-22 *Display Line 1.3 Small*, par. 0-23 *Display Line 2 Large* or par. 0-24 *Display Line 3 Large*. Use the ▲ or ▼ buttons on the LCP to change a character. Use the ◀ and ▶ buttons to move the cursor. When a character is highlighted by the cursor, this character can be changed. A character can be inserted by placing the cursor between two characters and pressing ▲ or ▼.

**0-70 Set Date and Time**

**Range:** 2000-01-01 [2000-01-01 00:00]  
00:00 –  
2099-12-01  
23:59 \*

**Function:** Sets the date and time of the internal clock. The format to be used is set in par. 0-71 and 0-72.



**NB!**  
This parameter does not display the actual time. This can be read in par. 0-89. The clock will not begin counting until a setting different from default has been made.

**0-71 Date Format**

|                 |   |
|-----------------|---|
| <b>Option:</b>  | <b>Function:</b>                            |
| [0] * YYY-MM-DD | Sets the date format to be used in the LCP. |
| [1] DD-MM-YYYY  | Sets the date format to be used in the LCP. |
| [2] MM/DD/YYYY  | Sets the date format to be used in the LCP. |

**0-72 Time Format**

|                |   |
|----------------|---|
| <b>Option:</b> | <b>Function:</b>                            |
| [0] * 24 h     | Sets the time format to be used in the LCP. |
| [1] 12 h       |   |

**0-74 DST/Summertime**

|                |  |
|----------------|--|
| <b>Option:</b> | <b>Function:</b>   |
| [0] * Off      | Choose how Daylight Saving Time/Summertime should be handled. For manual DST/Summertime enter the start date and end date in par. 0-76 <i>DST/Summertime Start</i> and par. 0-77 <i>DST/Summertime End</i> . |
| [2] Manual     |  |

**0-76 DST/Summertime Start**

**Range:**

0 N/A\* [0 - 0 N/A]

**Function:**

Sets the date and time when summertime/DST starts. The date is programmed in the format selected in par. 0-71 *Date Format*.

**0-77 DST/Summertime End**

**Range:**

0 N/A\* [0 - 0 N/A]

**Function:**

Sets the date and time when summertime/DST ends. The date is programmed in the format selected in par. 0-71 *Date Format*.

**5.2.3 General Settings, 1-0\***

Define whether the frequency converter operates in open loop or closed loop.

**1-00 Configuration Mode**

**Option:**

[0] \* Open Loop

**Function:**

Motor speed is determined by applying a speed reference or by setting desired speed when in Hand Mode.

Open Loop is also used if the frequency converter is part of a closed loop control system based on an external PID controller providing a speed reference signal as output.

[3] Closed Loop

Motor Speed will be determined by a reference from the built-in PID controller varying the motor speed as part of a closed loop control process (e.g. constant pressure or flow). The PID controller must be configured in par. 20-\*\* or via the Function Setups accessed by pressing the [Quick Menus] button.



**NB!**

This parameter cannot be changed when motor is running.



**NB!**

When set for Closed Loop, the commands Reversing and Start Reversing will not reverse the direction of the motor.

**1-20 Motor Power [kW]**

**Range:**

4.00 kW\* [0.09 - 3000.00 kW]

**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. Depending on the choices made in par. 0-03 *Regional Settings*, either par. 1-20 *Motor Power [kW]* or par. 1-21 *Motor Power [HP]* is made invisible.

**1-22 Motor Voltage**

**Range:**

400. V\* [10. - 1000. V]

**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

| Range:                 | Function:   |
|------------------------|---|
| 50. Hz* [20 - 1000 Hz] | Select the motor frequency value from the motor nameplate data. For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. Adapt par. 4-13 <i>Motor Speed High Limit [RPM]</i> and par. 3-03 <i>Maximum Reference</i> to the 87 Hz application. |



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

### 1-24 Motor Current

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



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

### 1-25 Motor Nominal Speed

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



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

### 1-29 Automatic Motor Adaptation (AMA)

| Option:                 | Function:  |
|-------------------------|--|
| [0] * Off               | No function  |
| [1] Enable complete AMA | The AMA function optimizes dynamic motor performance by automatically optimizing the advanced motor parameters par. 1-30 <i>Stator Resistance (Rs)</i> to par. 1-35 <i>Main Reactance (Xh)</i> while the motor is stationary. performs AMA of the stator resistance $R_s$ , the rotor resistance $R_r$ , the stator leakage reactance $X_{l1}$ , the rotor leakage reactance $X_{l2}$ and the main reactance $X_h$ . |
| [2] Enable reduced AMA  | performs a reduced AMA of the stator resistance $R_s$ in the system only. Select this option if an LC filter is used between the frequency converter and the motor.  |

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.

Note:

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



**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 motor power rating.



**NB!**

Avoid generating external torque during AMA



**NB!**

If one of the settings in par. 1-2\* Motor Data is changed, par. 1-30 *Stator Resistance (Rs)* to par. 1-39 *Motor Poles*, the advanced motor parameters, will return to default setting.

This parameter cannot be adjusted while the motor is running



**NB!**

Full AMA should be run without filter only while reduced AMA should be run with filter.

See section *Automatic Motor Adaptation* - application example.

### 5.2.4 3-0\* Reference Limits

Parameters for setting the reference unit, limits and ranges.

#### 3-02 Minimum Reference

**Range:**

0.000 Ref- [-999999.999 - par. 3-03 ReferenceFeed-ceFeedbackUnit] backUnit\*

**Function:**

Enter the desired minimum value for the remote reference. The Minimum Reference value and unit matches the configuration choice made in par. 1-00 *Configuration Mode* and par. 20-12 *Reference/Feedback Unit*, respectively.



**NB!**

If operating with par. 1-00, Configuration Mode set for Closed Loop [3], par. 20-13, Minimum Reference/Feedb. must be used.

#### 3-03 Maximum Reference

**Range:**

50.000 Ref- [par. 3-02 - 999999.999 ReferenceFeed-ceFeedbackUnit] backUnit\*

**Function:**

Enter the maximum acceptable value for the remote reference. The Maximum Reference value and unit matches the configuration choice made in par. 1-00 *Configuration Mode* and par. 20-12 *Reference/Feedback Unit*, respectively.



**NB!**

If operating with par. 1-00, Configuration Mode set for Closed Loop [3], par. 20-14, Maximum Reference/Feedb. must be used.

5

**3-10 Preset Reference**

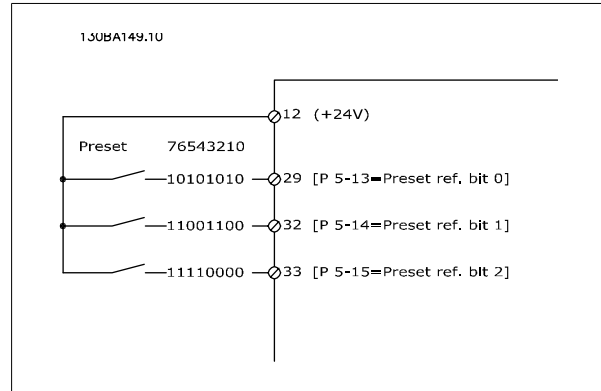
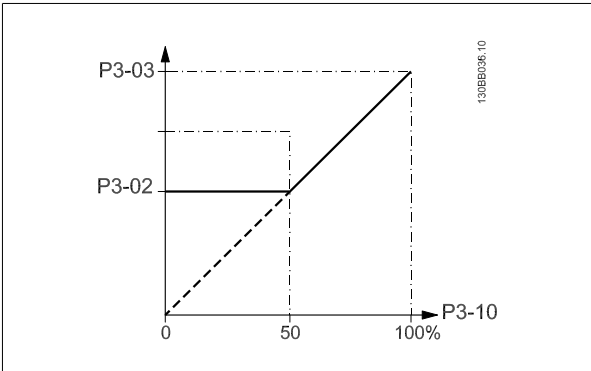
Array [8]

**Range:**

0.00 %\* [-100.00 - 100.00 %]

**Function:**

Enter up to eight different preset references (0-7) in this parameter, using array programming. The preset reference is stated as a percentage of the value Ref<sub>MAX</sub> (par. 3-03 *Maximum Reference*, for closed loop see par. 20-14 *Maximum Reference/Feedb.*). When using preset references, select Preset ref. bit 0 / 1 / 2 [16], [17] or [18] for the corresponding digital inputs in parameter group 5-1\* Digital Inputs.



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

**Range:**

10.00 s\* [1.00 - 3600.00 s]

**Function:**

Enter the ramp-up time, i.e. the acceleration time from 0 RPM to par. 1-25 *Motor Nominal Speed*. Choose a ramp-up time such that the output current does not exceed the current limit in par. 4-18 *Current Limit* during ramping. See ramp-down time in par. 3-42 *Ramp 1 Ramp Down Time*.

$$par.3 - 41 = \frac{tacc \times nnorm [par.1 - 25]}{ref[rpm]} [s]$$

**3-42 Ramp 1 Ramp Down Time**

**Range:**

20.00 s\* [1.00 - 3600.00 s]

**Function:**

Enter the ramp-down time, i.e. the deceleration time from par. 1-25 *Motor Nominal Speed* 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 *Current Limit*. See ramp-up time in par. 3-41 *Ramp 1 Ramp Up Time*.

$$par.3 - 42 = \frac{tdec \times nnorm [par.1 - 25]}{ref[rpm]} [s]$$

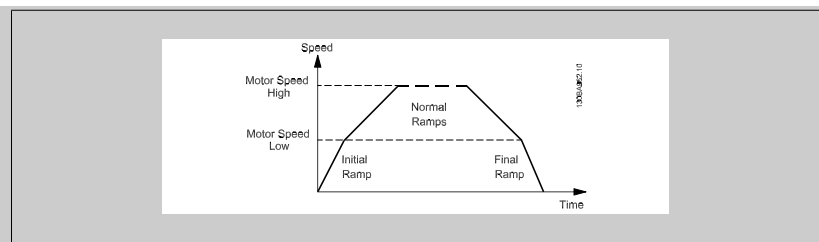
**3-84 Initial Ramp Time**

**Range:**

0 s\* [0 - 60 s]

**Function:**

Enter the initial ramp up time from zero speed to Motor Speed Low Limit, par. 4-11 or 4-12. Submersible deep well pumps can be damaged by running below minimum speed. A fast ramp time below minimum pump speed is recommended. This parameter may be applied as a fast ramp rate from zero speed to Motor Speed Low Limit.





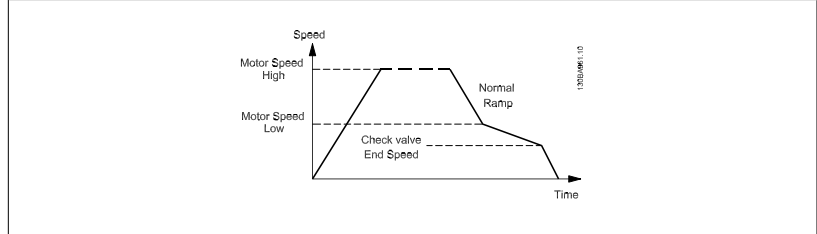
**3-85 Check Valve Ramp Time**

**Range:**

0 s\* [0 – 60 s]

**Function:**

In order to protect ball check valves in a stop situation, the check valve ramp can be utilized as a slow ramp rate from par. 4-11 *Motor Speed Low Limit [RPM]* or par. 4-12 *Motor Speed Low Limit [Hz]*, to Check Valve Ramp End Speed, set by the user in par. 3-86 or par. 3-87. When par. 3-85 is different from 0 seconds, the Check Valve Ramp Time is effectuated and will be used to ramp down the speed from Motor Speed Low Limit to the Check Valve End Speed in par. 3-86 or par. 3-87.



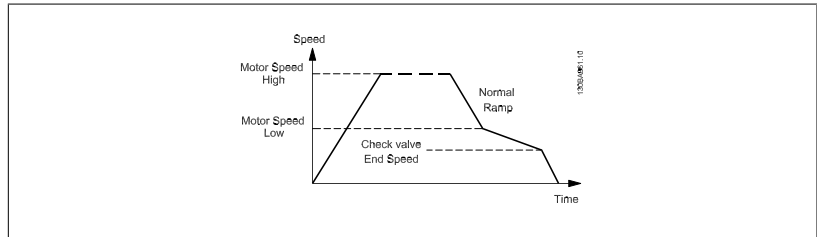
**3-86 Check Valve Ramp End Speed [RPM]**

**Range:**

0 [RPM]\* [0 – Motor Speed Low Limit [RPM]]

**Function:**

Set the speed in [RPM] below Motor Speed Low Limit where the Check Valve is expected to be closed and the Check Valve no longer shall be active.



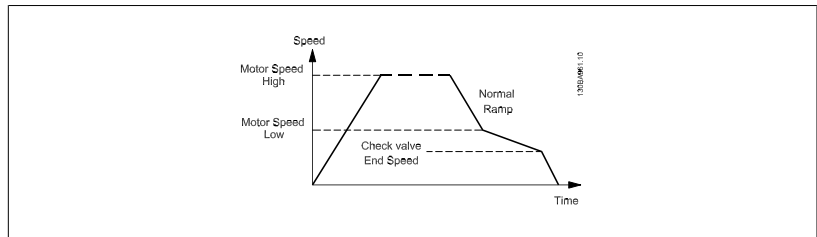
**3-87 Check Valve Ramp End Speed [Hz]**

**Range:**

0 [Hz]\* [0 – Motor Speed Low Limit [Hz]]

**Function:**

Set the speed in [Hz] below Motor Speed Low Limit where the Check Valve Ramp will no longer be active.



**3-88 Final Ramp Time**

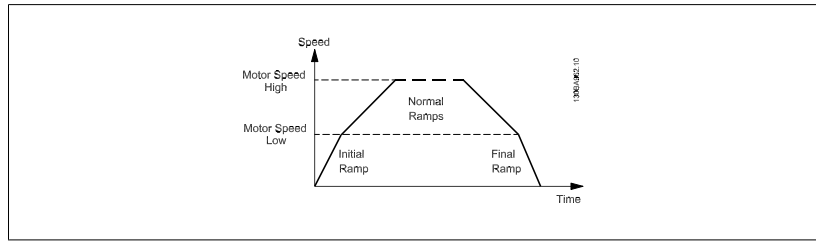
**Range:**

0 [s]\* [0 – 60 [s]]

**Function:**

Enter the Final Ramp Time to be used when ramping down from Motor Speed Low Limit, par. 4-11 or 4-12, to zero speed.

Submersible deep well pumps can be damaged by running below minimum speed. A fast ramp time below minimum pump speed is recommended. This parameter may be applied as a fast ramp rate from Motor Speed Low Limit to zero speed.



### 5.2.5 4-\*\* Limits and Warnings

Parameter group for configuring limits and warnings.

5

#### 4-11 Motor Speed Low Limit [RPM]

**Range:**

0 RPM\* [0 - par. 4-13 RPM]

**Function:**

Enter the minimum limit for motor speed. The Motor Speed Low Limit can be set to correspond to the manufacturer's recommended minimum motor speed. The Motor Speed Low Limit must not exceed the setting in par. 4-13 *Motor Speed High Limit [RPM]*.

#### 4-13 Motor Speed High Limit [RPM]

**Range:**

1500. RPM\* [par. 4-11 - 60000. RPM]

**Function:**

Enter the maximum limit for motor speed. The Motor Speed High Limit can be set to correspond to the manufacturer's maximum rated motor. The Motor Speed High Limit must exceed the setting in par. 4-11 *Motor Speed Low Limit [RPM]*. Only par. 4-11 *Motor Speed Low Limit [RPM]* or par. 4-12 *Motor Speed Low Limit [Hz]* will be displayed depending on other parameters in the Main Menu and depending on default settings dependant on global location.



**NB!**

The output frequency value of the frequency converter must not exceed a value higher than 1/10 of the switching frequency.



**NB!**

Any changes in par. 4-13 *Motor Speed High Limit [RPM]* will reset the value in par. 4-53 *Warning Speed High* to the same value as set in par. 4-13 *Motor Speed High Limit [RPM]*.

### 5.2.6 5-\*\* Digital In/Out

Parameter group for configuring the digital input and output.

#### 5-01 Terminal 27 Mode

**Option:**

[0] \* Input

[1] Output

**Function:**

Defines terminal 27 as a digital input.

Defines terminal 27 as a digital output.

Please not that this parameter cannot be adjusted while the motor is running.

### 5.2.7 5-1\* Digital Inputs

Parameters for configuring the input functions for the input terminals.

The digital inputs are used for selecting various functions in the frequency converter. All digital inputs can be set to the following functions:

| Digital input function  | Select | Terminal         |
|-------------------------|--------|------------------|
| No operation            | [0]    | All *term 32, 33 |
| Reset                   | [1]    | All              |
| Coast inverse           | [2]    | All              |
| Coast and reset inverse | [3]    | All              |
| DC-brake inverse        | [5]    | All              |
| Stop inverse            | [6]    | All              |
| External interlock      | [7]    | All              |
| Start                   | [8]    | All *term 18     |
| Latched start           | [9]    | All              |
| Reversing               | [10]   | All *term 19     |
| Start reversing         | [11]   | All              |
| Jog                     | [14]   | All *term 29     |
| Preset reference on     | [15]   | All              |
| Preset ref bit 0        | [16]   | All              |
| Preset ref bit 1        | [17]   | All              |
| Preset ref bit 2        | [18]   | All              |
| Freeze reference        | [19]   | All              |
| Freeze output           | [20]   | All              |
| Speed up                | [21]   | All              |
| Speed down              | [22]   | All              |
| Set-up select bit 0     | [23]   | All              |
| Set-up select bit 1     | [24]   | All              |
| Pulse input             | [32]   | term 29, 33      |
| Ramp bit 0              | [34]   | All              |
| Mains failure inverse   | [36]   | All              |
| Run Permissive          | [52]   |                  |
| Hand start              | [53]   |                  |
| Auto start              | [54]   |                  |
| DigiPot Increase        | [55]   | All              |
| DigiPot Decrease        | [56]   | All              |
| DigiPot Clear           | [57]   | All              |
| Counter A (up)          | [60]   | 29, 33           |
| Counter A (down)        | [61]   | 29, 33           |
| Reset Counter A         | [62]   | All              |
| Counter B (up)          | [63]   | 29, 33           |
| Counter B (down)        | [64]   | 29, 33           |
| Reset Counter B         | [65]   | All              |
| Sleep Mode              | [66]   |                  |
| Reset Maintenance Word  | [78]   |                  |
| Lead Pump Start         | [120]  |                  |
| Lead Pump Alternation   | [121]  |                  |
| Pump 1 Interlock        | [130]  |                  |
| Pump 2 Interlock        | [131]  |                  |
| Pump 3 Interlock        | [132]  |                  |

All = Terminals 18, 19, 27, 29, 32, X30/2, X30/3, X30/4. X30/ are the terminals on MCB 101.

Functions dedicated to only one digital input are stated in the associated parameter.

All digital inputs can be programmed to these functions:

|     |                         |   |
|-----|-------------------------|---|
| [0] | No operation            | No reaction to signals transmitted to terminal.   |
| [1] | Reset                   | Resets frequency converter after a TRIP/ALARM. Not all alarms can be reset.   |
| [2] | Coast inverse           | Leaves motor in free mode. Logic '0' => coasting stop.<br>(Default Digital input 27): Coasting stop, inverted input (NC).   |
| [3] | Coast and reset inverse | Reset and coasting stop Inverted input (NC).<br>Leaves motor in free mode and resets the frequency converter. Logic '0' => coasting stop and reset.   |
| [5] | DC-brake inverse        | Inverted input for DC braking (NC).<br>Stops motor by energizing it with a DC current for a certain time period. See par. 2-01 to par. 2-03.<br>The function is only active when the value in par. 2-02 is different from 0. Logic '0' => DC braking. |
| [6] | Stop inverse            | Stop Inverted function. Generates a stop function when the selected terminal goes from logical level '1' to '0'. The stop is performed according to the selected ramp time (par. 3-42 and par. 3-52).   |



**NB!**

When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *Torque limit & stop* [27] and connect this digital output to a digital input that is configured as coast.

5

|      |                     |  |
|------|---------------------|--|
| [7]  | External Interlock  | Same function as Coasting stop, inverse, but External Interlock generates the alarm message 'external fault' on the display when the terminal which is programmed for Coast Inverse is logic '0'. The alarm message will also be active via digital outputs and relay outputs, if programmed for External Interlock. The alarm can be reset using a digital input or the [RESET] key if the cause for the External Interlock has been removed. A delay can be programmed in par. 22-00, External Interlock Time. After applying a signal to the input, the reaction described above will be delayed with the time set in par. 22-00. |
| [8]  | Start               | Select start for a start/stop command. Logic '1' = start, logic '0' = stop.<br>(Default Digital input 18)  |
| [9]  | Latched start       | Motor starts, if a pulse is applied for min. 2 ms. Motor stops when Stop inverse is activated  |
| [10] | Reversing           | Changes direction of motor shaft rotation. Select Logic '1' to reverse. The reversing signal only changes the direction of rotation. It does not activate the start function. Select both directions in par. 4-10 <i>Motor Speed Direction</i> .<br>(Default Digital input 19).  |
| [11] | Start reversing     | Used for start/stop and for reversing on the same wire. Signals on start are not allowed at the same time.   |
| [14] | Jog                 | Used for activating jog speed. See par. 3-11.<br>(Default Digital input 29)  |
| [15] | Preset reference on | Used for shifting between external reference and preset reference. It is assumed that <i>External/preset</i> [1] has been selected in par. 3-04. Logic '0' = external reference active; logic '1' = one of the eight preset references is active.  |
| [16] | Preset ref bit 0    | Enables a choice between one of the eight preset references according to the table below.  |
| [17] | Preset ref bit 1    | Enables a choice between one of the eight preset references according to the table below.  |
| [18] | Preset ref bit 2    | Enables a choice between one of the eight preset references according to the table below.  |

| Preset ref. bit | 2 | 1 | 0 |
|-----------------|---|---|---|
| Preset ref. 0   | 0 | 0 | 0 |
| Preset ref. 1   | 0 | 0 | 1 |
| Preset ref. 2   | 0 | 1 | 0 |
| Preset ref. 3   | 0 | 1 | 1 |
| Preset ref. 4   | 1 | 0 | 0 |
| Preset ref. 5   | 1 | 0 | 1 |
| Preset ref. 6   | 1 | 1 | 0 |
| Preset ref. 7   | 1 | 1 | 1 |

|      |               |  |
|------|---------------|--|
| [19] | Freeze ref    | Freezes actual reference. The frozen reference is now the point of enable/condition for Speed up and Speed down to be used. If Speed up/down is used, the speed change always follows ramp 2 (par. 3-51 and 3-52) in the range 0 - par. 3-03 <i>Maximum Reference</i> .                |
| [20] | Freeze output | Freezes actual motor frequency (Hz). The frozen motor frequency is now the point of enable/condition for Speed up and Speed down to be used. If Speed up/down is used, the speed change always follows ramp 2 (par. 3-51 and 3-52) in the range 0 - par. 1-23 <i>Motor Frequency</i> . |



**NB!**

When Freeze output is active, the frequency converter cannot be stopped via a low 'start [13]' signal. Stop the frequency converter via a terminal programmed for Coasting inverse [2] or Coast and reset, inverse [3].

|      |            |  |
|------|------------|--|
| [21] | Speed up   | For digital control of the up/down speed is desired (motor potentiometer). Activate this function by selecting either Freeze reference or Freeze output. When Speed up is activated for less than 400 msec. the resulting reference will be increased by 0.1 %. If Speed up is activated for more than 400 msec. the resulting reference will ramp according to Ramp 1 in par. 3-41. |
| [22] | Speed down | Same as Speed up [21].   |

|      |                                   |   |
|------|-----------------------------------|---|
| [23] | Set-up select bit 0               | Selects one of the four set-ups. Set par. 0-10 <i>Active Set-up</i> to Multi Set-up.  |
| [24] | Set-up select bit 1               | Same as Set-up select bit 0 [23].<br>(Default Digital input 32)   |
| [32] | Pulse input                       | Select Pulse input when using a pulse sequence as either reference or feedback. Scaling is done in par. group 5-5*.   |
| [34] | Ramp bit 0                        | Select which ramp to use. Logic "0" will select ramp 1 while logic "1" will select ramp 2.  |
| [36] | Mains failure inverse             | Activates par. 14-10 <i>Mains Failure</i> . Mains failure inverse is active in the Logic "0" situation.   |
| [52] | Run Permissive                    | The input terminal, for which the Run permissive has been programmed must be logic "1" before a start command can be accepted. Run permissive has a logic 'AND' function related to the terminal which is programmed for <i>START</i> [8], <i>Jog</i> [14] or <i>Freeze Output</i> [20], which means that in order to start running the motor, both conditions must be fulfilled. If Run Permissive is programmed on multiple terminals, Run permissive needs only be logic '1' on one of the terminals for the function to be carried out. The digital output signal for Run Request ( <i>Start</i> [8], <i>Jog</i> [14] or <i>Freeze output</i> [20]) programmed in par. 5-3* Digital outputs, or par. 5-4* Relays, will not be affected by Run Permissive.   |
| [53] | Hand start                        | A signal applied will put the frequency converter into Hand mode as if button <i>Hand On</i> on the LCP has been pressed and a normal stop command will be overridden. If disconnecting the signal, the motor will stop. To make any other start commands valid, another digital input must be assign to <i>Auto Start</i> and a signal applied to this. The <i>Hand On</i> and <i>Auto On</i> buttons on the LCP has no impact. The <i>Off</i> button on the LCP will override <i>Hand Start</i> and <i>Auto Start</i> . Press either the <i>Hand On</i> or <i>Auto On</i> button to make <i>Hand Start</i> and <i>Auto Start</i> active again. If no signal on neither <i>Hand Start</i> nor <i>Auto Start</i> , the motor will stop regardless of any normal Start command applied. If signal applied to both <i>Hand Start</i> and <i>Auto Start</i> , the function will be <i>Auto Start</i> . If pressing the <i>Off</i> button on the LCP the motor will stop regardless of signals on <i>Hand Start</i> and <i>Auto Start</i> . |
| [54] | Auto start                        | A signal applied will put the frequency converter into Auto mode as if the LCP button <i>Auto On</i> has been pressed. See also <i>Hand Start</i> [53]  |
| [55] | DigiPot Increase                  | Uses the input as an INCREASE signal to the Digital Potentiometer function described in parameter group 3-9*  |
| [56] | DigiPot Decrease                  | Uses the input as a DECREASE signal to the Digital Potentiometer function described in parameter group 3-9*   |
| [57] | DigiPot Clear                     | Uses the input to CLEAR the Digital Potentiometer reference described in parameter group 3-9*   |
| [60] | Counter A (up)                    | (Terminal 29 or 33 only) Input for increment counting in the SLC counter.   |
| [61] | Counter A (down)                  | (Terminal 29 or 33 only) Input for decrement counting in the SLC counter.   |
| [62] | Reset Counter A                   | Input for reset of counter A.   |
| [63] | Counter B (up)                    | (Terminal 29 and 33 only) Input for increment counting in the SLC counter.  |
| [64] | Counter B (down)                  | (Terminal 29 and 33 only) Input for decrement counting in the SLC counter.  |
| [65] | Reset Counter B                   | Input for reset of counter B.   |
| [66] | Sleep Mode                        | Forces frequency converter into Sleep Mode (see par. 22-4*, Sleep Mode). Reacts on the rising edge of signal applied!   |
| [78] | Reset Preventive Maintenance Word | Resets all data in par. 16-96, Preventive Maintenance Word, to 0.   |

The below setting options are all related to the Cascade Controller. Wiring diagrams and settings for parameter, see group 25-\*\* for more details.

|             |                                   |  |
|-------------|-----------------------------------|--|
| [120]       | Lead Pump Start                   | Starts/Stops the Lead Pump (controlled by the frequency converter). A start requires that also a System Start signal has been applied e.g. to one of the digital inputs set for <i>Start</i> [8]!  |
| [121]       | Lead Pump Alternation             | Forces alternation of the lead pump in a Cascade Controller. <i>Lead Pump Alternation</i> , par. 25-50, must be set to either <i>At Command</i> [2] or <i>At Staging or At Command</i> [3]. <i>Alternation Event</i> , par. 25-51, can be set to any of the four options.  |
| [130 - 138] | Pump1 Interlock - Pump9 Interlock | For the above 9 setting options, par. 25-10, Pump Interlock, must be set to <i>On</i> [1]. The function will also depend on the setting in par. 25-06, Fixed Lead Pump. If set to <i>No</i> [0], then Pump1 refers to the pump controlled by relay RELAY1 etc. If set to <i>Yes</i> [1], Pump1 refers to the pump controlled by the frequency converter only (without any of the build in relays involved) and Pump2 to the pump |

controlled by the relay RELAY1. Variable speed pump (lead) cannot be interlocked in the basic Cascade Controller.

See below table:

| Setting in Par. 5-1*  | Setting in Par. 25-06                        |  |
|-----------------------|--|--|
|                       | [0] No                                       | [1] Yes  |
| [130] Pump1 Interlock | Controlled by RELAY1 (only if not lead pump) | Frequency Converter controlled (cannot be interlocked) |
| [131] Pump2 Interlock | Controlled by RELAY2                         | Controlled by RELAY1                                   |
| [132] Pump3 Interlock | Controlled by RELAY3                         | Controlled by RELAY2                                   |
| [133] Pump4 Interlock | Controlled by RELAY4                         | Controlled by RELAY3                                   |
| [134] Pump5 Interlock | Controlled by RELAY5                         | Controlled by RELAY4                                   |
| [135] Pump6 Interlock | Controlled by RELAY6                         | Controlled by RELAY5                                   |
| [136] Pump7 Interlock | Controlled by RELAY7                         | Controlled by RELAY6                                   |
| [137] Pump8 Interlock | Controlled by RELAY8                         | Controlled by RELAY7                                   |
| [138] Pump9 Interlock | Controlled by RELAY9                         | Controlled by RELAY8                                   |

**5-13 Terminal 29 Digital Input**

**Option:**

[0] \* No Operation

**Function:**

Same options and functions as par. 5-1\* *Digital Inputs*.

**5-14 Terminal 32 Digital Input**

**Option:**

[0] \* No operation

**Function:**

Same options and functions as par. 5-1\*, except for *Pulse input*.

[1] Reset

[2] Coast inverse

[3] Coast and reset inv

[5] DC-brake inverse

[6] Stop inverse

[7] External interlock

[8] Start

[9] Latched start

[10] Reversing

[11] Start reversing

[14] Jog

[15] Preset reference on

[16] Preset ref bit 0

[17] Preset ref bit 1

[18] Preset ref bit 2

[19] Freeze reference

[20] Freeze output

[21] Speed up

[22] Speed down

[23] Set-up select bit 0

[24] Set-up select bit 1

[34] Ramp bit 0

[36] Mains failure inverse

[37] Fire Mode

[52] Run permissive

- [53] Hand start
- [54] Auto start
- [55] DigiPot increase
- [56] DigiPot decrease
- [57] DigiPot clear
- [62] Reset Counter A
- [65] Reset Counter B
- [66] Sleep Mode
- [78] Reset Maint. Word
- [120] Lead Pump Start
- [121] Lead Pump Alternation
- [130] Pump 1 Interlock
- [131] Pump 2 Interlock
- [132] Pump 3 Interlock

**5-15 Terminal 33 Digital Input**

**Option:**

**Function:**

- |       |                       |   |
|-------|-----------------------|---|
| [0] * | No operation          | Same options and functions as par. 5-1* Digital Inputs. |
| [1]   | Reset                 |   |
| [2]   | Coast inverse         |   |
| [3]   | Coast and reset inv   |   |
| [5]   | DC-brake inverse      |   |
| [6]   | Stop inverse          |   |
| [7]   | External interlock    |   |
| [8]   | Start                 |   |
| [9]   | Latched start         |   |
| [10]  | Reversing             |   |
| [11]  | Start reversing       |   |
| [14]  | Jog                   |   |
| [15]  | Preset reference on   |   |
| [16]  | Preset ref bit 0      |   |
| [17]  | Preset ref bit 1      |   |
| [18]  | Preset ref bit 2      |   |
| [19]  | Freeze reference      |   |
| [20]  | Freeze output         |   |
| [21]  | Speed up              |   |
| [22]  | Speed down            |   |
| [23]  | Set-up select bit 0   |   |
| [24]  | Set-up select bit 1   |   |
| [30]  | Counter input         |   |
| [32]  | Pulse input           |   |
| [34]  | Ramp bit 0            |   |
| [36]  | Mains failure inverse |   |
| [37]  | Fire Mode             |   |
| [52]  | Run permissive        |   |
| [53]  | Hand start            |   |
| [54]  | Auto start            |   |

|       |                       |
|-------|-----------------------|
| [55]  | DigiPot increase      |
| [56]  | DigiPot decrease      |
| [57]  | DigiPot clear         |
| [60]  | Counter A (up)        |
| [61]  | Counter A (down)      |
| [62]  | Reset Counter A       |
| [63]  | Counter B (up)        |
| [64]  | Counter B (down)      |
| [65]  | Reset Counter B       |
| [66]  | Sleep Mode            |
| [78]  | Reset Maint. Word     |
| [120] | Lead Pump Start       |
| [121] | Lead Pump Alternation |
| [130] | Pump 1 Interlock      |
| [131] | Pump 2 Interlock      |
| [132] | Pump 3 Interlock      |

**5-30 Terminal 27 Digital Output**

| <b>Option:</b> | <b>Function:</b>   |
|----------------|--|
| [0] *          | No operation<br>Same options and functions as par. 5-3*. |
| [1]            | Control ready  |
| [2]            | Drive ready  |
| [3]            | Drive rdy/rem ctrl                                       |
| [4]            | Standby / no warning                                     |
| [5]            | Running  |
| [6]            | Running / no warning                                     |
| [8]            | Run on ref/no warn                                       |
| [9]            | Alarm  |
| [10]           | Alarm or warning   |
| [11]           | At torque limit  |
| [12]           | Out of current range                                     |
| [13]           | Below current, low                                       |
| [14]           | Above current, high                                      |
| [15]           | Out of speed range                                       |
| [16]           | Below speed, low   |
| [17]           | Above speed, high  |
| [18]           | Out of feedb. range                                      |
| [19]           | Below feedback, low                                      |
| [20]           | Above feedback, high                                     |
| [21]           | Thermal warning  |
| [25]           | Reverse  |
| [26]           | Bus OK   |
| [27]           | Torque limit & stop                                      |
| [28]           | Brake, no brake war                                      |
| [29]           | Brake ready, no fault                                    |
| [30]           | Brake fault (IGBT)                                       |
| [35]           | External Interlock                                       |



|       |                        |
|-------|------------------------|
| [40]  | Out of ref range       |
| [41]  | Below reference, low   |
| [42]  | Above ref, high        |
| [45]  | Bus ctrl.              |
| [46]  | Bus ctrl, 1 if timeout |
| [47]  | Bus ctrl, 0 if timeout |
| [55]  | Pulse output           |
| [60]  | Comparator 0           |
| [61]  | Comparator 1           |
| [62]  | Comparator 2           |
| [63]  | Comparator 3           |
| [64]  | Comparator 4           |
| [65]  | Comparator 5           |
| [70]  | Logic rule 0           |
| [71]  | Logic rule 1           |
| [72]  | Logic rule 2           |
| [73]  | Logic rule 3           |
| [74]  | Logic rule 4           |
| [75]  | Logic rule 5           |
| [80]  | SL digital output A    |
| [81]  | SL digital output B    |
| [82]  | SL digital output C    |
| [83]  | SL digital output D    |
| [84]  | SL digital output E    |
| [85]  | SL digital output F    |
| [160] | No alarm               |
| [161] | Running reverse        |
| [165] | Local ref active       |
| [166] | Remote ref active      |
| [167] | Start command act.     |
| [168] | Hand mode              |
| [169] | Auto mode              |
| [180] | Clock Fault            |
| [181] | Prev. Maintenance      |
| [190] | No-Flow                |
| [191] | Dry Pump               |
| [192] | End Of Curve           |
| [193] | Sleep Mode             |
| [194] | Broken Belt            |
| [195] | Bypass Valve Control   |
| [196] | Fire Mode              |
| [197] | Fire Mode was Act.     |
| [198] | Drive Bypass           |
| [200] | Full capacity          |
| [201] | Pump 1 running         |
| [202] | Pump 2 running         |
| [203] | Pump 3 running         |

## 5-40 Function Relay

Array [8]

(Relay 1 [0], Relay 2 [1], Relay 7 [6], Relay 8 [7], Relay 9 [8])

Select options to define the function of the relays.

The selection of each mechanical relay is realised in an array parameter.

5

|       |                        |
|-------|------------------------|
| [0]   | No Operation           |
| [1]   | Control Ready          |
| [2]   | Drive Ready            |
| [3]   | Drive Ready/Remote     |
| [4]   | Stand-by/No Warning    |
| [5] * | Running                |
| [6]   | Running/No Warning     |
| [8]   | Run on Ref./No Warning |
| [9]   | Alarm                  |
| [10]  | Alarm or Warning       |
| [11]  | At Torque Limit        |
| [12]  | Out of Current Range   |
| [13]  | Below Current, low     |
| [14]  | Above Current, high    |
| [15]  | Out of Speed Range     |
| [16]  | Below Speed, low       |
| [17]  | Above Speed, high      |
| [18]  | Out of Feedb. Range    |
| [19]  | Below Feedback, low    |
| [20]  | Above Feedback, high   |
| [21]  | Thermal Warning        |
| [25]  | Reverse                |
| [26]  | Bus OK                 |
| [27]  | Torque Limit & Stop    |
| [28]  | Brake, No Warning      |
| [29]  | Brake Ready, No Fault  |
| [30]  | Brake Fault (IGBT)     |
| [35]  | External Interlock     |
| [36]  | Control Word Bit 11    |
| [37]  | Control Word Bit 12    |
| [40]  | Out of Ref. Range      |
| [41]  | Below Reference, low   |
| [42]  | Above Ref. high        |
| [45]  | Bus ctrl               |
| [46]  | Bus ctrl, 1 if timeout |
| [47]  | Bus ctrl, 0 if timeout |
| [60]  | Comparator 0           |
| [61]  | Comparator 1           |
| [62]  | Comparator 2           |
| [63]  | Comparator 3           |
| [64]  | Comparator 4           |

|       |                      |
|-------|----------------------|
| [65]  | Comparator 5         |
| [70]  | Logic Rule 0         |
| [71]  | Logic Rule 1         |
| [72]  | Logic Rule 2         |
| [73]  | Logic Rule 3         |
| [74]  | Logic Rule 4         |
| [75]  | Logic Rule 5         |
| [80]  | SL Digital Output A  |
| [81]  | SL Digital Output B  |
| [82]  | SL Digital Output C  |
| [83]  | SL Digital Output D  |
| [84]  | SL Digital Output E  |
| [85]  | SL Digital Output F  |
| [160] | No Alarm             |
| [161] | Running Reverse      |
| [165] | Local Ref. Active    |
| [166] | Remote Ref. Active   |
| [167] | Start Cmd. Active    |
| [168] | Drive in Hand Mode   |
| [169] | Drive in Auto Mode   |
| [180] | Clock Fault          |
| [181] | Prev. Maintenance    |
| [190] | No-Flow              |
| [191] | Dry Pump             |
| [192] | End of Curve         |
| [193] | Sleep Mode           |
| [194] | Broken Belt          |
| [195] | Bypass Valve Control |
| [199] | Pipe Filling         |
| [211] | Cascade Pump1        |
| [212] | Cascade Pump2        |
| [213] | Cascade Pump3        |
| [223] | Alarm, Trip Locked   |
| [224] | Bypass Mode Active   |

**5-53 Term. 29 High Ref./Feedb. Value**

|   |  |
|---|--|
| <b>Range:</b>                                   | <b>Function:</b>   |
| 100.000 N/ [-999999.999 - 999999.999 N/A]<br>A* | Enter the high reference value [RPM] for the motor shaft speed and the high feedback value, see also par. 5-58 <i>Term. 33 High Ref./Feedb. Value.</i> |

**5.2.8 6-\*\* Analog In/Out**

Parameter group for configuration of the analog input and output.

**6-00 Live Zero Timeout Time**

**Range:**

10 s\* [1 - 99 s]

**Function:**

Enter the Live Zero Time-out time period. Live Zero Time-out Time is active for analog inputs, i.e. terminal 53 or terminal 54, used as reference or feedback sources. If the reference signal value associated with the selected current input falls below 50% of the value set in par. 6-10 *Terminal 53 Low Voltage*, par. 6-12 *Terminal 53 Low Current*, par. 6-20 *Terminal 54 Low Voltage* or par. 6-22 *Terminal 54 Low Current* for a time period longer than the time set in par. 6-00 *Live Zero Timeout Time*, the function selected in par. 6-01 *Live Zero Timeout Function* will be activated.

**6-01 Live Zero Timeout Function**

**Option:**

**Function:**

Select the time-out function. The function set in par. 6-01 *Live Zero Timeout Function* will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 *Terminal 53 Low Voltage*, par. 6-12 *Terminal 53 Low Current*, par. 6-20 *Terminal 54 Low Voltage* or par. 6-22 *Terminal 54 Low Current* for a time period defined in par. 6-00 *Live Zero Timeout Time*. If several time-outs occur simultaneously, the frequency converter prioritises the time-out functions as follows:

1. par. 6-01 *Live Zero Timeout Function*
2. par. 8-04 *Control Timeout Function*

The output frequency of the frequency converter can be:

- [1] frozen at the present value
- [2] overruled to stop
- [3] overruled to jog speed
- [4] overruled to max. speed
- [5] overruled to stop with subsequent trip

[0] \* Off

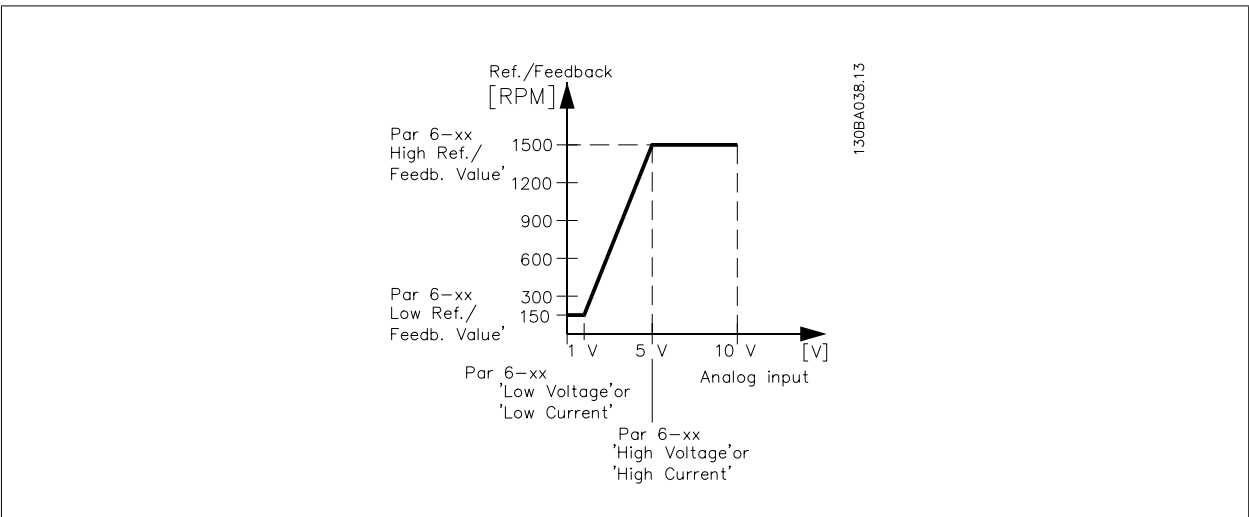
[1] Freeze output

[2] Stop

[3] Jogging

[4] Max. speed

[5] Stop and trip



| 6-10 Terminal 53 Low Voltage                |                    |   |
|---|--------------------|---|
| <b>Range:</b>                               |                    | <b>Function:</b>  |
| 0.07 V* [0.00 - par. 6-11 V]                |                    | Enter the low voltage value. This analog input scaling value should correspond to the low reference/feedback value set in par. 6-14 <i>Terminal 53 Low Ref./Feedb. Value</i> .                |
| 6-11 Terminal 53 High Voltage               |                    |   |
| <b>Range:</b>                               |                    | <b>Function:</b>  |
| 10.00 V* [par. 6-10 - 10.00 V]              |                    | Enter the high voltage value. This analog input scaling value should correspond to the high reference/feedback value set in par. 6-15 <i>Terminal 53 High Ref./Feedb. Value</i> .             |
| 6-14 Terminal 53 Low Ref./Feedb. Value      |                    |   |
| <b>Range:</b>                               |                    | <b>Function:</b>  |
| 0.000 N/A* [-999999.999 - 999999.999 N/A]   |                    | Enter the analog input scaling value that corresponds to the low voltage/low current set in par. 6-10 <i>Terminal 53 Low Voltage</i> and par. 6-12 <i>Terminal 53 Low Current</i> .           |
| 6-15 Terminal 53 High Ref./Feedb. Value     |                    |   |
| <b>Range:</b>                               |                    | <b>Function:</b>  |
| 50.000 N/A* [-999999.999 - 999999.999 N/A]  |                    | Enter the analog input scaling value that corresponds to the high voltage/high current value set in par. 6-11 <i>Terminal 53 High Voltage</i> and par. 6-13 <i>Terminal 53 High Current</i> . |
| 6-20 Terminal 54 Low Voltage                |                    |   |
| <b>Range:</b>                               |                    | <b>Function:</b>  |
| 0.07 V* [0.00 - par. 6-21 V]                |                    | Enter the low voltage value. This analog input scaling value should correspond to the low reference/feedback value, set in par. 6-24 <i>Terminal 54 Low Ref./Feedb. Value</i> .               |
| 6-21 Terminal 54 High Voltage               |                    |   |
| <b>Range:</b>                               |                    | <b>Function:</b>  |
| 10.00 V* [par. 6-20 - 10.00 V]              |                    | Enter the high voltage value. This analog input scaling value should correspond to the high reference/feedback value set in par. 6-25 <i>Terminal 54 High Ref./Feedb. Value</i> .             |
| 6-24 Terminal 54 Low Ref./Feedb. Value      |                    |   |
| <b>Range:</b>                               |                    | <b>Function:</b>  |
| 0.000 N/A* [-999999.999 - 999999.999 N/A]   |                    | Enter the analog input scaling value that corresponds to the low voltage/low current value set in par. 6-20 <i>Terminal 54 Low Voltage</i> and par. 6-22 <i>Terminal 54 Low Current</i> .     |
| 6-25 Terminal 54 High Ref./Feedb. Value     |                    |   |
| <b>Range:</b>                               |                    | <b>Function:</b>  |
| 100.000 N/A* [-999999.999 - 999999.999 N/A] |                    | Enter the analog input scaling value that corresponds to the high voltage/high current value set in par. 6-21 <i>Terminal 54 High Voltage</i> and par. 6-23 <i>Terminal 54 High Current</i> . |
| 6-50 Terminal 42 Output                     |                    |   |
| <b>Option:</b>                              |                    | <b>Function:</b>  |
|   |                    | Select the function of Terminal 42 as an analog current output. A motor current of 20 mA corresponds to $I_{max}$ .   |
| [0] *                                       | No operation       |   |
| [100]                                       | Output freq. 0-100 | : 0 - 100 Hz, (0-20 mA)   |
| [101]                                       | Reference Min-Max  | : Minimum reference - Maximum reference, (0-20 mA)  |
| [102]                                       | Feedback +-200%    | : -200% to +200% of par. 20-14, (0-20 mA)   |
| [103]                                       | Motor cur. 0-Imax  | : 0 - Inverter Max. Current (par. 16-37), (0-20 mA)   |
| [104]                                       | Torque 0-Tlim      | : 0 - Torque limit (par. 4-16), (0-20 mA)   |

|       |                      |  |
|-------|----------------------|--|
| [105] | Torque 0-Tnom        | : 0 - Motor rated torque, (0-20 mA)                                |
| [106] | Power 0-Pnom         | : 0 - Motor rated power, (0-20 mA)                                 |
| [107] | Speed 0-HighLim      | : 0 - Speed High Limit (par. 4-13 and par. 4-14), (0-20 mA)        |
| [113] | Ext. Closed Loop 1   | : 0 - 100%, (0-20 mA)  |
| [114] | Ext. Closed Loop 2   | : 0 - 100%, (0-20 mA)  |
| [115] | Ext. Closed Loop 3   | : 0 - 100%, (0-20 mA)  |
| [130] | Out frq 0-100 4-20mA | : 0 - 100 Hz   |
| [131] | Reference 4-20mA     | : Minimum Reference - Maximum Reference                            |
| [132] | Feedback 4-20mA      | : -200% to +200% of par. 20-14                                     |
| [133] | Motor cur. 4-20mA    | : 0 - Inverter Max. Current (par. 16-37 <i>Inv. Max. Current</i> ) |
| [134] | Torq.0-lim 4-20 mA   | : 0 - Torque limit (par. 4-16)                                     |
| [135] | Torq.0-nom 4-20mA    | : 0 - Motor rated torque   |
| [136] | Power 4-20mA         | : 0 - Motor rated power  |
| [137] | Speed 4-20mA         | : 0 - Speed High Limit (par. 4-13 and par. 4-14)                   |
| [139] | Bus ctrl.            | : 0 - 100%, (0-20 mA)  |
| [140] | Bus ctrl. 4-20 mA    | : 0 - 100%   |
| [141] | Bus ctrl t.o.        | : 0 - 100%, (0-20 mA)  |
| [142] | Bus ctrl t.o. 4-20mA | : 0 - 100%   |
| [143] | Ext. CL 1 4-20mA     | : 0 - 100%   |
| [144] | Ext. CL 2 4-20mA     | : 0 - 100%   |
| [145] | Ext. CL 3 4-20mA     | : 0 - 100%   |

**NB!**

Values for setting the Minimum Reference is found in open loop par. 3-02 *Minimum Reference* and for closed loop par. 20-13 *Minimum Reference/Feedb.* - values for maximum reference for open loop is found in par. 3-03 *Maximum Reference* and for closed loop par. 20-14 *Maximum Reference/Feedb.*

**6-51 Terminal 42 Output Min Scale**

**Range:**

0.00 %\* [0.00 - 200.00 %]

**Function:**

Scale for the minimum output (0 or 4 mA) of the analogue signal at terminal 42. Set the value to be the **percentage** of the full range of the variable selected in par. 6-50 *Terminal 42 Output*.

**6-52 Terminal 42 Output Max Scale**

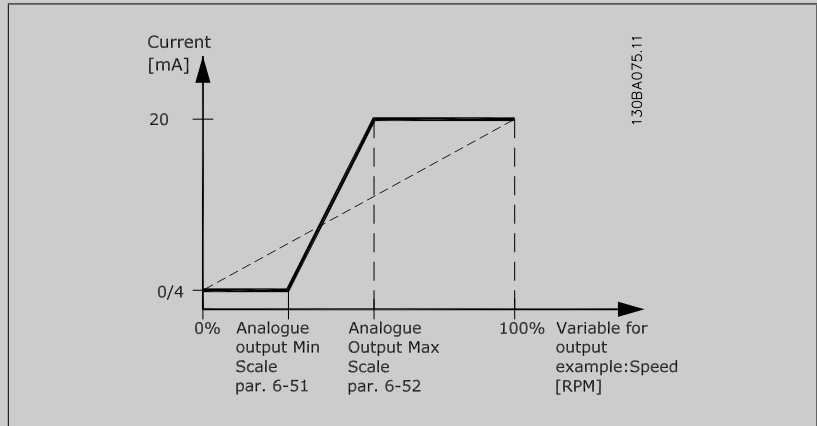
**Range:**

100.00 %\* [0.00 - 200.00 %]

**Function:**

Scale for the maximum output (20 mA) of the analog signal at terminal 42.

Set the value to be the percentage of the full range of the variable selected in par. 6-50 *Terminal 42 Output*.



It is possible to get a value lower than 20 mA at full scale by programming values >100% by using a formula as follows:

$$20 \text{ mA} / \text{desired maximum current} \times 100 \%$$

$$\text{i.e. } 10 \text{ mA} : \frac{20 \text{ mA}}{10 \text{ mA}} \times 100 \% = 200 \%$$

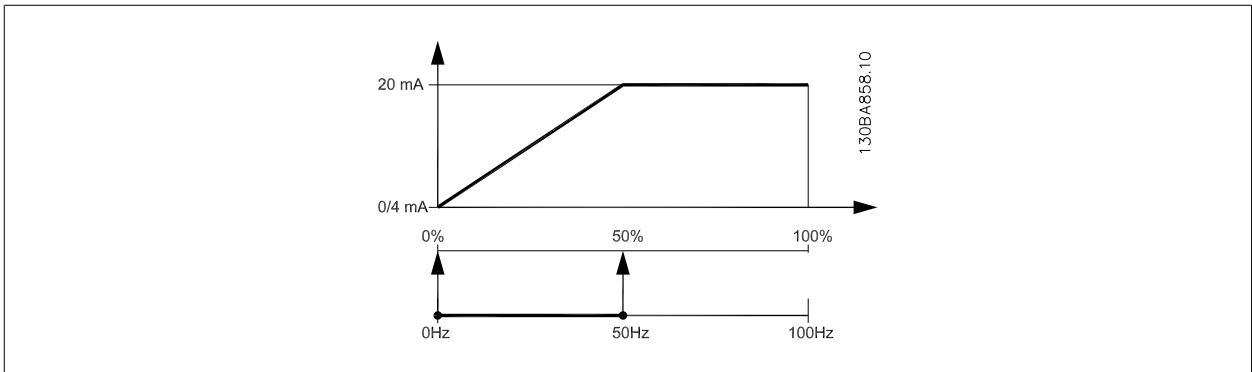
**EXAMPLE 1:**

Variable value= OUTPUT FREQUENCY, range = 0-100 Hz

Range needed for output = 0-50 Hz

Output signal 0 or 4 mA is needed at 0 Hz (0% of range) - set par. 6-51 *Terminal 42 Output Min Scale* to 0%

Output signal 20 mA is needed at 50 Hz (50% of range) - set par. 6-52 *Terminal 42 Output Max Scale* to 50%



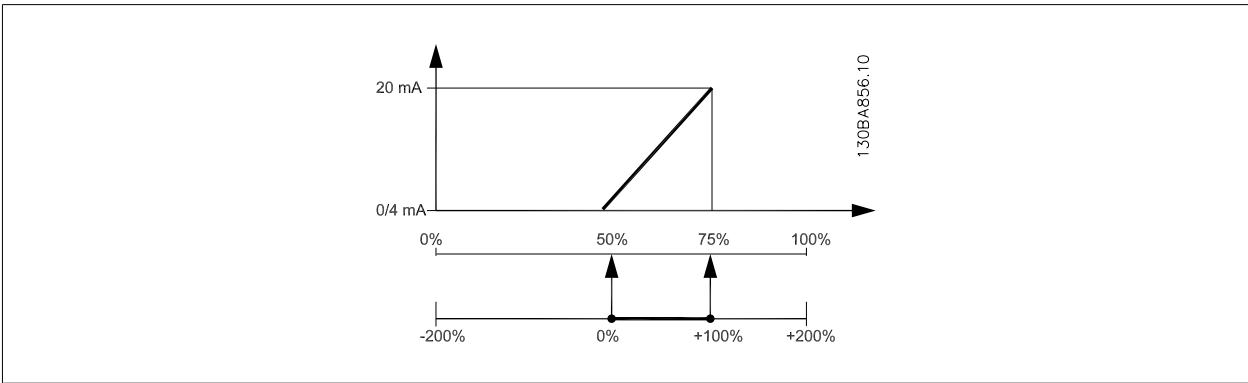
**EXAMPLE 2:**

Variable= FEEDBACK, range= -200% to +200%

Range needed for output= 0-100%

Output signal 0 or 4 mA is needed at 0% (50% of range) - set par. 6-51 *Terminal 42 Output Min Scale* to 50%

Output signal 20 mA is needed at 100% (75% of range) - set par. 6-52 *Terminal 42 Output Max Scale* to 75%



5

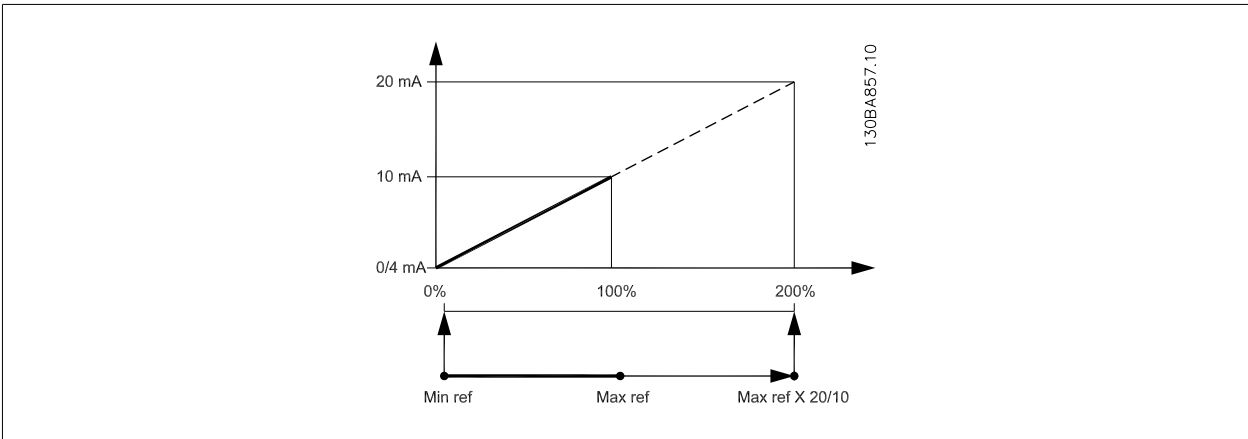
EXAMPLE 3:

Variable value= REFERENCE, range= Min ref - Max ref

Range needed for output= Min ref (0%) - Max ref (100%), 0-10 mA

Output signal 0 or 4 mA is needed at Min ref - set par. 6-51 Terminal 42 Output Min Scale to 0%

Output signal 10 mA is needed at Max ref (100% of range) - set par. 6-52 Terminal 42 Output Max Scale to 200% (20 mA / 10 mA x 100%=200%).



5.2.9 Drive Closed Loop, 20- \*\*

This parameter group is used for configuring the closed loop PID Controller, that controls the output frequency of the frequency converter.

20-12 Reference/Feedback Unit

| Option:  | Function:           |
|----------|---------------------|
| [0] None |                     |
| [1] *    | %                   |
| [5]      | PPM                 |
| [10]     | 1/min               |
| [11]     | RPM                 |
| [12]     | Pulse/s             |
| [20]     | l/s                 |
| [21]     | l/min               |
| [22]     | l/h                 |
| [23]     | m <sup>3</sup> /s   |
| [24]     | m <sup>3</sup> /min |
| [25]     | m <sup>3</sup> /h   |



|       |                      |   |
|-------|----------------------|---|
| [30]  | kg/s                 |   |
| [31]  | kg/min               |   |
| [32]  | kg/h                 |   |
| [33]  | t/min                |   |
| [34]  | t/h                  |   |
| [40]  | m/s                  |   |
| [41]  | m/min                |   |
| [45]  | m                    |   |
| [60]  | °C                   |   |
| [70]  | mbar                 |   |
| [71]  | bar                  |   |
| [72]  | Pa                   |   |
| [73]  | kPa                  |   |
| [74]  | m WG                 |   |
| [75]  | mm Hg                |   |
| [80]  | kW                   |   |
| [120] | GPM                  |   |
| [121] | gal/s                |   |
| [122] | gal/min              |   |
| [123] | gal/h                |   |
| [124] | CFM                  |   |
| [125] | ft <sup>3</sup> /s   |   |
| [126] | ft <sup>3</sup> /min |   |
| [127] | ft <sup>3</sup> /h   |   |
| [130] | lb/s                 |   |
| [131] | lb/min               |   |
| [132] | lb/h                 |   |
| [140] | ft/s                 |   |
| [141] | ft/min               |   |
| [145] | ft                   |   |
| [160] | °F                   |   |
| [170] | psi                  |   |
| [171] | lb/in <sup>2</sup>   |   |
| [172] | in WG                |   |
| [173] | ft WG                |   |
| [174] | in Hg                |   |
| [180] | HP                   | This parameter determines the unit that is used for the setpoint reference and feedback that the PID Controller will use for controlling the output frequency of the frequency converter. |

**20-21 Setpoint 1**

**Range:**

0.000 Proc- [-999999.999 - 999999.999 Proc-  
 essCtrlU- essCtrlUnit]  
 nit\*

**Function:**

Setpoint 1 is used in Closed Loop Mode to enter a setpoint reference that is used by the frequency converter's PID Controller. See the description of par. 20-20 *Feedback Function*.



**NB!**

Setpoint reference entered here is added to any other references that are enabled (see par. group 3-1\*).

### 20-81 PID Normal/Inverse Control

**Option:**

[0] \* Normal

[1] Inverse

**Function:**

*Normal* [0] causes the frequency converter's output frequency to decrease when the feedback is greater than the setpoint reference. This is common for pressure-controlled supply fan and pump applications.

*Inverse* [1] causes the frequency converter's output frequency to increase when the feedback is greater than the setpoint reference.

### 20-82 PID Start Speed [RPM]

**Range:**

0 RPM\* [0 - par. 4-13 RPM]

**Function:**

When the frequency converter is first started, it initially ramps up to this output speed in Open Loop Mode, following the active Ramp Up Time. When the output speed programmed here is reached, the frequency converter will automatically switch to Closed Loop Mode and the PID Controller will begin to function. This is useful in applications in which the driven load must first quickly accelerate to a minimum speed when it is started.



**NB!**

This parameter will only be visible if par. 0-02 *Motor Speed Unit* is set to [0], RPM.

### 20-93 PID Proportional Gain

**Range:**

0.50 N/A\* [0.00 - 10.00 N/A]

**Function:**

The proportional gain indicates the number of times the error between the set point and the feedback signal is to be applied.

If (Error x Gain) jumps with a value equal to what is set in par. 20-14 *Maximum Reference/Feedb.* the PID controller will try to change the output speed equal to what is set in par. 4-13 *Motor Speed High Limit [RPM]*/par. 4-14 *Motor Speed High Limit [Hz]* but in practice of course limited by this setting. The proportional band (error causing output to change from 0-100%) can be calculated by means of the formula:

$$\left( \frac{1}{\text{Proportional Gain}} \right) \times (\text{Max Reference})$$

**NB!**

Always set the desired for par. 20-14 *Maximum Reference/Feedb.* before setting the values for the PID controller in par. group 20-9\*.

### 20-94 PID Integral Time

**Range:**

20.00 s\* [0.01 - 10000.00 s]

**Function:**

Over time, the integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the Reference/Setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches zero. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable.

The value set, is the time needed for the integrator to add the same contribution as the proportional part for a certain deviation.

If the value is set to 10,000, the controller will act as a pure proportional controller with a P-band based on the value set in par. 20-93, *Proportional Gain*. When no deviation is present, the output from the proportional controller will be 0.

## 5.2.10 22-\*\* Miscellaneous

This group contains parameters used for monitoring water/ wastewater applications.

**22-20 Low Power Auto Set-up**

**Option:**

**Function:**

When set for *Enabled*, an auto set up sequence is activated, automatically setting speed to approx. 50 and 85% of rated motor speed (par. 4-13 *Motor Speed High Limit [RPM]*, par. 4-14 *Motor Speed High Limit [Hz]*). At those two speeds, the power consumption is automatically measured and stored. Before enabling Auto Set Up:

1. Close valve(s) in order to create a no flow condition
2. The frequency converter must be set for Open Loop (par. 1-00 *Configuration Mode*). Note that it is important also to set par. 1-03 *Torque Characteristics*.

[0] \* Off

[1] Enabled



**NB!**

Auto Set Up must be done when the system has reached normal operating temperature!



**NB!**

It is important that the par. 4-13 *Motor Speed High Limit [RPM]* or par. 4-14 *Motor Speed High Limit [Hz]* is set to the max. operational speed of the motor!

It is important to do the Auto Set-up before configuring the integrated PI Controller as settings will be reset when changing from Closed to Open Loop in par. 1-00 *Configuration Mode*.



**NB!**

Carry out the tuning with the same settings in par. 1-03 *Torque Characteristics*, as for operation after the tuning.

**22-21 Low Power Detection**

**Option:**

**Function:**

[0] \* Disabled

[1] Enabled

If selecting Enabled, the Low Power Detection commissioning must be carried out in order to set the parameters in group 22-3\* for proper operation!

**22-22 Low Speed Detection**

**Option:**

**Function:**

[0] \* Disabled

[1] Enabled

Select Enabled for detecting when the motor operates with a speed as set in par. 4-11 *Motor Speed Low Limit [RPM]* or par. 4-12 *Motor Speed Low Limit [Hz]*.

**22-23 No-Flow Function**

**Option:**

**Function:**

Common actions for Low Power Detection and Low Speed Detection (Individual selections not possible).

[0] \* Off

[1] Sleep Mode

[2] Warning

Messages in the Local Control Panel display (if mounted) and/or signal via a relay or a digital output.

[3] Alarm

The frequency converter trips and motor stays stopped until reset.

### 22-24 No-Flow Delay

**Range:**

10 s\* [1 - 600 s]

**Function:**

Set the time Low Power/Low Speed must stay detected to activate signal for actions. If detection disappears before run out of the timer, the timer will be reset.

### 22-26 Dry Pump Function

**Option:**

[0] \* Off

[1] Warning

[2] Alarm

**Function:**

*Low Power Detection* must be Enabled (par. 22-21 *Low Power Detection*) and commissioned (using either par. 22-3\*, *No Flow Power Tuning*, or par. 22-20 *Low Power Auto Set-up*) in order to use Dry Pump Detection.

Messages in the Local Control Panel display (if mounted) and/or signal via a relay or a digital output.

The frequency converter trips and motor stays stopped until reset.

### 22-27 Dry Pump Delay

**Range:**

10 s\* [0 - 600 s]

**Function:**

Defines for how long the Dry Pump condition must be active before activating Warning or Alarm

### 22-30 No-Flow Power

**Range:**

0.00 kW\* [0.00 - 0.00 kW]

**Function:**

Read out of calculated No Flow power at actual speed. If power drops to the display value the frequency converter will consider the condition as a No Flow situation.

### 22-31 Power Correction Factor

**Range:**

100 %\* [1 - 400 %]

**Function:**

Make corrections to the calculated power at par. 22-30 *No-Flow Power*.  
If No Flow is detected, when it should not be detected, the setting should be decreased. However, if No Flow is not detected, when it should be detected, the setting should be increased to above 100%.

### 22-32 Low Speed [RPM]

**Range:**

0 RPM\* [0 - par. 22-36 RPM]

**Function:**

To be used if par. 0-02 *Motor Speed Unit* has been set for RPM (parameter not visible if Hz selected).  
Set used speed for the 50% level.  
This function is used for storing values needed to tune No Flow Detection.

### 22-33 Low Speed [Hz]

**Range:**

0 Hz\* [0.0 - par. 22-37 Hz]

**Function:**

To be used if par. 0-02 *Motor Speed Unit* has been set for Hz (parameter not visible if RPM selected).  
Set used speed for the 50% level.  
The function is used for storing values needed to tune No Flow Detection.

### 22-34 Low Speed Power [kW]

**Range:**

0 kW\* [0.00 - 0.00 kW]

**Function:**

To be used if par. 0-03 *Regional Settings* has been set for International (parameter not visible if North America selected).  
Set power consumption at 50% speed level.  
This function is used for storing values needed to tune No Flow Detection.

**22-35 Low Speed Power [HP]**

|                            |   |
|----------------------------|---|
| <b>Range:</b>              | <b>Function:</b>  |
| 0 hp*     [0.00 - 0.00 hp] | To be used if par. 0-03 <i>Regional Settings</i> has been set for North America (parameter not visible if International selected).<br>Set power consumption at 50% speed level.<br>This function is used for storing values needed to tune No Flow Detection. |

**22-36 High Speed [RPM]**

|                                |  |
|--------------------------------|--|
| <b>Range:</b>                  | <b>Function:</b>   |
| 0 RPM*     [0 - par. 4-13 RPM] | To be used if par. 0-02 <i>Motor Speed Unit</i> has been set for RPM (parameter not visible if Hz selected).<br>Set used speed for the 85% level.<br>The function is used for storing values needed to tune No Flow Detection. |

**22-37 High Speed [Hz]**

|                                  |  |
|----------------------------------|--|
| <b>Range:</b>                    | <b>Function:</b>   |
| 0.0 Hz*     [0.0 - par. 4-14 Hz] | To be used if par. 0-02 <i>Motor Speed Unit</i> has been set for Hz (parameter not visible if RPM selected).<br>Set used speed for the 85% level.<br>The function is used for storing values needed to tune No Flow Detection. |

**22-38 High Speed Power [kW]**

|                            |   |
|----------------------------|---|
| <b>Range:</b>              | <b>Function:</b>  |
| 0 kW*     [0.00 - 0.00 kW] | To be used if par. 0-03 <i>Regional Settings</i> has been set for International (parameter not visible if North America selected).<br>Set power consumption at 85% speed level.<br>This function is used for storing values needed to tune No Flow Detection. |

**22-39 High Speed Power [HP]**

|                            |   |
|----------------------------|---|
| <b>Range:</b>              | <b>Function:</b>  |
| 0 hp*     [0.00 - 0.00 hp] | To be used if par. 0-03 <i>Regional Settings</i> has been set for North America (parameter not visible if International selected).<br>Set power consumption at 85% speed level.<br>This function is used for storing values needed to tune No Flow Detection. |

**22-40 Minimum Run Time**

|                       |   |
|-----------------------|---|
| <b>Range:</b>         | <b>Function:</b>  |
| 10 s*     [0 - 600 s] | Set the desired minimum running time for the motor after a start command (digital input or Bus) before entering Sleep Mode. |

**22-41 Minimum Sleep Time**

|                       |  |
|-----------------------|--|
| <b>Range:</b>         | <b>Function:</b>   |
| 10 s*     [0 - 600 s] | Set the desired Minimum Time for staying in Sleep Mode. This will override any wake up conditions. |

**22-42 Wake-up Speed [RPM]**


|  |   |
|--|---|
| <b>Range:</b>                          | <b>Function:</b>  |
| 0 RPM*     [par. 4-11 - par. 4-13 RPM] | To be used if par. 0-02 <i>Motor Speed Unit</i> has been set for RPM (parameter not visible if Hz selected).<br>Only to be used if par. 1-00 <i>Configuration Mode</i> is set for Open Loop and speed reference is applied by an external controller.<br>Set the reference speed at which the Sleep Mode should be cancelled. |

**22-43 Wake-up Speed [Hz]**

|                                  |  |
|----------------------------------|--|
| <b>Range:</b>                    | <b>Function:</b>   |
| 0 Hz* [par. 4-12 - par. 4-14 Hz] | To be used if par. 0-02 <i>Motor Speed Unit</i> , has been set for Hz (parameter not visible if RPM selected). Only to be used if par. 1-00 <i>Configuration Mode</i> , is set for Open Loop and speed reference is applied by an external controller controlling the pressure. Set the reference speed at which the Sleep Mode should be cancelled. |

**22-44 Wake-up Ref./FB Difference**

|               |  |
|---------------|--|
| <b>Range:</b> | <b>Function:</b>   |
| 10%* [0-100%] | Only to be used if par. 1-00, <i>Configuration Mode</i> , is set for Closed Loop and the integrated PI controller is used for controlling the pressure. Set the pressure drop allowed in percentage of set point for the pressure (Pset) before cancelling the Sleep Mode. |



**NB!**  
If used in application where the integrated PI controller is set for inverse control in par. 20-71, *PID, Normal/Inverse Control*, the value set in par. 22-44 will automatically be added.

**22-45 Setpoint Boost**


|                     |  |
|---------------------|--|
| <b>Range:</b>       | <b>Function:</b>   |
| 0 %* [-100 - 100 %] | Only to be used if par. 1-00 <i>Configuration Mode</i> , is set for Closed Loop and the integrated PI controller is used. In systems with e.g. constant pressure control, it is advantageous to increase the system pressure before the motor is stopped. This will extend the time in which the motor is stopped and help to avoid frequent start/stop. Set the desired over pressure/temperature in percentage of set point for the pressure (Pset)/temperature before entering the Sleep Mode. If setting for 5%, the boost pressure will be Pset*1.05. The negative values can be used for e.g. cooling tower control where a negative change is needed. |

**22-46 Maximum Boost Time**

|                   |  |
|-------------------|--|
| <b>Range:</b>     | <b>Function:</b>   |
| 60 s* [0 - 600 s] | Only to be used if par. 1-00 <i>Configuration Mode</i> is set for Closed Loop and the integrated PI controller is used for controlling the pressure. Set the maximum time for which boost mode will be allowed. If the set time is exceeded, Sleep Mode will be entered, not waiting for the set boost pressure to be reached. |

**22-50 End of Curve Function**

|                |   |
|----------------|---|
| <b>Option:</b> | <b>Function:</b>  |
| [0] * Off      | End of Curve monitoring not active.   |
| [1] Warning    | A warning is issued in the display [W94].   |
| [2] Alarm      | An alarm is issued and the frequency converter trips. A message [A94] appears in the display. |



**NB!**  
Automatic restart will reset the alarm and start the system again.

**22-51 End of Curve Delay**

|                   |   |
|-------------------|---|
| <b>Range:</b>     | <b>Function:</b>  |
| 10 s* [0 - 600 s] | When an End of Curve condition is detected, a timer is activated. When the time set in this parameter expires, and the End of Curve condition has been steady in the entire period, the function set in par. 22-50 <i>End of Curve Function</i> will be activated. If the condition disappears before the timer expires, the timer will be reset. |

**22-80 Flow Compensation**

**Option:**

[0] \* Disabled

[1] Enabled

**Function:**

[0] *Disabled:* Set-Point compensation not active.

[1] *Enabled:* Set-Point compensation is active. Enabling this parameter allows the Flow Compensated Setpoint operation.

**22-81 Square-linear Curve Approximation**

**Range:**

100 %\* [0 - 100 %]

**Function:**

**Example 1:**

Adjustment of this parameter allows the shape of the control curve to be adjusted.

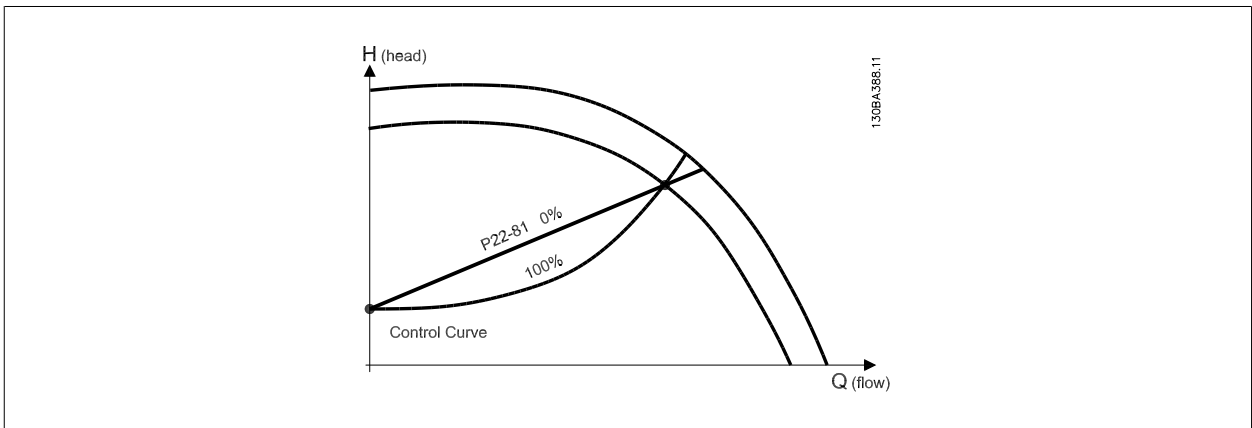
0 = Linear

100% = Ideal shape (theoretical).



**NB!**

Please note: Not visible when running in cascade.

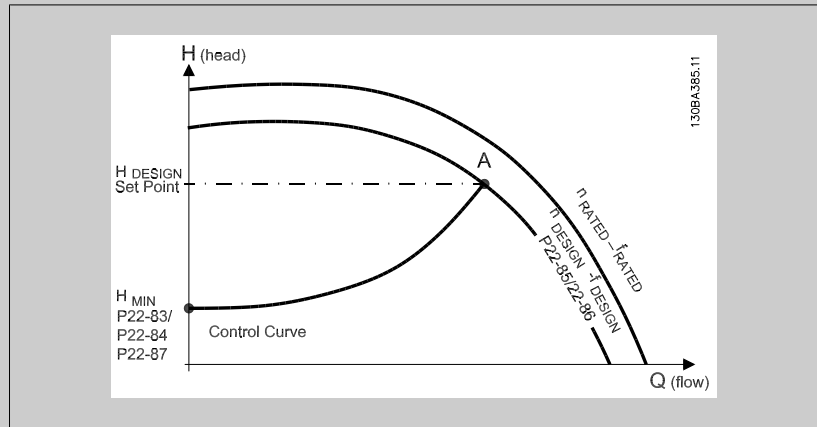


**22-82 Work Point Calculation**

**Option:**

**Function:**

**Example 1:** Speed at System Design Working Point is known:

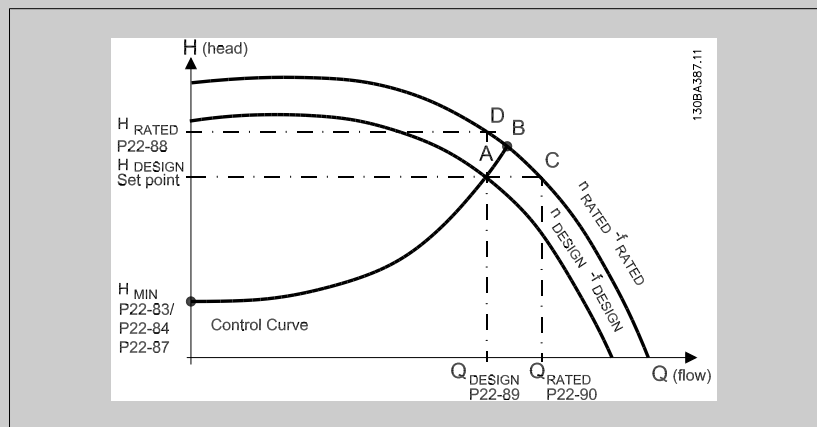


From the data sheet showing characteristics for the specific equipment at different speeds, simply reading across from the  $H_{DESIGN}$  point and the  $Q_{DESIGN}$  point allows us to find point A, which is the System Design Working Point. The pump characteristics at this point should be identified and the associated speed programmed. Closing the valves and adjusting the speed until  $H_{MIN}$  has been achieved allows the speed at the no flow point to be identified.

Adjustment of par. 22-81 *Square-linear Curve Approximation* then allows the shape of the control curve to be adjusted infinitely.

**Example 2:**

Speed at System Design Working Point is not known: Where the Speed at System Design Working Point is unknown, another reference point on the control curve needs to be determined by means of the data sheet. By looking at the curve for the rated speed and plotting the design pressure ( $H_{DESIGN}$ , Point C) the flow at that pressure  $Q_{RATED}$  can be determined. Similarly, by plotting the design flow ( $Q_{DESIGN}$ , Point D), the pressure  $H_D$  at that flow can be determined. Knowing these two points on the pump curve, along with  $H_{MIN}$  as described above, allows the frequency converter to calculate the reference point B and thus to plot the control curve which will also include the System design Working Point A.



[0] \* Disabled

*Disabled [0]:* Work Point Calculation not active. To be used if speed at design point is known (see table above).

[1] Enabled

*Enabled [1]:* Work Point Calculation is active. Enabling this parameter allows the calculation of the unknown System Design Working Point at 50/60 Hz speed, from the input data set in par. 22-83 *Speed at No-Flow [RPM]*, par. 22-84 *Speed at No-Flow [Hz]*, par. 22-87 *Pressure at No-Flow Speed*, par. 22-88 *Pressure at Rated Speed*, par. 22-89 *Flow at Design Point* and par. 22-90 *Flow at Rated Speed*.



**22-84 Speed at No-Flow [Hz]**

**Range:**

50.0 Hz\* [0.0 - par. 22-86 Hz]

**Function:**

Resolution 0.033 Hz.

The speed of the motor at which flow has effectively stopped and minimum pressure  $H_{MIN}$  is achieved should be entered here in Hz. Alternatively, the speed in RPM can be entered in par. 22-83 *Speed at No-Flow [RPM]*. If it has been decided to use Hz in par. 0-02 *Motor Speed Unit* then par. 22-86 *Speed at Design Point [Hz]* should also be used. Closing the valves and reducing the speed until minimum pressure  $H_{MIN}$  is achieved will determine this value.

**22-85 Speed at Design Point [RPM]**

**Range:**

1500. RPM\* [par. 22-83 - 60000. RPM]

**Function:**

Resolution 1 RPM.

Only visible when par. 22-82 *Work Point Calculation* is set to *Disable*. The speed of the motor at which the System Design Working Point is achieved should be entered here in RPM. Alternatively, the speed in Hz can be entered in par. 22-86 *Speed at Design Point [Hz]*. If it has been decided to use RPM in par. 0-02 *Motor Speed Unit* then par. 22-83 *Speed at No-Flow [RPM]* should also be used.

**22-86 Speed at Design Point [Hz]**

**Range:**

50/60.0 Hz\* [par. 22-84 - par. 4-19 Hz]

**Function:**

Resolution 0.033 Hz.

Only visible when par. 22-82 *Work Point Calculation* is set to *Disable*. The speed of the motor at which the System Design Working Point is achieved should be entered here in Hz. Alternatively, the speed in RPM can be entered in par. 22-85 *Speed at Design Point [RPM]*. If it has been decided to use Hz in par. 0-02 *Motor Speed Unit*, then par. 22-83 *Speed at No-Flow [RPM]* should also be used.

**22-87 Pressure at No-Flow Speed**

**Range:**

0.000 N/A\* [0.000 - par. 22-88 N/A]

**Function:**

Enter the pressure  $H_{MIN}$  corresponding to Speed at No Flow in Reference/Feedback Units.

**22-88 Pressure at Rated Speed**

**Range:**

999999.999 N/A\* [par. 22-87 - 999999.999 N/A]

**Function:**

Enter the value corresponding to the Pressure at Rated Speed, in Reference/Feedback Units. This value can be defined using the pump datasheet.

**22-83 Speed at No-Flow [RPM]**

**Range:**

300. RPM\* [0 - par. 22-85 RPM]

**Function:**

Resolution 1 RPM.

The speed of the motor at which flow is zero and minimum pressure  $H_{MIN}$  is achieved should be entered here in RPM. Alternatively, the speed in Hz can be entered in par. 22-84 *Speed at No-Flow [Hz]*. If it has been decided to use RPM in par. 0-02 *Motor Speed Unit* then par. 22-85 *Speed at Design Point [RPM]* should also be used. Closing the valves and reducing the speed until minimum pressure  $H_{MIN}$  is achieved will determine this value.

**22-90 Flow at Rated Speed**

**Range:**

0.000 N/A\* [0.000 - 999999.999 N/A]


**Function:**

Enter the value corresponding to Flow at Rated Speed. This value can be defined using the pump datasheet.


### 5.2.11 Timed Actions, 23-0\*

Use *Timed Actions* for actions needing to be performed on a daily or weekly basis, e.g. different references for working hours / non-working hours. Up to 10 Timed Actions can be programmed in the frequency converter. The Timed Action number is selected from the list when entering parameter group 23-0\* from the Local Control Panel. par. 23-00 *ON Time* – par. 23-04 *Occurrence* then refer to the selected Timed Action number. Each Timed Action is divided into an ON time and an OFF time, in which two different actions may be performed.

The actions programmed in Timed Actions are merged with corresponding actions from digital inputs, control work via bus and Smart Logic Controller, according to merge rules set up in 8-5\*, Digital/Bus.



**NB!**  
The clock (parameter group 0-7\*) must be correctly programmed for Timed Actions to function correctly.



**NB!**  
When mounting an Analog I/O MCB109 option card, a battery back up of the date and time is included.

**NB!**  
The PC-based Configuration Tool MCT 10 comprise a special guide for easy programming of Timed Actions.

#### 23-00 ON Time


Array [10]

**Range:**

0 N/A\* [0 - 0 N/A]

**Function:**

Sets the ON time for the Timed Action.



**NB!**  
The frequency converter has no back up of the clock function and the set date/ time will reset to default (2000-01-01 00:00) after a power down unless a Real Time Clock module with back up is installed. In par. 0-79 *Clock Fault* it is possible to program for a Warning in case clock has not been set properly, e.g. after a power down.

#### 23-01 ON Action

Arra [10]

**Option:**

**Function:**

Select the action during ON Time. See par. 13-52 *SL Controller Action* for descriptions of the options.

|       |                     |
|-------|---------------------|
| [0] * | Disabled            |
| [1]   | No action           |
| [2]   | Select set-up 1     |
| [3]   | Select set-up 2     |
| [4]   | Select set-up 3     |
| [5]   | Select set-up 4     |
| [10]  | Select preset ref 0 |
| [11]  | Select preset ref 1 |
| [12]  | Select preset ref 2 |
| [13]  | Select preset ref 3 |
| [14]  | Select preset ref 4 |
| [15]  | Select preset ref 5 |

- [16] Select preset ref 6
- [17] Select preset ref 7
- [18] Select ramp 1
- [19] Select ramp 2
- [22] Run
- [23] Run reverse
- [24] Stop
- [26] DC Brake
- [27] Coast
- [28] Freeze output
- [29] Start timer 0
- [30] Start timer 1
- [31] Start timer 2
- [32] Set digital out A low
- [33] Set digital out B low
- [34] Set digital out C low
- [35] Set digital out D low
- [36] Set digital out E low
- [37] Set digital out F low
- [38] Set digital out A high
- [39] Set digital out B high
- [40] Set digital out C high
- [41] Set digital out D high
- [42] Set digital out E high
- [43] Set digital out F high
- [60] Reset Counter A
- [61] Reset Counter B
- [70] Start Timer 3
- [71] Start Timer 4
- [72] Start Timer 5
- [73] Start Timer 6
- [74] Start Timer 7

**NB!**  
 For choices [32] - [43], see also par. group 5-3\*, *Digital Outputs* and 5-4\*, *Relays*.

**23-02 OFF Time**


Array [10]

**Range:**

0 N/A\* [0 - 0 N/A]

**Function:**

Sets the OFF time for the Timed Action.



**NB!**  
 The frequency converter has no back up of the clock function and the set date/ time will reset to default (2000-01-01 00:00) after a power down unless a Real Time Clock module with back up is installed. In par. 0-79 *Clock Fault* it is possible to program for a Warning in case clock has not been set properly, e.g. after a power down.

**23-03 OFF Action**

Array [10]

**Option:**

**Function:**

Select the action during OFF Time. See par. 13-52 *SL Controller Action* for descriptions of the options.

[0] \* Disabled

[1] No action

[2] Select set-up 1

[3] Select set-up 2

[4] Select set-up 3

[5] Select set-up 4

[10] Select preset ref 0

[11] Select preset ref 1

[12] Select preset ref 2

[13] Select preset ref 3

[14] Select preset ref 4

[15] Select preset ref 5

[16] Select preset ref 6

[17] Select preset ref 7

[18] Select ramp 1

[19] Select ramp 2

[22] Run

[23] Run reverse

[24] Stop

[26] DC Brake

[27] Coast

[28] Freeze output

[29] Start timer 0

[30] Start timer 1

[31] Start timer 2

[32] Set digital out A low

[33] Set digital out B low

[34] Set digital out C low

[35] Set digital out D low

[36] Set digital out E low

[37] Set digital out F low

[38] Set digital out A high

[39] Set digital out B high

[40] Set digital out C high

[41] Set digital out D high

[42] Set digital out E high

[43] Set digital out F high

[60] Reset Counter A

[61] Reset Counter B

[70] Start Timer 3

[71] Start Timer 4

[72] Start Timer 5

[73] Start Timer 6

[74] Start Timer 7

### 23-04 Occurrence

Array [10]

**Option:**

**Function:**

Select which day(s) the Timed Action applies to. Specify working/non-working days in par. 0-81 *Working Days*, par. 0-82 *Additional Working Days* and par. 0-83 *Additional Non-Working Days*.

[0] \* All days

[1] Working days

[2] Non-working days

[3] Monday

[4] Tuesday

[5] Wednesday

[6] Thursday

[7] Friday

[8] Saturday

[9] Sunday

## 5.2.12 Water Application Functions, 29- \*\*

The group contains parameters used for monitoring water / wastewater applications.

### 29-00 Pipe Fill Enable

**Option:**

**Function:**

[0] \* Disabled

Select Enabled to fill pipes at a user specified rate.

[1] Enabled

Select Enabled to fill pipes with a user specified rate.

### 29-01 Pipe Fill Speed [RPM]

**Range:**

**Function:**

Speed Low [Speed Low Limit - Speed High Limit\* it]

Set the filling speed for filling horizontal pipe systems. The speed can be selected in Hz or RPM depending on the choices made in par. 4-11 / par. 4-13 (RPM) or in par. 4-12 / par. 4-14 (Hz).

### 29-02 Pipe Fill Speed [Hz]

**Range:**

**Function:**

Motor [Speed Low Limit - Speed High Limit\* it] Speed Low it] Limit\*

Set the filling speed for filling horizontal pipe systems. The speed can be selected in Hz or RPM depending on the choices made in par. 4-11 / par. 4-13 (RPM) or in par. 4-12 / par. 4-14 (Hz).

### 29-03 Pipe Fill Time

**Range:**

**Function:**

0 s\* [0 - 3600 s]

Set the specified time for pipe filling of horizontal pipe systems.

### 29-04 Pipe Fill Rate

**Range:**

**Function:**

0.001 units/ [0.001 – 999999.999 units/s] s\*

Specifies the filling rate in units/second using the PI controller. Filling rate units are feedback units/second. This function is used for filling-up vertical pipe systems but will be active when the filling-time has expired, no matter what , until the pipe fill-set-point set in par. 29-05 is reached.

**29-05 Filled Setpoint**

**Range:**

0 s\* [0 – 999999,999 s]

**Function:**

Specifies the Filled Set-point at which the Pipe Fill Function will be disabled and the PID controller will take control. This function can be used both for horizontal and vertical pipe systems.

## 5.3 Parameter Options

### 5.3.1 Default settings

Changes during operation:

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

5

4-Set-up:

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

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

SR:

Size related

N/A:

No default value available.

Conversion index:

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

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

| Data type | Description                          | Type   |
|-----------|--------------------------------------|--------|
| 2         | Integer 8                            | Int8   |
| 3         | Integer 16                           | Int16  |
| 4         | Integer 32                           | Int32  |
| 5         | Unsigned 8                           | UInt8  |
| 6         | Unsigned 16                          | UInt16 |
| 7         | Unsigned 32                          | UInt32 |
| 9         | Visible String                       | VisStr |
| 33        | Normalized value 2 bytes             | N2     |
| 35        | Bit sequence of 16 boolean variables | V2     |
| 54        | Time difference w/o date             | TimD   |

5.3.2 Operation/Display 0-\*\*

| Par. No. #                     | Parameter description                | Default value            | 4-set-up    | FC 302 only | Change during operation | Conversion index | Type       |
|--------------------------------|--------------------------------------|--------------------------|-------------|-------------|-------------------------|------------------|------------|
| <b>0-0* Basic Settings</b>     |                                      |                          |             |             |                         |                  |            |
| 0-01                           | Language                             | [0] English              | 1 set-up    |             | TRUE                    | -                | Ujnt8      |
| 0-02                           | Motor Speed Unit                     | [0] RPM                  | 2 set-ups   |             | FALSE                   | -                | Ujnt8      |
| 0-03                           | Regional Settings                    | [0] International        | 2 set-ups   |             | FALSE                   | -                | Ujnt8      |
| 0-04                           | Operating State at Power-up          | [0] Resume               | All set-ups |             | TRUE                    | -                | Ujnt8      |
| 0-05                           | Local Mode Unit                      | [0] As Motor Speed Unit  | 2 set-ups   |             | FALSE                   | -                | Ujnt8      |
| <b>0-1* Set-up Operations</b>  |                                      |                          |             |             |                         |                  |            |
| 0-10                           | Active Set-up                        | [1] Set-up 1             | 1 set-up    |             | TRUE                    | -                | Ujnt8      |
| 0-11                           | Programming Set-up                   | [9] Active Set-up        | All set-ups |             | TRUE                    | -                | Ujnt8      |
| 0-12                           | This Set-up Linked to                | [0] Not linked           | All set-ups |             | FALSE                   | -                | Ujnt8      |
| 0-13                           | Readout: Linked Set-ups              | 0 N/A                    | All set-ups |             | FALSE                   | 0                | Ujnt16     |
| 0-14                           | Readout: Prog. Set-ups / Channel     | 0 N/A                    | All set-ups |             | TRUE                    | 0                | Int32      |
| <b>0-2* LCP Display</b>        |                                      |                          |             |             |                         |                  |            |
| 0-20                           | Display Line 1.1 Small               | 1601                     | All set-ups |             | TRUE                    | -                | Ujnt16     |
| 0-21                           | Display Line 1.2 Small               | 1662                     | All set-ups |             | TRUE                    | -                | Ujnt16     |
| 0-22                           | Display Line 1.3 Small               | 1614                     | All set-ups |             | TRUE                    | -                | Ujnt16     |
| 0-23                           | Display Line 2 Large                 | 1613                     | All set-ups |             | TRUE                    | -                | Ujnt16     |
| 0-24                           | Display Line 3 Large                 | 1652                     | All set-ups |             | TRUE                    | -                | Ujnt16     |
| 0-25                           | My Personal Menu                     | ExpressionLimit          | 1 set-up    |             | TRUE                    | 0                | Ujnt16     |
| <b>0-3* LCP Custom Readout</b> |                                      |                          |             |             |                         |                  |            |
| 0-30                           | Custom Readout Unit                  | [1] %                    | All set-ups |             | TRUE                    | -                | Ujnt8      |
| 0-31                           | Custom Readout Min Value             | ExpressionLimit          | All set-ups |             | TRUE                    | -2               | Int32      |
| 0-32                           | Custom Readout Max Value             | 100.00 CustomReadoutUnit | All set-ups |             | TRUE                    | -2               | Int32      |
| 0-37                           | Display Text 1                       | 0 N/A                    | 1 set-up    |             | TRUE                    | 0                | VisStr[25] |
| 0-38                           | Display Text 2                       | 0 N/A                    | 1 set-up    |             | TRUE                    | 0                | VisStr[25] |
| 0-39                           | Display Text 3                       | 0 N/A                    | 1 set-up    |             | TRUE                    | 0                | VisStr[25] |
| <b>0-4* LCP Keypad</b>         |                                      |                          |             |             |                         |                  |            |
| 0-40                           | [Hand on] Key on LCP                 | [1] Enabled              | All set-ups |             | TRUE                    | -                | Ujnt8      |
| 0-41                           | [Off] Key on LCP                     | [1] Enabled              | All set-ups |             | TRUE                    | -                | Ujnt8      |
| 0-42                           | [Auto on] Key on LCP                 | [1] Enabled              | All set-ups |             | TRUE                    | -                | Ujnt8      |
| 0-43                           | [Reset] Key on LCP                   | [1] Enabled              | All set-ups |             | TRUE                    | -                | Ujnt8      |
| 0-44                           | [Off/Reset] Key on LCP               | [1] Enabled              | All set-ups |             | TRUE                    | -                | Ujnt8      |
| 0-45                           | [Drive Bypass] Key on LCP            | [1] Enabled              | All set-ups |             | TRUE                    | -                | Ujnt8      |
| <b>0-5* Copy/Save</b>          |                                      |                          |             |             |                         |                  |            |
| 0-50                           | LCP Copy                             | [0] No copy              | All set-ups |             | FALSE                   | -                | Ujnt8      |
| 0-51                           | Set-up Copy                          | [0] No copy              | All set-ups |             | FALSE                   | -                | Ujnt8      |
| <b>0-6* Password</b>           |                                      |                          |             |             |                         |                  |            |
| 0-60                           | Main Menu Password                   | 100 N/A                  | 1 set-up    |             | TRUE                    | 0                | Ujnt16     |
| 0-61                           | Access to Main Menu w/o Password     | [0] Full access          | 1 set-up    |             | TRUE                    | -                | Ujnt8      |
| 0-65                           | Personal Menu Password               | 200 N/A                  | 1 set-up    |             | TRUE                    | 0                | Ujnt16     |
| 0-66                           | Access to Personal Menu w/o Password | [0] Full access          | 1 set-up    |             | TRUE                    | -                | Ujnt8      |

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| Par. No. #                 | Parameter description       | Default value   | 4-set-up    | Change during operation | Conversion index | Type       |
|----------------------------|-----------------------------|-----------------|-------------|-------------------------|------------------|------------|
| <b>0-7* Clock Settings</b> |                             |                 |             |                         |                  |            |
| 0-70                       | Date and Time               | ExpressionLimit | All set-ups | TRUE                    | 0                | TimeOfDay  |
| 0-71                       | Date Format                 | [0] YYYY-MM-DD  | 1 set-up    | TRUE                    | -                | UInt8      |
| 0-72                       | Time Format                 | [0] 24 h        | 1 set-up    | TRUE                    | -                | UInt8      |
| 0-74                       | DST/Summertime              | [0] Off         | 1 set-up    | TRUE                    | -                | UInt8      |
| 0-76                       | DST/Summertime Start        | ExpressionLimit | 1 set-up    | TRUE                    | 0                | TimeOfDay  |
| 0-77                       | DST/Summertime End          | ExpressionLimit | 1 set-up    | TRUE                    | 0                | TimeOfDay  |
| 0-79                       | Clock Fault                 | null            | 1 set-up    | TRUE                    | -                | UInt8      |
| 0-81                       | Working Days                | null            | 1 set-up    | TRUE                    | -                | UInt8      |
| 0-82                       | Additional Working Days     | ExpressionLimit | 1 set-up    | TRUE                    | 0                | TimeOfDay  |
| 0-83                       | Additional Non-Working Days | ExpressionLimit | 1 set-up    | TRUE                    | 0                | TimeOfDay  |
| 0-89                       | Date and Time Readout       | 0 N/A           | All set-ups | TRUE                    | 0                | VisStr[25] |



### 5.3.3 Load/Motor 1-\*\*-\*

| Par. No. #                      | Parameter description                | Default value             | 4-set-up    | Change during operation | Conversion index | Type   |
|---------------------------------|--------------------------------------|---------------------------|-------------|-------------------------|------------------|--------|
| <b>1-0* General Settings</b>    |                                      |                           |             |                         |                  |        |
| 1-00                            | Configuration Mode                   | null                      | All set-ups | TRUE                    | -                | Uint8  |
| 1-01                            | Motor Control Principle              | null                      | All set-ups | FALSE                   | -                | Uint8  |
| 1-03                            | Torque Characteristics               | [3] Auto Energy Optim. VT | All set-ups | TRUE                    | -                | Uint8  |
| <b>1-1* Motor Selection</b>     |                                      |                           |             |                         |                  |        |
| 1-10                            | Motor Construction                   | [0] Asynchron             | All set-ups | FALSE                   | -                | Uint8  |
| <b>1-2* Motor Data</b>          |                                      |                           |             |                         |                  |        |
| 1-20                            | Motor Power [kW]                     | ExpressionLimit           | All set-ups | FALSE                   | 1                | Uint32 |
| 1-21                            | Motor Power [HP]                     | ExpressionLimit           | All set-ups | FALSE                   | -2               | Uint32 |
| 1-22                            | Motor Voltage                        | ExpressionLimit           | All set-ups | FALSE                   | 0                | Uint16 |
| 1-23                            | Motor Frequency                      | ExpressionLimit           | All set-ups | FALSE                   | 0                | Uint16 |
| 1-24                            | Motor Current                        | ExpressionLimit           | All set-ups | FALSE                   | -2               | Uint32 |
| 1-25                            | Motor Nominal Speed                  | ExpressionLimit           | All set-ups | FALSE                   | 67               | Uint16 |
| 1-28                            | Motor Rotation Check                 | [0] Off                   | All set-ups | FALSE                   | -                | Uint8  |
| 1-29                            | Automatic Motor Adaptation (AMA)     | [0] Off                   | All set-ups | FALSE                   | -                | Uint8  |
| <b>1-3* Adv. Motor Data</b>     |                                      |                           |             |                         |                  |        |
| 1-30                            | Stator Resistance (Rs)               | ExpressionLimit           | All set-ups | FALSE                   | -4               | Uint32 |
| 1-31                            | Rotor Resistance (Rr)                | ExpressionLimit           | All set-ups | FALSE                   | -4               | Uint32 |
| 1-35                            | Main Reactance (Xh)                  | ExpressionLimit           | All set-ups | FALSE                   | -4               | Uint32 |
| 1-36                            | Iron Loss Resistance (Rfe)           | ExpressionLimit           | All set-ups | FALSE                   | -3               | Uint32 |
| 1-39                            | Motor Poles                          | ExpressionLimit           | All set-ups | FALSE                   | 0                | Uint8  |
| <b>1-5* Load Indep. Setting</b> |                                      |                           |             |                         |                  |        |
| 1-50                            | Motor Magnetisation at Zero Speed    | 100 %                     | All set-ups | TRUE                    | 0                | Uint16 |
| 1-51                            | Min Speed Normal Magnetising [RPM]   | ExpressionLimit           | All set-ups | TRUE                    | 67               | Uint16 |
| 1-52                            | Min Speed Normal Magnetising [Hz]    | ExpressionLimit           | All set-ups | TRUE                    | -1               | Uint16 |
| <b>1-6* Load Depen. Setting</b> |                                      |                           |             |                         |                  |        |
| 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                    | 0 %                       | 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  |
| <b>1-7* Start Adjustments</b>   |                                      |                           |             |                         |                  |        |
| 1-71                            | Start Delay                          | 0.0 s                     | All set-ups | TRUE                    | -1               | Uint16 |
| 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 |
| <b>1-8* Stop Adjustments</b>    |                                      |                           |             |                         |                  |        |
| 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 |
| 1-86                            | Trip Speed Low [RPM]                 | 0 RPM                     | All set-ups | TRUE                    | 67               | Uint16 |
| 1-87                            | Trip Speed Low [Hz]                  | 0 Hz                      | All set-ups | TRUE                    | -1               | Uint16 |
| <b>1-9* Motor Temperature</b>   |                                      |                           |             |                         |                  |        |
| 1-90                            | Motor Thermal Protection             | [4] ETR trip 1            | All set-ups | TRUE                    | -                | Uint8  |
| 1-91                            | Motor External Fan                   | [0] No                    | All set-ups | TRUE                    | -                | Uint16 |
| 1-93                            | Thermistor Source                    | [0] None                  | All set-ups | TRUE                    | -                | Uint8  |

### 5.3.4 Brakes 2- \*\*

| Par. No. #                      | Parameter description       | Default value   | 4-set-up    | Change during operation | Conversion index | Type   |
|---------------------------------|-----------------------------|-----------------|-------------|-------------------------|------------------|--------|
| <b>2-0* DC-Brake</b>            |                             |                 |             |                         |                  |        |
| 2-00                            | DC Hold/Preheat 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 |
| <b>2-1* Brake Energy Funct.</b> |                             |                 |             |                         |                  |        |
| 2-10                            | Brake Function              | [0] Off         | 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        | [2] Enabled     | All set-ups | TRUE                    | -                | Uint8  |

**5.3.5 Reference / Ramps 3-\*\*-\***

| Par. No. #                    | Parameter description            | Default value             | 4-set-up    | Change during operation | Conversion index | Type   |
|-------------------------------|----------------------------------|---------------------------|-------------|-------------------------|------------------|--------|
| <b>3-0* Reference Limits</b>  |                                  |                           |             |                         |                  |        |
| 3-02                          | Minimum Reference                | ExpressionLimit           | 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  |
| <b>3-1* References</b>        |                                  |                           |             |                         |                  |        |
| 3-10                          | Preset Reference                 | 0.00 %                    | All set-ups | TRUE                    | -2               | Int16  |
| 3-11                          | Jog Speed [Hz]                   | ExpressionLimit           | All set-ups | TRUE                    | -1               | UInt16 |
| 3-13                          | 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 1 Source               | [1] Analog input 53       | All set-ups | TRUE                    | -                | UInt8  |
| 3-16                          | Reference 2 Source               | [0] No function           | All set-ups | TRUE                    | -                | UInt8  |
| 3-17                          | Reference 3 Source               | [0] No function           | All set-ups | TRUE                    | -                | UInt8  |
| 3-19                          | Jog Speed [RPM]                  | ExpressionLimit           | All set-ups | TRUE                    | 67               | UInt16 |
| <b>3-4* Ramp 1</b>            |                                  |                           |             |                         |                  |        |
| 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 |
| <b>3-5* Ramp 2</b>            |                                  |                           |             |                         |                  |        |
| 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 |
| <b>3-8* Other Ramps</b>       |                                  |                           |             |                         |                  |        |
| 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 |
| 3-84                          | Initial Ramp Time                | 0.00 s                    | All set-ups | TRUE                    | -2               | UInt16 |
| 3-85                          | Check Valve Ramp Time            | 0.00 s                    | All set-ups | TRUE                    | -2               | UInt16 |
| 3-86                          | Check Valve Ramp End Speed [RPM] | ExpressionLimit           | All set-ups | TRUE                    | 67               | UInt16 |
| 3-87                          | Check Valve Ramp End Speed [Hz]  | ExpressionLimit           | All set-ups | TRUE                    | -1               | UInt16 |
| 3-88                          | Final Ramp Time                  | 0.00 s                    | All set-ups | TRUE                    | -2               | UInt16 |
| <b>3-9* Digital Pot.Meter</b> |                                  |                           |             |                         |                  |        |
| 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                    | 0 %                       | All set-ups | TRUE                    | 0                | Int16  |
| 3-95                          | Ramp Delay                       | ExpressionLimit           | All set-ups | TRUE                    | -3               | TimD   |

**5.3.6 Limits / Warnings 4-.\***

| Par. No. #                | Parameter description        | Default value                     | 4-set-up    | Change during operation | Conversion index | Type   |
|---------------------------|------------------------------|-----------------------------------|-------------|-------------------------|------------------|--------|
| <b>4-1* Motor Limits</b>  |                              |                                   |             |                         |                  |        |
| 4-10                      | Motor Speed Direction        | [0] Clockwise                     | 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      | 110.0 %                           | All set-ups | TRUE                    | -1               | Uint16 |
| 4-17                      | Torque Limit Generator 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         | ExpressionLimit                   | All set-ups | FALSE                   | -1               | Uint16 |
| <b>4-5* Adj. Warnings</b> |                              |                                   |             |                         |                  |        |
| 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  |
| <b>4-6* Speed Bypass</b>  |                              |                                   |             |                         |                  |        |
| 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 |
| 4-64                      | Semi-Auto Bypass Set-up      | [0] Off                           | All set-ups | FALSE                   | -                | Uint8  |

5.3.7 Digital In/Out 5-\*

| Par. No. #                   | Parameter description                | Default value           | 4-set-up    | Change during operation | Conversion index | Type   |
|------------------------------|--------------------------------------|-------------------------|-------------|-------------------------|------------------|--------|
| <b>5-0* Digital I/O mode</b> |                                      |                         |             |                         |                  |        |
| 5-00                         | Digital I/O Mode                     | [0] PNP - Active at 24V | 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 | TRUE                    | -                | Uint8  |
| <b>5-1* Digital Inputs</b>   |                                      |                         |             |                         |                  |        |
| 5-10                         | Terminal 18 Digital Input            | [8] Start               | All set-ups | TRUE                    | -                | Uint8  |
| 5-11                         | Terminal 19 Digital Input            | [0] No operation        | All set-ups | TRUE                    | -                | Uint8  |
| 5-12                         | Terminal 27 Digital Input            | null                    | All set-ups | TRUE                    | -                | Uint8  |
| 5-13                         | Terminal 29 Digital Input            | [0] No operation        | All set-ups | 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  |
| <b>5-3* Digital Outputs</b>  |                                      |                         |             |                         |                  |        |
| 5-30                         | Terminal 27 Digital Output           | [0] No operation        | All set-ups | TRUE                    | -                | Uint8  |
| 5-31                         | Terminal 29 Digital Output           | [0] No operation        | All set-ups | TRUE                    | -                | Uint8  |
| 5-32                         | Term X30/6 Digi Out (MCB 101)        | [0] No operation        | All set-ups | TRUE                    | -                | Uint8  |
| 5-33                         | Term X30/7 Digi Out (MCB 101)        | [0] No operation        | All set-ups | TRUE                    | -                | Uint8  |
| <b>5-4* Relays</b>           |                                      |                         |             |                         |                  |        |
| 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 |
| <b>5-5* Pulse Input</b>      |                                      |                         |             |                         |                  |        |
| 5-50                         | Term. 29 Low Frequency               | 100 Hz                  | All set-ups | TRUE                    | 0                | Uint32 |
| 5-51                         | Term. 29 High Frequency              | 100 Hz                  | All set-ups | TRUE                    | 0                | Uint32 |
| 5-52                         | Term. 29 Low Ref./Feedb. Value       | 0.000 N/A               | All set-ups | TRUE                    | -3               | Int32  |
| 5-53                         | Term. 29 High Ref./Feedb. Value      | 100.000 N/A             | All set-ups | TRUE                    | -3               | Int32  |
| 5-54                         | Pulse Filter Time Constant #29       | 100 ms                  | All set-ups | 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 N/A               | All set-ups | TRUE                    | -3               | Int32  |
| 5-58                         | Term. 33 High Ref./Feedb. Value      | 100.000 N/A             | All set-ups | TRUE                    | -3               | Int32  |
| 5-59                         | Pulse Filter Time Constant #33       | 100 ms                  | All set-ups | FALSE                   | -3               | Uint16 |
| <b>5-6* Pulse Output</b>     |                                      |                         |             |                         |                  |        |
| 5-60                         | Terminal 27 Pulse Output Variable    | [0] No operation        | All set-ups | TRUE                    | -                | Uint8  |
| 5-62                         | Pulse Output Max Freq #27            | 5000 Hz                 | All set-ups | TRUE                    | 0                | Uint32 |
| 5-63                         | Terminal 29 Pulse Output Variable    | [0] No operation        | All set-ups | TRUE                    | -                | Uint8  |
| 5-65                         | Pulse Output Max Freq #29            | 5000 Hz                 | All set-ups | TRUE                    | 0                | Uint32 |
| 5-66                         | Terminal X30/6 Pulse Output Variable | [0] No operation        | All set-ups | TRUE                    | -                | Uint8  |
| 5-68                         | Pulse Output Max Freq #X30/6         | 5000 Hz                 | All set-ups | TRUE                    | 0                | Uint32 |
| <b>5-9* Bus Controlled</b>   |                                      |                         |             |                         |                  |        |
| 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 |
| 5-97                         | Pulse Out #X30/6 Bus Control         | 0.00 %                  | All set-ups | TRUE                    | -2               | N2     |
| 5-98                         | Pulse Out #X30/6 Timeout Preset      | 0.00 %                  | 1 set-up    | TRUE                    | -2               | Uint16 |

**5.3.8 Analog In/Out 6-.\***

| Par. No. #                      | Parameter description                | Default value            | 4-set-up    | Change during operation | Conversion index | Type   |
|---------------------------------|--------------------------------------|--------------------------|-------------|-------------------------|------------------|--------|
| <b>6-0* Analog I/O Mode</b>     |                                      |                          |             |                         |                  |        |
| 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  |
| <b>6-1* Analog Input 53</b>     |                                      |                          |             |                         |                  |        |
| 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              | 4.00 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    | 0.000 N/A                | 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 |
| 6-17                            | Terminal 53 Live Zero                | [1] Enabled              | All set-ups | TRUE                    | -                | UInt8  |
| <b>6-2* Analog Input 54</b>     |                                      |                          |             |                         |                  |        |
| 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              | 4.00 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    | 0.000 N/A                | All set-ups | TRUE                    | -3               | Int32  |
| 6-25                            | Terminal 54 High Ref./Feedb. Value   | 100.000 N/A              | All set-ups | TRUE                    | -3               | Int32  |
| 6-26                            | Terminal 54 Filter Time Constant     | 0.001 s                  | All set-ups | TRUE                    | -3               | UInt16 |
| 6-27                            | Terminal 54 Live Zero                | [1] Enabled              | All set-ups | TRUE                    | -                | UInt8  |
| <b>6-3* Analog Input X30/11</b> |                                      |                          |             |                         |                  |        |
| 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   | 0.000 N/A                | All set-ups | TRUE                    | -3               | Int32  |
| 6-35                            | Term. X30/11 High Ref./Feedb. Value  | 100.000 N/A              | All set-ups | TRUE                    | -3               | Int32  |
| 6-36                            | Term. X30/11 Filter Time Constant    | 0.001 s                  | All set-ups | TRUE                    | -3               | UInt16 |
| 6-37                            | Term. X30/11 Live Zero               | [1] Enabled              | All set-ups | TRUE                    | -                | UInt8  |
| <b>6-4* Analog Input X30/12</b> |                                      |                          |             |                         |                  |        |
| 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   | 0.000 N/A                | All set-ups | TRUE                    | -3               | Int32  |
| 6-45                            | Term. X30/12 High Ref./Feedb. Value  | 100.000 N/A              | All set-ups | TRUE                    | -3               | Int32  |
| 6-46                            | Term. X30/12 Filter Time Constant    | 0.001 s                  | All set-ups | TRUE                    | -3               | UInt16 |
| 6-47                            | Term. X30/12 Live Zero               | [1] Enabled              | All set-ups | TRUE                    | -                | UInt8  |
| <b>6-5* Analog Output 42</b>    |                                      |                          |             |                         |                  |        |
| 6-50                            | Terminal 42 Output                   | [100] Output freq. 0-100 | 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 |
| <b>6-6* Analog Output X30/8</b> |                                      |                          |             |                         |                  |        |
| 6-60                            | Terminal X30/8 Output                | [0] No operation         | 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  |
| 6-63                            | Terminal X30/8 Output Bus Control    | 0.00 %                   | All set-ups | TRUE                    | -2               | N2     |
| 6-64                            | Terminal X30/8 Output Timeout Preset | 0.00 %                   | 1 set-up    | TRUE                    | -2               | UInt16 |

5.3.9 Comm. and Options 8-\*

| Par. No. #                      | Parameter description         | Default value           | 4-set-up    | Change during operation | Conversion index | Type       |
|---------------------------------|-------------------------------|-------------------------|-------------|-------------------------|------------------|------------|
| <b>8-0* General Settings</b>    |                               |                         |             |                         |                  |            |
| 8-01                            | Control Site                  | null                    | All set-ups | TRUE                    | -                | Uint8      |
| 8-02                            | Control Source                | null                    | All set-ups | TRUE                    | -                | Uint8      |
| 8-03                            | Control Timeout Time          | ExpressionLimit         | 1 set-up    | TRUE                    | -1               | Uint32     |
| 8-04                            | Control Timeout Function      | [0] Off                 | 1 set-up    | TRUE                    | -                | Uint8      |
| 8-05                            | End-of-Timeout Function       | [1] Resume set-up       | 1 set-up    | TRUE                    | -                | Uint8      |
| 8-06                            | Reset Control Timeout         | [0] Do not reset        | All set-ups | TRUE                    | -                | Uint8      |
| 8-07                            | Diagnosis Trigger             | [0] Disable             | 2 set-ups   | TRUE                    | -                | Uint8      |
| <b>8-1* Control Settings</b>    |                               |                         |             |                         |                  |            |
| 8-10                            | Control Profile               | [0] FC profile          | All set-ups | TRUE                    | -                | Uint8      |
| 8-13                            | Configurable Status Word STW  | [1] Profile Default     | All set-ups | TRUE                    | -                | Uint8      |
| 8-14                            | Configurable Control Word CTW | [1] Profile default     | All set-ups | TRUE                    | -                | Uint8      |
| <b>8-3* FC Port Settings</b>    |                               |                         |             |                         |                  |            |
| 8-30                            | Protocol                      | null                    | 1 set-up    | TRUE                    | -                | Uint8      |
| 8-31                            | Address                       | ExpressionLimit         | 1 set-up    | TRUE                    | 0                | Uint8      |
| 8-32                            | Baud Rate                     | null                    | 1 set-up    | TRUE                    | -                | Uint8      |
| 8-33                            | Parity / Stop Bits            | null                    | 1 set-up    | TRUE                    | -                | Uint8      |
| 8-35                            | Minimum Response Delay        | ExpressionLimit         | 1 set-up    | TRUE                    | -3               | Uint16     |
| 8-36                            | Max Response Delay            | ExpressionLimit         | 1 set-up    | TRUE                    | -3               | Uint16     |
| 8-37                            | Maximum Inter-Char Delay      | ExpressionLimit         | 1 set-up    | TRUE                    | -5               | Uint16     |
| <b>8-4* FC MC protocol set</b>  |                               |                         |             |                         |                  |            |
| 8-40                            | Telegram Selection            | [1] Standard telegram 1 | 2 set-ups   | TRUE                    | -                | Uint8      |
| <b>8-5* Digital/Bus</b>         |                               |                         |             |                         |                  |            |
| 8-50                            | Coasting 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              | null                    | 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      |
| <b>8-7* BACnet</b>              |                               |                         |             |                         |                  |            |
| 8-70                            | BACnet Device Instance        | 1 N/A                   | 1 set-up    | TRUE                    | 0                | Uint32     |
| 8-72                            | MS/TP Max Masters             | 127 N/A                 | 1 set-up    | TRUE                    | 0                | Uint8      |
| 8-73                            | MS/TP Max Info Frames         | 1 N/A                   | 1 set-up    | TRUE                    | 0                | Uint16     |
| 8-74                            | "I-Am" Service                | [0] Send at power-up    | 1 set-up    | TRUE                    | -                | Uint8      |
| 8-75                            | Initialisation Password       | ExpressionLimit         | 1 set-up    | TRUE                    | 0                | VisStr[20] |
| <b>8-8* FC Port Diagnostics</b> |                               |                         |             |                         |                  |            |
| 8-80                            | Bus Message Count             | 0 N/A                   | All set-ups | TRUE                    | 0                | Uint32     |
| 8-81                            | Bus Error Count               | 0 N/A                   | All set-ups | TRUE                    | 0                | Uint32     |
| 8-82                            | Slave Message Rcvd            | 0 N/A                   | All set-ups | TRUE                    | 0                | Uint32     |
| 8-83                            | Slave Error Count             | 0 N/A                   | All set-ups | TRUE                    | 0                | Uint32     |
| <b>8-9* Bus Jog / Feedback</b>  |                               |                         |             |                         |                  |            |
| 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     |
| 8-94                            | Bus Feedback 1                | 0 N/A                   | 1 set-up    | TRUE                    | 0                | N2         |
| 8-95                            | Bus Feedback 2                | 0 N/A                   | 1 set-up    | TRUE                    | 0                | N2         |
| 8-96                            | Bus Feedback 3                | 0 N/A                   | 1 set-up    | TRUE                    | 0                | N2         |

**5.3.10 Profibus 9 - \* \***

| Par. No. # | Parameter description     | Default value            | 4-set-up    | Change during operation | Conversion 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   | ExpressionLimit          | 2 set-ups   | TRUE                    | -                | Uint16    |
| 9-16       | PCD Read Configuration    | ExpressionLimit          | 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                   | -                | Uint16    |
| 9-28       | Process Control           | [1] Enable cyclic master | 2 set-ups   | FALSE                   | -                | Uint8     |
| 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 Number              | 0 N/A                    | All set-ups | TRUE                    | 0                | Uint16    |
| 9-52       | Fault Situation Counter   | 0 N/A                    | All set-ups | TRUE                    | 0                | Uint16    |
| 9-53       | Profibus Warning Word     | 0 N/A                    | All set-ups | TRUE                    | 0                | Uint16    |
| 9-64       | Actual Baud Rate          | 0 N/A                    | All set-ups | TRUE                    | 0                | V2        |
| 9-63       | Device Identification     | [255] No baudrate found  | All set-ups | TRUE                    | -                | Uint8     |
| 9-65       | Profile Number            | 0 N/A                    | All set-ups | TRUE                    | 0                | Uint16    |
| 9-67       | Control Word 1            | 0 N/A                    | All set-ups | TRUE                    | 0                | OctStr[2] |
| 9-68       | Status Word 1             | 0 N/A                    | All set-ups | TRUE                    | 0                | V2        |
| 9-71       | Profibus Save Data Values | [0] Off                  | All set-ups | TRUE                    | -                | Uint8     |
| 9-72       | ProfibusDriveReset        | [0] No action            | 1 set-up    | FALSE                   | -                | Uint8     |
| 9-80       | Defined Parameters (1)    | 0 N/A                    | All set-ups | FALSE                   | 0                | Uint16    |
| 9-81       | Defined Parameters (2)    | 0 N/A                    | All set-ups | FALSE                   | 0                | Uint16    |
| 9-82       | Defined Parameters (3)    | 0 N/A                    | All set-ups | FALSE                   | 0                | Uint16    |
| 9-83       | Defined Parameters (4)    | 0 N/A                    | All set-ups | FALSE                   | 0                | Uint16    |
| 9-84       | Defined Parameters (5)    | 0 N/A                    | All set-ups | FALSE                   | 0                | Uint16    |
| 9-90       | Changed Parameters (1)    | 0 N/A                    | All set-ups | FALSE                   | 0                | Uint16    |
| 9-91       | Changed Parameters (2)    | 0 N/A                    | All set-ups | FALSE                   | 0                | Uint16    |
| 9-92       | Changed Parameters (3)    | 0 N/A                    | All set-ups | FALSE                   | 0                | Uint16    |
| 9-93       | Changed Parameters (4)    | 0 N/A                    | All set-ups | FALSE                   | 0                | Uint16    |
| 9-94       | Changed Parameters (5)    | 0 N/A                    | All set-ups | FALSE                   | 0                | Uint16    |



**5.3.11 CAN Fieldbus 10- \*\***

| Par. No. #                    | Parameter description          | Default value   | 4-set-up    | Change during operation | Conversion index | Type   |
|-------------------------------|--------------------------------|-----------------|-------------|-------------------------|------------------|--------|
| <b>10-0* Common Settings</b>  |                                |                 |             |                         |                  |        |
| 10-00                         | CAN Protocol                   | null            | 2 set-ups   | FALSE                   | -                | Uint8  |
| 10-01                         | Baud Rate Select               | null            | 2 set-ups   | TRUE                    | -                | Uint8  |
| 10-02                         | MAC ID                         | ExpressionLimit | 2 set-ups   | TRUE                    | 0                | Uint8  |
| 10-05                         | Readout Transmit Error Counter | 0 N/A           | All set-ups | TRUE                    | 0                | Uint8  |
| 10-06                         | Readout Receive Error Counter  | 0 N/A           | All set-ups | TRUE                    | 0                | Uint8  |
| 10-07                         | Readout Bus Off Counter        | 0 N/A           | All set-ups | TRUE                    | 0                | Uint8  |
| <b>10-1* DeviceNet</b>        |                                |                 |             |                         |                  |        |
| 10-10                         | Process Data Type Selection    | null            | All set-ups | TRUE                    | -                | Uint8  |
| 10-11                         | Process Data Config Write      | ExpressionLimit | 2 set-ups   | TRUE                    | -                | Uint16 |
| 10-12                         | Process Data Config Read       | ExpressionLimit | 2 set-ups   | TRUE                    | -                | Uint16 |
| 10-13                         | Warning Parameter              | 0 N/A           | All set-ups | TRUE                    | 0                | Uint16 |
| 10-14                         | Net Reference                  | [0] Off         | 2 set-ups   | TRUE                    | -                | Uint8  |
| 10-15                         | Net Control                    | [0] Off         | 2 set-ups   | TRUE                    | -                | Uint8  |
| <b>10-2* COS Filters</b>      |                                |                 |             |                         |                  |        |
| 10-20                         | COS Filter 1                   | 0 N/A           | All set-ups | FALSE                   | 0                | Uint16 |
| 10-21                         | COS Filter 2                   | 0 N/A           | All set-ups | FALSE                   | 0                | Uint16 |
| 10-22                         | COS Filter 3                   | 0 N/A           | All set-ups | FALSE                   | 0                | Uint16 |
| 10-23                         | COS Filter 4                   | 0 N/A           | All set-ups | FALSE                   | 0                | Uint16 |
| <b>10-3* Parameter Access</b> |                                |                 |             |                         |                  |        |
| 10-30                         | Array Index                    | 0 N/A           | 2 set-ups   | TRUE                    | 0                | Uint8  |
| 10-31                         | Store Data Values              | [0] Off         | All set-ups | TRUE                    | -                | Uint8  |
| 10-32                         | DeviceNet Revision             | ExpressionLimit | All set-ups | TRUE                    | 0                | Uint16 |
| 10-33                         | Store Always                   | [0] Off         | 1 set-up    | TRUE                    | -                | Uint8  |
| 10-34                         | DeviceNet Product Code         | 130 N/A         | 1 set-up    | TRUE                    | 0                | Uint16 |
| 10-39                         | DeviceNet F Parameters         | 0 N/A           | All set-ups | TRUE                    | 0                | Uint32 |

### 5.3.12 Smart Logic 13-.\*

| Par. No. #                | Parameter description | Default value        | 4-set-up    | Change during operation | Conversion index | Type  |
|---------------------------|-----------------------|----------------------|-------------|-------------------------|------------------|-------|
| <b>13-0* SLC Settings</b> |                       |                      |             |                         |                  |       |
| 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 |
| <b>13-1* Comparators</b>  |                       |                      |             |                         |                  |       |
| 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 |
| <b>13-2* Timers</b>       |                       |                      |             |                         |                  |       |
| 13-20                     | SL Controller Timer   | ExpressionLimit      | 1 set-up    | TRUE                    | -3               | TimD  |
| <b>13-4* Logic Rules</b>  |                       |                      |             |                         |                  |       |
| 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 |
| <b>13-5* States</b>       |                       |                      |             |                         |                  |       |
| 13-51                     | SL Controller Event   | null                 | 2 set-ups   | TRUE                    | -                | Uint8 |
| 13-52                     | SL Controller Action  | null                 | 2 set-ups   | TRUE                    | -                | Uint8 |

**5.3.13 Special Functions 14- \*\***

| Par. No. #                       | Parameter description               | Default value             | 4-set-up    | Change during operation | Conversion index | Type   |
|----------------------------------|-------------------------------------|---------------------------|-------------|-------------------------|------------------|--------|
| <b>14-0* Inverter Switching</b>  |                                     |                           |             |                         |                  |        |
| 14-00                            | Switching Pattern                   | null                      | All set-ups | TRUE                    | -                | Uint8  |
| 14-01                            | Switching Frequency                 | null                      | All set-ups | TRUE                    | -                | Uint8  |
| 14-03                            | Overmodulation                      | [1] On                    | All set-ups | FALSE                   | -                | Uint8  |
| 14-04                            | PWM Random                          | [0] Off                   | All set-ups | TRUE                    | -                | Uint8  |
| <b>14-1* Mains On/Off</b>        |                                     |                           |             |                         |                  |        |
| 14-10                            | Mains Failure                       | [0] No function           | All set-ups | FALSE                   | -                | Uint8  |
| 14-11                            | Mains Voltage at Mains Fault        | ExpressionLimit           | All set-ups | TRUE                    | 0                | Uint16 |
| 14-12                            | Function at Mains Imbalance         | [3] Derate                | All set-ups | TRUE                    | -                | Uint8  |
| <b>14-2* Reset Functions</b>     |                                     |                           |             |                         |                  |        |
| 14-20                            | Reset Mode                          | [10] Automatic reset x 10 | All set-ups | TRUE                    | -                | Uint8  |
| 14-21                            | Automatic Restart Time              | 10 s                      | All set-ups | TRUE                    | 0                | Uint16 |
| 14-22                            | Operation Mode                      | [0] Normal operation      | All set-ups | TRUE                    | -                | Uint8  |
| 14-23                            | Typecode Setting                    | null                      | 2 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        | ExpressionLimit           | 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  |
| <b>14-3* Current Limit Ctrl.</b> |                                     |                           |             |                         |                  |        |
| 14-30                            | Current Lim Ctrl, Proportional Gain | 100 %                     | All set-ups | FALSE                   | 0                | Uint16 |
| 14-31                            | Current Lim Ctrl, Integration Time  | 0.020 s                   | All set-ups | FALSE                   | -3               | Uint16 |
| <b>14-4* Energy Optimising</b>   |                                     |                           |             |                         |                  |        |
| 14-40                            | VT Level                            | 66 %                      | All set-ups | FALSE                   | 0                | Uint8  |
| 14-41                            | AEO Minimum Magnetisation           | ExpressionLimit           | All set-ups | TRUE                    | 0                | Uint8  |
| 14-42                            | Minimum AEO Frequency               | 10 Hz                     | All set-ups | TRUE                    | 0                | Uint8  |
| 14-43                            | Motor Cosphi                        | ExpressionLimit           | All set-ups | TRUE                    | -2               | Uint16 |
| <b>14-5* Environment</b>         |                                     |                           |             |                         |                  |        |
| 14-50                            | RFI Filter                          | [1] On                    | 1 set-up    | 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  |
| 14-59                            | Actual Number of Inverter Units     | ExpressionLimit           | 1 set-up    | FALSE                   | 0                | Uint8  |
| <b>14-6* Auto Derate</b>         |                                     |                           |             |                         |                  |        |
| 14-60                            | Function at Over Temperature        | [1] Derate                | All set-ups | TRUE                    | -                | Uint8  |
| 14-61                            | Function at Inverter Overload       | [1] Derate                | All set-ups | TRUE                    | -                | Uint8  |
| 14-62                            | Inv. Overload Derate Current        | 95 %                      | All set-ups | TRUE                    | 0                | Uint16 |
| <b>14-8* Options</b>             |                                     |                           |             |                         |                  |        |
| 14-80                            | Option Supplied by External 24VDC   | [0] No                    | 2 set-ups   | FALSE                   | -                | Uint8  |

**5.3.14 FC Information 15- \*\***

| Par. No. #                        | Parameter description             | Default value         | 4-set-up    | Change during operation | Conversion index | Type       |
|-----------------------------------|-----------------------------------|-----------------------|-------------|-------------------------|------------------|------------|
| <b>15-0* Operating Data</b>       |                                   |                       |             |                         |                  |            |
| 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 Up's                        | 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 Volt's                       | 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      |
| 15-08                             | Number of Starts                  | 0 N/A                 | All set-ups | FALSE                   | 0                | Uint32     |
| <b>15-1* Data Log Settings</b>    |                                   |                       |             |                         |                  |            |
| 15-10                             | Logging Source                    | 0                     | 2 set-ups   | TRUE                    | -                | Uint16     |
| 15-11                             | Logging Interval                  | ExpressionLimit       | 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      |
| <b>15-2* Historic Log</b>         |                                   |                       |             |                         |                  |            |
| 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     |
| 15-23                             | Historic Log: Date and Time       | ExpressionLimit       | All set-ups | FALSE                   | 0                | TimeOfDay  |
| <b>15-3* Alarm Log</b>            |                                   |                       |             |                         |                  |            |
| 15-30                             | Alarm Log: Error Code             | 0 N/A                 | All set-ups | FALSE                   | 0                | Uint8      |
| 15-31                             | Alarm Log: Value                  | 0 N/A                 | All set-ups | FALSE                   | 0                | Int16      |
| 15-32                             | Alarm Log: Time                   | 0 s                   | All set-ups | FALSE                   | 0                | Uint32     |
| 15-33                             | Alarm Log: Date and Time          | ExpressionLimit       | All set-ups | FALSE                   | 0                | TimeOfDay  |
| 15-34                             | Alarm Log: Setpoint               | 0.000 ProcessCtrlUnit | All set-ups | FALSE                   | -3               | Int32      |
| 15-35                             | Alarm Log: Feedback               | 0.000 ProcessCtrlUnit | All set-ups | FALSE                   | -3               | Int32      |
| 15-36                             | Alarm Log: Current Demand         | 0 %                   | All set-ups | FALSE                   | 0                | Uint8      |
| 15-37                             | Alarm Log: Process Ctrl Unit      | [0]                   | All set-ups | FALSE                   | -                | Uint8      |
| <b>15-4* Drive Identification</b> |                                   |                       |             |                         |                  |            |
| 15-40                             | FC Type                           | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[6]  |
| 15-41                             | Power Section                     | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[20] |
| 15-42                             | Voltage                           | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[20] |
| 15-43                             | Software Version                  | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[5]  |
| 15-44                             | Ordered Typecode String           | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[40] |
| 15-45                             | Actual Typecode String            | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[40] |
| 15-46                             | Frequency Converter Ordering No   | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[8]  |
| 15-47                             | Power Card Ordering No            | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[8]  |
| 15-48                             | LCP Id No                         | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[20] |
| 15-49                             | SW ID Control Card                | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[20] |
| 15-50                             | SW ID Power Card                  | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[20] |
| 15-51                             | Frequency Converter Serial Number | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[10] |
| 15-53                             | Power Card Serial Number          | 0 N/A                 | All set-ups | FALSE                   | 0                | VisStr[19] |

| Par. No. #                  | Parameter description     | Default value | 4-set-up    | Change during operation | Conversion index | Type       |
|-----------------------------|---------------------------|---------------|-------------|-------------------------|------------------|------------|
| <b>15-6* Option Ident</b>   |                           |               |             |                         |                  |            |
| 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[18] |
| 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] |
| <b>15-9* Parameter Info</b> |                           |               |             |                         |                  |            |
| 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     |
| 15-98                       | Drive Identification      | 0 N/A         | All set-ups | FALSE                   | 0                | VisStr[40] |
| 15-99                       | Parameter Metadata        | 0 N/A         | All set-ups | FALSE                   | 0                | Uint16     |

5.3.15 Data Readouts 16- \*\*

| Par. No. #                     | Parameter description | Default value               | 4-set-up    | Change during operation | Conversion index | Type  |
|--------------------------------|-----------------------|-----------------------------|-------------|-------------------------|------------------|-------|
| <b>16-0* General Status</b>    |                       |                             |             |                         |                  |       |
| 16-00                          | Control Word          | 0 N/A                       | All set-ups | TRUE                    | 0                | V2    |
| 16-01                          | Reference [Unit]      | 0.000 ReferenceFeedbackUnit | All set-ups | TRUE                    | -3               | Int32 |
| 16-02                          | Reference [%]         | 0.0 %                       | All set-ups | TRUE                    | -1               | Int16 |
| 16-03                          | Status Word           | 0 N/A                       | All set-ups | TRUE                    | 0                | V2    |
| 16-05                          | Main Actual Value [%] | 0.00 %                      | All set-ups | TRUE                    | -2               | N2    |
| 16-09                          | Custom Readout        | 0.00 CustomReadoutUnit      | All set-ups | TRUE                    | -2               | Int32 |
| <b>16-1* Motor Status</b>      |                       |                             |             |                         |                  |       |
| 16-10                          | Power [kW]            | 0.00 kW                     | All set-ups | TRUE                    | 1                | Int32 |
| 16-11                          | Power [hp]            | 0.00 hp                     | All set-ups | TRUE                    | -2               | Int32 |
| 16-12                          | Motor Voltage         | 0.0 V                       | All set-ups | TRUE                    | -1               | Int16 |
| 16-13                          | Frequency             | 0.0 Hz                      | All set-ups | TRUE                    | -1               | Int16 |
| 16-14                          | Motor Current         | 0.00 A                      | All set-ups | TRUE                    | -2               | Int32 |
| 16-15                          | Frequency [%]         | 0.00 %                      | All set-ups | TRUE                    | -2               | N2    |
| 16-16                          | Torque [Nm]           | 0.0 Nm                      | All set-ups | TRUE                    | -1               | Int32 |
| 16-17                          | Speed [RPM]           | 0 RPM                       | All set-ups | TRUE                    | 67               | Int32 |
| 16-18                          | Motor Thermal         | 0 %                         | All set-ups | TRUE                    | 0                | Int8  |
| 16-22                          | Torque [%]            | 0 %                         | All set-ups | TRUE                    | 0                | Int16 |
| <b>16-3* Drive Status</b>      |                       |                             |             |                         |                  |       |
| 16-30                          | DC Link Voltage       | 0 V                         | All set-ups | TRUE                    | 0                | Int16 |
| 16-32                          | Brake Energy /s       | 0.000 kW                    | All set-ups | TRUE                    | 0                | Int32 |
| 16-33                          | Brake Energy /2 min   | 0.000 kW                    | All set-ups | TRUE                    | 0                | Int32 |
| 16-34                          | Heatsink Temp.        | 0 °C                        | All set-ups | TRUE                    | 100              | Int8  |
| 16-35                          | Inverter Thermal      | 0 %                         | All set-ups | TRUE                    | 0                | Int8  |
| 16-36                          | Inv. Norm. Current    | ExpressionLimit             | All set-ups | TRUE                    | -2               | Int32 |
| 16-37                          | Inv. Max. Current     | ExpressionLimit             | All set-ups | TRUE                    | -2               | Int32 |
| 16-38                          | SL Controller State   | 0 N/A                       | All set-ups | TRUE                    | 0                | Int8  |
| 16-39                          | Control Card Temp.    | 0 °C                        | All set-ups | TRUE                    | 100              | Int8  |
| 16-40                          | Logging Buffer Full   | [0] No                      | All set-ups | TRUE                    | -                | Int8  |
| <b>16-5* Ref. &amp; Feedb.</b> |                       |                             |             |                         |                  |       |
| 16-50                          | External Reference    | 0.0 N/A                     | All set-ups | TRUE                    | -1               | Int16 |
| 16-52                          | Feedback [Unit]       | 0.000 ProcessCtrlUnit       | All set-ups | TRUE                    | -3               | Int32 |
| 16-53                          | Digi Pot Reference    | 0.00 N/A                    | All set-ups | TRUE                    | -2               | Int16 |
| 16-54                          | Feedback 1 [Unit]     | 0.000 ProcessCtrlUnit       | All set-ups | TRUE                    | -3               | Int32 |
| 16-55                          | Feedback 2 [Unit]     | 0.000 ProcessCtrlUnit       | All set-ups | TRUE                    | -3               | Int32 |
| 16-56                          | Feedback 3 [Unit]     | 0.000 ProcessCtrlUnit       | All set-ups | TRUE                    | -3               | Int32 |
| 16-58                          | PID Output [%]        | 0.0 %                       | All set-ups | TRUE                    | -1               | Int16 |
| 16-59                          | Adjusted Setpoint     | 0.000 ProcessCtrlUnit       | All set-ups | TRUE                    | -3               | Int32 |

| Par. No. #                          | Parameter description      | Default value | 4-set-up    | Change during operation | Conversion index | Type   |
|-------------------------------------|----------------------------|---------------|-------------|-------------------------|------------------|--------|
| <b>16-6* Inputs &amp; Outputs</b>   |                            |               |             |                         |                  |        |
| 16-60                               | Digital Input              | 0 N/A         | All set-ups | TRUE                    | 0                | Uint16 |
| 16-61                               | Terminal 53 Switch Setting | [0] Current   | All set-ups | TRUE                    | -                | Uint8  |
| 16-62                               | Analog Input 53            | 0.000 N/A     | All set-ups | TRUE                    | -3               | Int32  |
| 16-63                               | Terminal 54 Switch Setting | [0] Current   | All set-ups | TRUE                    | -                | Uint8  |
| 16-64                               | Analog Input 54            | 0.000 N/A     | All set-ups | TRUE                    | -3               | Int32  |
| 16-65                               | Analog Output 42 [mA]      | 0.000 N/A     | All set-ups | TRUE                    | -3               | Int16  |
| 16-66                               | Digital Output [bin]       | 0 N/A         | All set-ups | TRUE                    | 0                | Int16  |
| 16-67                               | Pulse Input #29 [Hz]       | 0 N/A         | All set-ups | TRUE                    | 0                | Int32  |
| 16-68                               | Pulse Input #33 [Hz]       | 0 N/A         | All set-ups | TRUE                    | 0                | Int32  |
| 16-69                               | Pulse Output #27 [Hz]      | 0 N/A         | All set-ups | TRUE                    | 0                | Int32  |
| 16-70                               | Pulse Output #29 [Hz]      | 0 N/A         | All set-ups | TRUE                    | 0                | Int32  |
| 16-71                               | Relay Output [bin]         | 0 N/A         | All set-ups | TRUE                    | 0                | Uint16 |
| 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  |
| 16-75                               | Analog In X30/11           | 0.000 N/A     | All set-ups | TRUE                    | -3               | Int32  |
| 16-76                               | Analog In X30/12           | 0.000 N/A     | All set-ups | TRUE                    | -3               | Int32  |
| 16-77                               | Analog Out X30/8 [mA]      | 0.000 N/A     | All set-ups | TRUE                    | -3               | Int16  |
| <b>16-8* Fieldbus &amp; FC Port</b> |                            |               |             |                         |                  |        |
| 16-80                               | Fieldbus CTW 1             | 0 N/A         | All set-ups | TRUE                    | 0                | V2     |
| 16-82                               | Fieldbus REF 1             | 0 N/A         | All set-ups | TRUE                    | 0                | N2     |
| 16-84                               | Comm. Option STW           | 0 N/A         | All set-ups | TRUE                    | 0                | V2     |
| 16-85                               | FC Port CTW 1              | 0 N/A         | All set-ups | TRUE                    | 0                | V2     |
| 16-86                               | FC Port REF 1              | 0 N/A         | All set-ups | TRUE                    | 0                | N2     |
| <b>16-9* Diagnosis Readouts</b>     |                            |               |             |                         |                  |        |
| 16-90                               | Alarm Word                 | 0 N/A         | All set-ups | TRUE                    | 0                | Uint32 |
| 16-91                               | Alarm Word 2               | 0 N/A         | All set-ups | TRUE                    | 0                | Uint32 |
| 16-92                               | Warning Word               | 0 N/A         | All set-ups | TRUE                    | 0                | Uint32 |
| 16-93                               | Warning Word 2             | 0 N/A         | All set-ups | TRUE                    | 0                | Uint32 |
| 16-94                               | Ext. Status Word           | 0 N/A         | All set-ups | TRUE                    | 0                | Uint32 |
| 16-95                               | Ext. Status Word 2         | 0 N/A         | All set-ups | TRUE                    | 0                | Uint32 |
| 16-96                               | Maintenance Word           | 0 N/A         | All set-ups | TRUE                    | 0                | Uint32 |

## 5.3.16 Data Readouts 2 18-.\*

| Par. No. #                        | Parameter description          | Default value   | 4-set-up    | Change during operation | Conversion index | Type      |
|-----------------------------------|--------------------------------|-----------------|-------------|-------------------------|------------------|-----------|
| <b>18-0* Maintenance Log</b>      |                                |                 |             |                         |                  |           |
| 18-00                             | Maintenance Log: Item          | 0 N/A           | All set-ups | FALSE                   | 0                | Uint8     |
| 18-01                             | Maintenance Log: Action        | 0 N/A           | All set-ups | FALSE                   | 0                | Uint8     |
| 18-02                             | Maintenance Log: Time          | 0 s             | All set-ups | FALSE                   | 0                | Uint32    |
| 18-03                             | Maintenance Log: Date and Time | ExpressionLimit | All set-ups | FALSE                   | 0                | TimeOfDay |
| <b>18-3* Inputs &amp; Outputs</b> |                                |                 |             |                         |                  |           |
| 18-30                             | Analog Input X42/1             | 0.000 N/A       | All set-ups | FALSE                   | -3               | Int32     |
| 18-31                             | Analog Input X42/3             | 0.000 N/A       | All set-ups | FALSE                   | -3               | Int32     |
| 18-32                             | Analog Input X42/5             | 0.000 N/A       | All set-ups | FALSE                   | -3               | Int32     |
| 18-33                             | Analog Out X42/7 [V]           | 0.000 N/A       | All set-ups | FALSE                   | -3               | Int16     |
| 18-34                             | Analog Out X42/9 [V]           | 0.000 N/A       | All set-ups | FALSE                   | -3               | Int16     |
| 18-35                             | Analog Out X42/11 [V]          | 0.000 N/A       | All set-ups | FALSE                   | -3               | Int16     |



**5.3.17 FC Closed Loop 20- \*\***

| Par. No. #                      | Parameter description       | Default value               | 4-set-up    | Change during operation | Conversion index | Type   |
|---------------------------------|-----------------------------|-----------------------------|-------------|-------------------------|------------------|--------|
| <b>20-0* Feedback</b>           |                             |                             |             |                         |                  |        |
| 20-00                           | Feedback 1 Source           | [2] Analog input 54         | All set-ups | TRUE                    | -                | Uint8  |
| 20-01                           | Feedback 1 Conversion       | [0] Linear                  | All set-ups | FALSE                   | -                | Uint8  |
| 20-02                           | Feedback 1 Source Unit      | null                        | All set-ups | TRUE                    | -                | Uint8  |
| 20-03                           | Feedback 2 Source           | [0] No function             | All set-ups | TRUE                    | -                | Uint8  |
| 20-04                           | Feedback 2 Conversion       | [0] Linear                  | All set-ups | FALSE                   | -                | Uint8  |
| 20-05                           | Feedback 2 Source Unit      | null                        | All set-ups | TRUE                    | -                | Uint8  |
| 20-06                           | Feedback 3 Source           | [0] No function             | All set-ups | TRUE                    | -                | Uint8  |
| 20-07                           | Feedback 3 Conversion       | [0] Linear                  | All set-ups | FALSE                   | -                | Uint8  |
| 20-08                           | Feedback 3 Source Unit      | null                        | All set-ups | TRUE                    | -                | Uint8  |
| 20-12                           | Reference/Feedback Unit     | null                        | All set-ups | TRUE                    | -                | Uint8  |
| <b>20-2* Feedback/Setpoint</b>  |                             |                             |             |                         |                  |        |
| 20-20                           | Feedback Function           | [4] Maximum                 | All set-ups | TRUE                    | -                | Uint8  |
| 20-21                           | Setpoint 1                  | 0.000 ProcessCtrlUnit       | All set-ups | TRUE                    | -3               | Int32  |
| 20-22                           | Setpoint 2                  | 0.000 ProcessCtrlUnit       | All set-ups | TRUE                    | -3               | Int32  |
| 20-23                           | Setpoint 3                  | 0.000 ProcessCtrlUnit       | All set-ups | TRUE                    | -3               | Int32  |
| <b>20-7* PID Autotuning</b>     |                             |                             |             |                         |                  |        |
| 20-70                           | Closed Loop Type            | [0] Auto                    | 2 set-ups   | TRUE                    | -                | Uint8  |
| 20-71                           | PID Performance             | [0] Normal                  | 2 set-ups   | TRUE                    | -                | Uint8  |
| 20-72                           | PID Output Change           | 0.10 N/A                    | 2 set-ups   | TRUE                    | -2               | Uint16 |
| 20-73                           | Minimum Feedback Level      | -999999.000 ProcessCtrlUnit | 2 set-ups   | TRUE                    | -3               | Int32  |
| 20-74                           | Maximum Feedback Level      | 999999.000 ProcessCtrlUnit  | 2 set-ups   | TRUE                    | -3               | Int32  |
| 20-79                           | PID Autotuning              | [0] Disabled                | All set-ups | TRUE                    | -                | Uint8  |
| <b>20-8* PID Basic Settings</b> |                             |                             |             |                         |                  |        |
| 20-81                           | PID Normal/ Inverse Control | [0] Normal                  | All set-ups | TRUE                    | -                | Uint8  |
| 20-82                           | PID Start Speed [RPM]       | ExpressionLimit             | All set-ups | TRUE                    | 67               | Uint16 |
| 20-83                           | PID Start Speed [Hz]        | ExpressionLimit             | All set-ups | TRUE                    | -1               | Uint16 |
| 20-84                           | On Reference Bandwidth      | 5 %                         | All set-ups | TRUE                    | 0                | Uint8  |
| <b>20-9* PID Controller</b>     |                             |                             |             |                         |                  |        |
| 20-91                           | PID Anti Windup             | [1] On                      | All set-ups | TRUE                    | -                | Uint8  |
| 20-93                           | PID Proportional Gain       | 2.00 N/A                    | All set-ups | TRUE                    | -2               | Uint16 |
| 20-94                           | PID Integral Time           | 8.00 s                      | All set-ups | TRUE                    | -2               | Uint32 |
| 20-95                           | PID Differentiation Time    | 0.00 s                      | All set-ups | TRUE                    | -2               | Uint16 |
| 20-96                           | PID Diff. Gain Limit        | 5.0 N/A                     | All set-ups | TRUE                    | -1               | Uint16 |

## 5.3.18 Ext. Closed Loop 21-.\*

| Par. No. #                      | Parameter description         | Default value       | 4-set-up    | Change during operation | Conversion index | Type   |
|---------------------------------|-------------------------------|---------------------|-------------|-------------------------|------------------|--------|
| <b>21-0* Ext. CL Autotuning</b> |                               |                     |             |                         |                  |        |
| 21-00                           | Closed Loop Type              | [0] Auto            | 2 set-ups   | TRUE                    | -                | Uint8  |
| 21-01                           | PID Performance               | [0] Normal          | 2 set-ups   | TRUE                    | -                | Uint8  |
| 21-02                           | PID Output Change             | 0.10 N/A            | 2 set-ups   | TRUE                    | -2               | Uint16 |
| 21-03                           | Minimum Feedback Level        | -999999.000 N/A     | 2 set-ups   | TRUE                    | -3               | Int32  |
| 21-04                           | Maximum Feedback Level        | 999999.000 N/A      | 2 set-ups   | TRUE                    | -3               | Int32  |
| 21-09                           | PID Auto Tuning               | [0] Disabled        | All set-ups | TRUE                    | -                | Uint8  |
| <b>21-1* Ext. CL 1 Ref./Fb.</b> |                               |                     |             |                         |                  |        |
| 21-10                           | Ext. 1 Ref./Feedback Unit     | [0]                 | All set-ups | TRUE                    | -                | Uint8  |
| 21-11                           | Ext. 1 Minimum Reference      | 0.000 ExtPID1Unit   | All set-ups | TRUE                    | -3               | Int32  |
| 21-12                           | Ext. 1 Maximum Reference      | 100.000 ExtPID1Unit | All set-ups | TRUE                    | -3               | Int32  |
| 21-13                           | Ext. 1 Reference Source       | [0] No function     | All set-ups | TRUE                    | -                | Uint8  |
| 21-14                           | Ext. 1 Feedback Source        | [0] No function     | All set-ups | TRUE                    | -                | Uint8  |
| 21-15                           | Ext. 1 Setpoint               | 0.000 ExtPID1Unit   | All set-ups | TRUE                    | -3               | Int32  |
| 21-17                           | Ext. 1 Reference [Unit]       | 0.000 ExtPID1Unit   | All set-ups | TRUE                    | -3               | Int32  |
| 21-18                           | Ext. 1 Feedback [Unit]        | 0.000 ExtPID1Unit   | All set-ups | TRUE                    | -3               | Int32  |
| 21-19                           | Ext. 1 Output [%]             | 0 %                 | All set-ups | TRUE                    | 0                | Int32  |
| <b>21-2* Ext. CL 1 PID</b>      |                               |                     |             |                         |                  |        |
| 21-20                           | Ext. 1 Normal/Inverse Control | [0] Normal          | All set-ups | TRUE                    | -                | Uint8  |
| 21-21                           | Ext. 1 Proportional Gain      | 0.50 N/A            | All set-ups | TRUE                    | -2               | Uint16 |
| 21-22                           | Ext. 1 Integral Time          | 20.00 s             | All set-ups | TRUE                    | -2               | Uint32 |
| 21-23                           | Ext. 1 Differentiation Time   | 0.00 s              | All set-ups | TRUE                    | -2               | Uint16 |
| 21-24                           | Ext. 1 Dif. Gain Limit        | 5.0 N/A             | All set-ups | TRUE                    | -1               | Uint16 |
| <b>21-3* Ext. CL 2 Ref./Fb.</b> |                               |                     |             |                         |                  |        |
| 21-30                           | Ext. 2 Ref./Feedback Unit     | [0]                 | All set-ups | TRUE                    | -                | Uint8  |
| 21-31                           | Ext. 2 Minimum Reference      | 0.000 ExtPID2Unit   | All set-ups | TRUE                    | -3               | Int32  |
| 21-32                           | Ext. 2 Maximum Reference      | 100.000 ExtPID2Unit | All set-ups | TRUE                    | -3               | Int32  |
| 21-33                           | Ext. 2 Reference Source       | [0] No function     | All set-ups | TRUE                    | -                | Uint8  |
| 21-34                           | Ext. 2 Feedback Source        | [0] No function     | All set-ups | TRUE                    | -                | Uint8  |
| 21-35                           | Ext. 2 Setpoint               | 0.000 ExtPID2Unit   | All set-ups | TRUE                    | -3               | Int32  |
| 21-37                           | Ext. 2 Reference [Unit]       | 0.000 ExtPID2Unit   | All set-ups | TRUE                    | -3               | Int32  |
| 21-38                           | Ext. 2 Feedback [Unit]        | 0.000 ExtPID2Unit   | All set-ups | TRUE                    | -3               | Int32  |
| 21-39                           | Ext. 2 Output [%]             | 0 %                 | All set-ups | TRUE                    | 0                | Int32  |
| <b>21-4* Ext. CL 2 PID</b>      |                               |                     |             |                         |                  |        |
| 21-40                           | Ext. 2 Normal/Inverse Control | [0] Normal          | All set-ups | TRUE                    | -                | Uint8  |
| 21-41                           | Ext. 2 Proportional Gain      | 0.50 N/A            | All set-ups | TRUE                    | -2               | Uint16 |
| 21-42                           | Ext. 2 Integral Time          | 20.00 s             | All set-ups | TRUE                    | -2               | Uint32 |
| 21-43                           | Ext. 2 Differentiation Time   | 0.00 s              | All set-ups | TRUE                    | -2               | Uint16 |
| 21-44                           | Ext. 2 Dif. Gain Limit        | 5.0 N/A             | All set-ups | TRUE                    | -1               | Uint16 |

| Par. No. #   | Parameter description         | Default value       | 4-set-up    | Change during operation | Conversion index | Type   |
|--------------|-------------------------------|---------------------|-------------|-------------------------|------------------|--------|
| <b>21-5*</b> | <b>Ext. CL 3 Ref./Fb.</b>     |                     |             |                         |                  |        |
| 21-50        | Ext. 3 Ref./Feedback Unit     | [0]                 | All set-ups | TRUE                    | -                | Uint8  |
| 21-51        | Ext. 3 Minimum Reference      | 0.000 ExtPID3Unit   | All set-ups | TRUE                    | -3               | Int32  |
| 21-52        | Ext. 3 Maximum Reference      | 100.000 ExtPID3Unit | All set-ups | TRUE                    | -3               | Int32  |
| 21-53        | Ext. 3 Reference Source       | [0] No function     | All set-ups | TRUE                    | -                | Uint8  |
| 21-54        | Ext. 3 Feedback Source        | [0] No function     | All set-ups | TRUE                    | -                | Uint8  |
| 21-55        | Ext. 3 Setpoint               | 0.000 ExtPID3Unit   | All set-ups | TRUE                    | -3               | Int32  |
| 21-57        | Ext. 3 Reference [Unit]       | 0.000 ExtPID3Unit   | All set-ups | TRUE                    | -3               | Int32  |
| 21-58        | Ext. 3 Feedback [Unit]        | 0.000 ExtPID3Unit   | All set-ups | TRUE                    | -3               | Int32  |
| 21-59        | Ext. 3 Output [%]             | 0 %                 | All set-ups | TRUE                    | 0                | Int32  |
| <b>21-6*</b> | <b>Ext. CL 3 PID</b>          |                     |             |                         |                  |        |
| 21-60        | Ext. 3 Normal/Inverse Control | [0] Normal          | All set-ups | TRUE                    | -                | Uint8  |
| 21-61        | Ext. 3 Proportional Gain      | 0.50 N/A            | All set-ups | TRUE                    | -2               | Uint16 |
| 21-62        | Ext. 3 Integral Time          | 20.00 s             | All set-ups | TRUE                    | -2               | Uint32 |
| 21-63        | Ext. 3 Differentiation Time   | 0.00 s              | All set-ups | TRUE                    | -2               | Uint16 |
| 21-64        | Ext. 3 Dif. Gain Limit        | 5.0 N/A             | All set-ups | TRUE                    | -1               | Uint16 |

5.3.19 Application Functions 22-\*. \*

| Par. No. #                          | Parameter description      | Default value                      | 4-set-up    | Change during operation | Conversion index | Type   |
|-------------------------------------|----------------------------|------------------------------------|-------------|-------------------------|------------------|--------|
| <b>22-0* Miscellaneous</b>          |                            |                                    |             |                         |                  |        |
| 22-00                               | External Interlock Delay   | 0 s                                | All set-ups | TRUE                    | 0                | Uint16 |
| <b>22-2* No-Flow Detection</b>      |                            |                                    |             |                         |                  |        |
| 22-20                               | Low Power Auto Set-up      | [0] Off                            | All set-ups | FALSE                   | -                | Uint8  |
| 22-21                               | Low Power Detection        | [0] Disabled                       | All set-ups | TRUE                    | -                | Uint8  |
| 22-22                               | Low Speed Detection        | [0] Disabled                       | All set-ups | TRUE                    | -                | Uint8  |
| 22-23                               | No-Flow Function           | [0] Off                            | All set-ups | TRUE                    | -                | Uint8  |
| 22-24                               | No-Flow Delay              | 10 s                               | All set-ups | TRUE                    | 0                | Uint16 |
| 22-26                               | Dry Pump Function          | [0] Off                            | All set-ups | TRUE                    | -                | Uint8  |
| 22-27                               | Dry Pump Delay             | 10 s                               | All set-ups | TRUE                    | 0                | Uint16 |
| <b>22-3* No-Flow Power Tuning</b>   |                            |                                    |             |                         |                  |        |
| 22-30                               | No-Flow Power              | 0.00 kW                            | All set-ups | TRUE                    | 1                | Uint32 |
| 22-31                               | Power Correction Factor    | 100 %                              | All set-ups | TRUE                    | 0                | Uint16 |
| 22-32                               | Low Speed [RPM]            | ExpressionLimit                    | All set-ups | TRUE                    | 67               | Uint16 |
| 22-33                               | Low Speed [Hz]             | ExpressionLimit                    | All set-ups | TRUE                    | -1               | Uint16 |
| 22-34                               | Low Speed Power [kW]       | ExpressionLimit                    | All set-ups | TRUE                    | 1                | Uint32 |
| 22-35                               | Low Speed Power [HP]       | ExpressionLimit                    | All set-ups | TRUE                    | -2               | Uint32 |
| 22-36                               | High Speed [RPM]           | ExpressionLimit                    | All set-ups | TRUE                    | 67               | Uint16 |
| 22-37                               | High Speed [Hz]            | ExpressionLimit                    | All set-ups | TRUE                    | -1               | Uint16 |
| 22-38                               | High Speed Power [kW]      | ExpressionLimit                    | All set-ups | TRUE                    | 1                | Uint32 |
| 22-39                               | High Speed Power [HP]      | ExpressionLimit                    | All set-ups | TRUE                    | -2               | Uint32 |
| <b>22-4* Sleep Mode</b>             |                            |                                    |             |                         |                  |        |
| 22-40                               | Minimum Run Time           | 60 s                               | All set-ups | TRUE                    | 0                | Uint16 |
| 22-41                               | Minimum Sleep Time         | 30 s                               | All set-ups | TRUE                    | 0                | Uint16 |
| 22-42                               | Wake-up Speed [RPM]        | ExpressionLimit                    | All set-ups | TRUE                    | 67               | Uint16 |
| 22-43                               | Wake-up Speed [Hz]         | ExpressionLimit                    | All set-ups | TRUE                    | -1               | Uint16 |
| 22-44                               | Wake-up Ref./FB Difference | 10 %                               | All set-ups | TRUE                    | 0                | Int8   |
| 22-45                               | Setpoint Boost             | 0 %                                | All set-ups | TRUE                    | 0                | Int8   |
| 22-46                               | Maximum Boost Time         | 60 s                               | All set-ups | TRUE                    | 0                | Uint16 |
| <b>22-5* End of Curve</b>           |                            |                                    |             |                         |                  |        |
| 22-50                               | End of Curve Function      | [0] Off                            | All set-ups | TRUE                    | -                | Uint8  |
| 22-51                               | End of Curve Delay         | 10 s                               | All set-ups | TRUE                    | 0                | Uint16 |
| <b>22-6* Broken Belt Detection</b>  |                            |                                    |             |                         |                  |        |
| 22-60                               | Broken Belt Function       | [0] Off                            | All set-ups | TRUE                    | -                | Uint8  |
| 22-61                               | Broken Belt Torque         | 10 %                               | All set-ups | TRUE                    | 0                | Uint8  |
| 22-62                               | Broken Belt Delay          | 10 s                               | All set-ups | TRUE                    | 0                | Uint16 |
| <b>22-7* Short Cycle Protection</b> |                            |                                    |             |                         |                  |        |
| 22-75                               | Short Cycle Protection     | [0] Disabled                       | All set-ups | TRUE                    | -                | Uint8  |
| 22-76                               | Interval between Starts    | start_to_start_min_on_time (P2277) | All set-ups | TRUE                    | 0                | Uint16 |
| 22-77                               | Minimum Run Time           | 0 s                                | All set-ups | TRUE                    | 0                | Uint16 |

| Par. No. #                     | Parameter description             | Default value   | 4-set-up    | Change during operation | Conversion index | Type   |
|--------------------------------|-----------------------------------|-----------------|-------------|-------------------------|------------------|--------|
| <b>22-8* Flow Compensation</b> |                                   |                 |             |                         |                  |        |
| 22-80                          | Flow Compensation                 | [0] Disabled    | All set-ups | TRUE                    | -                | UInt8  |
| 22-81                          | Square-linear Curve Approximation | 100 %           | All set-ups | TRUE                    | 0                | UInt8  |
| 22-82                          | Work Point Calculation            | [0] Disabled    | All set-ups | TRUE                    | -                | UInt8  |
| 22-83                          | Speed at No-Flow [RPM]            | ExpressionLimit | All set-ups | TRUE                    | 67               | UInt16 |
| 22-84                          | Speed at No-Flow [Hz]             | ExpressionLimit | All set-ups | TRUE                    | -1               | UInt16 |
| 22-85                          | Speed at Design Point [RPM]       | ExpressionLimit | All set-ups | TRUE                    | 67               | UInt16 |
| 22-86                          | Speed at Design Point [Hz]        | ExpressionLimit | All set-ups | TRUE                    | -1               | UInt16 |
| 22-87                          | Pressure at No-Flow Speed         | 0.000 N/A       | All set-ups | TRUE                    | -3               | Int32  |
| 22-88                          | Pressure at Rated Speed           | 999999.999 N/A  | All set-ups | TRUE                    | -3               | Int32  |
| 22-89                          | Flow at Design Point              | 0.000 N/A       | All set-ups | TRUE                    | -3               | Int32  |
| 22-90                          | Flow at Rated Speed               | 0.000 N/A       | All set-ups | TRUE                    | -3               | Int32  |

**5.3.20 Timed Actions 23-.\* \***

| Par. No. #                     | Parameter description     | Default value      | 4-set-up    | Change during operation | Conversion index | Type                 |
|--------------------------------|---------------------------|--------------------|-------------|-------------------------|------------------|----------------------|
| <b>23-0* Timed Actions</b>     |                           |                    |             |                         |                  |                      |
| 23-00                          | ON Time                   | ExpressionLimit    | 2 set-ups   | TRUE                    | 0                | TimeOfDay-<br>WoDate |
| 23-01                          | ON Action                 | [0] Disabled       | 2 set-ups   | TRUE                    | -                | Uint8                |
| 23-02                          | OFF Time                  | ExpressionLimit    | 2 set-ups   | TRUE                    | 0                | TimeOfDay-<br>WoDate |
| 23-03                          | OFF Action                | [0] Disabled       | 2 set-ups   | TRUE                    | -                | Uint8                |
| 23-04                          | Occurrence                | [0] All days       | 2 set-ups   | TRUE                    | -                | Uint8                |
| <b>23-1* Maintenance</b>       |                           |                    |             |                         |                  |                      |
| 23-10                          | Maintenance Item          | [1] Motor bearings | 1 set-up    | TRUE                    | -                | Uint8                |
| 23-11                          | Maintenance Action        | [1] Lubricate      | 1 set-up    | TRUE                    | -                | Uint8                |
| 23-12                          | Maintenance Time Base     | [0] Disabled       | 1 set-up    | TRUE                    | -                | Uint8                |
| 23-13                          | Maintenance Time Interval | 1 h                | 1 set-up    | TRUE                    | 74               | Uint32               |
| 23-14                          | Maintenance Date and Time | ExpressionLimit    | 1 set-up    | TRUE                    | 0                | TimeOfDay            |
| <b>23-1* Maintenance Reset</b> |                           |                    |             |                         |                  |                      |
| 23-15                          | Reset Maintenance Word    | [0] Do not reset   | All set-ups | TRUE                    | -                | Uint8                |
| 23-16                          | Maintenance Text          | 0 N/A              | 1 set-up    | TRUE                    | 0                | VisStr[20]           |
| <b>23-5* Energy Log</b>        |                           |                    |             |                         |                  |                      |
| 23-50                          | Energy Log Resolution     | [5] Last 24 Hours  | 2 set-ups   | TRUE                    | -                | Uint8                |
| 23-51                          | Period Start              | ExpressionLimit    | 2 set-ups   | TRUE                    | 0                | TimeOfDay            |
| 23-53                          | Energy Log                | 0 N/A              | All set-ups | TRUE                    | 0                | Uint32               |
| 23-54                          | Reset Energy Log          | [0] Do not reset   | All set-ups | TRUE                    | -                | Uint8                |
| <b>23-6* Trending</b>          |                           |                    |             |                         |                  |                      |
| 23-60                          | Trend Variable            | [0] Power [kW]     | 2 set-ups   | TRUE                    | -                | Uint8                |
| 23-61                          | Continuous Bin Data       | 0 N/A              | All set-ups | TRUE                    | 0                | Uint32               |
| 23-62                          | Timed Bin Data            | 0 N/A              | All set-ups | TRUE                    | 0                | Uint32               |
| 23-63                          | Timed Period Start        | ExpressionLimit    | 2 set-ups   | TRUE                    | 0                | TimeOfDay            |
| 23-64                          | Timed Period Stop         | ExpressionLimit    | 2 set-ups   | TRUE                    | 0                | TimeOfDay            |
| 23-65                          | Minimum Bin Value         | ExpressionLimit    | 2 set-ups   | TRUE                    | 0                | Uint8                |
| 23-66                          | Reset Continuous Bin Data | [0] Do not reset   | All set-ups | TRUE                    | -                | Uint8                |
| 23-67                          | Reset Timed Bin Data      | [0] Do not reset   | All set-ups | TRUE                    | -                | Uint8                |
| <b>23-8* Payback Counter</b>   |                           |                    |             |                         |                  |                      |
| 23-80                          | Power Reference Factor    | 100 %              | 2 set-ups   | TRUE                    | 0                | Uint8                |
| 23-81                          | Energy Cost               | 1.00 N/A           | 2 set-ups   | TRUE                    | -2               | Uint32               |
| 23-82                          | Investment                | 0 N/A              | 2 set-ups   | TRUE                    | 0                | Uint32               |
| 23-83                          | Energy Savings            | 0 kWh              | All set-ups | TRUE                    | 75               | Int32                |
| 23-84                          | Cost Savings              | 0 N/A              | All set-ups | TRUE                    | 0                | Int32                |

5.3.21 Cascade Controller 25-\*\*

| Par. No. #                        | Parameter description       | Default value                   | 4-set-up    | Change during operation | Conversion index | Type                              |
|-----------------------------------|-----------------------------|---------------------------------|-------------|-------------------------|------------------|-----------------------------------|
| <b>25-0* System Settings</b>      |                             |                                 |             |                         |                  |                                   |
| 25-00                             | Cascade Controller          | null                            | 2 set-ups   | FALSE                   | -                | Uint8                             |
| 25-02                             | Motor Start                 | [0] Direct on Line              | 2 set-ups   | FALSE                   | -                | Uint8                             |
| 25-04                             | Pump Cycling                | null                            | All set-ups | TRUE                    | -                | Uint8                             |
| 25-05                             | Fixed Lead Pump             | null                            | 2 set-ups   | FALSE                   | -                | Uint8                             |
| 25-06                             | Number of Pumps             | 2 N/A                           | 2 set-ups   | FALSE                   | 0                | Uint8                             |
| <b>25-2* Bandwidth Settings</b>   |                             |                                 |             |                         |                  |                                   |
| 25-20                             | Staging Bandwidth           | ExpressionLimit                 | All set-ups | TRUE                    | 0                | Uint8                             |
| 25-21                             | Override Bandwidth          | 100 %                           | All set-ups | TRUE                    | 0                | Uint8                             |
| 25-22                             | Fixed Speed Bandwidth       | casco_staging_bandwidth (P2520) | All set-ups | TRUE                    | 0                | Uint8                             |
| 25-23                             | SBW Staging Delay           | 15 s                            | All set-ups | TRUE                    | 0                | Uint16                            |
| 25-24                             | SBW Destaging Delay         | 15 s                            | All set-ups | TRUE                    | 0                | Uint16                            |
| 25-25                             | OBW Time                    | 10 s                            | All set-ups | TRUE                    | 0                | Uint16                            |
| 25-26                             | Destage At No-Flow          | [0] Disabled                    | All set-ups | TRUE                    | -                | Uint8                             |
| 25-27                             | Stage Function              | null                            | All set-ups | TRUE                    | -                | Uint8                             |
| 25-28                             | Stage Function Time         | 15 s                            | All set-ups | TRUE                    | 0                | Uint16                            |
| 25-29                             | Destage Function            | null                            | All set-ups | TRUE                    | -                | Uint8                             |
| 25-30                             | Destage Function Time       | 15 s                            | All set-ups | TRUE                    | 0                | Uint16                            |
| <b>25-4* Staging Settings</b>     |                             |                                 |             |                         |                  |                                   |
| 25-40                             | Ramp Down Delay             | 10.0 s                          | All set-ups | TRUE                    | -1               | Uint16                            |
| 25-41                             | Ramp Up Delay               | 2.0 s                           | All set-ups | TRUE                    | -1               | Uint16                            |
| 25-42                             | Staging Threshold           | ExpressionLimit                 | All set-ups | TRUE                    | 0                | Uint8                             |
| 25-43                             | Destaging Threshold         | ExpressionLimit                 | All set-ups | TRUE                    | 0                | Uint8                             |
| 25-44                             | Staging Speed [RPM]         | 0 RPM                           | All set-ups | TRUE                    | 67               | Uint16                            |
| 25-45                             | Staging Speed [Hz]          | 0.0 Hz                          | All set-ups | TRUE                    | -1               | Uint16                            |
| 25-46                             | Destaging Speed [RPM]       | 0 RPM                           | All set-ups | TRUE                    | 67               | Uint16                            |
| 25-47                             | Destaging Speed [Hz]        | 0.0 Hz                          | All set-ups | TRUE                    | -1               | Uint16                            |
| <b>25-5* Alternation Settings</b> |                             |                                 |             |                         |                  |                                   |
| 25-50                             | Lead Pump Alternation       | null                            | All set-ups | TRUE                    | -                | Uint8                             |
| 25-51                             | Alternation Event           | [0] External                    | All set-ups | TRUE                    | -                | Uint8                             |
| 25-52                             | Alternation Time Interval   | 24 h                            | All set-ups | TRUE                    | 74               | Uint16                            |
| 25-53                             | Alternation Timer Value     | 0 N/A                           | All set-ups | TRUE                    | 0                | VisStr[7]<br>TimeOfDay-<br>WoDate |
| 25-54                             | Alternation Predefined Time | ExpressionLimit                 | All set-ups | TRUE                    | 0                | Uint8                             |
| 25-55                             | Alternate if Load < 50%     | [1] Enabled                     | All set-ups | TRUE                    | -                | Uint8                             |
| 25-56                             | Staging Mode at Alternation | [0] Slow                        | All set-ups | TRUE                    | -                | Uint8                             |
| 25-58                             | Run Next Pump Delay         | 0.1 s                           | All set-ups | TRUE                    | -1               | Uint16                            |
| 25-59                             | Run on Mains Delay          | 0.5 s                           | All set-ups | TRUE                    | -1               | Uint16                            |

| Par. No. #           | Parameter description | Default value    | 4-set-up    | Change during operation | Conversion index | Type       |
|----------------------|-----------------------|------------------|-------------|-------------------------|------------------|------------|
| <b>25-8* Status</b>  |                       |                  |             |                         |                  |            |
| 25-80                | Cascade Status        | 0 N/A            | All set-ups | TRUE                    | 0                | VisStr[25] |
| 25-81                | Pump Status           | 0 N/A            | All set-ups | TRUE                    | 0                | VisStr[25] |
| 25-82                | Lead Pump             | 0 N/A            | All set-ups | TRUE                    | 0                | Uint8      |
| 25-83                | Relay Status          | 0 N/A            | All set-ups | TRUE                    | 0                | VisStr[4]  |
| 25-84                | Pump ON Time          | 0 h              | All set-ups | TRUE                    | 74               | Uint32     |
| 25-85                | Relay ON Time         | 0 h              | All set-ups | TRUE                    | 74               | Uint32     |
| 25-86                | Reset Relay Counters  | [0] Do not reset | All set-ups | TRUE                    | -                | Uint8      |
| <b>25-9* Service</b> |                       |                  |             |                         |                  |            |
| 25-90                | Pump Interlock        | [0] Off          | All set-ups | TRUE                    | -                | Uint8      |
| 25-91                | Manual Alternation    | 0 N/A            | All set-ups | TRUE                    | 0                | Uint8      |



**5.3.22 Analog I/O Option MCB 109 26-\*\***

| Par. No. #                      | Parameter description              | Default value    | 4-set-up    | Change during operation | Conversion index | Type   |
|---------------------------------|------------------------------------|------------------|-------------|-------------------------|------------------|--------|
| <b>26-0* Analog I/O Mode</b>    |                                    |                  |             |                         |                  |        |
| 26-00                           | Terminal X42/1 Mode                | [1] Voltage      | All set-ups | TRUE                    | -                | Uint8  |
| 26-01                           | Terminal X42/3 Mode                | [1] Voltage      | All set-ups | TRUE                    | -                | Uint8  |
| 26-02                           | Terminal X42/5 Mode                | [1] Voltage      | All set-ups | TRUE                    | -                | Uint8  |
| <b>26-1* Analog Input X42/1</b> |                                    |                  |             |                         |                  |        |
| 26-10                           | Terminal X42/1 Low Voltage         | 0.07 V           | All set-ups | TRUE                    | -2               | Int16  |
| 26-11                           | Terminal X42/1 High Voltage        | 10.00 V          | All set-ups | TRUE                    | -2               | Int16  |
| 26-14                           | Term. X42/1 Low Ref./Feedb. Value  | 0.000 N/A        | All set-ups | TRUE                    | -3               | Int32  |
| 26-15                           | Term. X42/1 High Ref./Feedb. Value | 100.000 N/A      | All set-ups | TRUE                    | -3               | Int32  |
| 26-16                           | Term. X42/1 Filter Time Constant   | 0.001 s          | All set-ups | TRUE                    | -3               | Uint16 |
| 26-17                           | Term. X42/1 Live Zero              | [1] Enabled      | All set-ups | TRUE                    | -                | Uint8  |
| <b>26-2* Analog Input X42/3</b> |                                    |                  |             |                         |                  |        |
| 26-20                           | Terminal X42/3 Low Voltage         | 0.07 V           | All set-ups | TRUE                    | -2               | Int16  |
| 26-21                           | Terminal X42/3 High Voltage        | 10.00 V          | All set-ups | TRUE                    | -2               | Int16  |
| 26-24                           | Term. X42/3 Low Ref./Feedb. Value  | 0.000 N/A        | All set-ups | TRUE                    | -3               | Int32  |
| 26-25                           | Term. X42/3 High Ref./Feedb. Value | 100.000 N/A      | All set-ups | TRUE                    | -3               | Int32  |
| 26-26                           | Term. X42/3 Filter Time Constant   | 0.001 s          | All set-ups | TRUE                    | -3               | Uint16 |
| 26-27                           | Term. X42/3 Live Zero              | [1] Enabled      | All set-ups | TRUE                    | -                | Uint8  |
| <b>26-3* Analog Input X42/5</b> |                                    |                  |             |                         |                  |        |
| 26-30                           | Terminal X42/5 Low Voltage         | 0.07 V           | All set-ups | TRUE                    | -2               | Int16  |
| 26-31                           | Terminal X42/5 High Voltage        | 10.00 V          | All set-ups | TRUE                    | -2               | Int16  |
| 26-34                           | Term. X42/5 Low Ref./Feedb. Value  | 0.000 N/A        | All set-ups | TRUE                    | -3               | Int32  |
| 26-35                           | Term. X42/5 High Ref./Feedb. Value | 100.000 N/A      | All set-ups | TRUE                    | -3               | Int32  |
| 26-36                           | Term. X42/5 Filter Time Constant   | 0.001 s          | All set-ups | TRUE                    | -3               | Uint16 |
| 26-37                           | Term. X42/5 Live Zero              | [1] Enabled      | All set-ups | TRUE                    | -                | Uint8  |
| <b>26-4* Analog Out X42/7</b>   |                                    |                  |             |                         |                  |        |
| 26-40                           | Terminal X42/7 Output              | [0] No operation | All set-ups | TRUE                    | -                | Uint8  |
| 26-41                           | Terminal X42/7 Min. Scale          | 0.00 %           | All set-ups | TRUE                    | -2               | Int16  |
| 26-42                           | Terminal X42/7 Max. Scale          | 100.00 %         | All set-ups | TRUE                    | -2               | Int16  |
| 26-43                           | Terminal X42/7 Bus Control         | 0.00 %           | All set-ups | TRUE                    | -2               | N2     |
| 26-44                           | Terminal X42/7 Timeout Preset      | 0.00 %           | 1 set-up    | TRUE                    | -2               | Uint16 |
| <b>26-5* Analog Out X42/9</b>   |                                    |                  |             |                         |                  |        |
| 26-50                           | Terminal X42/9 Output              | [0] No operation | All set-ups | TRUE                    | -                | Uint8  |
| 26-51                           | Terminal X42/9 Min. Scale          | 0.00 %           | All set-ups | TRUE                    | -2               | Int16  |
| 26-52                           | Terminal X42/9 Max. Scale          | 100.00 %         | All set-ups | TRUE                    | -2               | Int16  |
| 26-53                           | Terminal X42/9 Bus Control         | 0.00 %           | All set-ups | TRUE                    | -2               | N2     |
| 26-54                           | Terminal X42/9 Timeout Preset      | 0.00 %           | 1 set-up    | TRUE                    | -2               | Uint16 |
| <b>26-6* Analog Out X42/11</b>  |                                    |                  |             |                         |                  |        |
| 26-60                           | Terminal X42/11 Output             | [0] No operation | All set-ups | TRUE                    | -                | Uint8  |
| 26-61                           | Terminal X42/11 Min. Scale         | 0.00 %           | All set-ups | TRUE                    | -2               | Int16  |
| 26-62                           | Terminal X42/11 Max. Scale         | 100.00 %         | All set-ups | TRUE                    | -2               | Int16  |
| 26-63                           | Terminal X42/11 Bus Control        | 0.00 %           | All set-ups | TRUE                    | -2               | N2     |
| 26-64                           | Terminal X42/11 Timeout Preset     | 0.00 %           | 1 set-up    | TRUE                    | -2               | Uint16 |

5.3.23 Cascade CTL Option 27 - \*\*

| Par. No. #                        | Parameter description            | Default value           | 4-set-up    | Change during operation | Conversion index | Type         |
|-----------------------------------|----------------------------------|-------------------------|-------------|-------------------------|------------------|--------------|
| <b>27-0* Control &amp; Status</b> |                                  |                         |             |                         |                  |              |
| 27-01                             | Pump Status                      | [0] Ready               | All set-ups | TRUE                    | -                | Uint8        |
| 27-02                             | Manual Pump Control              | [0] No Operation        | 2 set-ups   | TRUE                    | -                | Uint8        |
| 27-03                             | Current Runtime Hours            | 0 h                     | All set-ups | TRUE                    | 74               | Uint32       |
| 27-04                             | Pump Total Lifetime Hours        | 0 h                     | All set-ups | TRUE                    | 74               | Uint32       |
| <b>27-1* Configuration</b>        |                                  |                         |             |                         |                  |              |
| 27-10                             | Cascade Controller               | [0] Disabled            | 2 set-ups   | FALSE                   | -                | Uint8        |
| 27-11                             | Number Of Drives                 | 1 N/A                   | 2 set-ups   | FALSE                   | 0                | Uint8        |
| 27-12                             | Number Of Pumps                  | ExpressionLimit         | 2 set-ups   | FALSE                   | 0                | Uint8        |
| 27-14                             | Pump Capacity                    | 100 %                   | 2 set-ups   | FALSE                   | 0                | Uint16       |
| 27-16                             | Runtime Balancing                | [0] Balanced Priority 1 | 2 set-ups   | TRUE                    | -                | Uint8        |
| 27-17                             | Motor Starters                   | [0] Direct Online       | 2 set-ups   | FALSE                   | -                | Uint8        |
| 27-18                             | Spin Time for Unused Pumps       | ExpressionLimit         | All set-ups | TRUE                    | 0                | Uint16       |
| 27-19                             | Reset Current Runtime Hours      | [0] Do not reset        | All set-ups | TRUE                    | -                | Uint8        |
| <b>27-2* Bandwidth Settings</b>   |                                  |                         |             |                         |                  |              |
| 27-20                             | Normal Operating Range           | ExpressionLimit         | All set-ups | TRUE                    | 0                | Uint8        |
| 27-21                             | Override Limit                   | 100 %                   | All set-ups | TRUE                    | 0                | Uint8        |
| 27-22                             | Fixed Speed Only Operating Range | ExpressionLimit         | All set-ups | TRUE                    | 0                | Uint8        |
| 27-23                             | Staging Delay                    | 15 s                    | All set-ups | TRUE                    | 0                | Uint16       |
| 27-24                             | Destaging Delay                  | 15 s                    | All set-ups | TRUE                    | 0                | Uint16       |
| 27-25                             | Override Hold Time               | 10 s                    | All set-ups | TRUE                    | 0                | Uint16       |
| 27-27                             | Min Speed Destage Delay          | ExpressionLimit         | All set-ups | TRUE                    | 0                | Uint16       |
| <b>27-3* Staging Speed</b>        |                                  |                         |             |                         |                  |              |
| 27-31                             | Stage On Speed [RPM]             | ExpressionLimit         | All set-ups | TRUE                    | 67               | Uint16       |
| 27-32                             | Stage On Speed [Hz]              | ExpressionLimit         | All set-ups | TRUE                    | -1               | Uint16       |
| 27-33                             | Stage Off Speed [RPM]            | ExpressionLimit         | All set-ups | TRUE                    | 67               | Uint16       |
| 27-34                             | Stage Off Speed [Hz]             | ExpressionLimit         | All set-ups | TRUE                    | -1               | Uint16       |
| <b>27-4* Staging Settings</b>     |                                  |                         |             |                         |                  |              |
| 27-40                             | Auto Tune Staging Settings       | [1] Enabled             | All set-ups | TRUE                    | -                | Uint8        |
| 27-41                             | Ramp Down Delay                  | 10.0 s                  | All set-ups | TRUE                    | -1               | Uint16       |
| 27-42                             | Ramp Up Delay                    | 2.0 s                   | All set-ups | TRUE                    | -1               | Uint16       |
| 27-43                             | Staging Threshold                | ExpressionLimit         | All set-ups | TRUE                    | 0                | Uint8        |
| 27-44                             | Destaging Threshold              | ExpressionLimit         | All set-ups | TRUE                    | 0                | Uint8        |
| 27-45                             | Staging Speed [RPM]              | 0 RPM                   | All set-ups | TRUE                    | 67               | Uint16       |
| 27-46                             | Staging Speed [Hz]               | 0.0 Hz                  | All set-ups | TRUE                    | -1               | Uint16       |
| 27-47                             | Destaging Speed [RPM]            | 0 RPM                   | All set-ups | TRUE                    | 67               | Uint16       |
| 27-48                             | Destaging Speed [Hz]             | 0.0 Hz                  | All set-ups | TRUE                    | -1               | Uint16       |
| <b>27-5* Alternate Settings</b>   |                                  |                         |             |                         |                  |              |
| 27-50                             | Automatic Alternation            | [0] Disabled            | All set-ups | FALSE                   | -                | Uint8        |
| 27-51                             | Alternation Event                | null                    | All set-ups | TRUE                    | -                | Uint8        |
| 27-52                             | Alternation Time Interval        | 0 min                   | All set-ups | TRUE                    | 70               | Uint16       |
| 27-53                             | Alternation Timer Value          | 0 min                   | All set-ups | TRUE                    | 70               | Uint16       |
| 27-54                             | Alternation At Time of Day       | [0] Disabled            | All set-ups | TRUE                    | -                | Uint8        |
| 27-55                             | Alternation Predefined Time      | ExpressionLimit         | All set-ups | TRUE                    | 0                | TimeOfDayWo- |
| 27-56                             | Alternate Capacity is <          | 0 %                     | All set-ups | TRUE                    | 0                | Date         |
| 27-58                             | Run Next Pump Delay              | 0.1 s                   | All set-ups | TRUE                    | -1               | Uint16       |

| Par. No. #                  | Parameter description         | Default value      | 4-set-up    | Change during operation | Conversion index | Type   |
|-----------------------------|-------------------------------|--------------------|-------------|-------------------------|------------------|--------|
| <b>27-6* Digital Inputs</b> |                               |                    |             |                         |                  |        |
| 27-60                       | Terminal X66/1 Digital Input  | [0] No operation   | All set-ups | TRUE                    | -                | Uint8  |
| 27-61                       | Terminal X66/3 Digital Input  | [0] No operation   | All set-ups | TRUE                    | -                | Uint8  |
| 27-62                       | Terminal X66/5 Digital Input  | [0] No operation   | All set-ups | TRUE                    | -                | Uint8  |
| 27-63                       | Terminal X66/7 Digital Input  | [0] No operation   | All set-ups | TRUE                    | -                | Uint8  |
| 27-64                       | Terminal X66/9 Digital Input  | [0] No operation   | All set-ups | TRUE                    | -                | Uint8  |
| 27-65                       | Terminal X66/11 Digital Input | [0] No operation   | All set-ups | TRUE                    | -                | Uint8  |
| 27-66                       | Terminal X66/13 Digital Input | [0] No operation   | All set-ups | TRUE                    | -                | Uint8  |
| <b>27-7* Connections</b>    |                               |                    |             |                         |                  |        |
| 27-70                       | Relay                         | [0] Standard Relay | 2 set-ups   | FALSE                   | -                | Uint8  |
| <b>27-9* Readouts</b>       |                               |                    |             |                         |                  |        |
| 27-91                       | Cascade Reference             | 0.0 %              | All set-ups | TRUE                    | -1               | Int16  |
| 27-92                       | % Of Total Capacity           | 0 %                | All set-ups | TRUE                    | 0                | Uint16 |
| 27-93                       | Cascade Option Status         | [0] Disabled       | All set-ups | TRUE                    | -                | Uint8  |

5.3.24 Water Application Functions 29-.\*

| Par. No. #   | Parameter description | Default value         | 4-set-up    | Change during operation | Conversion index | Type   |
|--------------|-----------------------|-----------------------|-------------|-------------------------|------------------|--------|
| <b>29-0*</b> | <b>Pipe Fill</b>      |                       |             |                         |                  |        |
| 29-00        | Pipe Fill Enable      | [0] Disabled          | 2 set-ups   | FALSE                   | -                | Uint8  |
| 29-01        | Pipe Fill Speed [RPM] | ExpressionLimit       | All set-ups | TRUE                    | 67               | Uint16 |
| 29-02        | Pipe Fill Speed [Hz]  | ExpressionLimit       | All set-ups | TRUE                    | -1               | Uint16 |
| 29-03        | Pipe Fill Time        | 0.00 s                | All set-ups | TRUE                    | -2               | Uint32 |
| 29-04        | Pipe Fill Rate        | 0.001 ProcessCtrlUnit | All set-ups | TRUE                    | -3               | Int32  |
| 29-05        | Filled Setpoint       | 0.000 ProcessCtrlUnit | All set-ups | TRUE                    | -3               | Int32  |

**5.3.25 Bypass Option 31 - \*\***

| Par. No. # | Parameter description    | Default value | 4-set-up    | Change during operation | Conversion index | Type   |
|------------|--------------------------|---------------|-------------|-------------------------|------------------|--------|
| 31-00      | Bypass Mode              | [0] Drive     | All set-ups | TRUE                    | -                | Uint8  |
| 31-01      | Bypass Start Time Delay  | 30 s          | All set-ups | TRUE                    | 0                | Uint16 |
| 31-02      | Bypass Trip Time Delay   | 0 s           | All set-ups | TRUE                    | 0                | Uint16 |
| 31-03      | Test Mode Activation     | [0] Disabled  | All set-ups | TRUE                    | -                | Uint8  |
| 31-10      | Bypass Status Word       | 0 N/A         | All set-ups | FALSE                   | 0                | V2     |
| 31-11      | Bypass Running Hours     | 0 h           | All set-ups | FALSE                   | 74               | Uint32 |
| 31-19      | Remote Bypass Activation | [0] Disabled  | 2 set-ups   | TRUE                    | -                | Uint8  |

6

## 6 General Specifications

### Mains supply (L1, L2, L3):

|  |   |
|--|---|
| Supply voltage                                   | 380-480 V ±10%                                |
| Supply voltage                                   | 525-690 V ±10%                                |
| Supply frequency                                 | 50/60 Hz                                      |
| Max. imbalance temporary between mains phases    | 3.0 % of rated supply voltage                 |
| True Power Factor (λ)                            | ≥ 0.9 nominal at rated load                   |
| Displacement Power Factor (cosφ) near unity      | (> 0.98)                                      |
| Switching on input supply L1, L2, L3 (power-ups) | maximum once/2 min.                           |
| Environment according to EN60664-1               | overvoltage category III / pollution degree 2 |

*The unit is suitable for use on a circuit capable of delivering not more than 100.000 RMS symmetrical Amperes, 480/690 V maximum.*

### Motor output (U, V, W):

|                     |                            |
|---------------------|----------------------------|
| Output voltage      | 0 - 100% of supply voltage |
| Output frequency    | 0 - 800* Hz                |
| Switching on output | Unlimited                  |
| Ramp times          | 1 - 3600 sec.              |

\* Voltage and power dependent

### Torque characteristics:

|                                   |                              |
|-----------------------------------|------------------------------|
| Starting torque (Constant torque) | maximum 110% for 1 min.*     |
| Starting torque                   | maximum 135% up to 0.5 sec.* |
| Overload torque (Constant torque) | maximum 110% for 1 min.*     |

*\*Percentage relates to VLT AQUA Drive's nominal torque.*

### Cable lengths and cross sections:

|  |   |
|--|---|
| Max. motor cable length, screened/armoured                           | VLT AQUA Drive: 150 m                                   |
| Max. motor cable length, unscreened/unarmoured                       | VLT AQUA Drive: 300 m                                   |
| Max. cross section to motor, mains, load sharing and brake *         |   |
| Maximum cross section to control terminals, rigid wire               | 1.5 mm <sup>2</sup> /16 AWG (2 x 0.75 mm <sup>2</sup> ) |
| Maximum cross section to control terminals, flexible cable           | 1 mm <sup>2</sup> /18 AWG                               |
| Maximum cross section to control terminals, cable with enclosed core | 0.5 mm <sup>2</sup> /20 AWG                             |
| Minimum cross section to control terminals                           | 0.25 mm <sup>2</sup>                                    |

*\* See Mains Supply tables for more information!*

### Digital inputs:

|                                  |   |
|----------------------------------|---|
| Programmable digital inputs      | 4 (6)   |
| Terminal number                  | 18, 19, 27 <sup>1)</sup> , 29 <sup>1)</sup> , 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     | > 19 V DC   |
| Voltage level, logic '1' NPN     | < 14 V DC   |
| Maximum voltage on input         | 28 V DC   |
| Input resistance, R <sub>i</sub> | approx. 4 k   |

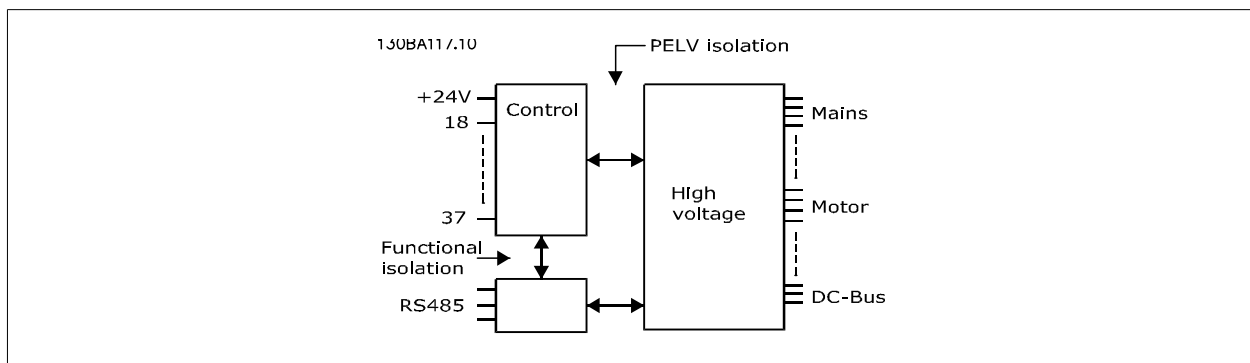
*All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.*

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

## 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                | : 0 to + 10 V (scaleable)         |
| Input resistance, $R_i$      | approx. 10 k $\Omega$             |
| Max. voltage                 | $\pm$ 20 V                        |
| Current mode                 | Switch S201/switch S202 = ON (I)  |
| Current level                | 0/4 to 20 mA (scaleable)          |
| Input resistance, $R_i$      | approx. 200 $\Omega$              |
| Max. current                 | 30 mA                             |
| Resolution for analog inputs | 10 bit (+ sign)                   |
| Accuracy of analog inputs    | Max. error 0.5% of full scale     |
| Bandwidth                    | : 200 Hz                          |

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



## Pulse inputs:

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

## Analog output:

|   |                                 |
|---|---------------------------------|
| Number of programmable analog outputs         | 1                               |
| Terminal number                               | 42                              |
| Current range at analog output                | 0/4 - 20 mA                     |
| Max. resistor load to common at analog output | 500 $\Omega$                    |
| Accuracy on analog output                     | Max. error: 0.8 % of full scale |
| Resolution on analog output                   | 8 bit                           |

The analog output 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).



Digital output:

|  |                                 |
|--|---------------------------------|
| Programmable digital/pulse outputs           | 2                               |
| Terminal number                              | 27, 29 <sup>1)</sup>            |
| 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.

Control card, 24 V DC output:

|                 |          |
|-----------------|----------|
| Terminal number | 12, 13   |
| 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.

Relay outputs:

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

1) IEC 60947 part 4 and 5

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

2) Overvoltage Category II

3) UL applications 300 V AC 2A

Control card, 10 V DC output:

|                 |               |
|-----------------|---------------|
| Terminal number | 50            |
| Output voltage  | 10.5 V ±0.5 V |
| Max. load       | 25 mA         |

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

Control characteristics:

|   |  |
|---|--|
| Resolution of output frequency at 0 - 1000 Hz           | : +/- 0.003 Hz                         |
| System response time (terminals 18, 19, 27, 29, 32, 33) | : ≤ 2 ms                               |
| Speed control range (open loop)                         | 1:100 of synchronous speed             |
| Speed accuracy (open loop)                              | 30 - 4000 rpm: Maximum error of ±8 rpm |

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



## Surroundings:

|   |   |
|---|---|
| Enclosure, frame size D and E                         | IP 00, IP 21, IP 54   |
| Enclosure, frame size F                               | IP 21, IP 54  |
| Vibration test  | 0.7 g   |
| Relative humidity                                     | 5% - 95%(IEC 721-3-3; Class 3K3 (non-condensing) during operation |
| Aggressive environment (IEC 721-3-3), uncoated        | class 3C2   |
| Aggressive environment (IEC 721-3-3), coated          | class 3C3   |
| Test method according to IEC 60068-2-43 H2S (10 days) |   |
| Ambient temperature (at 60 AVM switching mode)        |   |
| - with derating                                       | max. 55 ° C <sup>1)</sup>   |
| - with full output power, typical EFF2 motors         | max. 50 ° C <sup>1)</sup>   |
| - at full continuous FC output current                | max. 45 ° C <sup>1)</sup>   |

<sup>1)</sup> For more information on derating see the Design Guide, section on Special Conditions.

|   |                 |
|---|-----------------|
| 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          |
| Maximum altitude above sea level with derating          | 3000 m          |

Derating for high altitude, see section on special conditions

|                         |  |
|-------------------------|--|
| EMC standards, Emission | EN 61800-3, EN 61000-6-3/4, EN 55011, IEC 61800-3<br>EN 61800-3, EN 61000-6-1/2, |
| EMC standards, Immunity | EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6             |

See section on special conditions!

## Control card performance:

|   |                          |
|---|--------------------------|
| Scan interval                           | : 5 ms                   |
| Control card, USB serial communication: |                          |
| USB standard                            | 1.1 (Full speed)         |
| USB plug                                | USB type B "device" plug |



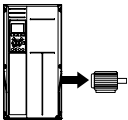
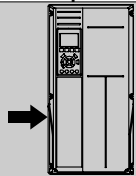
Connection to PC is carried out via a standard host/device USB cable.

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

The USB connection is not galvanically isolated from protection earth. Use only isolated laptop/PC as connection to the USB connector on VLT AQUA Drive or an isolated USB cable/converter.

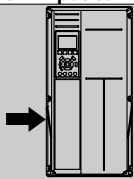
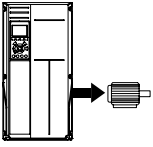
## Protection and Features:

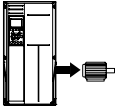
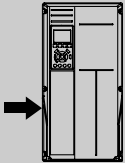
- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the frequency converter trips if the temperature reaches 95 °C ± 5°C. An overload temperature cannot be reset until the temperature of the heatsink is below 70 °C ± 5°C (Guideline - these temperatures may vary for different power sizes, enclosures etc.). VLT AQUA Drive has an auto derating function to avoid it's heatsink reaching 95 deg C.
- 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 is protected against earth faults on motor terminals U, V, W.

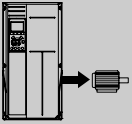
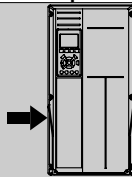
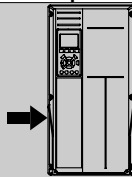
| <b>Mains Supply 3 x 380 - 480 VAC</b>   |  | P110             | P132             | P160                  | P200                  | P250                  |
|---|--|------------------|------------------|-----------------------|-----------------------|-----------------------|
|   | Typical Shaft output at 400 V [kW]   | 110              | 132              | 160                   | 200                   | 250                   |
|   | Typical Shaft output at 460 V [HP]   | 150              | 200              | 250                   | 300                   | 350                   |
|   | Enclosure IP21   | D1               | D1               | D2                    | D2                    | D2                    |
|   | Enclosure IP54   | D1               | D1               | D2                    | D2                    | D2                    |
|   | Enclosure IP00   | D3               | D3               | D4                    | D4                    | D4                    |
| <b>Output current</b>   |  |                  |                  |                       |                       |                       |
|  | Continuous (at 400 V) [A]  | 212              | 260              | 315                   | 395                   | 480                   |
|   | Intermittent (60 sec overload) (at 400 V) [A]  | 233              | 286              | 347                   | 435                   | 528                   |
|   | Continuous (at 460/ 480 V) [A]   | 190              | 240              | 302                   | 361                   | 443                   |
|   | Intermittent (60 sec overload) (at 460/ 480 V) [A]                                       | 209              | 264              | 332                   | 397                   | 487                   |
|   | Continuous KVA (at 400 V) [KVA]  | 147              | 180              | 218                   | 274                   | 333                   |
|   | Continuous KVA (at 460 V) [KVA]  | 151              | 191              | 241                   | 288                   | 353                   |
| <b>Max. input current</b>   |  |                  |                  |                       |                       |                       |
|  | Continuous (at 400 V) [A]  | 204              | 251              | 304                   | 381                   | 463                   |
|   | Continuous (at 460/ 480 V) [A]   | 183              | 231              | 291                   | 348                   | 427                   |
|   | Max. cable size, mains motor, brake and load share [mm <sup>2</sup> (AWG <sup>2</sup> )] | 2 x 70 (2 x 2/0) | 2 x 70 (2 x 2/0) | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) |
|   | Max. external pre-fuses [A] <sup>1</sup>   | 300              | 350              | 400                   | 500                   | 600                   |
|   | Estimated power loss at rated max. load [W] <sup>4</sup> , 400 V                         | 3234             | 3782             | 4213                  | 5119                  | 5893                  |
|   | Estimated power loss at rated max. load [W] <sup>4</sup> , 460 V                         | 2947             | 3665             | 4063                  | 4652                  | 5634                  |
|   | Weight, enclosure IP21, IP 54 [kg]   | 96               | 104              | 125                   | 136                   | 151                   |
|   | Weight, enclosure IP00 [kg]  | 82               | 91               | 112                   | 123                   | 138                   |
|   | Efficiency <sup>4)</sup>   | 0.98             |                  |                       |                       |                       |
|   | Output frequency   | 0 - 800 Hz       |                  |                       |                       |                       |
|   | Heatsink overtemp. trip  | 85 °C            | 90 °C            | 105 °C                | 105 °C                | 115 °C                |
|   | Power card ambient trip  | 60 °C            |                  |                       |                       |                       |

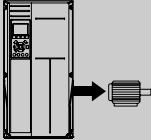
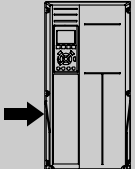
| Mains Supply 3 x 380 - 480 VAC   |                       |                       |                       |                       |
|--|-----------------------|-----------------------|-----------------------|-----------------------|
|  | P315                  | P355                  | P400                  | P450                  |
| Typical Shaft output at 400 V [kW]   | 315                   | 355                   | 400                   | 450                   |
| Typical Shaft output at 460 V [HP]   | 450                   | 500                   | 600                   | 600                   |
| Enclosure IP21   | E1                    | E1                    | E1                    | E1                    |
| Enclosure IP54   | E1                    | E1                    | E1                    | E1                    |
| Enclosure IP00   | E2                    | E2                    | E2                    | E2                    |
| <b>Output current</b>  |                       |                       |                       |                       |
| Continuous (at 400 V) [A]  | 600                   | 658                   | 745                   | 800                   |
| Intermittent (60 sec over-load) (at 400 V) [A]                                     | 660                   | 724                   | 820                   | 880                   |
| Continuous (at 460/ 480 V) [A]   | 540                   | 590                   | 678                   | 730                   |
| Intermittent (60 sec over-load) (at 460/ 480 V) [A]                                | 594                   | 649                   | 746                   | 803                   |
| Continuous KVA (at 400 V) [KVA]  | 416                   | 456                   | 516                   | 554                   |
| Continuous KVA (at 460 V) [KVA]  | 430                   | 470                   | 540                   | 582                   |
| <b>Max. input current</b>  |                       |                       |                       |                       |
| Continuous (at 400 V) [A]  | 590                   | 647                   | 733                   | 787                   |
| Continuous (at 460/ 480 V) [A]   | 531                   | 580                   | 667                   | 718                   |
| Max. cable size, mains, motor and load share [mm <sup>2</sup> (AWG <sup>2</sup> )] | 4x240 (4x500 mcm)     | 4x240 (4x500 mcm)     | 4x240 (4x500 mcm)     | 4x240 (4x500 mcm)     |
| Max. cable size, brake [mm <sup>2</sup> (AWG <sup>2</sup> )]                       | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) |
| Max. external pre-fuses [A] <sup>1</sup>   | 700                   | 900                   | 900                   | 900                   |
| Estimated power loss at rated max. load [W] <sup>4</sup> , 400 V                   | 6790                  | 7701                  | 8879                  | 9670                  |
| Estimated power loss at rated max. load [W] <sup>4</sup> , 460 V                   | 6082                  | 6953                  | 8089                  | 8803                  |
| Weight, enclosure IP21, IP 54 [kg]   | 263                   | 270                   | 272                   | 313                   |
| Weight, enclosure IP00 [kg]  | 221                   | 234                   | 236                   | 277                   |
| Efficiency <sup>3</sup>  | 0.98                  |                       |                       |                       |
| Output frequency   | 0 - 600 Hz            |                       |                       |                       |
| Heatsink overtemp. trip  | 95 °C                 |                       |                       |                       |
| Power card ambient trip  | 68 °C                 |                       |                       |                       |

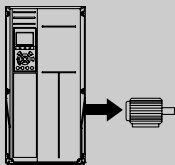
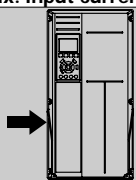
6



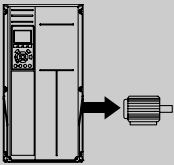
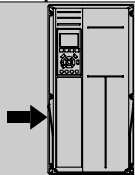
| <b>Mains Supply 3 x 380 - 480 VAC</b>   |   |  |                   |            |                   |                     |       |      |
|---|---|--|-------------------|------------|-------------------|---------------------|-------|------|
|   | P500  | P560   | P630              | P710       | P800              | P1M0                |       |      |
| Typical Shaft output at 400 V [kW]  | 500   | 560  | 630               | 710        | 800               | 1000                |       |      |
| Typical Shaft output at 460 V [HP]  | 650   | 750  | 900               | 1000       | 1200              | 1350                |       |      |
| Enclosure IP21, 54 without/ with options cabinet                                  | F1/F3   | F1/F3  | F1/F3             | F1/F3      | F2/F4             | F2/F4               |       |      |
| <b>Output current</b>   |   |  |                   |            |                   |                     |       |      |
|  | Continuous (at 400 V) [A]   | 880  | 990               | 1120       | 1260              | 1460                | 1720  |      |
|   | Intermittent (60 sec overload) (at 400 V) [A]                                     | 968  | 1089              | 1232       | 1386              | 1606                | 1892  |      |
|   | Continuous (at 460/ 480 V) [A]  | 780  | 890               | 1050       | 1160              | 1380                | 1530  |      |
|   | Intermittent (60 sec overload) (at 460/ 480 V) [A]                                | 858  | 979               | 1155       | 1276              | 1518                | 1683  |      |
|   | Continuous KVA (at 400 V) [KVA]   | 610  | 686               | 776        | 873               | 1012                | 1192  |      |
|   | Continuous KVA (at 460 V) [KVA]   | 621  | 709               | 837        | 924               | 1100                | 1219  |      |
|   | <b>Max. input current</b>   |  |                   |            |                   |                     |       |      |
|   |  | Continuous (at 400 V) [A]                                    | 857               | 964        | 1090              | 1227                | 1422  | 1675 |
|   |   | Continuous (at 460/ 480 V) [A]                               | 759               | 867        | 1022              | 1129                | 1344  | 1490 |
|   |   | Max. cable size, motor [mm <sup>2</sup> (AWG <sup>2</sup> )] | 8x150 (8x300 mcm) |            |                   | 12x150 (12x300 mcm) |       |      |
| Max. cable size, mains [mm <sup>2</sup> (AWG <sup>2</sup> )]                      |   | 8x240 (8x500 mcm)  |                   |            |                   |                     |       |      |
| Max. cable size, loadsharing [mm <sup>2</sup> (AWG <sup>2</sup> )]                |   | 4x120 (4x250 mcm)  |                   |            |                   |                     |       |      |
| Max. cable size, brake [mm <sup>2</sup> (AWG <sup>2</sup> )]                      |   | 4x185 (4x350 mcm)  |                   |            | 6x185 (6x350 mcm) |                     |       |      |
| Max. external pre-fuses [A] <sup>1</sup>  |   | 1600   |                   | 2000       |                   | 2500                |       |      |
| Est. power loss at rated max. load [W] <sup>4</sup> , 400 V, F1 & F2              |   | 10647  | 12338             | 13201      | 15436             | 18084               | 20358 |      |
| Est. power loss at rated max. load [W] <sup>4</sup> , 460 V, F1 & F2              |   | 9414   | 11006             | 12353      | 14041             | 17137               | 17752 |      |
| Max added losses of A1 RFI, Circuit Breaker or Disconnect, & Contactor, F3 & F4   |   | 963  | 1054              | 1093       | 1230              | 2280                | 2541  |      |
| Max Panel Options Losses  | 400   |  |                   |            |                   |                     |       |      |
| Weight, enclosure IP21, IP 54 [kg]  | 1004/ 1299  | 1004/ 1299   | 1004/ 1299        | 1004/ 1299 | 1246/ 1541        | 1246/ 1541          |       |      |
| Weight Rectifier Module [kg]  | 102   | 102  | 102               | 102        | 136               | 136                 |       |      |
| Weight Inverter Module [kg]   | 102   | 102  | 102               | 136        | 102               | 102                 |       |      |
| Efficiency <sup>4</sup>   | 0.98  |  |                   |            |                   |                     |       |      |
| Output frequency  | 0-600 Hz  |  |                   |            |                   |                     |       |      |
| Heatsink overtemp. trip   | 95 °C   |  |                   |            |                   |                     |       |      |
| Power card ambient trip   | 68 °C   |  |                   |            |                   |                     |       |      |

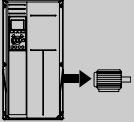
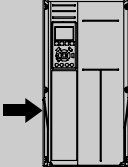
| <b>Mains Supply 3 x 525- 690 VAC</b>  |   |                           |      |      |      |      |     |
|---|---|---------------------------|------|------|------|------|-----|
|   |   | P45K                      | P55K | P75K | P90K | P110 |     |
|  | Typical Shaft output at 550 V [kW]  | 37                        | 45   | 55   | 75   | 90   |     |
|   | Typical Shaft output at 575 V [HP]  | 50                        | 60   | 75   | 100  | 125  |     |
|   | Typical Shaft output at 690 V [kW]  | 45                        | 55   | 75   | 90   | 110  |     |
|   | Enclosure IP21  | D1                        | D1   | D1   | D1   | D1   |     |
|   | Enclosure IP54  | D1                        | D1   | D1   | D1   | D1   |     |
|   | Enclosure IP00  | D2                        | D2   | D2   | D2   | D2   |     |
|   | <b>Output current</b>   |                           |      |      |      |      |     |
|  | Continuous (at 550 V) [A]   | 56                        | 76   | 90   | 113  | 137  |     |
|   | Intermittent (60 sec overload) (at 550 V) [A]                                     | 62                        | 84   | 99   | 124  | 151  |     |
|   | Continuous (at 575/ 690 V) [A]  | 54                        | 73   | 86   | 108  | 131  |     |
|   | Intermittent (60 sec overload) (at 575/ 690 V) [A]                                | 59                        | 80   | 95   | 119  | 144  |     |
|   | Continuous KVA (at 550 V) [KVA]   | 53                        | 72   | 86   | 108  | 131  |     |
|   | Continuous KVA (at 575 V) [KVA]   | 54                        | 73   | 86   | 108  | 130  |     |
|   | Continuous KVA (at 690 V) [KVA]   | 65                        | 87   | 103  | 129  | 157  |     |
|   | <b>Max. input current</b>   |                           |      |      |      |      |     |
|   |  | Continuous (at 550 V) [A] | 60   | 77   | 89   | 110  | 130 |
| Continuous (at 575 V) [A]   |   | 58                        | 74   | 85   | 106  | 124  |     |
| Continuous (at 690 V) [A]   |   | 58                        | 77   | 87   | 109  | 128  |     |
| Max. cable size, mains, motor, load share and brake [mm <sup>2</sup> (AWG)]       | 2x70 (2x2/0)  |                           |      |      |      |      |     |
| Max. external pre-fuses [A] <sup>1</sup>  | 125   | 160                       | 200  | 200  | 250  |      |     |
| Estimated power loss at rated max. load [W] <sup>4</sup> , 575 V                  | 1398  | 1645                      | 1827 | 2157 | 2533 |      |     |
| Estimated power loss at rated max. load [W] <sup>4</sup> , 690 V                  | 1458  | 1717                      | 1913 | 2262 | 2662 |      |     |
| Weight, enclosure IP21, IP 54 [kg]  | 96  |                           |      |      |      |      |     |
| Weight, enclosure IP00 [kg]   | 82  |                           |      |      |      |      |     |
| Efficiency <sup>4)</sup>  | 0.97  | 0.97                      | 0.98 | 0.98 | 0.98 |      |     |
| Output frequency  | 0 - 600 Hz  |                           |      |      |      |      |     |
| Heatsink overtemp. trip   | 85 °C   |                           |      |      |      |      |     |
| Power card ambient trip   | 60 °C   |                           |      |      |      |      |     |

| <b>Mains Supply 3 x 525- 690 VAC</b>  |   |                            |                  |                       |                       |     |
|---|---|----------------------------|------------------|-----------------------|-----------------------|-----|
|   | P132  | P160                       | P200             | P250                  |                       |     |
| Typical Shaft output at 550 V [kW]  | 110   | 132                        | 160              | 200                   |                       |     |
| Typical Shaft output at 575 V [HP]  | 150   | 200                        | 250              | 300                   |                       |     |
| Typical Shaft output at 690 V [kW]  | 132   | 160                        | 200              | 250                   |                       |     |
| Enclosure IP21  | D1  | D1                         | D2               | D2                    |                       |     |
| Enclosure IP54  | D1  | D1                         | D2               | D2                    |                       |     |
| Enclosure IP00  | D3  | D3                         | D4               | D4                    |                       |     |
| <b>Output current</b>   |   |                            |                  |                       |                       |     |
|  | Continuous (at 550 V) [A]   | 162                        | 201              | 253                   | 303                   |     |
|   | Intermittent (60 sec over-load) (at 550 V) [A]                                    | 178                        | 221              | 278                   | 333                   |     |
|   | Continuous (at 575/ 690 V) [A]  | 155                        | 192              | 242                   | 290                   |     |
|   | Intermittent (60 sec over-load) (at 575/ 690 V) [A]                               | 171                        | 211              | 266                   | 319                   |     |
|   | Continuous KVA (at 550 V) [KVA]   | 154                        | 191              | 241                   | 289                   |     |
|   | Continuous KVA (at 575 V) [KVA]   | 154                        | 191              | 241                   | 289                   |     |
|   | Continuous KVA (at 690 V) [KVA]   | 185                        | 229              | 289                   | 347                   |     |
|   | <b>Max. input current</b>   |                            |                  |                       |                       |     |
|   |  | Continuous (at 550 V ) [A] | 158              | 198                   | 245                   | 299 |
|   |   | Continuous (at 575 V) [A]  | 151              | 189                   | 234                   | 286 |
|   |   | Continuous (at 690 V) [A]  | 155              | 197                   | 240                   | 296 |
|   | Max. cable size, mains motor, load share and brake [mm <sup>2</sup> (AWG)]        | 2 x 70 (2 x 2/0)           | 2 x 70 (2 x 2/0) | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) |     |
| Max. external pre-fuses [A] <sub>1</sub>  | 315   | 350                        | 350              | 400                   |                       |     |
| Estimated power loss at rated max. load [W] <sup>4)</sup> , 575 V                 | 2963  | 3430                       | 4051             | 4867                  |                       |     |
| Estimated power loss at rated max. load [W] <sup>4)</sup> , 690 V                 | 3430  | 3612                       | 4292             | 5156                  |                       |     |
| Weight, Enclosure IP21, IP 54 [kg]  | 96  | 104                        | 125              | 136                   |                       |     |
| Weight, Enclosure IP00 [kg]   | 82  | 91                         | 112              | 123                   |                       |     |
| Efficiency <sup>4)</sup>  | 0.98  |                            |                  |                       |                       |     |
| Output frequency  | 0 - 600 Hz  |                            |                  |                       |                       |     |
| Heatsink overtemp. trip   | 85 °C   | 90 °C                      | 110 °C           | 110 °C                |                       |     |
| Power card ambient trip   | 60 °C   |                            |                  |                       |                       |     |

| Mains Supply 3 x 525- 690 VAC   |   | P315                               | P400                  | P450 |     |
|---|---|------------------------------------|-----------------------|------|-----|
|   |   | Typical Shaft output at 550 V [kW] | 250                   | 315  | 355 |
| Typical Shaft output at 575 V [HP]  | 350   | 400                                | 450                   |      |     |
| Typical Shaft output at 690 V [kW]  | 315   | 400                                | 450                   |      |     |
| Enclosure IP21  | D2  | D2                                 | E1                    |      |     |
| Enclosure IP54  | D2  | D2                                 | E1                    |      |     |
| Enclosure IP00  | D4  | D4                                 | E2                    |      |     |
| <b>Output current</b>   |   |                                    |                       |      |     |
|  | Continuous (at 550 V) [A]   | 360                                | 418                   | 470  |     |
|   | Intermittent (60 sec overload) (at 550 V) [A]                                     | 396                                | 460                   | 517  |     |
|   | Continuous (at 575/ 690 V) [A]  | 344                                | 400                   | 450  |     |
|   | Intermittent (60 sec overload) (at 575/ 690 V) [A]                                | 378                                | 440                   | 495  |     |
|   | Continuous KVA (at 550 V) [KVA]   | 343                                | 398                   | 448  |     |
|   | Continuous KVA (at 575 V) [KVA]   | 343                                | 398                   | 448  |     |
|   | Continuous KVA (at 690 V) [KVA]   | 411                                | 478                   | 538  |     |
|   | <b>Max. input current</b>   |                                    |                       |      |     |
|   |  | Continuous (at 550 V) [A]          | 355                   | 408  | 453 |
|   |   | Continuous (at 575 V) [A]          | 339                   | 390  | 434 |
| Continuous (at 690 V) [A]   |   | 352                                | 400                   | 434  |     |
| Max. cable size, mains, motor and load share [mm <sup>2</sup> (AWG)]              | 2 x 185 (2 x 350 mcm)   | 2 x 185 (2 x 350 mcm)              | 4 x 240 (4 x 500 mcm) |      |     |
| Max. cable size, brake [mm <sup>2</sup> (AWG)]                                    | 2 x 185 (2 x 350 mcm)   | 2 x 185 (2 x 350 mcm)              | 2 x 185 (2 x 350 mcm) |      |     |
| Max. external pre-fuses [A] <sup>1</sup>  | 500   | 550                                | 700                   |      |     |
| Estimated power loss at rated max. load [W] <sup>4)</sup> , 575 V                 | 5493  | 5852                               | 6132                  |      |     |
| Estimated power loss at rated max. load [W] <sup>4)</sup> , 690 V                 | 5821  | 6149                               | 6440                  |      |     |
| Weight, enclosure IP21, IP 54 [kg]  | 151   | 165                                | 263                   |      |     |
| Weight, enclosure IP00 [kg]   | 138   | 151                                | 221                   |      |     |
| Efficiency <sup>4)</sup>  | 0.98  |                                    |                       |      |     |
| Output frequency  | 0 - 600 Hz  | 0 - 500 Hz                         | 0 - 500 Hz            |      |     |
| Heatsink overtemp. trip   | 110 °C  | 110 °C                             | 85 °C                 |      |     |
| Power card ambient trip   | 60 °C   | 60 °C                              | 68 °C                 |      |     |



| <b>Mains Supply 3 x 525- 690 VAC</b>  |   |                           |                       |     |     |  |
|---|---|---------------------------|-----------------------|-----|-----|--|
|   | P500  | P560                      | P630                  |     |     |  |
| Typical Shaft output at 550 V [kW]  | 400   | 450                       | 500                   |     |     |  |
| Typical Shaft output at 575 V [HP]  | 500   | 600                       | 650                   |     |     |  |
| Typical Shaft output at 690 V [kW]  | 500   | 560                       | 630                   |     |     |  |
| Enclosure IP21  | E1  | E1                        | E1                    |     |     |  |
| Enclosure IP54  | E1  | E1                        | E1                    |     |     |  |
| Enclosure IP00  | E2  | E2                        | E2                    |     |     |  |
| <b>Output current</b>   |   |                           |                       |     |     |  |
|  | Continuous (at 550 V) [A]   | 523                       | 596                   | 630 |     |  |
|   | Intermittent (60 sec overload) (at 550 V) [A]                                     | 575                       | 656                   | 693 |     |  |
|   | Continuous (at 575/ 690 V) [A]  | 500                       | 570                   | 630 |     |  |
|   | Intermittent (60 sec overload) (at 575/ 690 V) [A]                                | 550                       | 627                   | 693 |     |  |
|   | Continuous KVA (at 550 V) [KVA]   | 498                       | 568                   | 600 |     |  |
|   | Continuous KVA (at 575 V) [KVA]   | 498                       | 568                   | 627 |     |  |
|   | Continuous KVA (at 690 V) [KVA]   | 598                       | 681                   | 753 |     |  |
|   | <b>Max. input current</b>   |                           |                       |     |     |  |
|   |  | Continuous (at 550 V) [A] | 504                   | 574 | 607 |  |
|   |   | Continuous (at 575 V) [A] | 482                   | 549 | 607 |  |
| Continuous (at 690 V) [A]   |   | 482                       | 549                   | 607 |     |  |
| Max. cable size, mains, motor and load share [mm <sup>2</sup> (AWG)]              | 4x240 (4x500 mcm)   | 4x240 (4x500 mcm)         | 4x240 (4x500 mcm)     |     |     |  |
| Max. cable size, brake [mm <sup>2</sup> (AWG)]                                    | 2 x 185 (2 x 350 mcm)   | 2 x 185 (2 x 350 mcm)     | 2 x 185 (2 x 350 mcm) |     |     |  |
| Max. external pre-fuses [A] <sup>1</sup>  | 700   | 900                       | 900                   |     |     |  |
| Estimated power loss at rated max. load [W] <sup>4)</sup> , 575 V                 | 6903  | 8343                      | 9244                  |     |     |  |
| Estimated power loss at rated max. load [W] <sup>4)</sup> , 690 V                 | 7249  | 8727                      | 9673                  |     |     |  |
| Weight, enclosure IP21, IP 54 [kg]  | 263   | 272                       | 313                   |     |     |  |
| Weight, enclosure IP00 [kg]   | 221   | 236                       | 277                   |     |     |  |
| Efficiency <sup>4)</sup>  | 0.98  |                           |                       |     |     |  |
| Output frequency  | 0 - 500 Hz  |                           |                       |     |     |  |
| Heatsink overtemp. trip   | 85 °C   |                           |                       |     |     |  |
| Power card ambient trip   | 68 °C   |                           |                       |     |     |  |

| <b>Mains Supply 3 x 525- 690 VAC</b>  |   | P710              | P800       | P900       | P1M0                | P1M2   |
|---|---|-------------------|------------|------------|---------------------|--------|
|   | Typical Shaft output at 550 V [kW]                                    | 560               | 670        | 750        | 850                 | 1000   |
|   | Typical Shaft output at 575 V [HP]                                    | 750               | 950        | 1050       | 1150                | 1350   |
|   | Typical Shaft output at 690 V [kW]                                    | 710               | 800        | 900        | 1000                | 1200   |
|   | Enclosure IP21, 54 without/ with options cabinet                      | F1/ F3            | F1/ F3     | F1/ F3     | F2/ F4              | F2/ F4 |
| <b>Output current</b>   |   |                   |            |            |                     |        |
|  | Continuous (at 550 V) [A]   | 763               | 889        | 988        | 1108                | 1317   |
|   | Intermittent (60 s overload, at 550 V) [A]                            | 839               | 978        | 1087       | 1219                | 1449   |
|   | Continuous (at 575/ 690 V) [A]  | 730               | 850        | 945        | 1060                | 1260   |
|   | Intermittent (60 s overload, at 575/690 V) [A]                        | 803               | 935        | 1040       | 1166                | 1386   |
|   | Continuous KVA (at 550 V) [KVA]                                       | 727               | 847        | 941        | 1056                | 1255   |
|   | Continuous KVA (at 575 V) [KVA]                                       | 727               | 847        | 941        | 1056                | 1255   |
|   | Continuous KVA (at 690 V) [KVA]                                       | 872               | 1016       | 1129       | 1267                | 1506   |
| <b>Max. input current</b>   |   |                   |            |            |                     |        |
|  | Continuous (at 550 V) [A]   | 743               | 866        | 962        | 1079                | 1282   |
|   | Continuous (at 575 V) [A]   | 711               | 828        | 920        | 1032                | 1227   |
|   | Continuous (at 690 V) [A]   | 711               | 828        | 920        | 1032                | 1227   |
|   | Max. cable size, motor [mm <sup>2</sup> (AWG <sup>2</sup> )]          | 8x150 (8x300 mcm) |            |            | 12x150 (12x300 mcm) |        |
|   | Max. cable size, mains [mm <sup>2</sup> (AWG <sup>2</sup> )]          | 8x240 (8x500 mcm) |            |            |                     |        |
|   | Max. cable size, load-sharing [mm <sup>2</sup> (AWG <sup>2</sup> )]   | 4x120 (4x250 mcm) |            |            |                     |        |
|   | Max. cable size, brake [mm <sup>2</sup> (AWG <sup>2</sup> )]          | 4x185 (4x350 mcm) |            |            | 6x185 (6x350 mcm)   |        |
|   | Max. external pre-fuses [A] <sup>1)</sup>                             | 1600              |            |            |                     | 2000   |
|   | Est. power loss at rated max. load [W] <sup>4)</sup> , 575 V, F1 & F2 | 10771             | 12272      | 13835      | 15592               | 18281  |
|   | Est. power loss at rated max. load [W] <sup>4)</sup> , 690 V, F1 & F2 | 11315             | 12903      | 14533      | 16375               | 19207  |
| Max added losses of Circuit Breaker or Disconnect & Contactor, F3 & F4            | 422   | 526               | 610        | 658        | 855                 |        |
| Max Panel Options Losses  | 400   |                   |            |            |                     |        |
| Weight, enclosure IP21, IP 54 [kg]  | 1004/ 1299  | 1004/ 1299        | 1004/ 1299 | 1246/ 1541 | 1246/ 1541          |        |
| Weight, Rectifier Module [kg]   | 102   | 102               | 102        | 136        | 136                 |        |
| Weight, Inverter Module [kg]  | 102   | 102               | 136        | 102        | 102                 |        |
| Efficiency <sup>4)</sup>  | 0.98  |                   |            |            |                     |        |
| Output frequency  | 0-500 Hz  |                   |            |            |                     |        |
| Heatsink overtemp. trip   | 85 °C   |                   |            |            |                     |        |
| Power card amb. trip  | 68 °C   |                   |            |            |                     |        |

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

2) American Wire Gauge.

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

4) The typical power loss is at nominal load conditions and expected to be within +/-15% (tolerance relates to variety in voltage and cable conditions). Values are based on a typical motor efficiency (eff2/eff3 border line). Motors with lower efficiency will also add to the power loss in the frequency converter and opposite. If the switching frequency is increased compared to the default setting, the power losses may rise significantly. LCP and typical control card power consumptions are included. Further options and customer load may add up to 30W to the losses. (Though typical only 4W extra for a fully loaded control card, or options for slot A or slot B, each).

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

## 7 Troubleshooting

### 7.1 Alarms and warnings

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

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

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

**This may be done in four 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.
4. By resetting automatically using the [Auto Reset] function, which is a default setting for VLT AQUA Drive. see par. 14-20 *Reset Mode* in VLT AQUA Drive Programming Guide



**NB!**

After a manual reset using the [RESET] button on the LCP, the [AUTO ON] or [HAND ON] button must be pressed to restart the motor.

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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, means that the mains supply must be switched off before the alarm can be reset. After being switched back on, the frequency converter is no longer blocked and may be reset as described above once the cause has been rectified.

Alarms that are not trip-locked can also be reset using the automatic reset function in par. 14-20 *Reset Mode* (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 it can be specified whether it is a warning or an alarm that is to be displayed for a given fault.

This is possible, for instance, in par. 1-90 *Motor Thermal Protection*. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash on the frequency converter. Once the problem has been rectified, only the alarm continues flashing.

| 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 timeout                   | (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  | Heatsink overtemp                      | 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               |                 |                     |
| 35  | Out of frequency range                 | X       | X               |                 |                     |
| 36  | Mains failure                          | X       | X               |                 |                     |
| 37  | Phase Imbalance                        | X       | X               |                 |                     |
| 38  | Internal fault                         |         | X               | X               |                     |
| 39  | Heatsink sensor                        |         | 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                |
| 46  | Pwr. card supply                       |         | X               | X               |                     |
| 47  | 24 V supply low                        | X       | X               | X               |                     |
| 48  | 1.8 V supply low                       |         | X               | X               |                     |
| 49  | Speed limit                            | X       |                 |                 |                     |
| 50  | 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 timeout                            |         | X               |                 |                     |
| 58  | AMA internal fault                     | X       | X               |                 |                     |
| 59  | Current limit                          | X       |                 |                 |                     |
| 60  | External Interlock                     | X       |                 |                 |                     |
| 62  | Output Frequency at Maximum Limit      | X       |                 |                 |                     |
| 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 Activated                    |         | X <sup>1)</sup> |                 |                     |
| 69  | Pwr. Card Temp                         |         | X               | X               |                     |
| 70  | Illegal FC configuration               |         |                 | X               |                     |
| 71  | PTC 1 Safe Stop                        | X       | X <sup>1)</sup> |                 |                     |
| 72  | Dangerous Failure                      |         |                 | X <sup>1)</sup> |                     |
| 73  | Safe Stop Auto Restart                 |         |                 |                 |                     |
| 79  | Illegal PS config                      |         | X               | X               |                     |
| 80  | Drive Initialised to Default Value     |         | X               |                 |                     |
| 91  | Analog input 54 wrong settings         |         |                 | X               |                     |
| 92  | NoFlow                                 | X       | X               |                 | 22-2*               |
| 93  | Dry Pump                               | X       | X               |                 | 22-2*               |
| 94  | End of Curve                           | X       | X               |                 | 22-5*               |
| 95  | Broken Belt                            | X       | X               |                 | 22-6*               |
| 96  | Start Delayed                          | X       |                 |                 | 22-7*               |
| 97  | Stop Delayed                           | X       |                 |                 | 22-7*               |
| 98  | Clock Fault                            | X       |                 |                 | 0-7*                |

Table 7.1: Alarm/Warning code list

| No. | Description       | Warning | Alarm/Trip | Alarm/Trip Lock | Parameter Reference |
|-----|-------------------|---------|------------|-----------------|---------------------|
| 220 | Overload Trip     |         | X          |                 |                     |
| 243 | Brake IGBT        | X       | X          |                 |                     |
| 244 | Heatsink temp     | X       | X          | X               |                     |
| 245 | Heatsink sensor   |         | X          | X               |                     |
| 246 | Pwr.card supply   |         | X          | X               |                     |
| 247 | Pwr.card temp     |         | X          | X               |                     |
| 248 | Illegal PS config |         | X          | X               |                     |
| 250 | New spare part    |         |            | X               |                     |
| 251 | New Type Code     |         | X          | X               |                     |

Table 7.3: Alarm/Warning code list

(X) Dependent on parameter

1) Can not be Auto reset via par. 14-20 *Reset Mode*

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 frequency converter or cause dangerous conditions. A trip lock is an action when an alarm occurs, which may cause damage to frequency converter or connected parts. A Trip Lock situation can only be reset by a power cycling.

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

| Alarm Word and Extended Status Word |          |            |                   |                  |                      |
|-------------------------------------|----------|------------|-------------------|------------------|----------------------|
| Bit                                 | Hex      | Dec        | Alarm Word        | Warning Word     | Extended Status Word |
| 0                                   | 00000001 | 1          | Brake Check       | Brake Check      | Ramping              |
| 1                                   | 00000002 | 2          | Pwr. Card Temp    | Pwr. Card Temp   | AMA Running          |
| 2                                   | 00000004 | 4          | Earth Fault       | Earth Fault      | Start CW/CCW         |
| 3                                   | 00000008 | 8          | Ctrl.Card Temp    | Ctrl.Card Temp   | Slow Down            |
| 4                                   | 00000010 | 16         | Ctrl. Word TO     | 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  |                      |
| 17                                  | 00020000 | 131072     | Internal Fault    | 10V Low          |                      |
| 18                                  | 00040000 | 262144     | Brake Overload    | Brake Overload   |                      |
| 19                                  | 00080000 | 524288     | U phase Loss      | Brake Resistor   |                      |
| 20                                  | 00100000 | 1048576    | V phase Loss      | Brake IGBT       |                      |
| 21                                  | 00200000 | 2097152    | W phase Loss      | Speed Limit      |                      |
| 22                                  | 00400000 | 4194304    | Fieldbus Fault    | Fieldbus Fault   |                      |
| 23                                  | 00800000 | 8388608    | 24 V Supply Low   | 24V Supply Low   |                      |
| 24                                  | 01000000 | 16777216   | Mains Failure     | Mains Failure    |                      |
| 25                                  | 02000000 | 33554432   | 1.8V Supply Low   | Current Limit    |                      |
| 26                                  | 04000000 | 67108864   | Brake Resistor    | Low Temp         |                      |
| 27                                  | 08000000 | 134217728  | Brake IGBT        | Voltage Limit    |                      |
| 28                                  | 10000000 | 268435456  | Option Change     | Unused           |                      |
| 29                                  | 20000000 | 536870912  | Drive Initialised | Unused           |                      |
| 30                                  | 40000000 | 1073741824 | Safe Stop         | Unused           |                      |

Table 7.4: 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 diagnosis. See also par. 16-90 *Alarm Word*, par. 16-92 *Warning Word* and par. 16-94 *Ext. Status Word*.

### 7.1.1 Fault messages

#### WARNING 1, 10 volts low

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

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

This condition can be caused by a short in a connected potentiometer or improper wiring of the potentiometer.

**Troubleshooting:** Remove the wiring from terminal 50. If the warning clears, the problem is with the customer wiring. If the warning does not clear, replace the control card.

#### WARNING/ALARM 2, Live zero error

This warning or alarm will only appear if programmed by the user in parameter 6-01, Live Zero Timeout Function. The signal on one of the analog inputs is less than 50% of the minimum value programmed for that input. This condition can be caused by broken wiring or faulty device sending the signal.

##### Troubleshooting:

Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. MCB 101 terminals 11 and 12 for signals, terminal 10 common. MCB 109 terminals 1, 3, 5 for signals, terminals 2, 4, 6 common).

Check that the drive programming and switch settings match the analog signal type.

Perform Input Terminal Signal Test.

#### WARNING/ALARM 3, No motor

No motor has been connected to the output of the frequency converter. This warning or alarm will only appear if programmed by the user in parameter 1-80, Function at Stop.

**Troubleshooting:** Check the connection between the drive and the motor.

#### 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 for a fault in the input rectifier on the frequency converter. Options are programmed at parameter 14-12, Function at Mains Imbalance

**Troubleshooting:** 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 high voltage warning limit. The limit is dependent on the drive voltage rating. The frequency converter is still active.

#### WARNING 6, DC link voltage low

The intermediate circuit voltage (DC) is lower than the low voltage warning limit. The limit is dependent on the drive voltage rating. The frequency converter is still active.

#### WARNING/ALARM 7, DC overvoltage

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

##### Troubleshooting:

Connect a brake resistor

Extend the ramp time

Change the ramp type

Activate functions in par. 2-10 *Brake Function*

Increase par. 14-26 *Trip Delay at Inverter Fault*

#### WARNING/ALARM 8, DC under voltage

If the intermediate circuit voltage (DC) drops below the under voltage limit, the frequency converter checks if a 24 V backup supply is connected. If no 24 V backup supply is connected, the frequency converter trips after a fixed time delay. The time delay varies with unit size.

##### Troubleshooting:

Check that the supply voltage matches the frequency converter voltage.

Perform Input voltage test

Perform soft charge and rectifier circuit test

#### 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. The frequency converter *cannot* be reset until the counter is below 90%.

The fault is that the frequency converter is overloaded by more than 100% for too long.

##### Troubleshooting:

Compare the output current shown on the LCP keypad with the drive rated current.

Compare the output current shown on the LCP keypad with measured motor current.

Display the Thermal Drive Load on the keypad and monitor the value. When running above the drive continuous current rating, the counter should increase. When running below the drive continuous current rating, the counter should decrease.

Note: See the derating section in the Design Guide for more details if a high switching frequency is required.

#### WARNING/ALARM 10, Motor overload temperature

According to the electronic thermal protection (ETR), the motor is too hot. Select whether the frequency converter gives a warning or an alarm when the counter reaches 100% in par. 1-90 *Motor Thermal Protection*. The fault is that the motor is overloaded by more than 100% for too long.

##### Troubleshooting:

Check if motor is over heating.

If the motor is mechanically overloaded

That the motor par. 1-24 *Motor Current* is set correctly.

Motor data in parameters 1-20 through 1-25 are set correctly.

The setting in parameter 1-91, Motor External Fan.

Run AMA in parameter 1-29.

#### WARNING/ALARM 11, Motor thermistor over temp

The thermistor or the thermistor connection is disconnected. Select whether the frequency converter gives a warning or an alarm when the counter reaches 100% in par. 1-90 *Motor Thermal Protection*.

##### Troubleshooting:

Check if motor is over heating.

Check if the motor is mechanically overloaded.

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 a KTY sensor is used, check for correct connection between terminal 54 and 55.

If using a thermal switch or thermistor, check the programming of parameter 1-93 matches sensor wiring.

If using a KTY sensor, check the programming of parameters 1-95, 1-96, and 1-97 match sensor wiring.

**WARNING/ALARM 12, Torque limit**

The torque is higher than the value in par. 4-16 *Torque Limit Motor Mode* (in motor operation) or the torque is higher than the value in par. 4-17 *Torque Limit Generator Mode* (in regenerative operation). Parameter 14-25 can be used to change this from a warning only condition to a warning followed by an alarm.

**WARNING/ALARM 13, Over Current**

The inverter peak current limit (approx. 200% of the rated current) is exceeded. The warning lasts about 1.5 sec., then the frequency converter trips and issues an alarm. If extended mechanical brake control is selected, trip can be reset externally.

**Troubleshooting:**

This fault may be caused by shock loading or fast acceleration with high inertia loads.

Turn off the frequency converter. Check if the motor shaft can be turned.

Check that the motor size matches the frequency converter.

Incorrect motor data in parameters 1-20 through 1-25.

**ALARM 14, Earth (ground) 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.

**Troubleshooting:**

Turn off the frequency converter and remove the earth fault.

Measure the resistance to ground of the motor leads and the motor with a megohmmeter to check for earth faults in the motor.

Perform current sensor test.

**ALARM 15, Hardware mismatch**

A fitted option is not operational with the present control board hardware or software.

Record the value of the following parameters and contact your Danfoss supplier:

- 15-40 FC Type
- 15-41 Power Section
- 15-42 Voltage
- 15-43 Software Version
- 15-45 Actual Typecode String
- 15-49 SW ID Control Card
- 15-50 SW ID Power Card
- 15-60 Option Mounted (for each option slot)
- 15-61 Option SW Version (for each option slot)

**ALARM 16, Short circuit**

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

**WARNING/ALARM 17, Control word timeout**

There is no communication to the frequency converter.

The warning will only be active when par. 8-04 *Control Word Timeout Function* is NOT set to OFF.

If par. 8-04 *Control Word Timeout Function* is set to *Stop* and *Trip*, a warning appears and the frequency converter ramps down until it trips, while giving an alarm.

**Troubleshooting:**

Check connections on the serial communication cable.

Increase par. 8-03 *Control Word Timeout Time*

Check operation of the communication equipment.

Verify proper installation based on EMC requirements.

**WARNING 23, Internal fan fault**

The fan warning function is an extra protection function that checks if the fan is running / mounted. The fan warning can be disabled in par. 14-53 *Fan Monitor* ([0] Disabled).

For the D, E, and F Frame drives, the regulated voltage to the fans is monitored.

**Troubleshooting:**

Check fan resistance.

Check soft charge fuses.

**WARNING 24, External fan fault**

The fan warning function is an extra protection function that checks if the fan is running / mounted. The fan warning can be disabled in par. 14-53 *Fan Monitor* ([0] Disabled).

For the D, E, and F Frame drives, the regulated voltage to the fans is monitored.

**Troubleshooting:**

Check fan resistance.


Check soft charge fuses.

**WARNING 25, Brake resistor short circuit**

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*).

**WARNING/ALARM 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 seconds, on the basis of the resistance value of the brake resistor, 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 *Brake Power Monitoring*, the frequency converter cuts out and issues this alarm, when the dissipated braking power is higher than 100%.



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

**WARNING/ALARM 27, Brake chopper fault**

The brake transistor is monitored during operation and if it short-circuits, the brake function disconnects and issues a warning. 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/ALARM 28, Brake check failed**

Brake resistor fault: the brake resistor is not connected or not working. Check parameter 2-15, Brake Check.

**ALARM 29, Heatsink temp**

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

**Troubleshooting:**

- Ambient temperature too high.
- Too long motor cable.
- Incorrect clearance above and below the drive.
- Dirty heatsink.
- Blocked air flow around the drive.
- Damaged heatsink fan.

For the D, E, and F Frame Drives, this alarm is based on the temperature measured by the heatsink sensor mounted inside the IGBT modules. For the F Frame drives, this alarm can also be caused by the thermal sensor in the Rectifier module.

**Troubleshooting:**

- Check fan resistance.
- Check soft charge fuses.
- IGBT thermal sensor.

**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. Let unit cool to operating temperature.

**WARNING/ALARM 34, Fieldbus communication fault**

The fieldbus on the communication option card is not working.

**WARNING/ALARM 35, Out of frequency range:**

This warning is active if the output frequency has reached the high limit (set in parameter 4-53) or low limit (set in parameter 4-52). In *Process Control*, *Closed Loop* (parameter 1-00) this warning is displayed.

**WARNING/ALARM 36, Mains failure**

This warning/alarm is only active if the supply voltage to the frequency converter is lost and par. 14-10 *Mains Failure* is NOT set to OFF. Check the fuses to the frequency converter

**ALARM 38, Internal fault**

It may be necessary to contact your Danfoss supplier. Some typical alarm messages:

|           |  |
|-----------|--|
| 0         | Serial port cannot be initialized. Serious hardware failure  |
| 256-258   | Power EEPROM data is defect or too old   |
| 512       | Control board EEPROM data is defect or too old   |
| 513       | Communication time out reading EEPROM data   |
| 514       | Communication time out reading EEPROM data   |
| 515       | Application Orientated Control cannot recognize the EEPROM data                                    |
| 516       | Cannot write to the EEPROM because a write command is on progress                                  |
| 517       | Write command is under time out  |
| 518       | Failure in the EEPROM  |
| 519       | Missing or invalid Barcode data in EEPROM  |
| 783       | Parameter value outside of min/max limits  |
| 1024-1279 | A cantelegram that has to be sent, couldn't be sent  |
| 1281      | Digital Signal Processor flash timeout   |
| 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)  |
| 1379      | Option A did not respond when calculating Platform Version.  |
| 1380      | Option B did not respond when calculating Platform Version.  |
| 1381      | Option C0 did not respond when calculating Platform Version.                                       |
| 1382      | Option C1 did not respond when calculating Platform Version.                                       |
| 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   |
| 2064-2072 | H081x: option in slot x has restarted  |
| 2080-2088 | H082x: option in slot x has issued a powerup-wait  |
| 2096-2104 | H083x: option in slot x has issued a legal powerup-wait  |
| 2304      | Could not read any data from power EEPROM  |
| 2305      | Missing SW version from power unit   |
| 2314      | Missing power unit data from power unit  |
| 2315      | Missing SW version from power unit   |
| 2316      | Missing io_statepage from power unit   |
| 2324      | Power card configuration is determined to be incorrect at power up   |
| 2325      | A power card has stopped communicating while main power is applied   |
| 2326      | Power card configuration is determined to be incorrect after the delay for power cards to register           |
| 2327      | Too many power card locations have been registered as present  |
| 2330      | Power size information between the power cards does not match  |
| 2561      | No communication from DSP to ATACD   |
| 2562      | No communication from ATACD to DSP (state running)   |
| 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  |
| 2836      | cListMempool to small  |
| 3072-5122 | Parameter value is outside its limits  |
| 5123      | Option in slot A: Hardware incompatible with Control board hardware  |
| 5124      | Option in slot B: Hardware incompatible with Control board hardware  |
| 5125      | Option in slot C0: Hardware incompatible with Control board hardware   |
| 5126      | Option in slot C1: Hardware incompatible with Control board hardware   |
| 5376-6231 | Out of memory  |

**ALARM 39, Heatsink sensor**

No feedback from the heatsink temperature sensor.

The signal from the IGBT thermal sensor is not available on the power card. The problem could be on the power card, on the gate drive card, or the ribbon cable between the power card and gate drive card.

**WARNING 40, Overload of Digital Output Terminal 27**

Check the load connected to terminal 27 or remove short-circuit connection. Check par. 5-00 *Digital I/O Mode* and par. 5-01 *Terminal 27 Mode*.

**WARNING 41, Overload of Digital Output Terminal 29**

Check the load connected to terminal 29 or remove short-circuit connection. Check par. 5-00 *Digital I/O Mode* and par. 5-02 *Terminal 29 Mode*.

**WARNING 42, Overload of Digital Output on X30/6 or Overload of Digital Output on X30/7**

For X30/6, check the load connected to X30/6 or remove short-circuit connection. Check par. 5-32 *Term X30/6 Digi Out (MCB 101)*.

For X30/7, check the load connected to X30/7 or remove short-circuit connection. Check par. 5-33 *Term X30/7 Digi Out (MCB 101)*.

**ALARM 46, Power card supply**

The supply on the power card is out of range.

There are three power supplies generated by the switch mode power supply (SMPS) on the power card: 24 V, 5V, +/- 18V. When powered with 24 VDC with the MCB 107 option, only the 24 V and 5 V supplies are monitored. When powered with three phase mains voltage, all three supplied are monitored.

**WARNING 47, 24 V supply low**

The 24 VDC is measured on the control card. The external 24 VDC backup power supply may be overloaded, otherwise contact your Danfoss supplier.

**WARNING 48, 1.8 V supply low**

The 1.8 Volt DC supply used on the control card is outside of allowable limits. The power supply is measured on the control card.

**WARNING 49, Speed limit**

The speed is not within the specified range in par. 4-11 *Motor Speed Low Limit [RPM]* and par. 4-13 *Motor Speed High Limit [RPM]*.

**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 parameter out of range**

The parameter 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 timeout**

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  $R_s$  and  $R_r$  are increased. In most cases, however, this is not critical.

**ALARM 58, AMA internal fault**

Contact your Danfoss supplier.

**WARNING 59, Current limit**

The current is higher than the value in par. 4-18, *Current Limit*.

**WARNING 60, External interlock**

External interlock has been activated. To resume normal operation, apply 24 VDC to the terminal programmed for external interlock and reset the frequency converter (via serial communication, digital I/O, or by pressing reset button on keypad).

**WARNING 61, Tracking error**

An error has been detected between calculated motor speed and speed measurement from feedback device. The function for Warning/Alarm/Disable is set in par 4-30, *Motor Feedback Loss Function*, error setting in par 4-31, *Motor Feedback Speed Error*, and the allowed error time in par 4-32, *Motor Feedback Loss Timeout*. During a commissioning procedure the function may be effective.

**WARNING 62, Output frequency at maximum limit**

The output frequency is higher than the value set in par. 4-19 *Max Output Frequency*

**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**

This warning is based on the temperature sensor in the IGBT module.

**Troubleshooting:**

The heatsink temperature measured as 0° C could indicate that the temperature sensor is defective causing the fan speed to increase to the maximum. If the sensor wire between the IGBT and the gate drive card is disconnected, this warning would result. Also, check the IGBT thermal sensor.

**ALARM 67, Option module configuration has changed**

One or more options have either been added or removed since the last power-down.

**ALARM 68, Safe stop activated**

Safe stop has been activated. To resume normal operation, apply 24 VDC to terminal 37, then send a reset signal (via Bus, Digital I/O, or by pressing the reset key. See parameter 5-19, Terminal 37 Safe Stop.

**ALARM 69, Power card temperature**

The temperature sensor on the power card is either too hot or too cold.

**Troubleshooting:**

Check the operation of the door fans.

Check that the filters for the door fans are not blocked.

Check that the gland plate is properly installed on IP 21 and IP 54 (NEMA 1 and NEMA 12) drives.

**ALARM 70, Illegal FC Configuration**

Actual combination of control board and power board is illegal.

**WARNING/ALARM 71, PTC 1 safe stop**

Safe Stop has been activated from the MCB 112 PTC Thermistor Card (motor too warm). Normal operation can be resumed when the MCB 112 applies 24 V DC to T-37 again (when the motor temperature reaches an acceptable level) and when the Digital Input from the MCB 112 is deactivated. When that happens, a reset signal must be sent (via serial communication, digital I/O, or by pressing reset button on keypad). Note that if automatic restart is enabled, the motor may start when the fault is cleared.

**ALARM 72, Dangerous failure**

Safe stop with trip lock. Unexpected signal levels on safe stop and digital input from the MCB 112 PTC thermistor card.

**Warning 73, Safe stop auto restart**

Safe stopped. Note that with automatic restart enabled, the motor may start when the fault is cleared.

**WARNING 77, Reduced power mode:**

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

**ALARM 79, Illegal power section configuration**

The scaling card is the incorrect part number or not installed. Also MK102 connector on the power card could not be installed.

**ALARM 80, Drive initialized to default value**

Parameter settings are initialized to default settings after a manual reset.

**ALARM 91, Analog input 54 wrong settings**

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

**ALARM 92, No flow**

A no-load situation has been detected in the system. See parameter group 22-2.

**ALARM 93, Dry pump**

A no-flow situation and high speed indicates that the pump has run dry. See parameter group 22-2.

**ALARM 94, End of curve**

Feedback stays lower than the set point which may indicate leakage in the pipe system. See parameter group 22-5.

**ALARM 95, Broken belt**

Torque is below the torque level set for no load, indicating a broken belt. See parameter group 22-6.

**ALARM 96, Start delayed**

Motor start has been delayed due to short-cycle protection active. See parameter group 22-7.

**WARNING 97, Stop delayed**

Stopping the motor has been delayed due to short cycle protection is active. See parameter group 22-7.

**WARNING 98, Clock fault**

Clock Fault. Time is not set or RTC clock (if mounted) has failed. See parameter group 0-7.

**ALARM 243, Brake IGBT**

This alarm is only for F Frame drives. It is equivalent to Alarm 27. The report value in the alarm log indicates which power module generated the alarm:

- 1 = left most inverter module.
- 2 = middle inverter module in F2 or F4 drive.
- 2 = right inverter module in F1 or F3 drive.
- 3 = right inverter module in F2 or F4 drive.
- 5 = rectifier module.

**ALARM 244, Heatsink temperature**

This alarm is only for F Frame drives. It is equivalent to Alarm 29. The report value in the alarm log indicates which power module generated the alarm:

- 1 = left most inverter module.
- 2 = middle inverter module in F2 or F4 drive.
- 2 = right inverter module in F1 or F3 drive.
- 3 = right inverter module in F2 or F4 drive.
- 5 = rectifier module.

**ALARM 245, Heatsink sensor**

This alarm is only for F Frame drives. It is equivalent to Alarm 39. The report value in the alarm log indicates which power module generated the alarm:

- 1 = left most inverter module.
- 2 = middle inverter module in F2 or F4 drive.
- 2 = right inverter module in F1 or F3 drive.
- 3 = right inverter module in F2 or F4 drive.
- 5 = rectifier module.

**ALARM 246, Power card supply**

This alarm is only for F Frame drives. It is equivalent to Alarm 46. The report value in the alarm log indicates which power module generated the alarm:

- 1 = left most inverter module.
- 2 = middle inverter module in F2 or F4 drive.
- 2 = right inverter module in F1 or F3 drive.
- 3 = right inverter module in F2 or F4 drive.
- 5 = rectifier module.

**ALARM 247, Power card temperature**

This alarm is only for F Frame drives. It is equivalent to Alarm 69. The report value in the alarm log indicates which power module generated the alarm:

- 1 = left most inverter module.
- 2 = middle inverter module in F2 or F4 drive.
- 2 = right inverter module in F1 or F3 drive.
- 3 = right inverter module in F2 or F4 drive.
- 5 = rectifier module.

**ALARM 248, Illegal power section configuration**

This alarm is only for F-frame drives. It is equivalent to Alarm 79. The report value in the alarm log indicates which power module generated the alarm:

- 1 = left most inverter module.
- 2 = middle inverter module in F2 or F4 drive.
- 2 = right inverter module in F1 or F3 drive.
- 3 = right inverter module in F2 or F4 drive.
- 5 = rectifier module.

**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 *Typecode Setting* according to the label on the unit. Remember to select 'Save to EEPROM' to complete.

**ALARM 251, New type code**

The frequency converter has a new type code.

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