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1 How to Read the Instruction Manual

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 and software environment.

Although Danfoss has tested and reviewed the documentation within this manual, Danfoss makes no warranty or representation, neither expressed nor implied, with respect to this documentation, including its quality, performance, or fitness for a particular purpose.

In no event shall Danfoss be liable for direct, indirect, special, incidental, or consequential damages arising out of the use, or the inability to use information contained in this manual, even if advised of the possibility of such damages. In particular, Danfoss is not responsible for any costs, including but not limited to those incurred as a result of lost profits or revenue, loss or damage of equipment, loss of computer programs, loss of data, the costs to substitute these, or any claims by third parties.

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.

1.1.2 Symbols

Symbols used in this manual:



NOTE!
Indicates something to be noted by the reader.



Indicates a general warning.



Indicates a high-voltage warning.



Indicates a default setting

1.1.3 Available literature

- Instruction Manual MG.11.Ax.yy provides the necessary information for getting the adjustable frequency drive up and running.
- Design Guide MG.11.Bx.yy contains all technical information about the adjustable frequency drive and customer design and applications.
- Programming Guide MG.11.Cx.yy provides information on how to program and includes complete parameter descriptions.
- Mounting Instruction, Analog I/O Option MCB109, MI.38.Bx.yy
- PC-based Configuration Tool MCT 10, MG.10.Ax.yy enables the user to configure the adjustable frequency drive from a Windows™-based PC environment.
- Danfoss VLT® Energy Box software at www.danfoss.com/BusinessAreas/DrivesSolutions, then choose PC Software Download
- VLT® HVAC Drive Applications, MG.11.Tx.yy
- Instruction Manual BACnet, MG.11.Dx.yy
- Instruction Manual Profibus, MG.33.Cx.yy.
- Instruction Manual Device Net, MG.33.Dx.yy
- Instruction Manual LonWorks, MG.11.Ex.yy
- Instruction Manual High Power, MG.11.Fx.yy
- Instruction Manual Metasys, MG.11.Gx.yy
- Instruction Manual FLN, MG.11.Zx.yy

x = Revision number

yy = Language code

Danfoss technical literature is available in print from your local Danfoss Sales Office or online at:
www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm

1.1.4 Abbreviations and Standards

| Abbreviations: | Terms: | SI units: | I-P units: |
|------------------|-------------------------------|-----------------------|-----------------------|
| a | Acceleration | m/s ² | ft/s ² |
| AWG | American wire gauge | | |
| Auto Tune | Automatic Motor Tuning | | |
| °C | Celsius | | |
| I | Current | A | Amp |
| I _{LIM} | Current limit | | |
| Joule | Energy | J = N•m | ft-lb, Btu |
| °F | Fahrenheit | | |
| FC | Adjustable Frequency Drive | | |
| f | Frequency | Hz | Hz |
| kHz | Kilohertz | kHz | kHz |
| LCP | Local Control Panel | | |
| mA | Milliampere | | |
| ms | Millisecond | | |
| min | Minute | | |
| MCT | Motion Control Tool | | |
| M-TYPE | Motor Type Dependent | | |
| Nm | Newton meters | | in-lbs |
| I _{M,N} | Nominal motor current | | |
| f _{M,N} | Nominal motor frequency | | |
| P _{M,N} | Nominal motor power | | |
| U _{M,N} | Nominal motor voltage | | |
| par. | Parameter | | |
| PELV | Protective Extra Low Voltage | | |
| Watt | Power | W | Btu/hr, hp |
| Pascal | Pressure | Pa = N/m ² | psi, psf, ft of water |
| I _{INV} | Rated Inverter Output Current | | |
| RPM | Revolutions Per Minute | | |
| SR | Size Related | | |
| T | Temperature | C | F |
| t | Time | s | s, hr |
| T _{LIM} | Torque limit | | |
| U | Voltage | V | V |

Table 1.1: Abbreviation and Standards table

2 Safety

2.1.1 High voltage warning



The voltage of the adjustable frequency drive and the MCO 101 option card is dangerous whenever it is connected to line power. Incorrect installation of the motor or adjustable frequency drive may cause damage to the equipment, serious injury or death. Consequently, it is essential to comply with the instructions in this manual as well as local and national rules and safety regulations.

2

2.1.2 Safety instructions



Prior to using functions directly or indirectly influencing personal safety (e.g., Safe Stop, Fire Mode or other functions either forcing the motor to stop or attempting to keep it functioning), a thorough risk analysis and system test must be carried out. The system tests must include testing failure modes regarding the control signaling (analog and digital signals and serial communication).



NOTE!
Before using fire mode, contact Danfoss

- Make sure the adjustable frequency drive is properly grounded.
- Do not remove AC line input connections, motor connections or other power connections while the adjustable frequency drive is connected to line power.
- Protect users against supply voltage.
- Protect the motor against overloading in accordance with national and local regulations.
- The ground leakage current exceeds 3.5 mA.
- The [OFF] key is not a safety switch. It does not disconnect the adjustable frequency drive from line power.

2.1.3 General Warning



Warning:

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

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

Before touching any potentially live parts of the VLT AQUA Drive FC 200, wait at least the minimum time as follows:

380-480 V, 150-600 hp [110-450 kW], wait at least 15 minutes.

525-690 V, 175-850 hp [132-630 kW], wait at least 20 minutes.

A shorter time is allowed only if indicated on the nameplate for the specific unit.

**Leakage Current**

The ground leakage current from the VLT AQUA Drive FC 200 exceeds 3.5 mA. According to IEC 61800-5-1, a reinforced protective ground connection must be ensured by means of: a min. 0.015 in² [10 mm²] Cu or 0.025 in² [16 mm²] Al PE wire or an additional PE wire, with the same cable cross-section as the line power wiring, must be terminated separately.

Residual Current Device

This product can cause DC current in the protective conductor. If a residual current device (RCD) is used for extra protection, only an RCD of Type B (time delayed) may be used on the supply side of this product. See also RCD Application Note MN.90.GX.02.

Protective grounding of the VLT AQUA Drive FC 200 and the use of RCDs must always follow national and local regulations.

2.1.4 Before Commencing Repair Work

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

2.1.5 Special conditions

Electrical ratings:

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

The adjustable frequency drives also support other special applications, which affect the electrical ratings of the adjustable frequency drive.

Special conditions that affect the electrical ratings might be:

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

Other applications might also affect the electrical ratings.

Consult the relevant sections in this manual and in the *Design Guide, MG.11.BX.YY* for information about the electrical ratings.


Installation requirements:

The overall electrical safety of the adjustable frequency drive requires special installation considerations regarding:

- Fuses and circuit breakers for overcurrent and short-circuit protection
- Selection of power cables (line power, motor, brake, load sharing 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 *Design Guide* for information about the installation requirements.

2.1.6 Caution



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

2

| Voltage | Power size | Min. Waiting Time |
|---|---------------------------|-------------------|
| 380–480 V | 150–350 HP [110–250 kW] | 20 minutes |
| | 450–1350 HP [315–1000 kW] | 40 minutes |
| 525–690 V | 60–550 HP [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. | | |

2.1.7 Installation at high altitudes (PELV)



Installation at high altitude:

380–480 V: At altitudes above 9842 ft [3 km], please contact Danfoss regarding PELV.

525–690 V: At altitudes above 6561 ft [2 km], please contact Danfoss regarding PELV.

2.1.8 Avoid unintended Start.

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

- Disconnect the adjustable frequency drive from line power whenever personal safety considerations make it necessary to avoid an unintended start.
- To avoid an 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 line power supply or lost motor connection may cause a stopped motor to start.

2.1.9 Safe Stop of the Adjustable Frequency Drive

For versions equipped with a Safe Stop terminal 37 input, the adjustable frequency drive 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 deemed suitable for the requirements of Safety Category 3 in EN 954-1. This functionality is called Safe Stop. Prior to integrating and using safe stop in an installation, a thorough risk analysis must be carried out on the installation 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 *Design Guide* must be followed! The information and instructions contained in the Instruction Manual are not sufficient for a correct and safe use of the safe stop functionality!

Prüf- und Zertifizierungsstelle
im BG-PRÜFZERT



BGIA
Berufsgenossenschaftliches
Institut für Arbeitsschutz

Hauptverband der gewerblichen
Berufsgenossenschaften

Translation

In any case, the German
original shall prevail.

Type Test Certificate

05 06004

No. of certificate

Name and address of the
holder of the certificate:
(customer) Danfoss Drives A/S, Ulnaes 1
DK-6300 Graasten, Dänemark

Name and address of the
manufacturer: Danfoss Drives A/S, Ulnaes 1
DK-6300 Graasten, Dänemark

Ref. of customer:

Ref. of Test and Certification Body:
Apf/Köh VE-Nr. 2003 23220

Date of Issue:
13.04.2005

Product designation: Frequency converter with integrated safety functions

Type: VLT® Automation Drive FC 302

Intended purpose: Implementation of safety function „Safe Stop“

Testing based on: EN 954-1, 1997-03,
DKE AK 226.03, 1998-06,
EN ISO 13849-2; 2003-12,
EN 61800-3, 2001-02,
EN 61800-5-1, 2003-09,

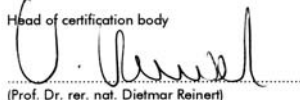
Test certificate: No.: 2003 23220 from 13.04.2005

Remarks: The presented types of the frequency converter FC 302 meet the requirements laid down in the test bases.
With correct wiring a category 3 according to DIN EN 954-1 is reached for the safety function.

The type tested complies with the provisions laid down in the directive 98/37/EC (Machinery).

Further conditions are laid down in the Rules of Procedure for Testing and Certification of April 2004.

Head of certification body



(Prof. Dr. rer. nat. Dietmar Reinert)

Certification officer



(Dipl.-Ing. R. Apfeld)

PZB10E
01.05



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130BA491

This certificate also covers FC 102 and FC 202!

2.1.10 IT Line Power



IT Line Power

Do not connect 400 V adjustable frequency drives with RFI filters to line supplies with a voltage between phase and ground of more than 440 V.

For IT line power and delta ground (grounded leg), AC line voltage may exceed 440 V between phase and ground.

2

par. 14-50 *RFI 1* can be used to disconnect the internal RFI capacitors from the RFI filter to ground. If this is done, it will reduce the RFI performance to A2 level.

2.1.11 Software version and approvals:

Software version: 2.8.x



This manual can be used with all adjustable frequency drives with software version 2.8.x.
The software version number can be seen from par. 15-43 *Software Version*.

2.1.12 Disposal Instructions



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 Mechanical Installation

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 Instruction Manual and Design Guide.

3.1.2 How to Get Started

The adjustable frequency drive is designed for quick installation and is EMC-compliant. Just follow the steps described below.



Read the safety instructions before installing the unit.

Mechanical Installation

- Mechanical mounting

Electrical Installation

- Connection to Line and Protecting Ground
- Motor connection and cables
- Fuses and circuit breakers
- Control terminals - cables

Quick set-up

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

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

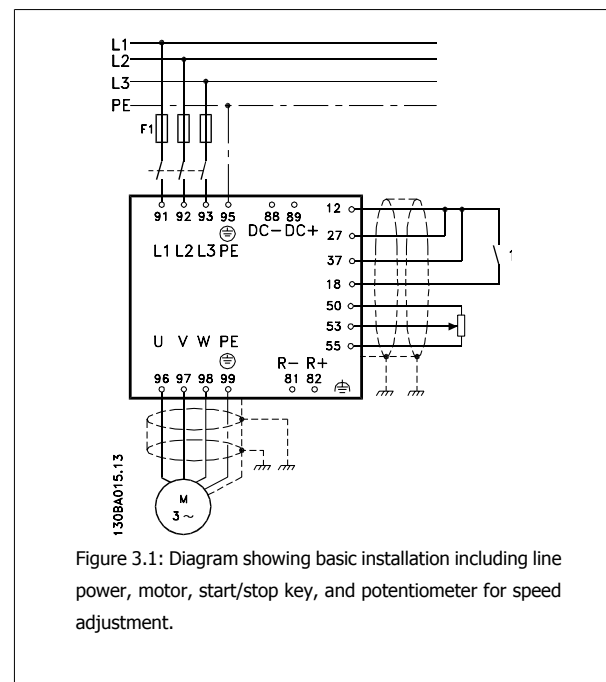


Figure 3.1: Diagram showing basic installation including line power, motor, start/stop key, and potentiometer for speed adjustment.

3.2 Pre-installation

3.2.1 Planning the Installation Site

**NOTE!**

Before performing the installation, it is important to plan the installation of the adjustable frequency drive. 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 in the respective Design Guides):

- Ambient operating temperature
- Installation method
- How to cool the unit
- Position of the adjustable frequency drive.
- 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 adjustable frequency drive.
- If the adjustable frequency drive is without built-in fuses, ensure that the external fuses are rated correctly.

3.2.2 Receiving the Adjustable Frequency Drive

When receiving the adjustable frequency drive, make sure that the packaging is intact, and look for any damage that might have occurred to the unit during transport. If damage has occurred, immediately contact the shipping company to make a damage claim.

3.2.3 Transportation and Unpacking

Before unpacking the adjustable frequency drive, it is recommended to unload it as close as possible to the final installation site. Remove the box and handle the adjustable frequency drive on the pallet, as long as possible.

**NOTE!**

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.

3

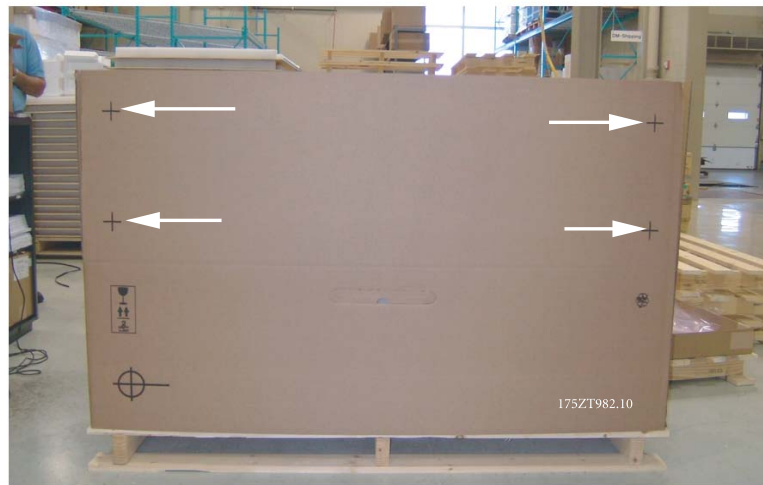


Figure 3.2: Mounting Template

3.2.4 Lifting

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

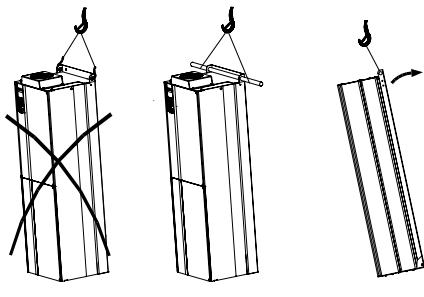
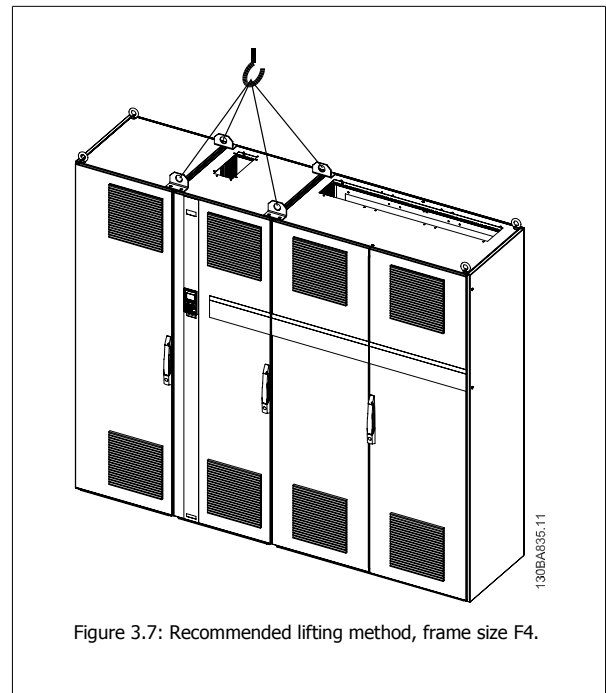
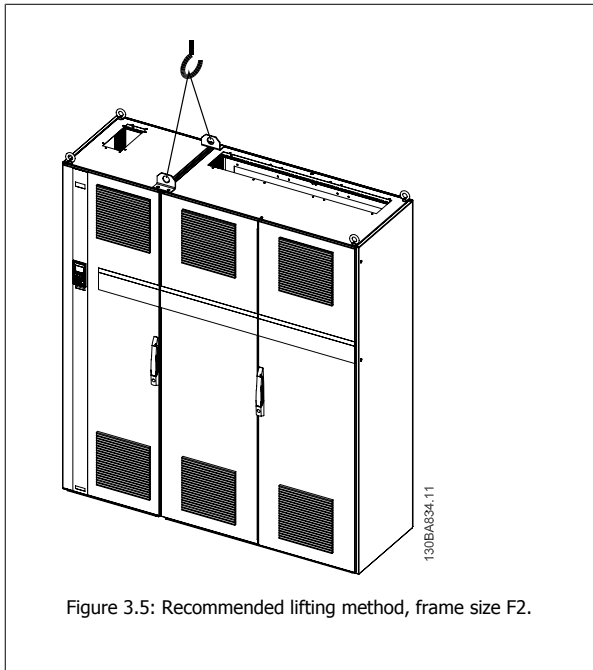
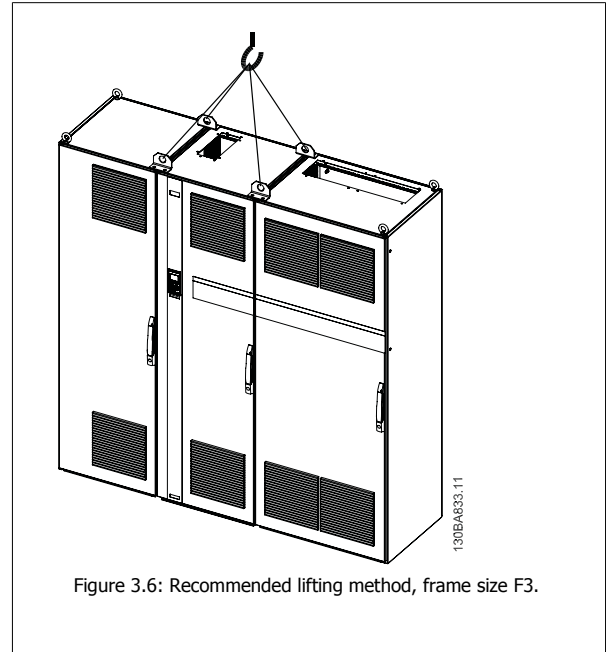
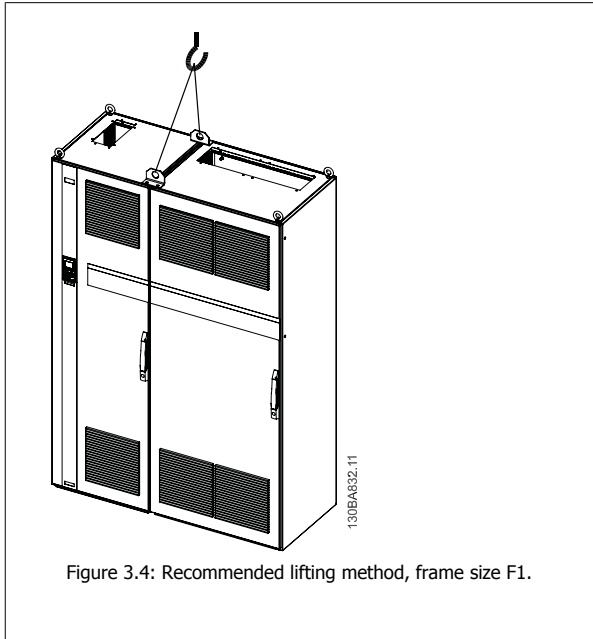


Figure 3.3: Recommended lifting method, frame sizes D and E .



NOTE!

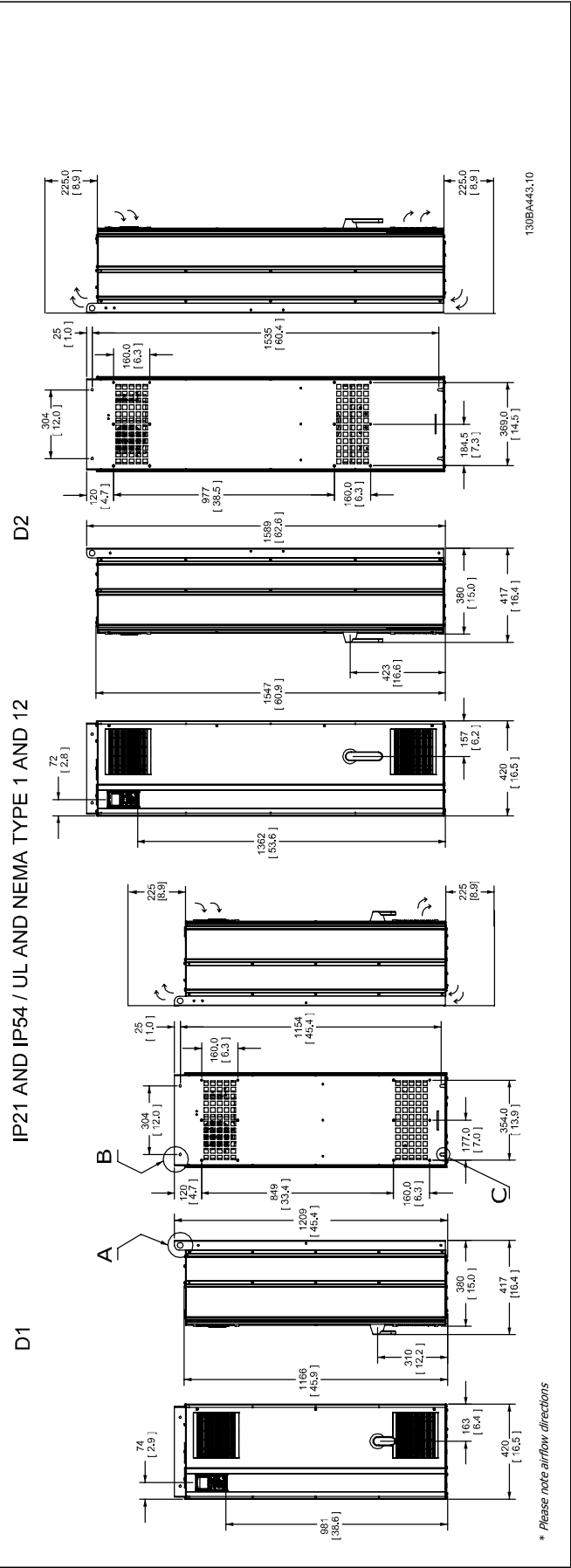
The lifting bar must be able to handle the weight of the adjustable frequency drive. See *Mechanical Dimensions* for the weight of the different frame sizes. Maximum diameter for bar is 1 in [25 cm]. The angle from the top of the drive to the lifting cable should be 60 degrees or greater.

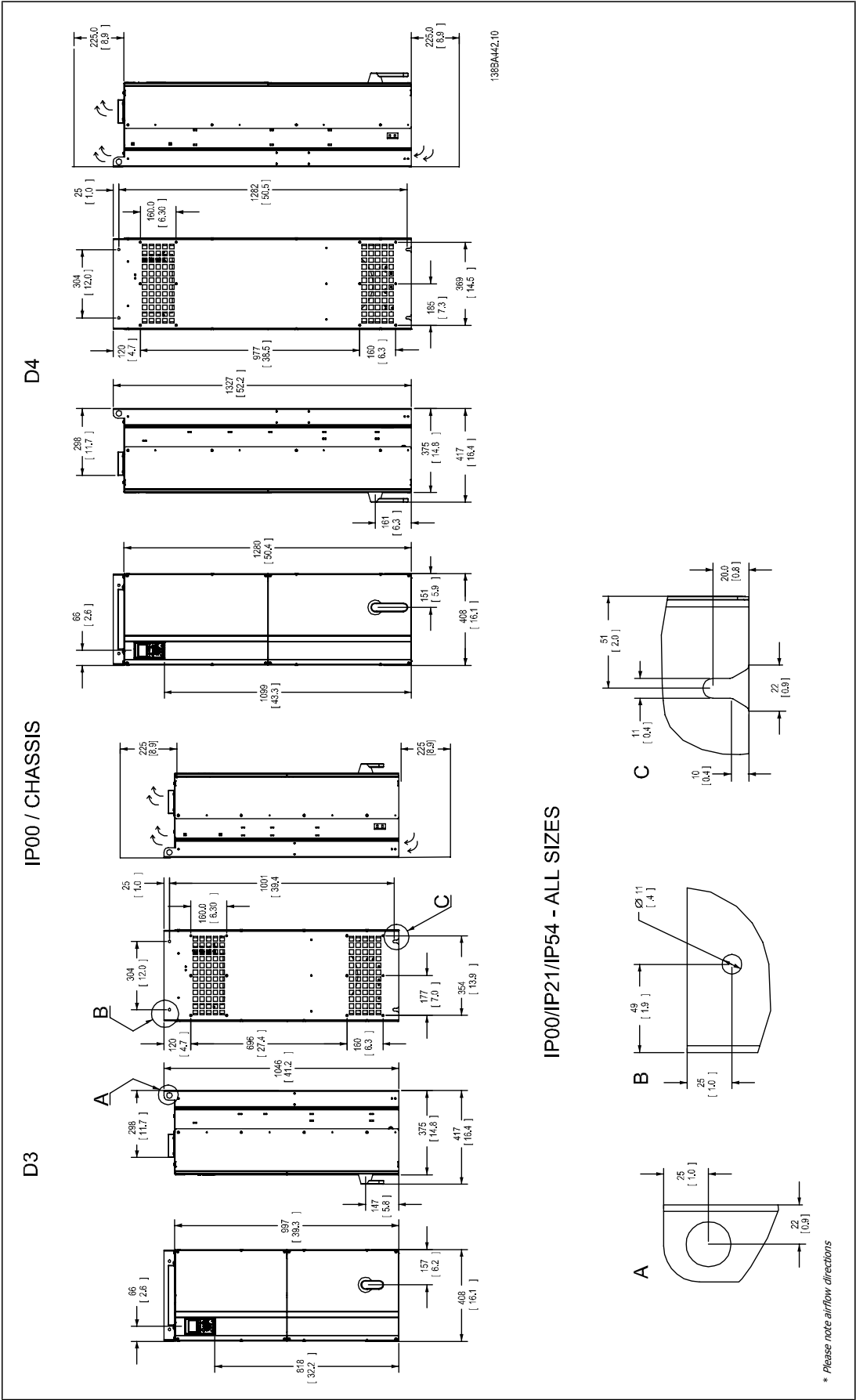


NOTE!

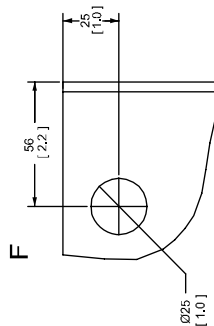
Note the plinth is provided in the same packaging as the adjustable frequency drive but is not attached to F1-F4 frames during shipment. The plinth is required to allow airflow to the drive to provide proper cooling. The F frames should be positioned on top of the plinth in the final installation location.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

3.2.5 Mechanical Dimensions

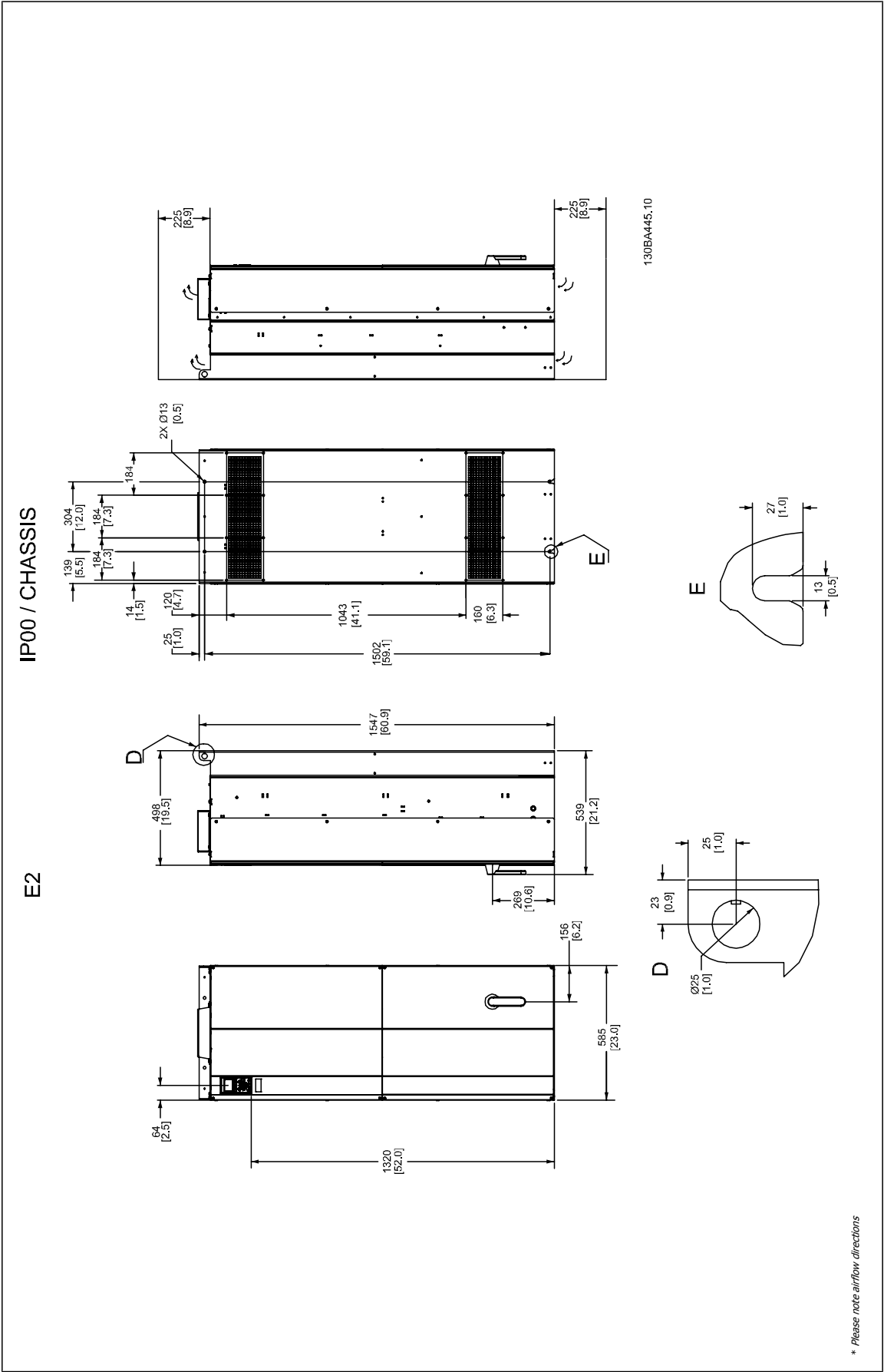


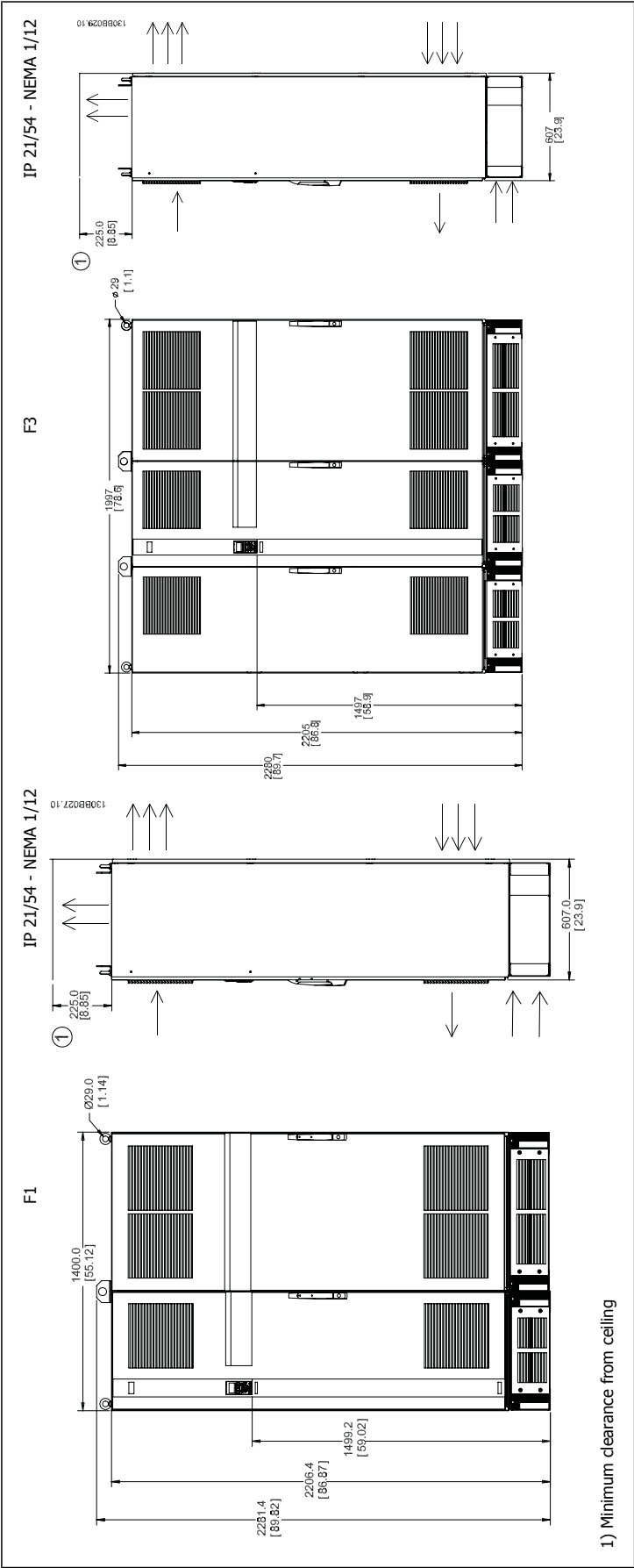


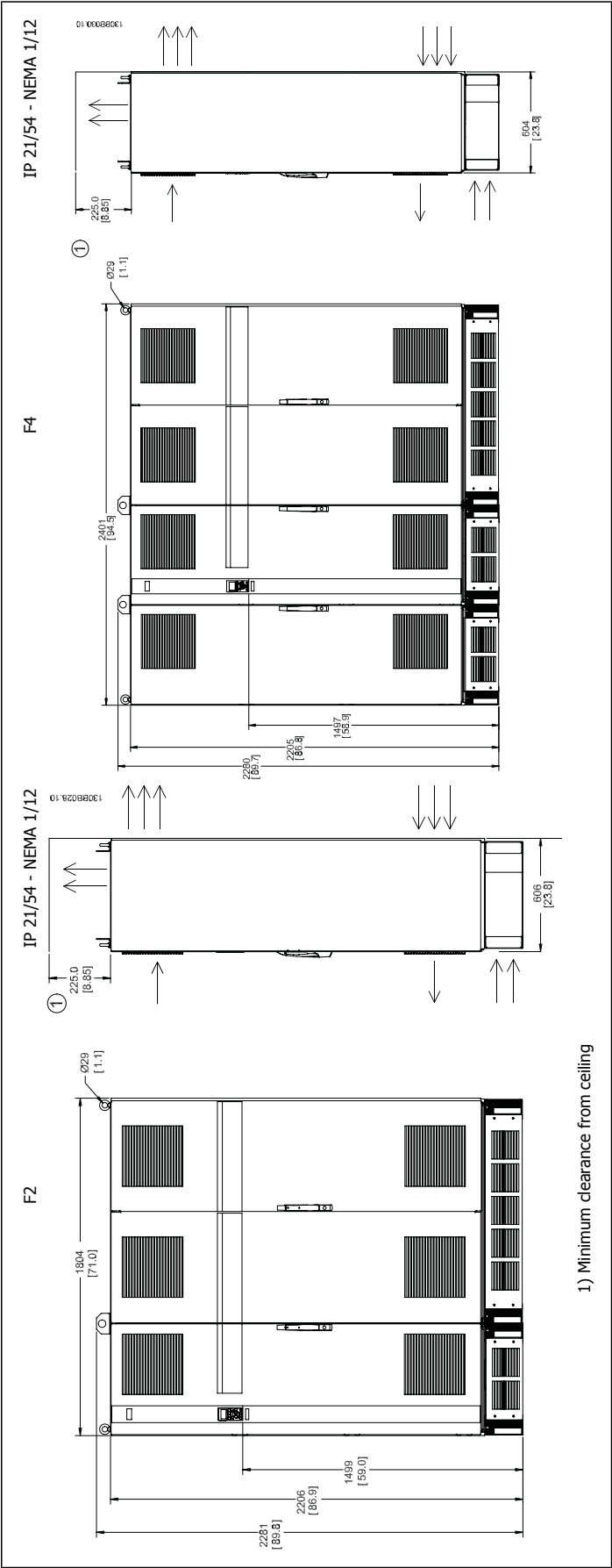
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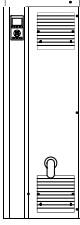


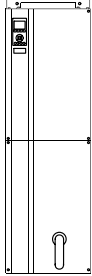


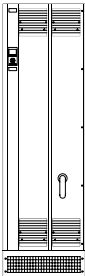
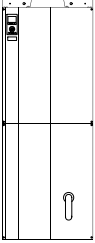
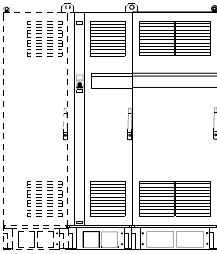
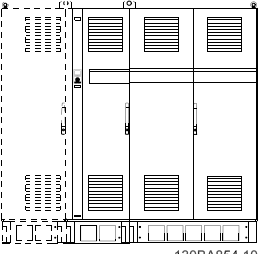


| Mechanical dimensions, Frame size D | | | | | | | | |
|-------------------------------------|--------|--|--|-------------------|--|--------------------|--|--|
| Frame Size | | | D1 | | D2 | | D3 | D4 |
| | | | 150–175 HP [110–132 kW] at 400 V (380–480 V) 60–250 HP [45–160 kW] at 690 V (525–690 V) | | 250–350 HP [160–250 kW] at 400 V (380–480 V) 300–550 HP [200–400 kW] at 690 V (525–690 V) | | 150–175 HP [110–132 kW] at 400 V (380–480 V) 60–250 HP [45–160 kW] at 690 V (525–690 V) | 250–350 HP [160–250 kW] at 400 V (380–480 V) 300–550 HP [200–400 kW] at 690 V (525–690 V) |
| IP NEMA | | | 21 Type 1 | 54 Type 12 | 21 Type 1 | 54 Type 12 | 00 Chassis | 00 Chassis |
| Shipping dimensions | Height | | 25.6 in [650 mm] | 25.6 in [650 mm] | 25.6 in [650 mm] | 25.6 in [650 mm] | 25.6 in [650 mm] | 25.6 in [650 mm] |
| | Width | | 68.1 in [1730 mm] | 68.1 in [1730 mm] | 68.1 in [1730 mm] | 68.1 in [1730 mm] | 48 in [1220 mm] | 58.7 in [1490 mm] |
| | Depth | | 22.4 in [570 mm] | 22.4 in [570 mm] | 22.4 in [570 mm] | 22.4 in [570 mm] | 22.4 in [570 mm] | 22.4 in [570 mm] |
| Drive dimensions | Height | | 47.6 in [1209 mm] | 47.6 in [1209 mm] | 62.6 in [1589 mm] | 62.6 in [1589 mm] | 41.2 in [1046 mm] | 52.2 in [1327 mm] |
| | Width | | 16.5 in [420 mm] | 16.5 in [420 mm] | 16.5 in [420 mm] | 16.5 in [420 mm] | 16.1 in [408 mm] | 16.1 in [408 mm] |
| | Depth | | 15 in [380 mm] | 15 in [380 mm] | 15 in [380 mm] | 15 in [380 mm] | 14.8 in [375 mm] | 14.8 in [375 mm] |
| Max weight | | | 229 lb [104 kg] | 229 lb [104 kg] | 332.9 lbs [151 kg] | 332.9 lbs [151 kg] | 200 lbs [91 kg] | 304 lbs [138 kg] |

| Mechanical dimensions, frame size E and F | | | | | | | | |
|---|--------|--|--|---|---|---|---|---|
| Frame Size | | | E1 | E2 | F1 | F2 | F3 | F4 |
| | | | 450–600 HP [315–450 kW] at 400 V (380–480 V) 600–850 HP [450–630 kW] at 690 V (525–690 V) | 450–600 HP [315–450 kW] at 400 V (380–480 V) 1000–850 HP [450–630 kW] at 690 V (525–690 V) | 675–950 HP [500–710 kW] at 400 V (380–480 V) 950–1200 HP [710–900 kW] at 690 V (525–690 V) | 1075–1350 HP [800–1000 kW] at 400 V (380–480 V) 1350–1600 HP [1000–1200 kW] at 690 V (525–690 V) | 675–950 HP [500–710 kW] at 400 V (380–480 V) 950–1200 HP [710–900 kW] at 690 V (525–690 V) | 1075–1350 HP [800–1000 kW] at 400 V (380–480 V) 1350–1600 HP [1000–1200 kW] at 690 V (525–690 V) |
| IP NEMA | | | 21, 54 Type 1/ Type 12 | 00 Chassis | 21, 54 Type 1/ Type 12 | 21, 54 Type 1/ Type 12 | 21, 54 Type 1/ Type 12 | 21, 54 Type 1/ Type 12 |
| Shipping dimensions | Height | | 33.1 in [840 mm] | 32.7 in [831 mm] | 91.5 in [2324 mm] | 91.5 in [2324 mm] | 91.5 in [2324 mm] | 91.5 in [2324 mm] |
| | Width | | 86.5 in [2197 mm] | 67.1 in [1705 mm] | 61.8 in [1569 mm] | 77.2 in [1962 mm] | 85 in [2159 mm] | 100.1 in [2559 mm] |
| | Depth | | 28 in [736 mm] | 28 in [736 mm] | 36.5 in [927 mm] | 36.5 in [927 mm] | 36.5 in [927 mm] | 36.5 in [927 mm] |
| Drive dimensions | Height | | 78.7 in [2000 mm] | 60.9 in [1547 mm] | 2204 | 2204 | 2204 | 2204 |
| | Width | | 23.6 in [600 mm] | 23 in [585 mm] | 1400 | 1800 | 2000 | 2400 |
| | Depth | | 19.5 in [494 mm] | 19.6 in [498 mm] | 606 | 606 | 606 | 606 |
| Max weight | | | 690 lbs [313 kg] | 610 [277 kg] | 1004 | 1246 | 1299 | 1541 |

3.2.6 Rated Power

| Frame size | | D1 | D2 | D3 | D4 |
|--|------|---|--|--|--|
| | |  |  |  |  |
| | | 130BA481.10 | 130BA482.10 | 130BA478.10 | 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 (380 - 480 V) 60-250 HP [45-160 kW] at 690 V (525-690 V) | 200-350 HP [150-250 kW] at 400 V (380-480 V) 300-550 HP [200-400 kW] at 690 V (525-690 V) | 150-175 HP [110-132 kW] at 400 V (380-480 V) 60-250 HP [45-160 kW] at 690 V (525-690 V) | 175-350 HP [150-250 kW] at 400 V (380-480 V) 300-550 HP [200-400 kW] at 690 V (525-690 V) |

| Frame size | | E1 | E2 | F1 / F3 | F2 / F4 |
|--|------|--|--|---|---|
| | |  |  |  |  |
| | | 130BA483.10 | 130BA480.10 | 130BA855.10 | 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 | | 450-600 HP [315-450 kW] at 400 V (380-480 V) 600-850 HP [450-630 kW] at 690 V (525-690 V) | 450-600 HP [315-450 kW] at 400 V (380-480 V) 600-850 HP [450-630 kW] at 690 V (525-690 V) | 675-950 HP [500-710 kW] at 400 V (380-480 V) 950-1200 HP [710-900 kW] at 690 V (525-690 V) | 1075-1350 HP [800-1000 kW] at 400 V (380-480 V) 1350-1600 HP [1000-1200 kW] at 690 V (525-690 V) |



NOTE!

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

3

3.3.1 Tools Needed

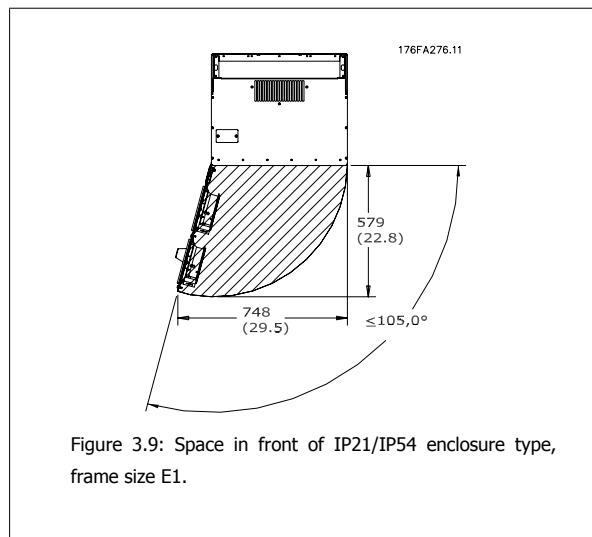
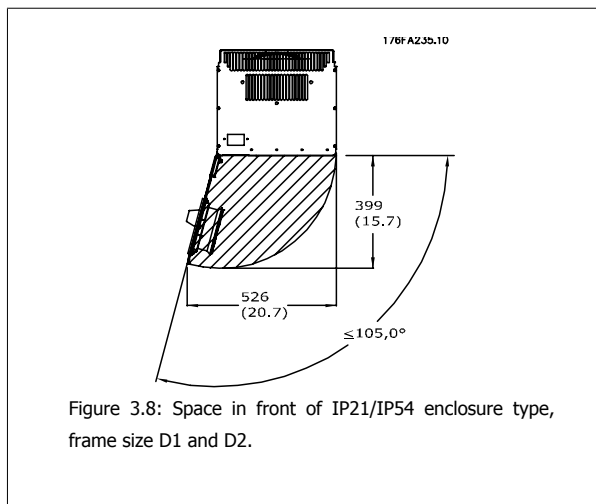
To perform the mechanical installation, the following tools are needed:

- Drill with 0.39 or 0.47 in [10 or 12 mm] drill.
- Tape measure
- Wrench with relevant metric sockets (0.28-0.67 in (7-17 mm))
- Extensions to wrench
- Sheet metal punch for conduits or cable connectors in IP 21/Nema 1 and IP 54 units
- Lifting bar to lift the unit (rod or tube max. Ø1 in [25 mm], able to lift minimum 880 lbs [400 kg]).
- Crane or other lifting aid to place the adjustable frequency drive 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 adjustable frequency drive to allow airflow and cable access. In addition, space in front of the unit must be considered to allow the panel door to be opened.



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 adjustable frequency drive is mounted, e.g., by using cable clamps.



NOTE!

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 terminal positions into consideration when you design for cable access.

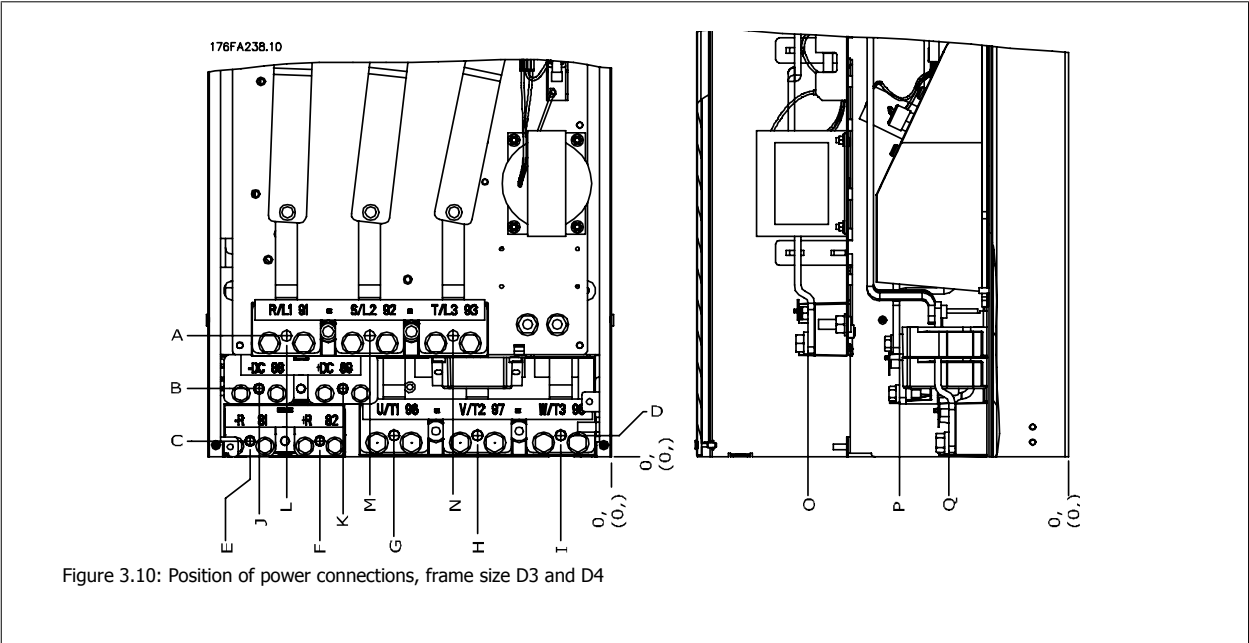


Figure 3.10: Position of power connections, frame size D3 and D4

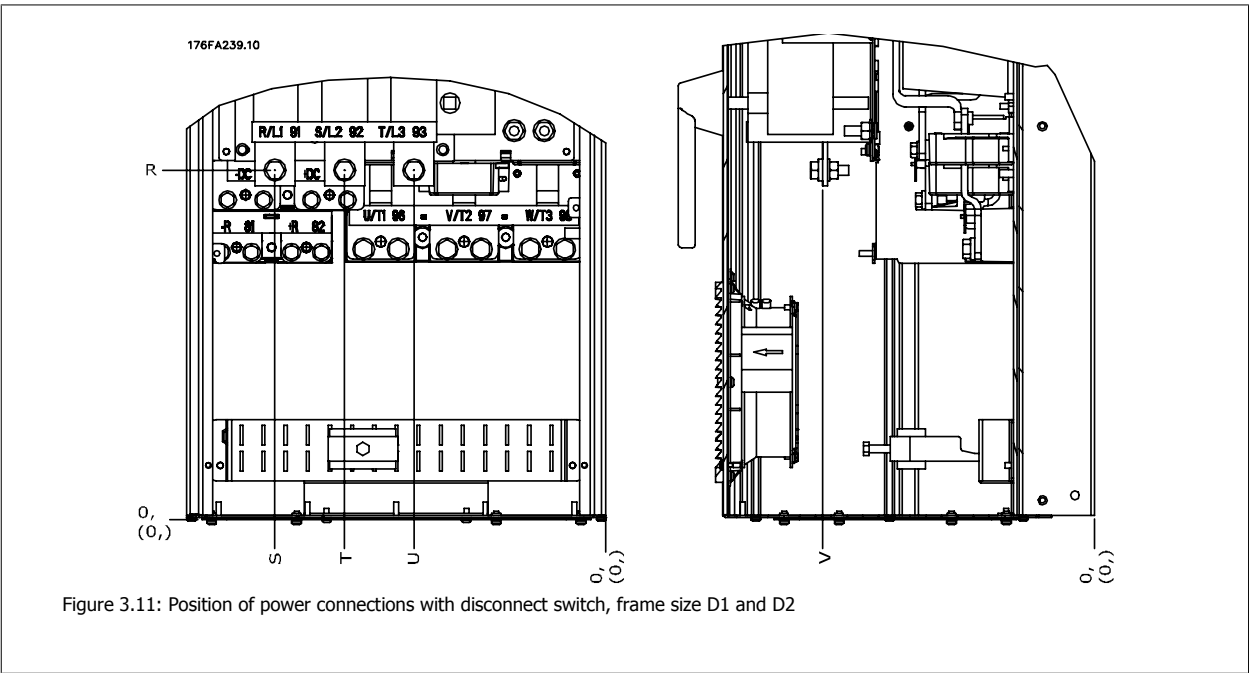


Figure 3.11: Position of power connections with disconnect switch, frame size D1 and D2

Be aware that the power cables are heavy and hard to bend. Give thought to the optimum position of the adjustable frequency drive for ensuring easy installation of the cables.



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

| | 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 the drawings above. Dimensions in mm (inches).

3.3.4 Terminal Locations - frame size E

Terminal locations - E1
Give thought to the following terminal positions when designing the cable access.

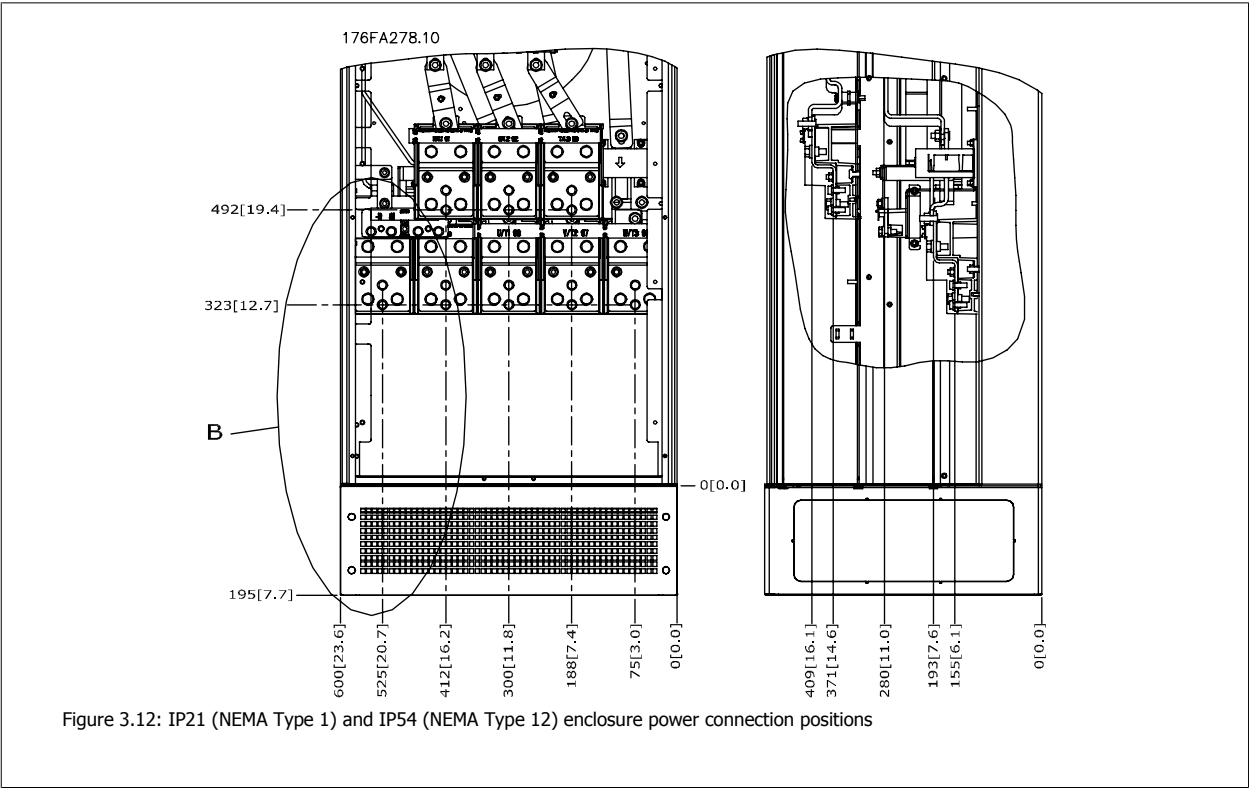


Figure 3.12: IP21 (NEMA Type 1) and IP54 (NEMA Type 12) enclosure power connection positions

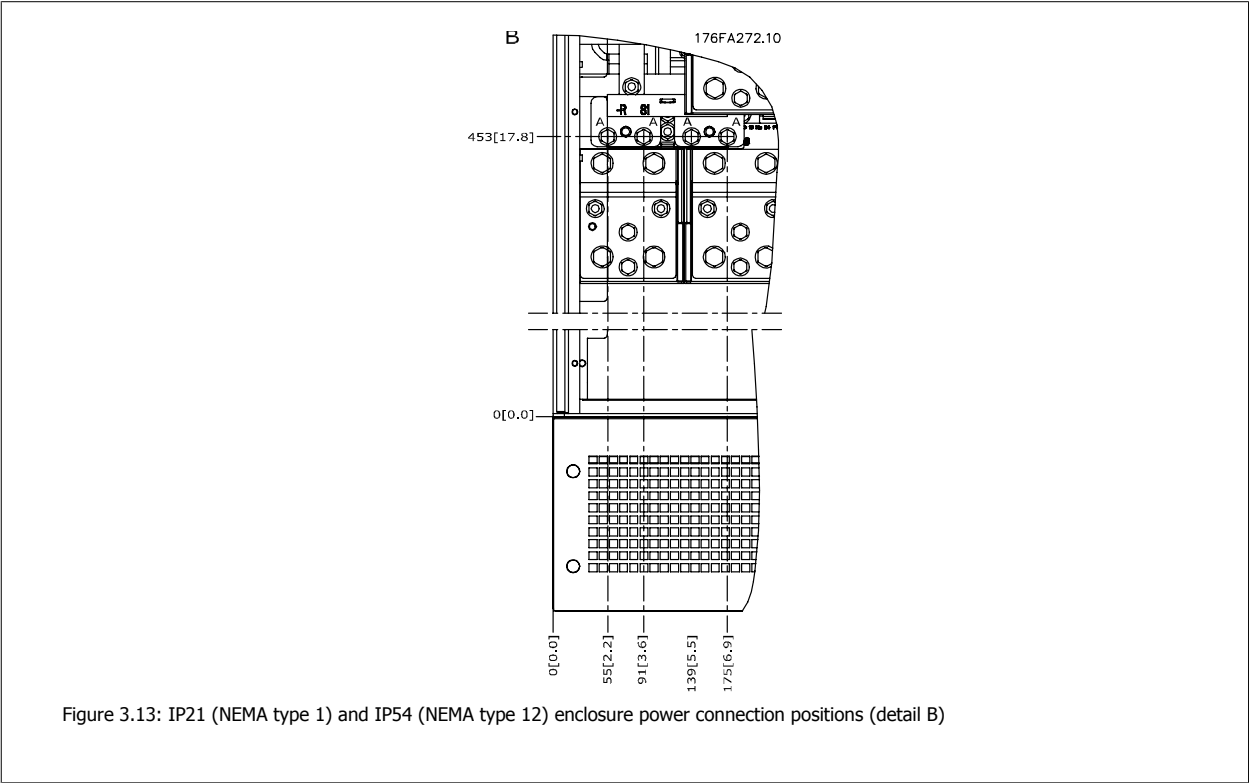


Figure 3.13: IP21 (NEMA type 1) and IP54 (NEMA type 12) enclosure power connection positions (detail B)

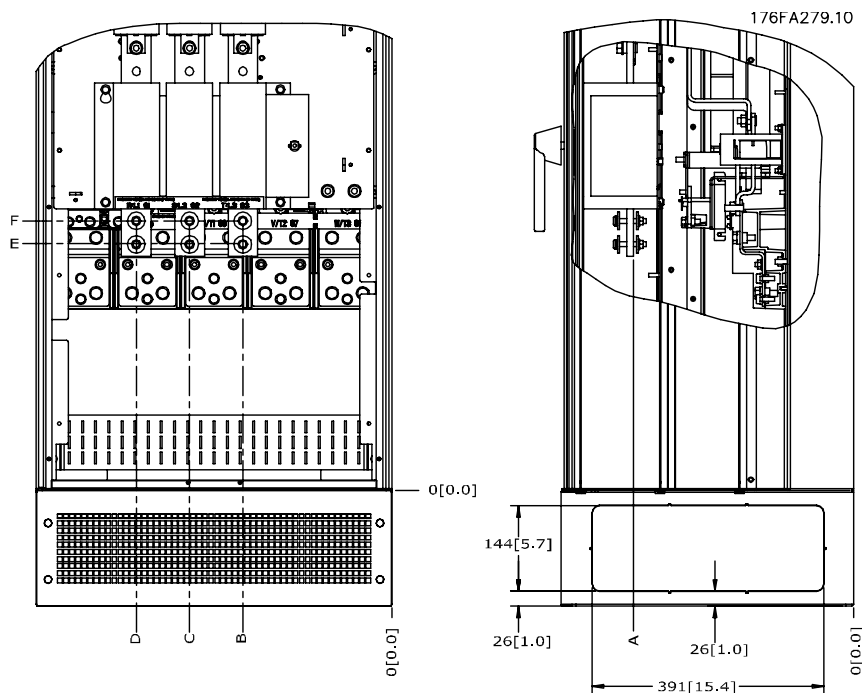
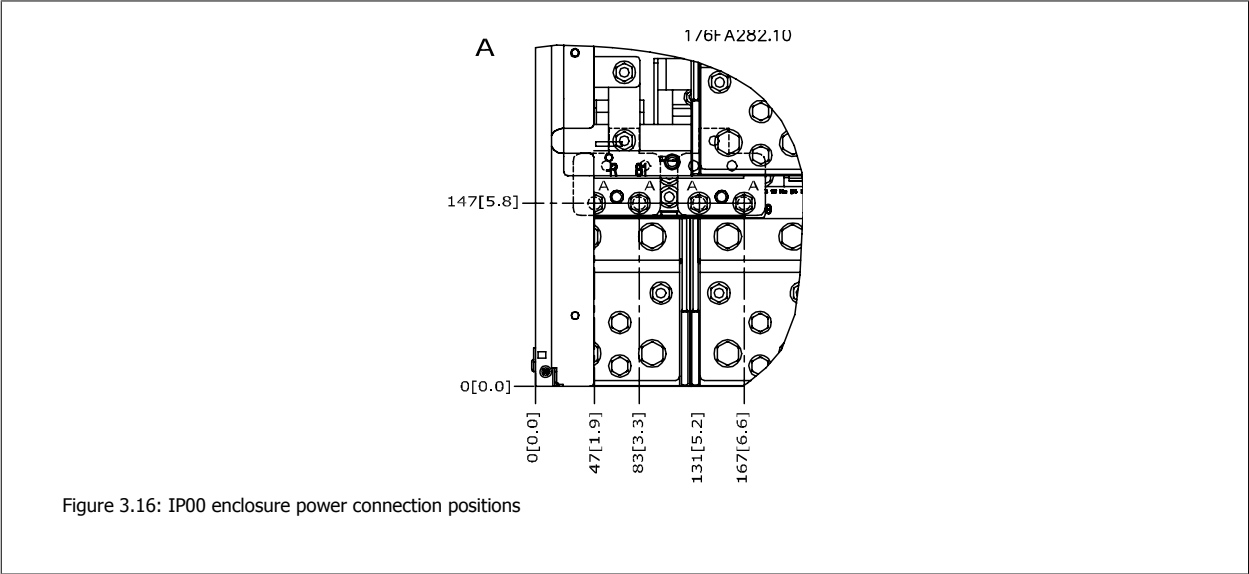
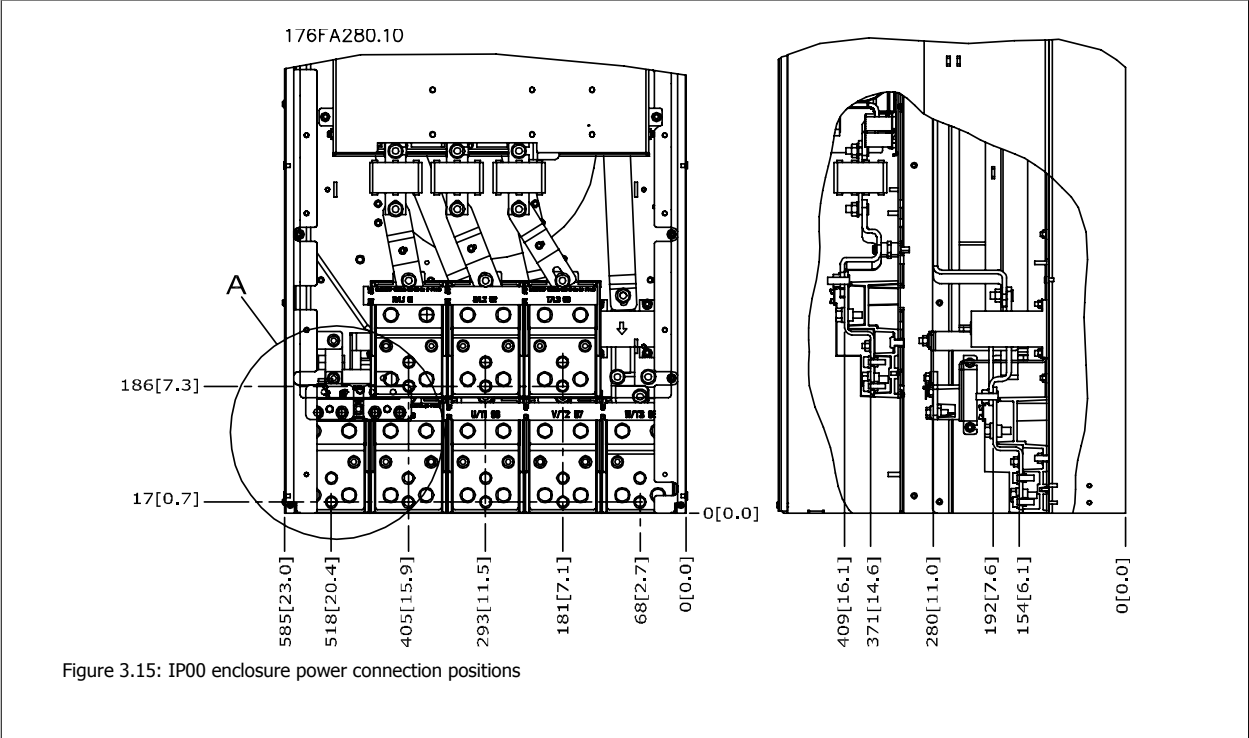


Figure 3.14: IP21 (NEMA type 1) and IP54 (NEMA type 12) enclosure power connection position of disconnect switch

| Frame size | UNIT TYPE | DIMENSION FOR DISCONNECT TERMINAL | | | | | |
|------------|---|-----------------------------------|------------|------------|------------|------------|------------|
| E1 | IP54/IP21 UL AND NEMA1/NEMA12 | | | | | | |
| | 350/450 hp [250/315 kW] (400 V) AND | | | | | | |
| | 500/600–675/850 hp [355/450–500/630 kW] (690 V) | 381 (15.0) | 253 (9.9) | 253 (9.9) | 431 (17.0) | 562 (22.1) | N/A |
| | 450/500–550/600 hp [315/355–400/450 kW] (400 V) | 371 (14.6) | 371 (14.6) | 341 (13.4) | 431 (17.0) | 431 (17.0) | 455 (17.9) |

Terminal locations - E2
Give thought to the following terminal positions when designing the cable access.



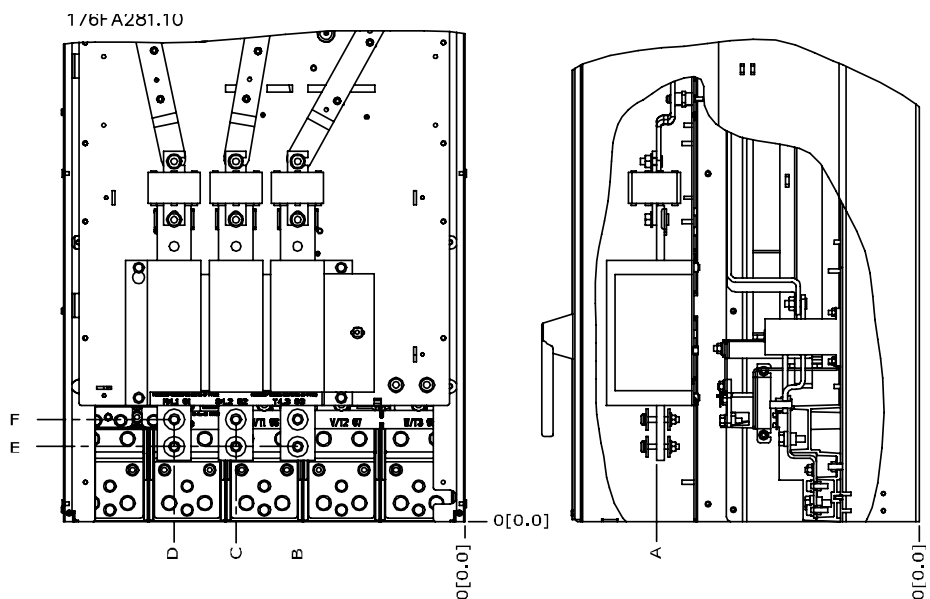


Figure 3.17: IP00 enclosure power connections positions of disconnect switch

Note that the power cables are heavy and difficult to bend. Give thought to the optimum position of the adjustable frequency drive for ensuring easy installation of the cables.

Each terminal allows for the use of up to 4 cables with cable lugs or the use of standard box lug. Ground is connected to relevant termination point in the drive.

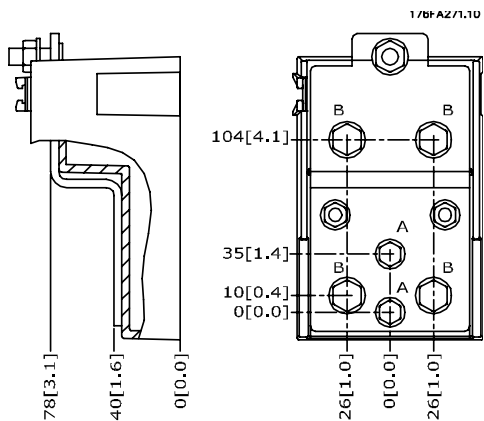



Figure 3.18: Terminal in details



NOTE!
Power connections can be made to positions A or B

| Frame size | UNIT TYPE | DIMENSION FOR DISCONNECT TERMINAL | | | | | |
|------------|---|-----------------------------------|-----------|------------|------------|------------|-----------|
| | IPOO/CHASSIS | A | B | C | D | E | F |
| E2 | 350/450 hp [250/315 kW] (400 V) AND | | | | | | |
| | 500/600–675/850 hp [355/450–500/630 kW] (690 V) | 381 (15.0) | 245 (9.6) | 334 (13.1) | 423 (16.7) | 256 (10.1) | N/A |
| | 450/500–550/600 hp [315/355-400/450 kW] (400 V) | 383 (15.1) | 244 (9.6) | 334 (13.1) | 424 (16.7) | 109 (4.3) | 149 (5.8) |

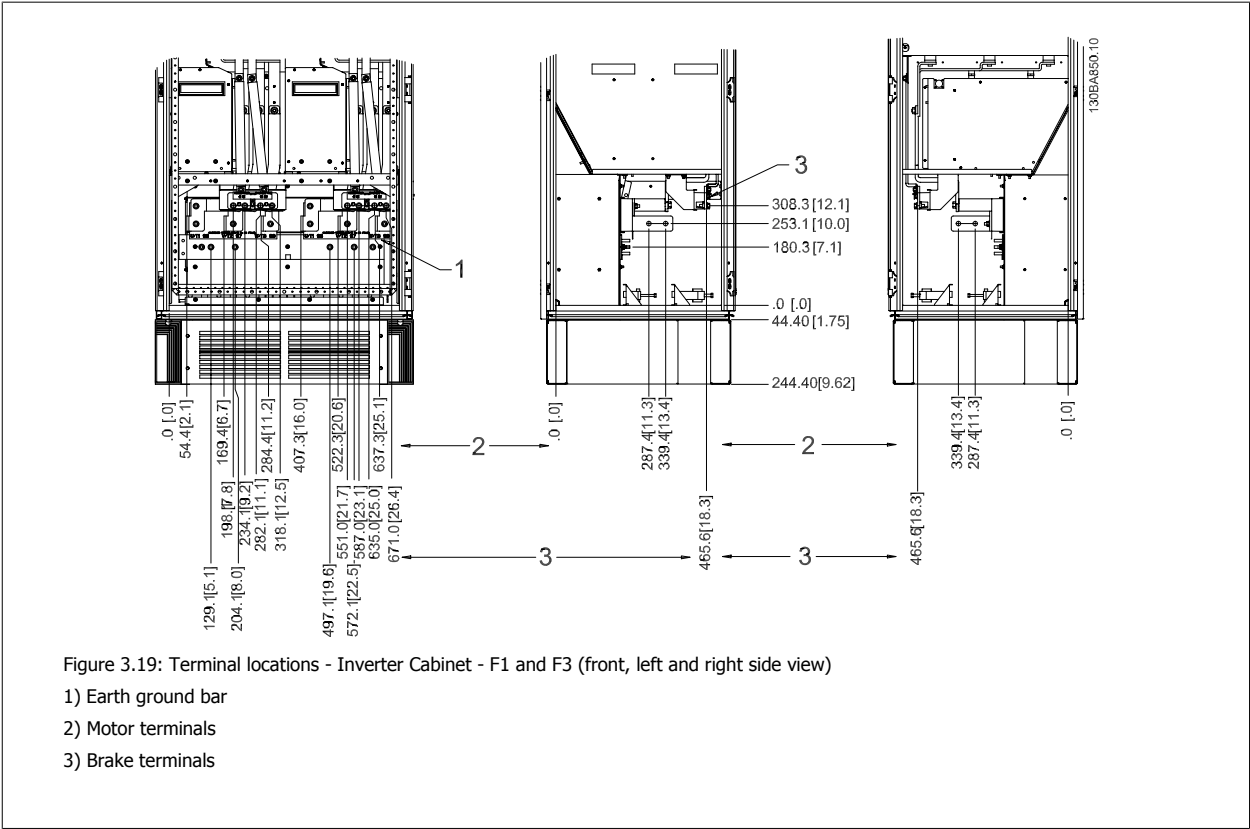
3.3.5 Terminal Locations - frame size F



NOTE!

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.

Terminal locations - frame size F1 and F3



Terminal locations - frame size F2 and F4

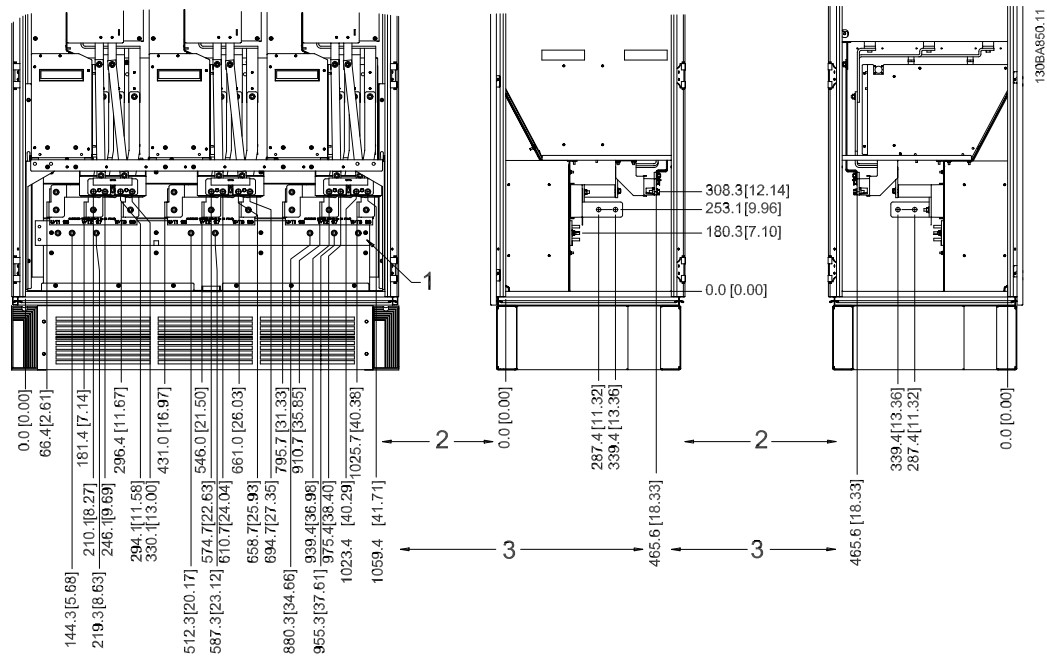
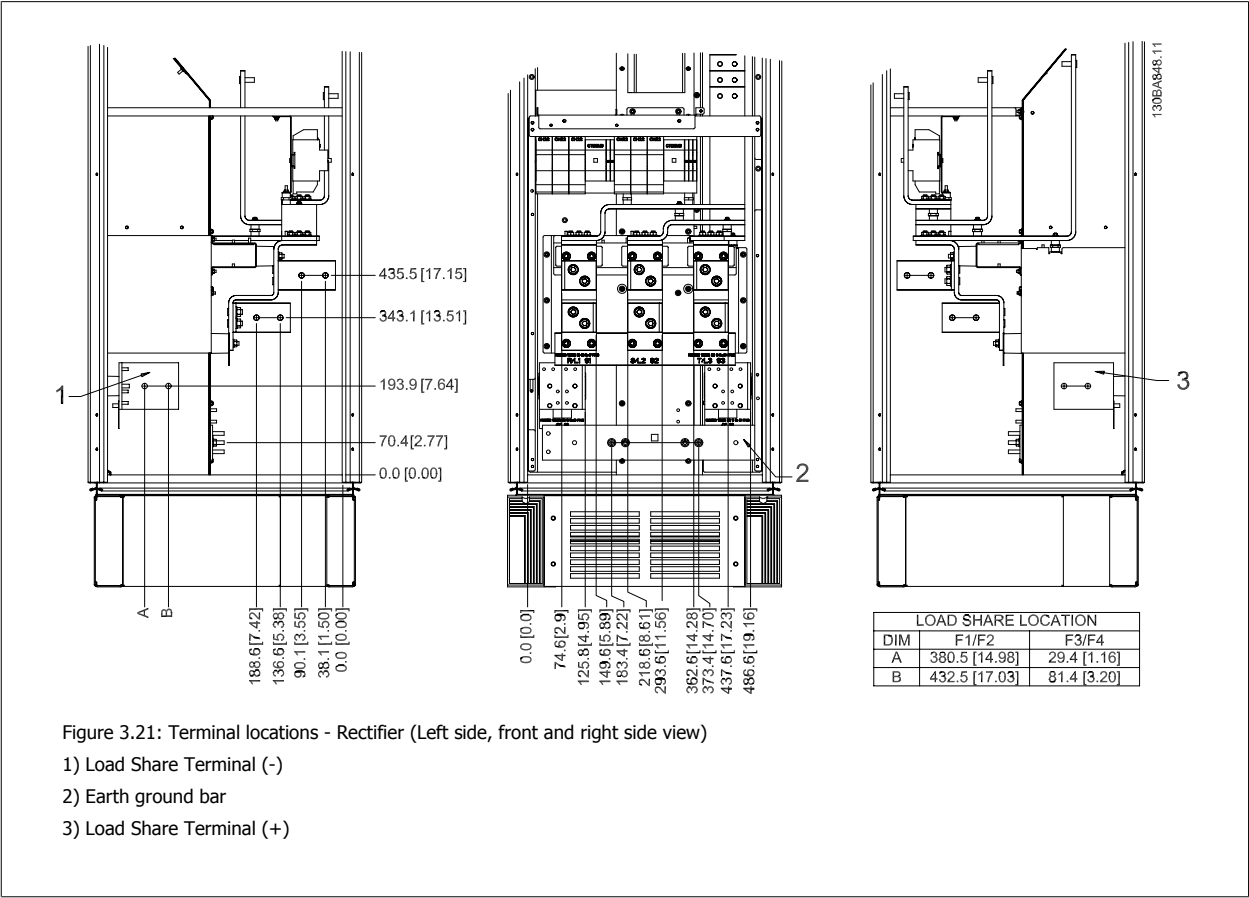


Figure 3.20: Terminal locations - Inverter Cabinet - F2 and F4 (front, left and right side view)

1) Earth ground bar

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



Terminal locations - Options Cabinet (F3 and F4)

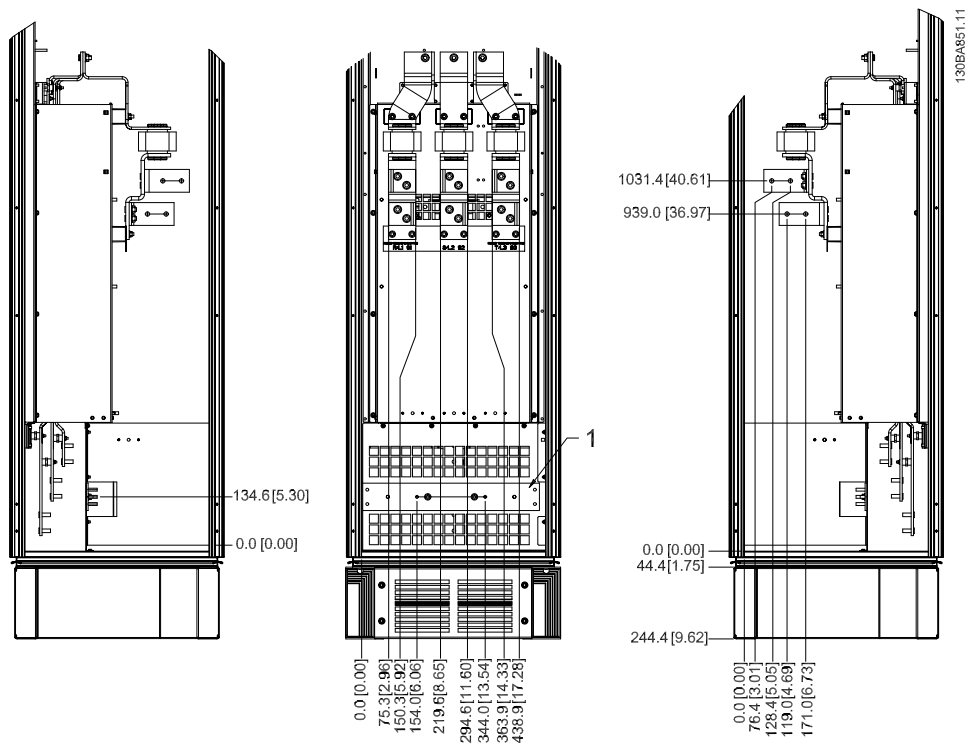


Figure 3.22: Terminal locations - Options Cabinet (Left side, front and right side view)

1) Earth ground bar

Figure 3.23: Terminal locations - Options Cabinet with circuit breaker/ molded case switch (Left side, front and right side view)

1) Earth ground bar

Cooling

Duct cooling

Back cooling



A door fan or fans are required on the Rittal cabinet to remove the losses not contained in the backchannel of the drive. The minimum door fan airflow required at the drive maximum ambient for the D3 and D4 is 391 m³/h (230 cfm). The minimum door fan airflow required at the drive maximum ambient for the E2 is 782 m³/h (460 cfm). If the ambient is below maximum or if additional components and heat loss 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.

The necessary airflow over the heatsink must be ensured. The flow rate is shown below.

| Enclosure protection | Frame size | Door fan/ Top fan airflow | Airflow over heatsink |
|--|-------------------|--|---|
| IP21 / NEMA 1 | D1 and D2 | 6,003 ft ³ /h [170 m ³ /h] (100 cfm) | 27,015 ft ³ [765 m ³ /h] (450 cfm) |
| IP54 / NEMA 12 | E1 | 12,006 ft ³ /h [340 m ³ /h] (200 cfm) | 50,994 ft ³ /h [1,444 m ³ /h] (850 cfm) |
| IP21 / NEMA 1 | F1, F2, F3 and F4 | 24,720 ft ³ /h [700 m ³ /h] (412 cfm)* | 34,784 ft ³ /h [985 m ³ /h] (580 cfm) |
| IP54 / NEMA 12 | F1, F2, F3 and F4 | 18,540 ft ³ /h [525 m ³ /h] (309 cfm)* | 34,784 ft ³ /h [985 m ³ /h] (580 cfm) |
| IP00 / Chassis | D3 and D4 | 9,005 ft ³ /h [255 m ³ /h] (150 cfm) | 27,015 ft ³ [765 m ³ /h] (450 cfm) |
| | E2 | 9,005 ft ³ /h [255 m ³ /h] (150 cfm) | 50,994 ft ³ /h [1,444 m ³ /h] (850 cfm) |
| * Airflow per fan. Frame size F contain multiple fans. | | | |

Table 3.2: Heatsink Air Flow

**NOTE!**

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 a minimum of 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 . Thought must be given to where the unit should be installed.

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

- Clearance space for cooling
- Clearance for opening the door
- Cable entry clearance 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 8.9 in [225 mm] below the adjustable frequency drive is needed. Mount the bolts at the bottom and lift the adjustable frequency drive up on the bolts. Tilt the adjustable frequency drive against the wall and mount the upper bolts. Tighten all four bolts to secure the adjustable frequency drive against the wall.

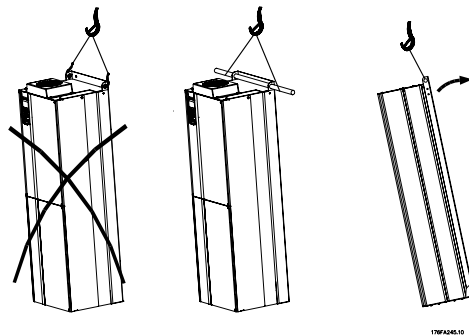


Figure 3.24: Lifting method for mounting drive on wall

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

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



NOTE!

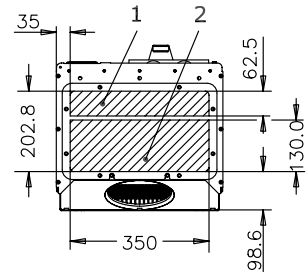
The gland plate must be fitted to the adjustable frequency drive to ensure the specified protection degree, as well as ensuring proper cooling of the unit. If the gland plate is not mounted, the adjustable frequency drive may trip on Alarm 69, Pwr. Card Temp



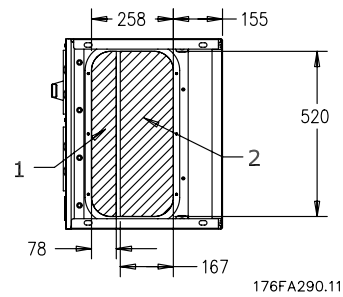
130BB073.10

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

Frame size D1 + D2

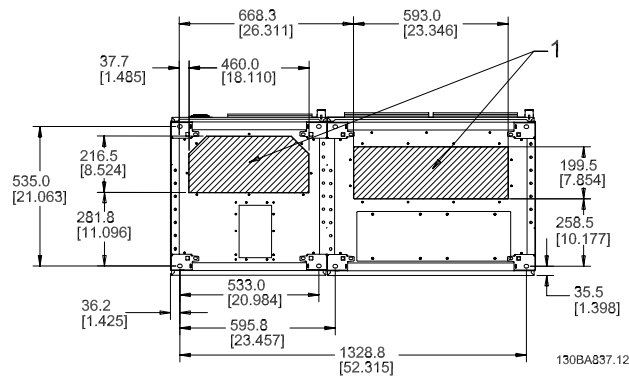


Frame size E1

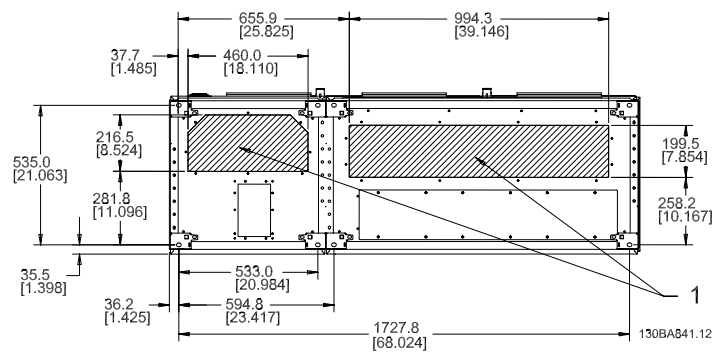


Cable entries viewed from the bottom of the adjustable frequency drive - 1) Line power side 2) Motor side

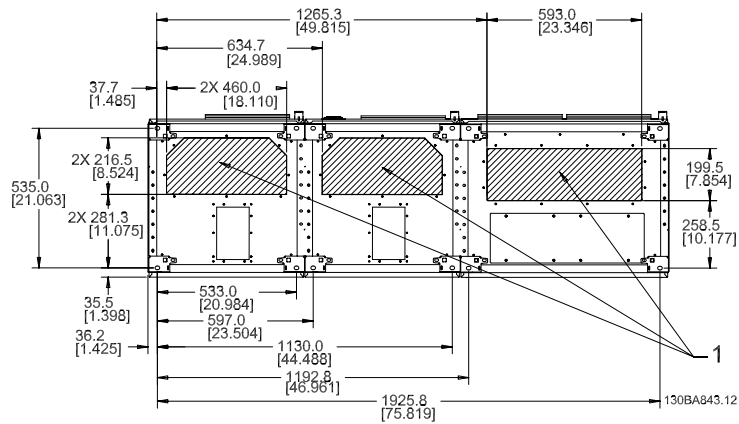
Frame size F1



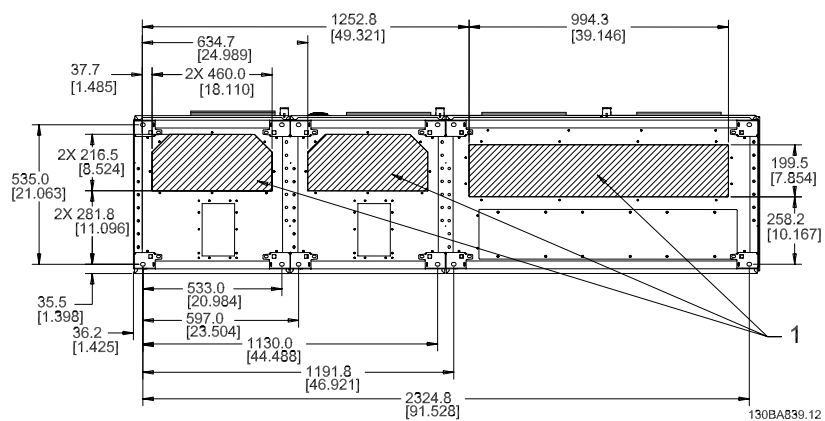
Frame size F2



Frame size F3



Frame size F4



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

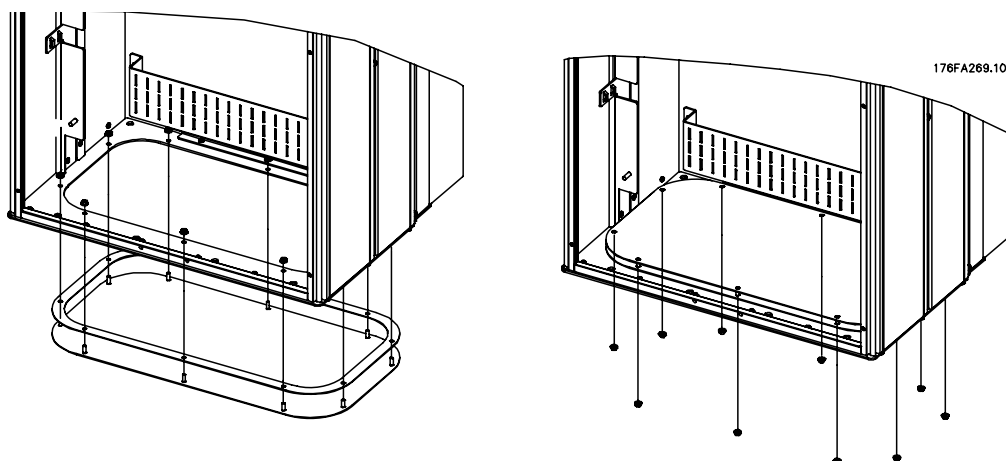


Figure 3.26: Mounting of bottom plate, Frame size E1.

The bottom plate of the E1 frame can be mounted from either inside 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 adjustable frequency drive 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 the screws.
- Torque the screws to 5.6 Nm (50 in-lbs).

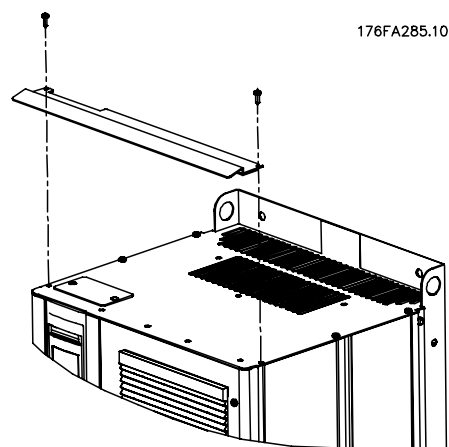


Figure 3.27: Install the drip shield.

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 adjustable frequency drives with duct work cooling kits in Rittal enclosures. In addition to the enclosure an 8 in [200 mm] base/plinth is required.

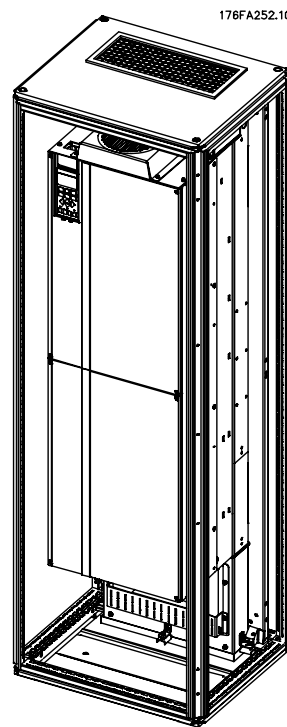


Figure 3.28: Installation of IP00 in Rittal TS8 enclosure.

The minimum enclosure dimension is:

- D3 and D4 frame: Depth 19.7 in [500 mm] and width 23.6 in [600 mm].
- E2 frame: Depth 23.6 in [600 mm] and width 31.5 in [800 mm].

The maximum depth and width are as required for the installation. When using multiple adjustable frequency drives 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 catalog for details). The duct work cooling kits listed in the table below are suitable for use only with IP 00 / Chassis adjustable frequency drives 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 adjustable frequency drive.

**NOTE!**

A door fan or fans are required on the Rittal cabinet to remove the losses not contained in the backchannel of the drive. The minimum door fan airflow required at the drive maximum ambient for the D3 and D4 is 391 m³/h (230 cfm). The minimum door fan airflow required at the drive maximum ambient for the E2 is 782 m³/h (460 cfm). If the ambient is below maximum or if additional components and heat loss 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. |
|-----------------------|-----------------------|----------------------|-------------------|
| 71 in [1800 mm] | 176F1824 | 176F1823 | Not possible |
| 79 in [2000 mm] | 176F1826 | 176F1825 | 176F1850 |
| 86.6 in [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:

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

**NOTE!**

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 adjustable frequency drive according to the pressure drop.

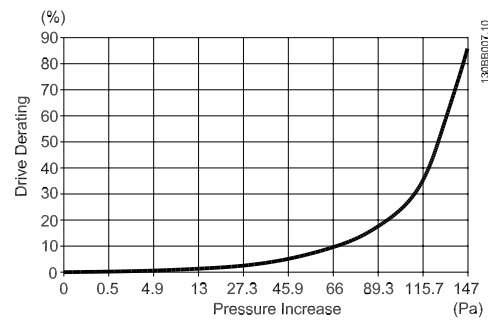


Figure 3.29: D Frame Derating vs. Pressure Change
Drive air flow: 450 cfm (765 m3/h)

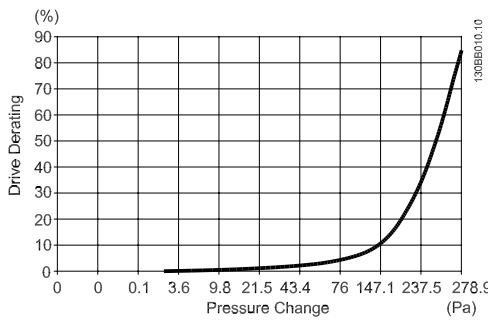


Figure 3.30: E Frame Derating vs. Pressure Change (Small Fan), P250T5 and P355T7-P400T7
Drive air flow: 650 cfm (1105 m3/h)

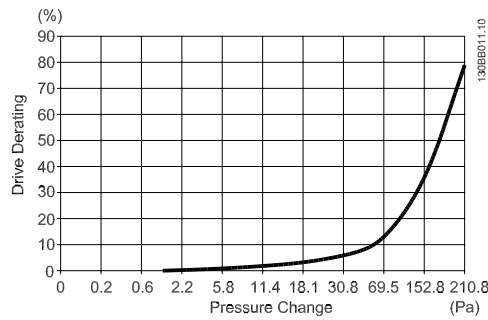


Figure 3.31: E Frame Derating vs. Pressure Change (Large Fan), P315T5-P400T5 and P500T7-P560T7
Drive air flow: 850 cfm (1445 m3/h)

3.4.2 Outside installation/ NEMA 3R kit for Rittal enclosures



This section is for the installation of NEMA 3R kits available for the adjustable frequency drive 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 19.7 in [500 mm] (23.6 in [600 mm] for E2 frame) and the kit is designed for a 23.6 in [600 mm] (31.5 in [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 for the installation.

**NOTE!**

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

**NOTE!**

A door fan or fans are required on the Rittal cabinet to remove the losses not contained in the backchannel of the drive. The minimum door fan airflow required at the drive maximum ambient for the D3 and D4 is 391 m³/h (230 cfm). The minimum door fan airflow required at the drive maximum ambient for the E2 is 782 m³/h (460 cfm). If the ambient is below maximum or if additional components and heat loss 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
- 0.63 in [16 mm], M5 torx screws for top vent cover
- 0.39 in [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)



NOTE!

Please see the instructions 175R5922 for further information

3

3.4.3 Installation on pedestal

This section describes the installation of a pedestal unit available for the adjustable frequency drives frames D1 and D2. This is an 8 in [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 adjustable frequency drive connector plate must be installed to provide adequate cooling air to the control components of the adjustable frequency drive via the door fan and to maintain the IP21/NEMA 1 or IP54/NEMA 12 degrees of enclosure protections.



Figure 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 0.28–0.67 in (7–17 mm) sockets
- T30 Torx Driver

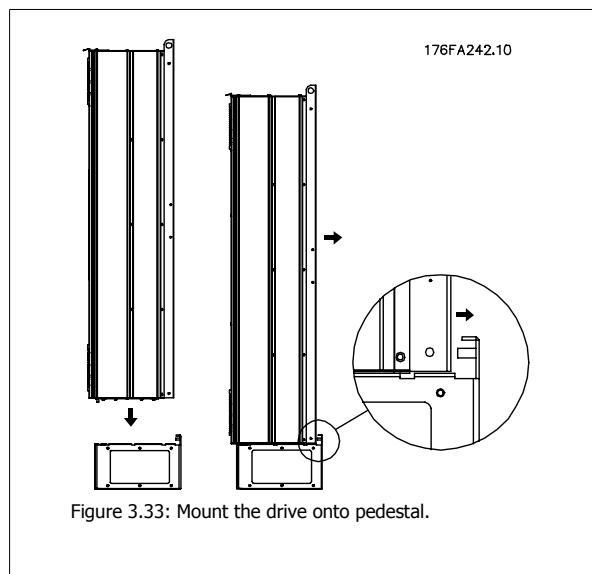
Torques:

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

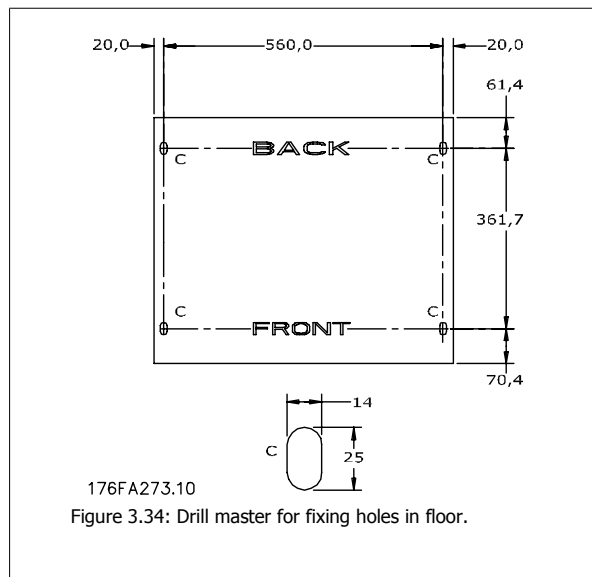
Kit Contents:

- Pedestal parts
- Instruction Manual

3



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



Mount the drive on the pedestal and using the enclosed bolts, attach it to the pedestal, as shown in the illustration.

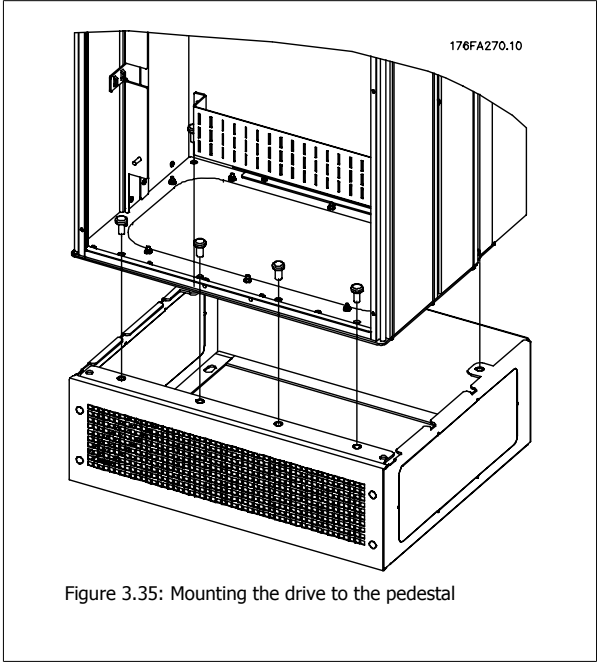


Figure 3.35: Mounting the drive to the pedestal



NOTE!
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 adjustable frequency drives in all D and E frames.
Do not attempt to remove RFI filters from input plates. Damage may occur to the RFI filters if they are removed from the input plate.



NOTE!
Where RFI filters are available, there are two different types 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 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 | 176F0253 | 176F0255 | 176F0257 | 176F0258 | 176F0260 |
| | FC 302: 250 kW | | | | | |
| | FC102/ 202: 500–600 HP [355–450 kW] | 176F0254 | 176F0256 | 176F0257 | 176F0259 | 176F0262 |
| | FC 302: 450–550 HP [315–400 kW] | | | | | |

| | 525–690 V | Fuses | Disconnect Fuses | RFI | RFI Fuses | RFI Disconnect Fuses |
|----|------------------------------------|----------|------------------|----------|-----------|----------------------|
| D1 | FC102/ 202: 60–125 HP [45–90 kW] | 175L8829 | 175L8828 | 175L8777 | NA | NA |
| | FC302: 50–100 HP [37–75 kW] | | | | | |
| | FC102/202: 150–250 HP [110–160 kW] | 175L8442 | 175L8445 | 175L8777 | NA | NA |
| | FC302: 125–175 HP [90–132 kW] | | | | | |
| D2 | All D2 power sizes | 175L8827 | 175L8826 | 175L8825 | NA | NA |
| E1 | FC102/202: 600–675 HP [450–500 kW] | 176F0253 | 176F0255 | NA | NA | NA |
| | FC302: 500–550 HP [355–400 kW] | | | | | |
| | FC102/202: 750–850 HP [560–630 kW] | 176F0254 | 176F0258 | NA | NA | NA |
| | FC302: 675–750 HP [500–560 kW] | | | | | |

Kit contents

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



Cautions

- The adjustable frequency drive contains dangerous voltages when connected to line voltage. No disassembly should be attempted with power applied
- Electrical parts on the adjustable frequency drive may contain dangerous voltages even after line power has been disconnected. Wait the minimum time listed on the drive label after disconnecting line power 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 (44–77 lbs [20–35 kg] depending on configuration). It is recommended that the disconnect switch be removed from the input plate for easier installation and then be reinstalled on the input plate after the input plate has been installed on the drive.



NOTE!

For further information, please see the Instruction Sheet, 175R5795

3.4.5 Installation of Line Power Shield for Adjustable Frequency Drives

This section is for the installation of a line power shield for the adjustable frequency drive 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)



NOTE!
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 adjustable frequency drives, 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 adjustable frequency drives increase visibility during servicing and maintenance. The housing light includes a power outlet for temporarily powering tools or other devices, available in two voltages:

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

Transformer Tap Set-up

If the cabinet light and outlet and/or the space heaters and 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 |
|---------------------|---------------|
| 380–440 V | 400 V |
| 441–490 V | 460 V |
| 491–550 V | 525 V |
| 551–625 V | 575 V |
| 626–660 V | 660 V |
| 661–690 V | 690 V |

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 the 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 line power 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 AC line 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, LEDs, 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 serial communication bus 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 set-up software

Dedicated thermistor inputs (2)

Features:


- Each module is capable of monitoring up to six thermistors in a 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.

4 Electrical Installation

4.1 Electrical Installation

4.1.1 Power Connections

Cabling and Fusing



NOTE!

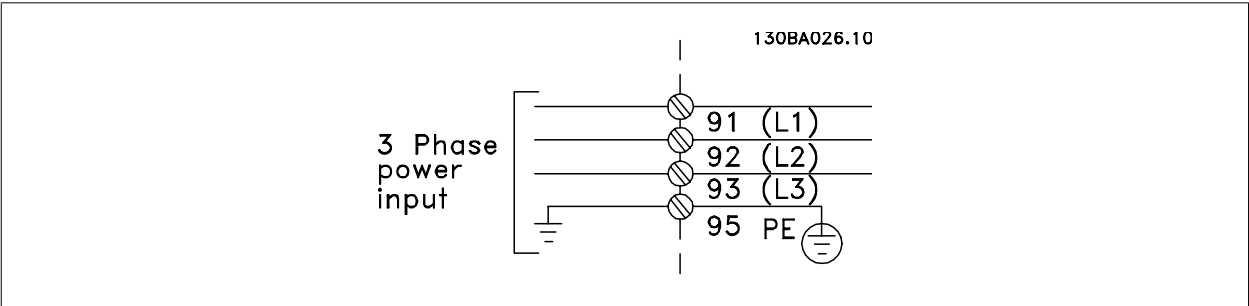
Cables General


All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. Copper (167°F [75°C]) conductors are recommended.

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

For protection of the adjustable frequency drive, 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 AC line input connections are fitted to the line power switch if this is included.





NOTE!

The motor cable must be shielded/armored. If an unshielded/unarmored cable is used, some EMC requirements are not complied with. Use a shielded/armored 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.

Shielding of cables:

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

Connect the motor cable shield to both the de-coupling plate of the adjustable frequency drive and to the metal housing of the motor.

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

Cable-length and cross-section:

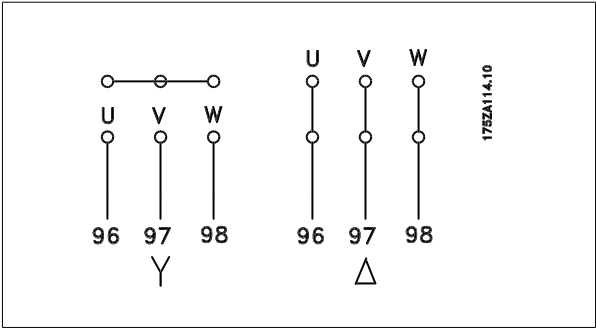
The adjustable frequency drive has been EMC tested with a given length of cable. Keep the motor cable as short as possible to reduce the noise level and leakage currents.

Switching frequency:

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

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

1)Protected Ground Connection



NOTE!

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

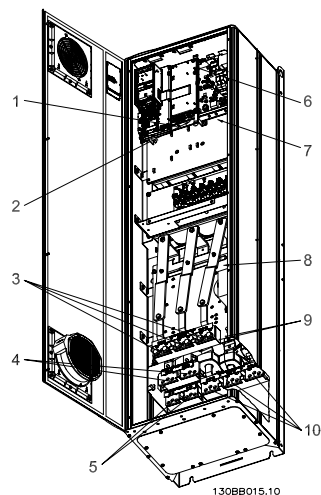


Figure 4.1: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12), frame size D1

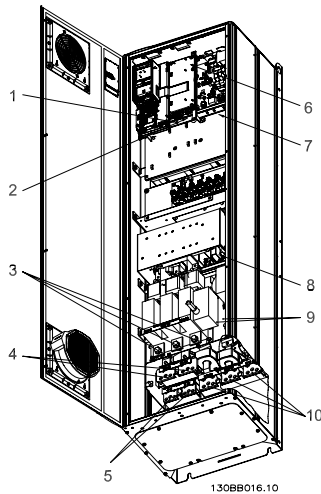


Figure 4.2: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12) with disconnect, fuse and RFI filter, frame size D2

| | |
|-----------------|--|
| 1) AUX Relay | 5) Brake |
| 01 02 03 | -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 |
| 3) Line | 100 101 102 103 |
| R S T | L1 L2 L1 L2 |
| 91 92 93 | 8) Fan Fuse (see fuse tables for part number) |
| L1 L2 L3 | 9) Line power ground |
| 4) Load sharing | 10) Motor |
| -DC +DC | U V W |
| 88 89 | 96 97 98 |
| | T1 T2 T3 |

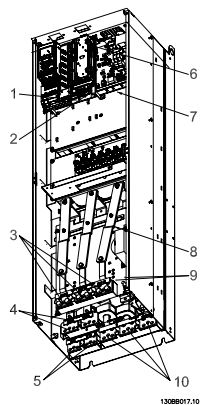


Figure 4.3: Compact IP 00 (Chassis), frame size D3

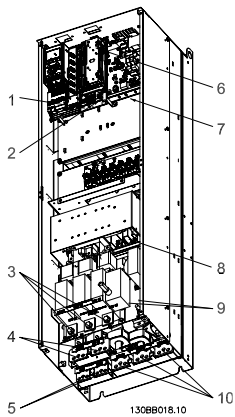
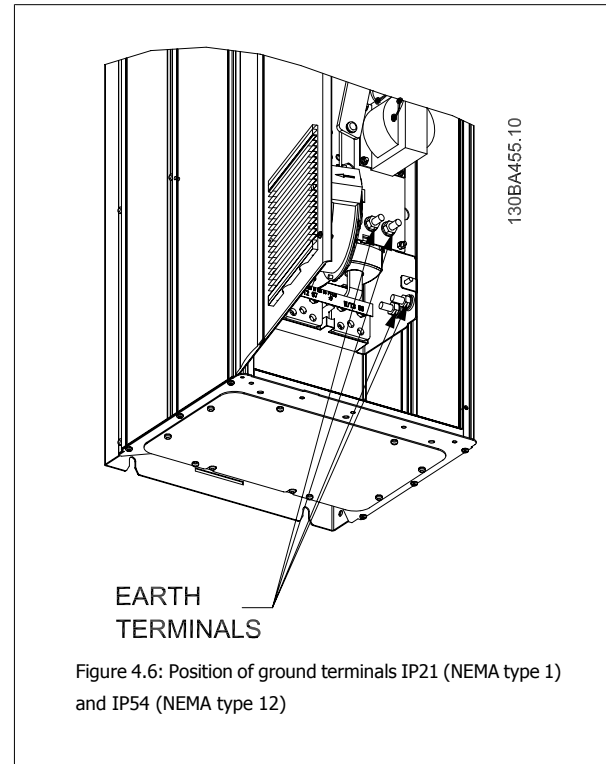
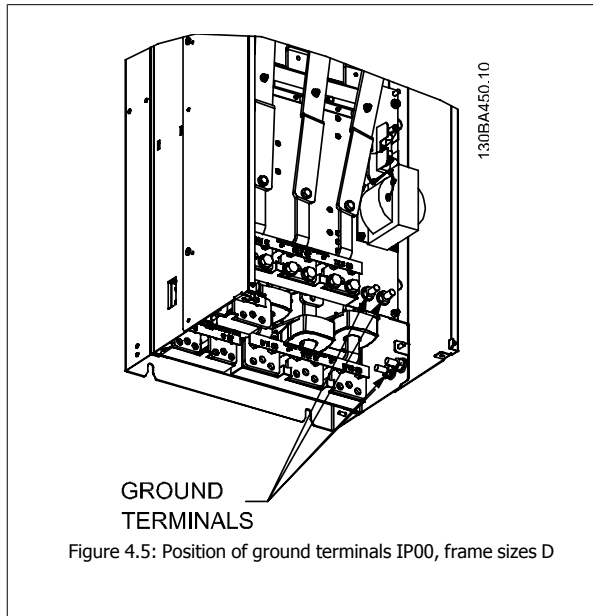


Figure 4.4: Compact IP 00 (Chassis) with disconnect, fuse and RFI filter, frame size D4

| | |
|-----------------|--|
| 1) AUX Relay | 5) Brake |
| 01 02 03 | -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 |
| 3) Line | 100 101 102 103 |
| R S T | L1 L2 L1 L2 |
| 91 92 93 | 8) Fan Fuse (see fuse tables for part number) |
| L1 L2 L3 | 9) Line power ground |
| 4) Load sharing | 10) Motor |
| -DC +DC | U V W |
| 88 89 | 96 97 98 |
| | T1 T2 T3 |



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

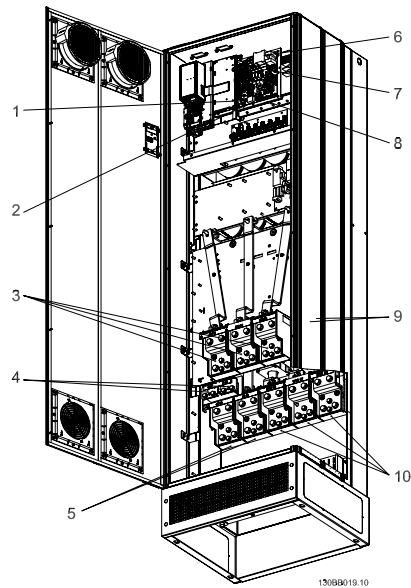


Figure 4.7: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12) frame size E1

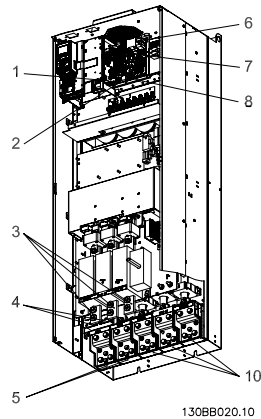
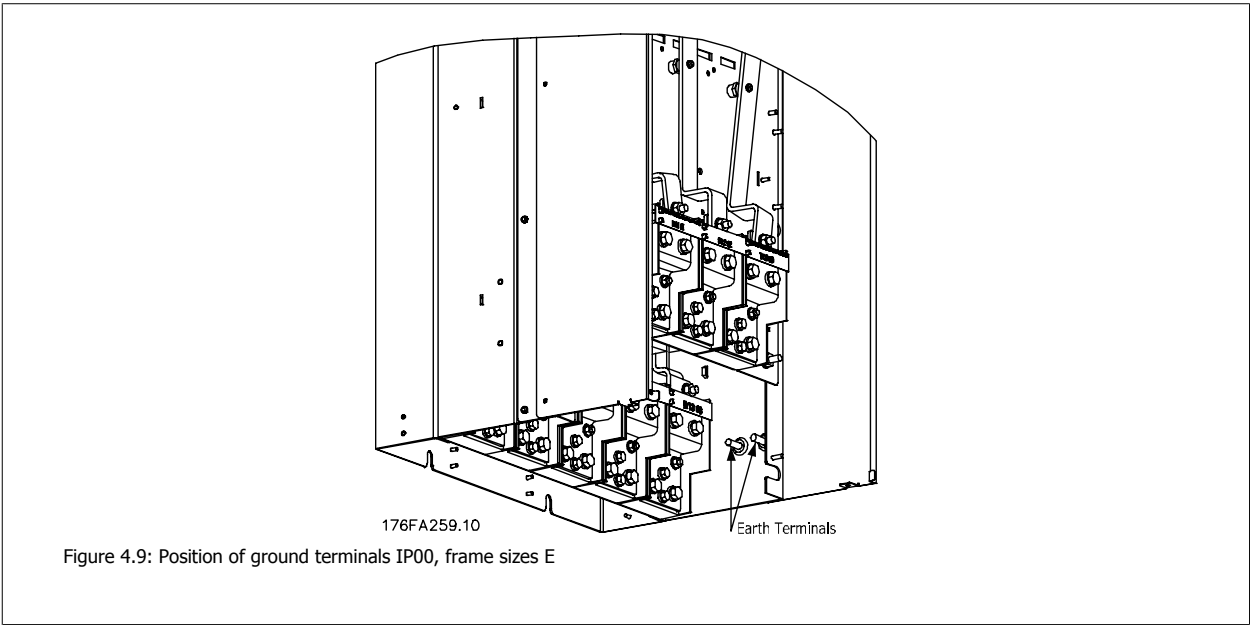


Figure 4.8: Compact IP 00 (Chassis) with disconnect, fuse and RFI filter, frame size E2

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



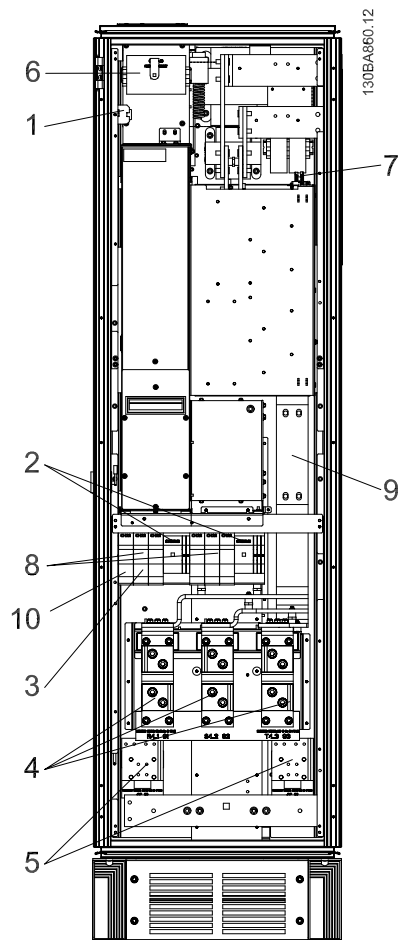


Figure 4.10: Rectifier Cabinet, frame size F1, F2, F3 and F4

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

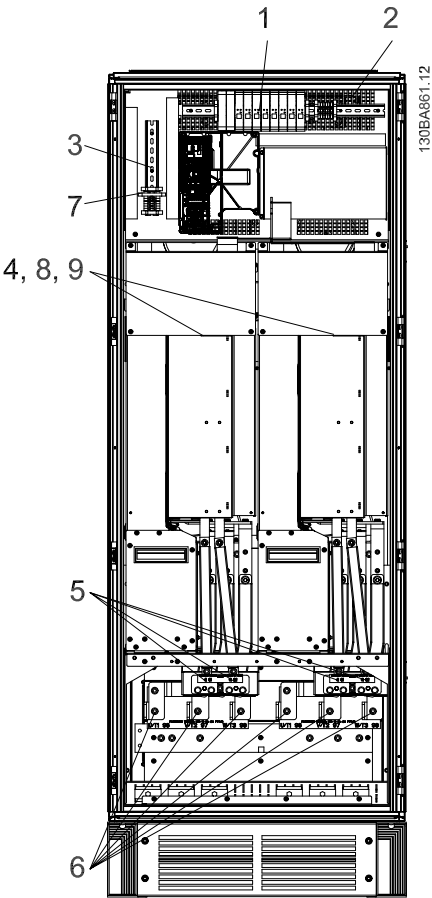


Figure 4.11: Inverter Cabinet, frame size F1 and F3

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

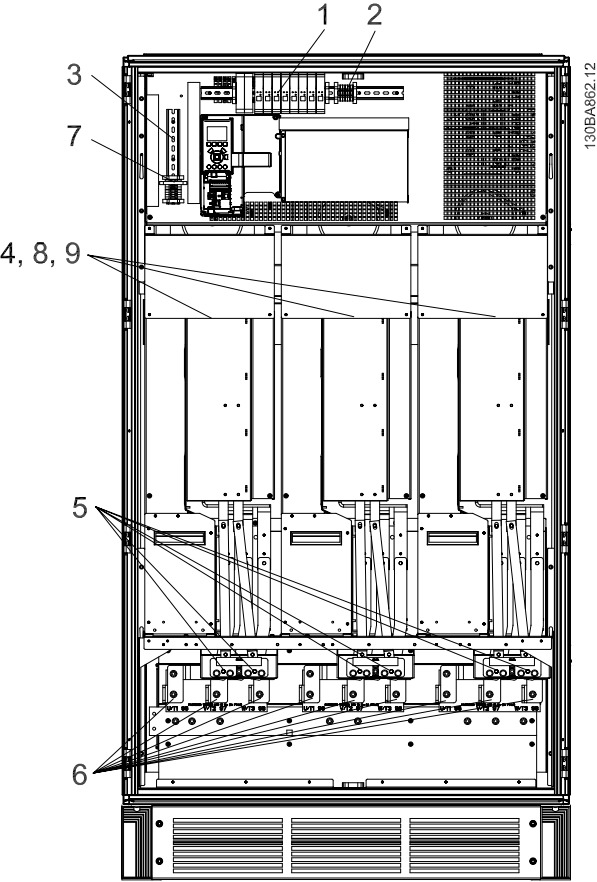


Figure 4.12: Inverter Cabinet, frame size F2 and F4

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

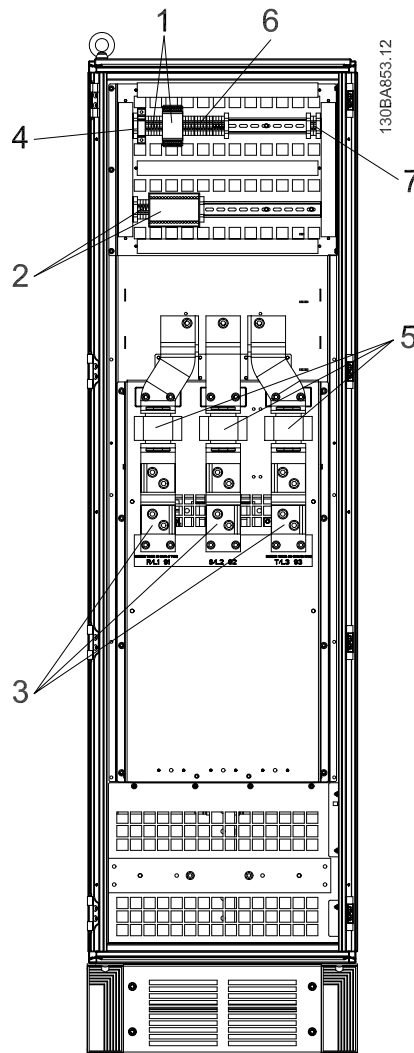


Figure 4.13: Options Cabinet, frame size F3 and F4

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

4.1.2 Grounding

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

- Safety grounding: Please note that the adjustable frequency drive has a high leakage current and must be grounded appropriately for safety reasons. Always follow local safety regulations.
- High-frequency grounding: Keep the ground wire connections as short as possible.

Connect the different ground 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 prevents having different HF voltages for the individual devices and prevents the risk of radio interference currents running in connection cables that may be used between the devices, as radio interference is reduced.

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

4.1.3 Extra Protection (RCD)

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

In the case of a ground 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.

4.1.4 RFI Switch

Line power supply isolated from ground

If the adjustable frequency drive is supplied from an isolated line power source (IT line power, floating delta and grounded delta) or TT/TN-S line power with grounded leg, the RFI switch is recommended to be turned off (OFF) ¹⁾ via par. 14-50 *RFI 1*. 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 82 ft [25 m], it is recommended to set par. 14-50 *RFI 1* to [ON].

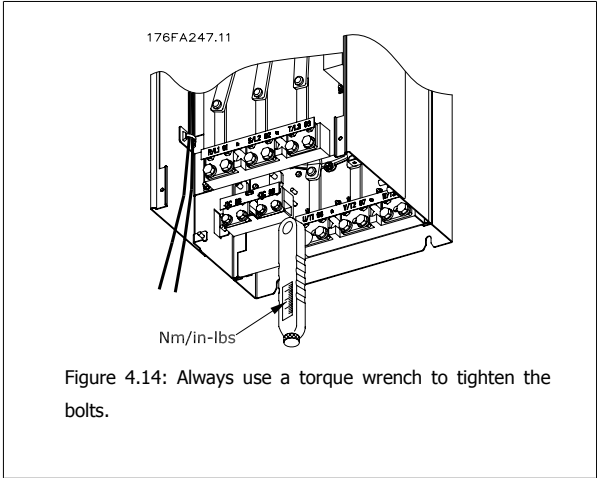
¹⁾ Not available for 525–600/690 V adjustable frequency drives.

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 ground capacity currents (according to IEC 61800-3).

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

4.1.5 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 | Line power | 19 Nm (168 in-lbs) | M10 |
| | Motor | | |
| | Load sharing | 9.5 (84 in-lbs) | M8 |
| | Brake | | |
| E1 and E2 | Line power | 19 NM (168 in-lbs) | M10 |
| | Motor | | |
| | Load sharing | 9.5 (84 in-lbs) | M8 |
| | Brake | | |
| F1, F2, F3 and F4 | Line power | 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 4.1: Torque for terminals

4.1.6 Shielded Cables

It is important that shielded and armored cables are connected properly to ensure high EMC immunity and low emissions.

Connection can be made using either cable connectors or clamps:

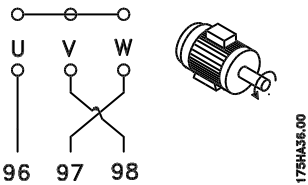
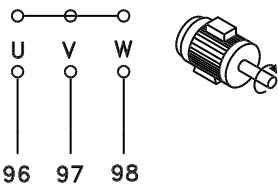
- EMC cable connectors: Generally available cable connectors can be used to ensure an optimum EMC connection.
- EMC cable clamp: Clamps allowing for easy connection are supplied with the adjustable frequency drive.

4.1.7 Motor cable

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

| Terminal No. | Function |
|----------------|-----------------------------|
| 96, 97, 98, 99 | Line power U/T1, V/T2, W/T3 |
| | Ground |

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



The direction of rotation can be changed by switching two phases in the motor cable or by changing the setting of par. 4-10 *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 8 ft [2.5 m], and quantity of cables must be equal from each inverter module to the common terminal in the junction box.



NOTE!
If a retrofit application requires unequal amount of wires per phase, please consult the factory for requirements.


4.1.8 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 shielded and the max. length from the adjustable frequency drive to the DC bar is limited to 82 feet [25 m].

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

The connection cable to the brake resistor must be shielded. Connect the shield by means of cable clamps to the conductive backplate at the adjustable frequency drive 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 V DC, 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.

4.1.9 Brake Resistor Temperature Switch

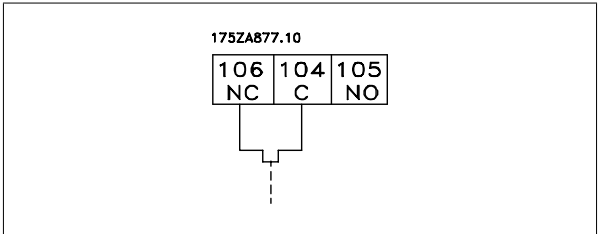
Torque: 0.5–0.6 Nm (5 in-lbs)
Screw size: M3

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 adjustable frequency drive will trip on warning / alarm 27, "Brake IGBT". If the connection is closed between 104 and 105, the adjustable frequency drive 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 adjustable frequency drive 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.



4.1.10 Load Sharing

| Terminal No. | Function |
|--------------|--------------|
| 88, 89 | Load sharing |

The connection cable must be shielded and the max. length from the adjustable frequency drive to the DC bar is limited to 82 ft [25 m].

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



Please note that voltages up to 1099 V DC 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 a line power disconnect may not isolate the adjustable frequency drive due to DC link connection

4.1.11 Shielding against Electrical Noise

Before mounting the line 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.



Figure 4.15: Mount the EMC shield.

4.1.12 AC line input connections

The line power supply must be connected to terminals 91, 92 and 93. Ground is connected to the terminal to the right of terminal 93.

| Terminal No. | Function |
|--------------|-----------------------------|
| 91, 92, 93 | Line power R/L1, S/L2, T/L3 |
| 94 | Ground |



Check the nameplate to ensure that the AC line voltage of the adjustable frequency drive matches the power supply of your plant.

4

Ensure that the power supply can supply the necessary current to the adjustable frequency drive.

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

4.1.13 External Fan Supply

If the adjustable frequency drive 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 AC line voltage connection for the cooling fans. The fans are factory-equipped to be supplied from a common AC line (jumpers between 100-102 and 101-103). If an 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 a LittleFuse KLK-5 or equivalent.

4.1.14 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 overcurrent protected according to national/international regulations.

Short-circuit protection:

The adjustable frequency drive 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 adjustable frequency drive provides full short-circuit protection in case of a short-circuit on the motor output.

Overcurrent protection

Provide overload protection to avoid fire hazard due to overheating of the cables in the installation. The adjustable frequency drive is equipped with internal overcurrent 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 overcurrent protection in the installation. Overcurrent 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 adjustable frequency drive.

| | | |
|-------------|-----------|---------|
| 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), 240 V, or 480 V, or 500 V, or 600 V 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 JFHR2 | Littelfuse E71611 JFHR2** | Ferraz- Shawmut E60314 JFHR2** | Bussmann E4274 H/JDDZ** | Bussmann E125085 JFHR2* | Internal Option Bussmann |
|---------------|------------------------------|-------------------------------|--------------------------|---------------------------------|---|-------------------------------|-------------------------------|--------------------------------|
| P110 | FWH-300 | JJS-300 | 2061032.25 | L50S-300 | A50-P300 | NOS-300 | 170M3017 | 170M3018 |
| P132 | FWH-350 | JJS-350 | 2061032.315 | L50S-350 | A50-P350 | NOS-350 | 170M3018 | 170M3018 |
| P160 | FWH-400 | JJS-400 | 2061032.35 | L50S-400 | A50-P400 | NOS-400 | 170M4012 | 170M4016 |
| P200 | FWH-500 | JJS-500 | 2061032.35 | L50S-500 | A50-P500 | NOS-500 | 170M4014 | 170M4016 |
| P250 | FWH-600 | JJS-600 | 2061032.40 | L50S-600 | A50-P600 | NOS-600 | 170M4016 | 170M4016 |

Table 4.2: 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 4.3: 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 4.4: 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 4.5: 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 E125085 JFHR2 | Amps | SIBA E180276 JFHR2 | Ferraz-Shawmut E76491 JFHR2 | Internal Option 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 4.6: 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 4.7: 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 4.8: 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 4.9: 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 | CTK-4 | 4 A, 600 V |

Table 4.10: SMPS Fuse

| Size/ Type | Bussmann PN* | Littelfuse | Rating |
|----------------------|--------------|------------|------------|
| P110-P315, 380–480 V | CTK-4 | | 4 A, 600 V |
| P45K-P500, 525–690 V | CTK-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 4.11: Fan Fuses

| Size/ Type | Bussmann PN* | Rating | Alternative Fuses |
|--------------------------------|------------------|-------------|---|
| P500-P1M0, 380–480 V 2.5–4.0 A | LPJ-6 SP or SPI | 6 A, 600 V | Any listed Class J Dual Element, Time Delay, 6 A |
| P710-P1M2, 525–690 V | LPJ-10 SP or SPI | 10 A, 600 V | Any listed Class J Dual Element, Time Delay, 10 A |
| P500-P1M0, 380–480 V 4.0–6.3 A | 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 |
| P500-P1M0, 380–480 V 6.3–10 A | 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, 20 A |
| P500-P1M0, 380–480 V 10–16 A | 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 4.12: 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 4.13: 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 4.14: Control Transformer Fuse

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

Table 4.15: NAMUR Fuse

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

Table 4.16: Safety Relay Coil Fuse with PILS Relay

4.1.15 Line power disconnectors - frame size D, E and F

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

4.1.16 F frame circuit breakers

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

4.1.17 F frame line power contactors

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

4.1.18 Motor Insulation

For motor cable lengths \leq than 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 AC line voltage due to transmission line effects in the motor cable. If a motor has lower insulation rating, it is recommended to use a du/dt or sine-wave filter.

| Nominal AC Line 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 |

4.1.19 Motor Bearing Currents

All motors installed with 150 hp [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 adjustable frequency drive for instance by shielded cable which has a 360° connection in the motor and the adjustable frequency drive.
 - Provide a low impedance path from adjustable frequency drive to building ground and from the motor to building ground. This can be difficult for pumps
 - Make a direct ground 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

4.1.20 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.

Serial communication bus connection

Connections are made to the relevant options on the control card. For details, see the relevant serial communication bus instruction. The cable must be placed to the left inside the adjustable frequency drive and tied down together with other control wires (see picture).

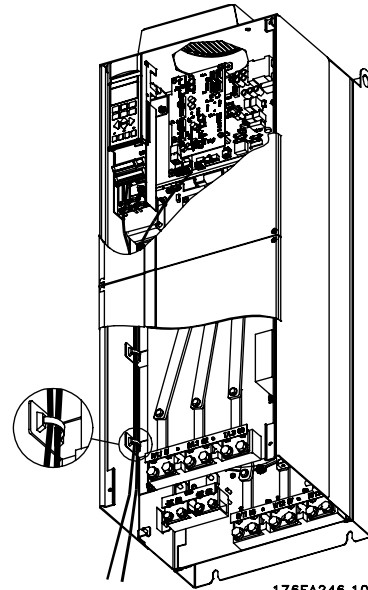


Figure 4.16: Wire path for control wiring.

In the Chassis (IP00) and NEMA 1 units, it is also possible to connect the serial communication bus 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 serial communication bus top connection: 176F1742



Figure 4.17: Top connection for serial communication bus.

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 a connection to line power. Please note that a warning of low voltage will be given when 24 V DC has been connected; however, there will be no tripping.

4



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

4.1.21 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.

4.1.22 Electrical Installation, Control Terminals

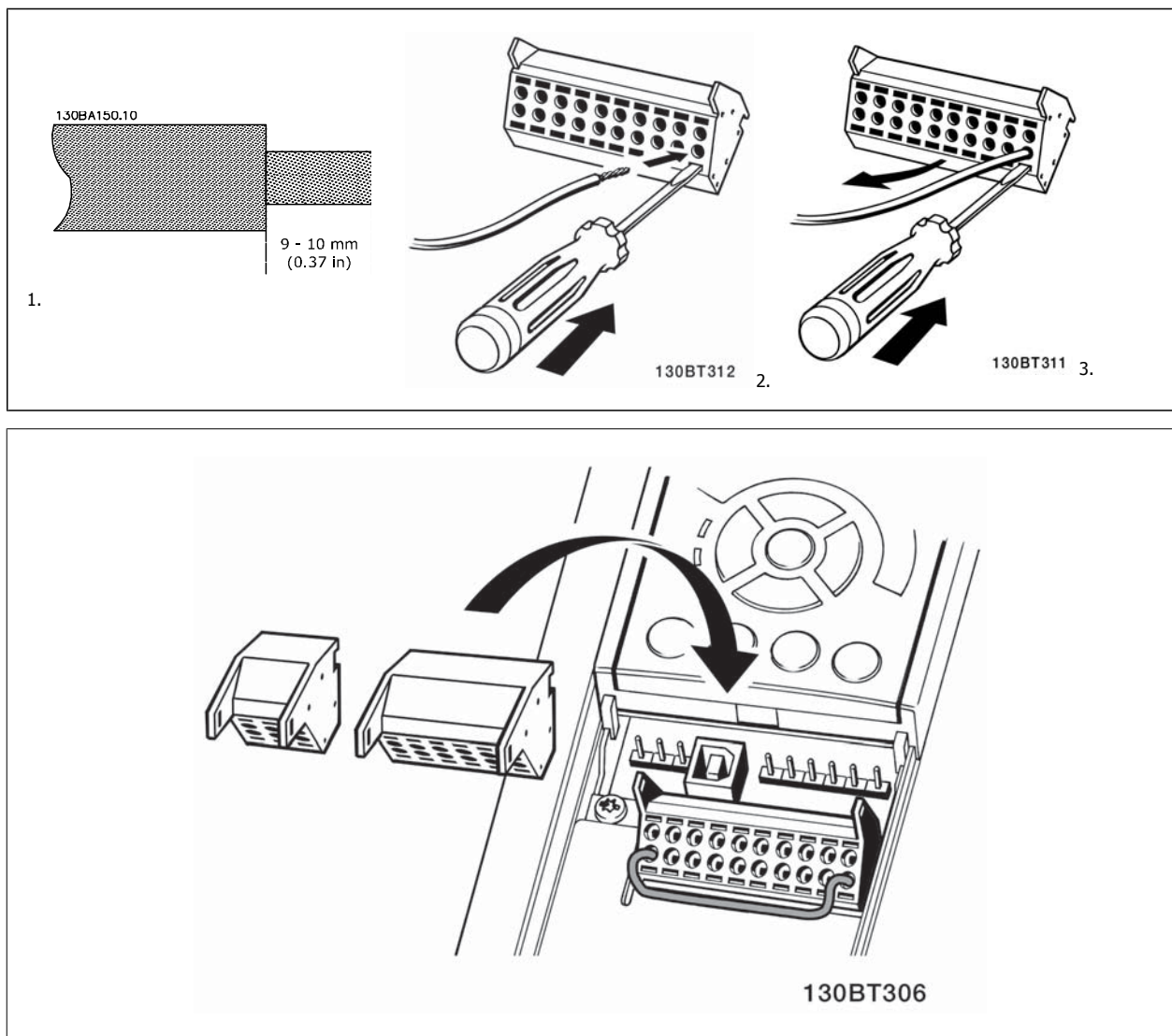
To connect the cable to the terminal:

1. Strip insulation by about 0.34–0.39 in [9–10 mm]
2. Insert a screwdriver¹⁾ in the square hole.
3. Insert the cable in the adjacent circular hole.
4. Remove the screwdriver. The cable is now mounted in the terminal.

To remove the cable from the terminal:

1. Insert a screwdriver¹⁾ in the square hole.
2. Pull out the cable.

¹⁾ Max. 0.015 x 0.1 in. [0.4 x 2.5 mm]



4.2 Connection Examples

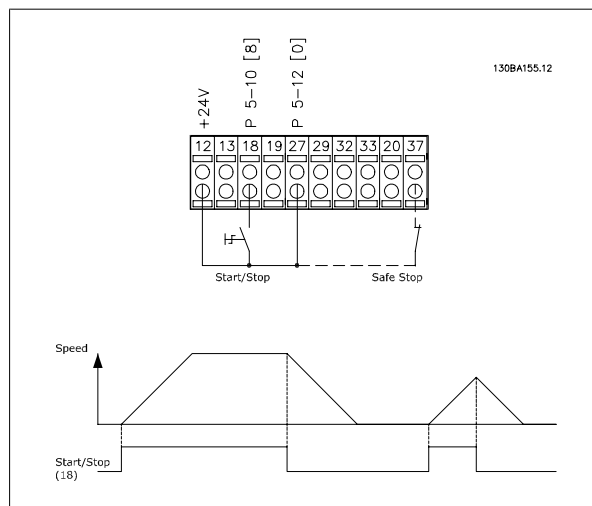
4.2.1 Start/ Stop

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

4

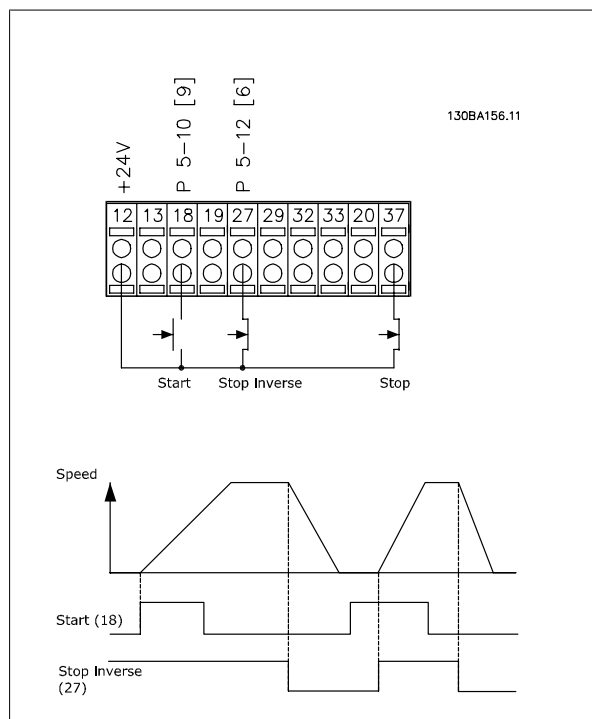


4.2.2 Pulse Start/ Stop

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



4.2.3 Speed Up/ Down

Terminals 29/ 32 = Speed up/ down: .

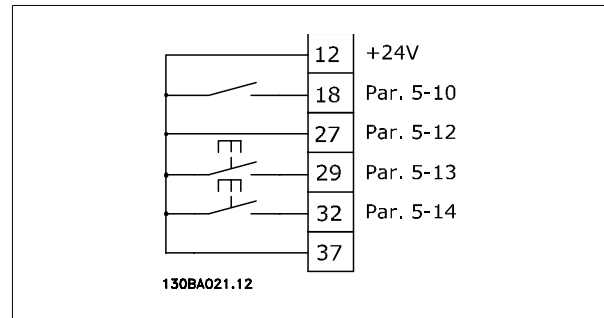
Terminal 18 = Par. 5-10 [9] *Start* (default)

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

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

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

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



4

4.2.4 Potentiometer Reference

Voltage reference via a potentiometer:

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

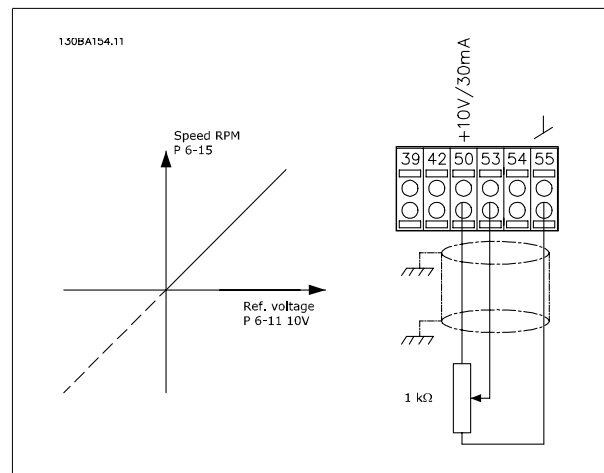
Terminal 53, Low Voltage = 0 Volt

Terminal 53, High Voltage = 10 Volt

Terminal 53, Low Ref./Feedback = 0 RPM

Terminal 53, High Ref./Feedback = 1,500 RPM

Switch S201 = OFF (U)



4.3 Electrical Installation - additional

4.3.1 Electrical Installation, Control Cables

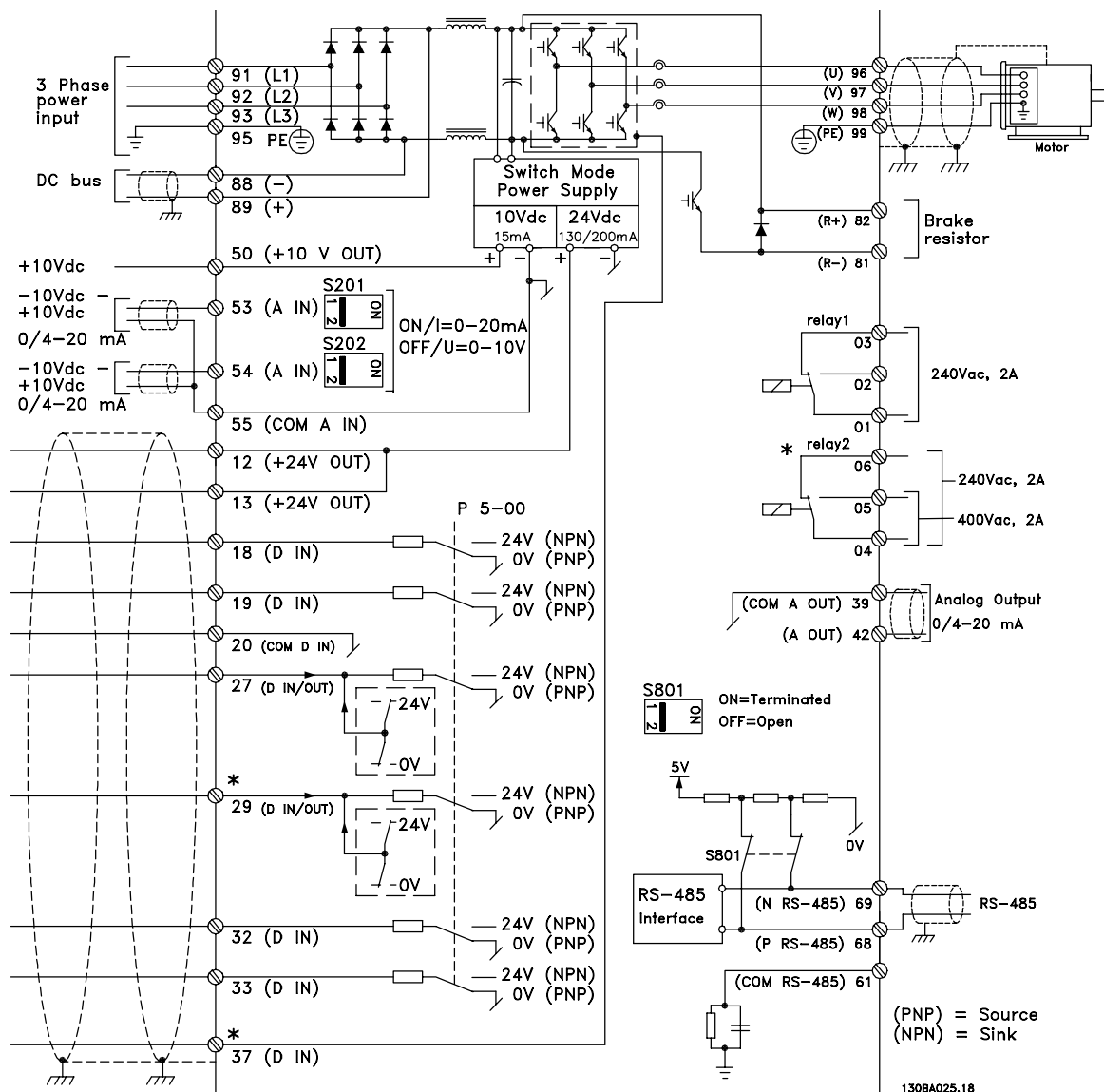


Figure 4.18: Diagram showing all electrical terminals without options.

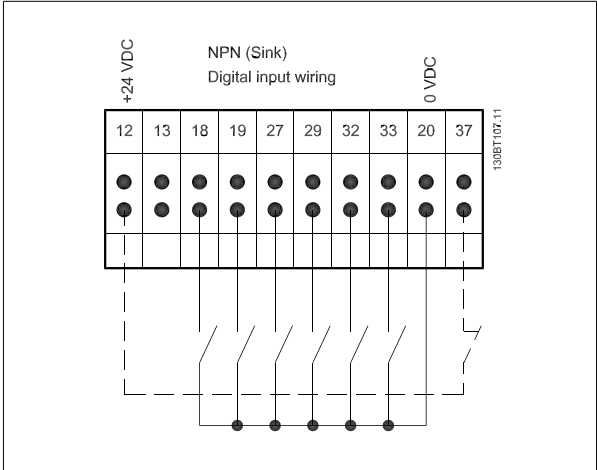
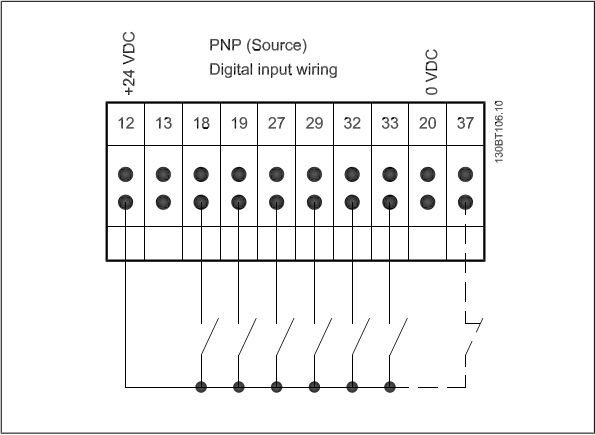
Terminal 37 is the input to be used for safe stop. For instructions on safe stop installation, refer to the section *Safe Stop Installation* in the adjustable frequency drive Design Guide. See also sections *Safe Stop* and *Safe Stop Installation*.

In rare cases, very long control cables and analog signals may, depending on installation, result in 50/60 Hz ground loops due to noise from line power supply cables.

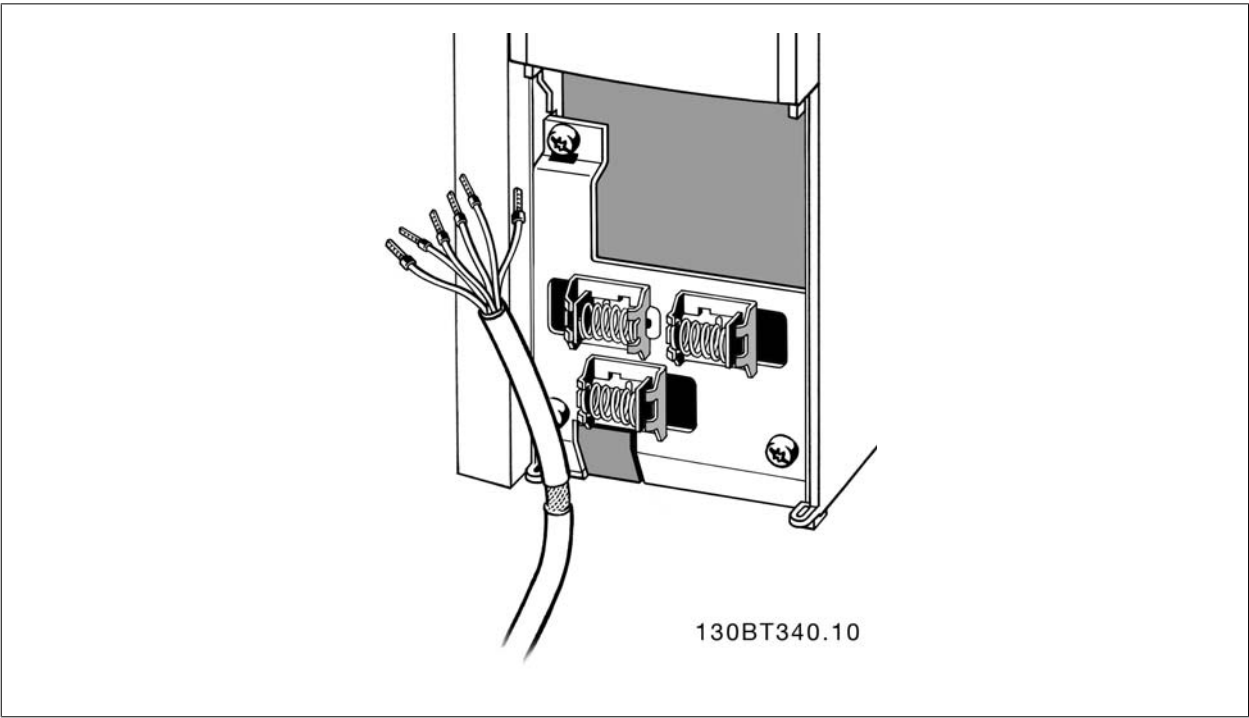
If this occurs, it may be necessary to break the shield or insert a 100 nF capacitor between shield and chassis.

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

Input polarity of control terminals



NOTE!
Control cables must be shielded/armored.



Connect the wires as described in the Instruction Manual for the adjustable frequency drive. Remember to connect the shields properly to ensure optimum electrical immunity.

4.3.2 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 for the analog input terminals 53 and 54, respectively.

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

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

Default setting:

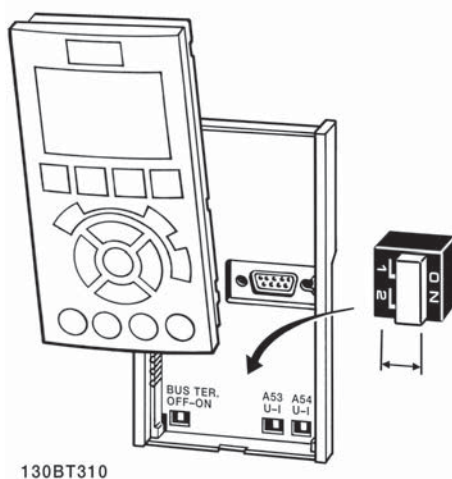
S201 (A53) = OFF (voltage input)

S202 (A54) = OFF (voltage input)

S801 (Bus termination) = OFF




When changing the function of S201, S202 or S801, be careful not to force the switch over. It is recommended to remove the LCP fixture (cradle) when operating the switches. The switches must not be operated while the adjustable frequency drive is powered.



4.4 Final Set-up and Test

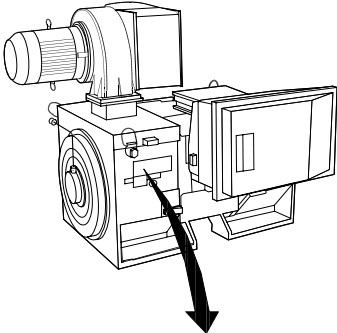
To test the set-up and ensure that the adjustable frequency drive is running, follow these steps.

Step 1. Locate the motor nameplate



NOTE!

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



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

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Step 2. Enter the motor nameplate data in this parameter list.
To access this list, first press the [QUICK MENU] key, then select "Q2 Quick Set-up".

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

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 adjustable frequency drive 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 adjustable frequency drive 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 adjustable frequency drive 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 the number and alarm description.



NOTE!

Unsuccessful AMA is often caused by incorrectly registered motor nameplate data or a too big difference between the motor power size and the adjustable frequency drive power size.

4

Step 4. Set speed limit and ramp time

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

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

Table 4.17: 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]*

4.5 Additional Connections

4.5.1 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 adjustable frequency drive is unable to 'support' the motor, such as when the load is too heavy, for example.
- 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 adjustable frequency drive carries out a stop command.

If the adjustable frequency drive is in alarm mode or in an overvoltage situation, the mechanical brake immediately cuts in.

4.5.2 Parallel Connection of Motors

The adjustable frequency drive 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 adjustable frequency drive.



NOTE!

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



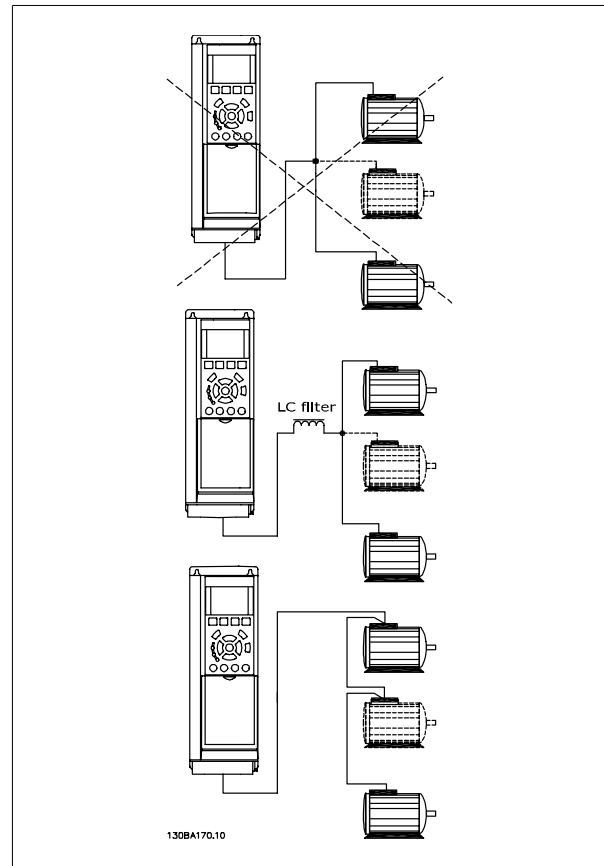
NOTE!

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



NOTE!

The electronic thermal relay (ETR) of the adjustable frequency drive cannot be used as motor protection for the individual motor of systems with parallel-connected motors. Provide further motor protection with, for example, thermistors in each motor or individual thermal relays (circuit breakers are not suitable for 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.

4.5.3 Motor Thermal Protection

The electronic thermal relay in the adjustable frequency drive 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 nameplate).

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

5 Annexes

5.1.1 Three ways of operating

The adjustable frequency drive can be operated in 3 ways:

1. Graphical Local Control Panel (GLCP), see 5.1.2
2. Numeric Local Control Panel (NLCP), see 5.1.3
3. RS-485 serial communication or USB, both for PC connection, see 5.1.4

If the adjustable frequency drive is fitted with a serial communication bus option, please refer to relevant documentation.

5.1.2 How to operate the Graphical LCP (GLCP)

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

The GLCP is divided into four functional groups:

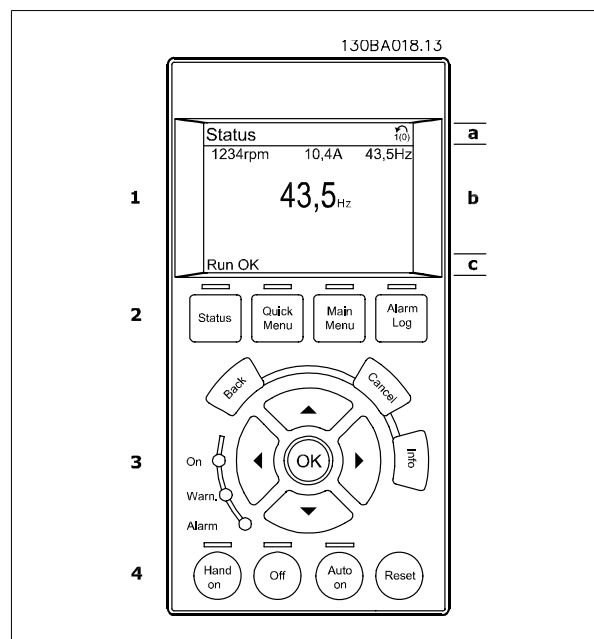
1. Graphical display with status lines.
2. Menu keys and LEDs - for selecting mode, changing parameters and switching between display functions.
3. Navigation keys and LEDs (LEDs).
4. Operation keys and LEDs.

Graphical display:

The LCD display is backlit 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:

The 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 an alarm/warning.

The number of the active set-up (selected as the active set-up in par. 0-10 *Active Set-up*0-10 Active Set-up) 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.

The middle section (b) shows up to 5 variables with related unit, regardless of status. In case of an alarm/warning, the warning is shown instead of the variables.

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

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

5

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 *Display Line 1.1 Small*0-20 Display Line 1.1 Small, par. 0-21 *Display Line 1.2 Small*0-21 Display Line 1.2 Small, par. 0-22 *Display Line 1.3 Small*0-22 Display Line 1.3 Small, par. 0-23 *Display Line 2 Large*0-23 Display Line 2 Large, and par. 0-24 *Display Line 3 Large*0-24 Display Line 3 Large, which can be accessed via [QUICK MENU], "Q3 Function Set-ups", "Q3-1 General Settings", "Q3-13 Display Settings".

Each value / measurement readout parameter selected in par. 0-20 *Display Line 1.1 Small*0-20 Display Line 1.1 Small to par. 0-24 *Display Line 3 Large*0-24 Display Line 3 Large 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

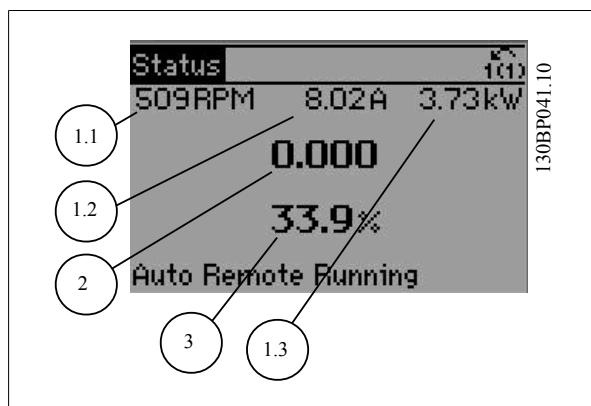
5.25 A; 15.2 A 105 A.

Status display I:

This readout 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, while 2 and 3 are shown in medium size.

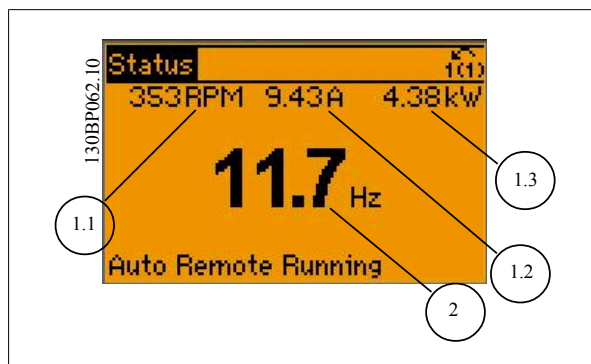


Status display II:

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, while 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 the section *Smart Logic Control*.

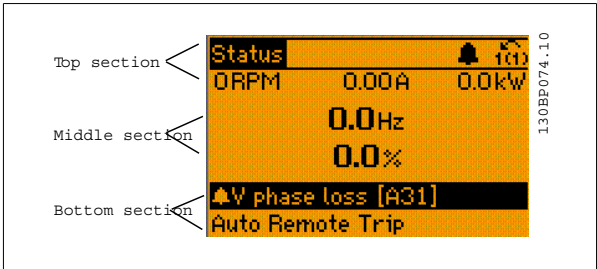


The bottom section always shows the state of the adjustable frequency drive in status mode.

Display Contrast Adjustment

Press [status] and [▲] for a darker display.

Press [status] and [▼] for a brighter display.

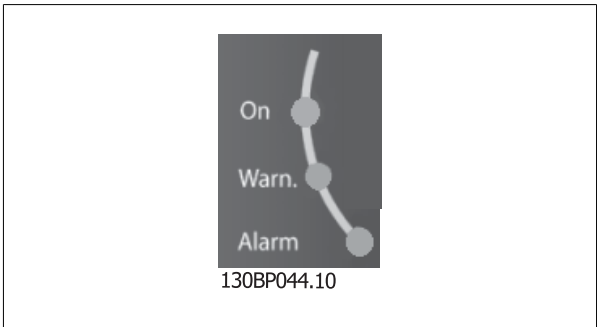


LEDs (LEDs):

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

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

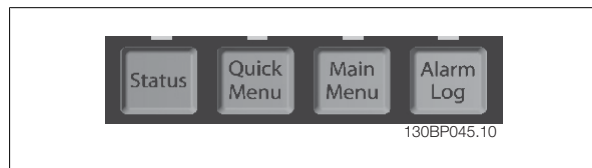
- Green LED/On: Control section is working.
- Yellow LED/Warn.: Indicates a warning.
- Flashing Red LED/Alarm: Indicates an alarm.



GLCP keys

Menu keys

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



[Status]

indicates the status of the adjustable frequency drive and/or the motor. Three 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, main menu mode or alarm mode. The [Status] key can also be used to toggle between single and double readout modes.

[Quick Menu]

allows quick set-up of the adjustable frequency drive. The most common HVAC functions can be programmed here.

The [Quick Menu] consists of:

- My Personal Menu
- Quick Set-up
- Function Set-up
- Changes Made
- Loggings

The function set-up provides quick and easy access to all the parameters required for the majority of HVAC applications, including most VAV and CAV supply and return fans, cooling tower fans, primary, secondary and condenser water pumps and other pump, fan and compressor applications. Among 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 fans, pumps and compressors.

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

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 *Main Menu Password* 0-60 Main Menu Password, par. 0-61 *Access to Main Menu w/o Password* 0-61 Access to Main Menu w/o Password, par. 0-65 *Personal Menu Password* 0-65 Personal Menu Password or par. 0-66 *Access to Personal Menu w/o Password* 0-66 Access to Personal Menu w/o Password. For the majority of HVAC applications, it is not necessary to access the Main Menu parameters. Instead, the Quick Menu, Quick Set-up and Function Set-up provide the simplest and quickest access to the most commonly 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). For additional details on a particular alarm, use the arrow keys to navigate to the alarm number and press [OK]. Information is displayed about the condition of the adjustable frequency drive before it enters alarm mode.

The Alarm log button on the LCP allows access to both the alarm log and maintenance log.

[Back]

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

[Cancel]

last change or command will be canceled 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].



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.



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



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[Hand On]

enables control of the adjustable frequency drive via the GLCP. [Hand on] also starts the motor and makes it possible to enter the motor speed data by using the arrow keys. The key can be selected as *Enable* [1] or *Disable* [0] via par. 0-40 [Hand on] Key on LCP0-40 [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
- Reversing
- Set-up select lsb - Set-up select msb
- Stop command from serial communication
- Quick stop
- DC brake



NOTE!
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 selected as Enable [1] or Disable [0] via par. 0-41 [Off] Key on LCP0-41 [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 line power supply.

[Auto On]
enables the adjustable frequency drive to be controlled via the control terminals and/or serial communication. When a start signal is applied to the control terminals and/or the bus, the adjustable frequency drive will start. The key can be selected as Enable [1] or Disable [0] via par. 0-42 [Auto on] Key on LCP0-42 [Auto on] Key on LCP.



NOTE!
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 adjustable frequency drive after an alarm (trip). It can be selected as Enable [1] or Disable [0] via par. 0-43 [Reset] Key on LCP0-43 [Reset] Key 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.

5.1.3 How to operate the 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 LEDs - changing parameters and switching between display functions.
- 3. Navigation keys and LEDs.
- 4. Operation keys and LEDs.



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

Select one of the following modes:
Status Mode: Displays the status of the adjustable frequency drive or the motor.
If an alarm occurs, the NLCP automatically switches to status mode.
A number of alarms can be displayed.
Quick Set-up or Main Menu Mode: Display parameters and parameter settings.

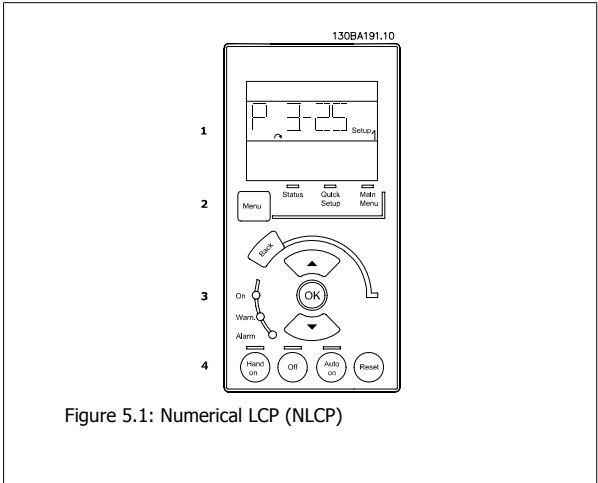


Figure 5.1: Numerical LCP (NLCP)

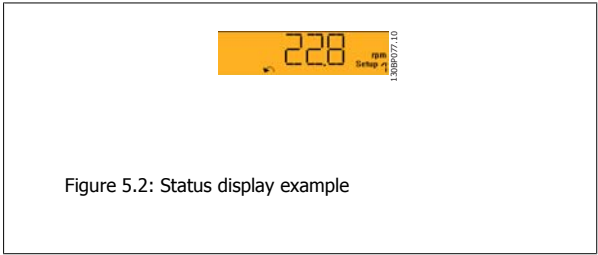


Figure 5.2: Status display example

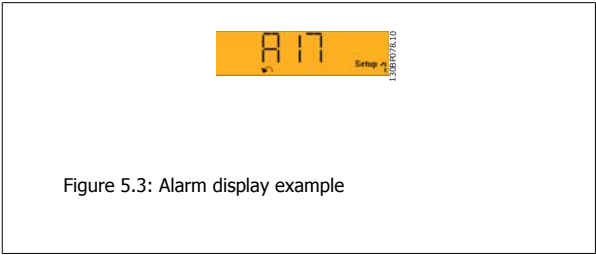


Figure 5.3: Alarm display example

LEDs:

- Green LED/On: Indicates whether 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 Set-up
- 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 Set-up is used to set up the adjustable frequency drive using only the most essential parameters.

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

Select the 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 desired data value and press [OK].

Navigation Keys

[Back]

for stepping backwards

Arrow [▲] [▼]

keys are used for navigating 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.

Operation Keys

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

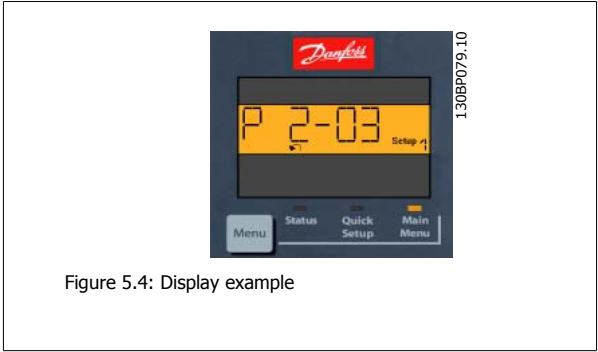


Figure 5.4: Display example

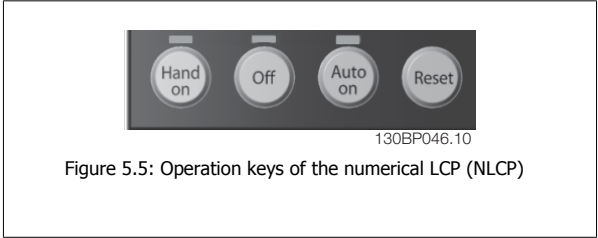


Figure 5.5: Operation keys of the numerical LCP (NLCP)

[Hand on]

enables control of the adjustable frequency drive via the LCP. [Hand on] also starts the motor and makes it 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 line power supply.

[Auto on]

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



NOTE!

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 adjustable frequency drive after an alarm (trip). The key can be *Enabled* [1] or *Disabled* [0] via par. 0-43 *[Reset] Key on LCP*.

5.1.4 RS-485 Bus Connection

One or more adjustable frequency drives can be connected to a controller (or master) using the standard RS-485 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 adjustable frequency drive is connected to a master, use parallel connections.

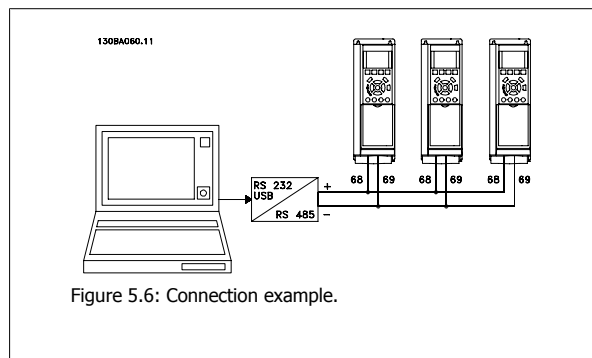


Figure 5.6: Connection example.

In order to avoid potential equalizing currents in the screen, ground 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 to ON.

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

5.1.5 How to Connect a PC to the Adjustable Frequency Drive

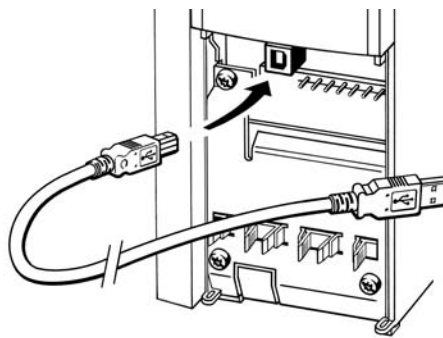
To control or program the adjustable frequency drive from a PC, install the PC-based Configuration Tool MCT 10.

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*.



NOTE!

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



130BT308

Figure 5.7: For control cable connections, see section on *Control Terminals*.

5.1.6 PC Software tools

PC-based Configuration Tool MCT 10

All adjustable frequency drives are equipped with a serial communication port. Danfoss provides a PC tool for communication between the PC and the adjustable frequency drive, 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 adjustable frequency drives. 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 adjustable frequency drive database
- Commissioning adjustable frequency drives on-line.
- Saving settings for all adjustable frequency drives.
- Replacing an adjustable frequency drive in a network.
- Simple and accurate documentation of adjustable frequency drive settings after commissioning.
- Expanding an existing network.
- Adjustable frequency drives developed in the future will be fully supported.

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

Save Adjustable Frequency Drive Settings:

- 1. Connect a PC to the unit via the USB COM port. (Note: Use a PC that is isolated from the line power, 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 on the PC.

Load Adjustable Frequency Drive Settings:


- 1. Connect a PC to the adjustable frequency drive via the 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 adjustable frequency drive.

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:

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

Ordering number:

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

MCT 10 can also be downloaded from the Danfoss Internet: *WWW.DANFOSS.COM, Business Area: Motion Controls.*

5.1.7 Tips and tricks

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

Table 5.1: Tips and tricks

5.1.8 Quick Transfer of Parameter Settings when using GLCP

Once the set-up of an adjustable frequency drive 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.



NOTE!

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 adjustable frequency drive and the parameter settings copied to this adjustable frequency drive.

Data transfer from LCP to adjustable frequency drive:

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 adjustable frequency drive, as indicated by the progress bar. When 100% is reached, press [OK].

5.1.9 Initialization to Default Settings

There are two ways to initialize the adjustable frequency drive to default: Recommended initialization and manual initialization.

Please be aware that they have different impacts according to the below description.

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

1. Select par. 14-22 *Operation Mode*
2. Press [OK]
3. Select "Initialization" (for NLCP select "2")
4. Press [OK]
5. Disconnect the power from the unit and wait for the display to turn off.
6. Reconnecting the power resets the adjustable frequency drive.
Please note that the first start-up takes a few more seconds.
7. Press [Reset]

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

par. 14-50 *RFI 1*
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 *Max Inter-Char Delay*
par. 15-00 *Operating Hours* to par. 15-05 *Over Volts*
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*



NOTE!

Parameters selected in par. 0-25 *My Personal Menu* will remain present with the default factory setting.

Manual initialization



NOTE!

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

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

This parameter initializes all except:

par. 15-00 *Operating Hours*

par. 15-03 *Power-ups*

par. 15-04 *Over Temps*

par. 15-05 *Over Volts*

6 How to Program

6.1.1 Parameter Set-up

| Group | Title | Function |
|-------|---------------------------|---|
| 0- | Operation and Display | Parameters used to program the fundamental functions of the adjustable frequency drive and the LCP including: selection of language; selection of which variables are displayed at each position in the display (e.g., static duct pressure or condenser water return temperature can be displayed with the setpoint in small digits in the top row and feedback in large digits in the center of the display); enabling/disabling of the LCP keys/buttons; passwords for the LCP; upload and download of commissioned parameters to/from the LCP and setting the built-in clock. |
| 1- | Load / Motor | Parameters used to configure the adjustable frequency drive for the specific application and motor including: open-loop or closed-loop operation; type of application such as compressor, fan or centrifugal pump; motor nameplate data; auto-tuning of the drive to the motor for optimum performance; flying start (typically used for fan applications) and motor thermal protection. |
| 2- | Brakes | Parameters used to configure braking functions of the adjustable frequency drive which although not common in many HVAC applications, can be useful on special fan applications. Parameters including: DC braking; dynamic/resistor braking and overvoltage control (which provides automatic adjustment of the deceleration rate (auto-ramping) to avoid tripping when decelerating large inertia fans). |
| 3- | Reference/Ramps | Parameters used to program the minimum and maximum reference limits of speed (RPM/Hz) in open-loop or in actual units when operating in closed-loop); digital/preset references; jog speed; definition of the source of each reference (e.g., which analog input the reference signal is connected to); ramp-up and ramp-down times and digital potentiometer settings. |
| 4- | Limits/Warnings | Parameters used to program limits and warnings of operation including: allowable motor direction; minimum and maximum motor speeds (e.g., in pump applications it is typical to program a minimum speed to approx 30–40% to ensure pump seals are adequately lubricated at all times, avoid cavitation and ensure adequate head is produced at all times to create flow); torque and current limits to protect the pump, fan or compressor driven by the motor; warnings for low/high current, speed, reference, and feedback; missing motor phase protection; speed bypass frequencies including semi-automatic set-up of these frequencies (e.g., to avoid resonance conditions on cooling towers and other fans). |
| 5- | Digital In / Out | Parameters used to program the functions of all digital inputs, digital outputs, relay outputs, pulse inputs and pulse outputs for terminals on the control card and all option cards. |
| 6- | Analog In / Out | Parameters used to program the functions associated with all analog inputs and analog outputs for the terminals on the control card and General Purpose I/O option (MCB101) (note: NOT Analog I/O option MCB109, see parameter group 26-00) including: analog input live zero timeout function (which, for example, can be used to command a cooling tower fan to operate at full speed if the condenser water return sensor fails); scaling of the analog input signals (for example, to match the analog input to the mA and pressure range of a static duct pressure sensor); filter time constant to filter out electrical noise on the analog signal which can sometimes occur when long cables are installed; function and scaling of the analog outputs (for example, to provide an analog output representing motor current or kW to an analog input of a DDC controller) and to configure the analog outputs to be controlled by the BMS via a high level interface (HLI) (e.g., to control a chilled water valve) including the ability to define a default value of these outputs in the event of the HLI failing. |
| 8- | Communication and Options | Parameters used for configuring and monitoring functions associated with the serial communications / high level interface to the adjustable frequency drive. |
| 9- | Profibus | Parameters only applicable when a Profibus option is installed. |
| 10- | CAN Ser. Com. Bus | Parameters only applicable when a DeviceNet option is installed. |
| 11- | LonWorks | Parameters only applicable when a Lonworks option is installed. |
| 13- | Smart Logic Controller | Parameters used to configure the built in Smart Logic Controller (SLC), which can be used for simple functions such as comparators (e.g., if running above xHz, activate output relay), timers (e.g., when a start signal is applied, first activate output relay to open supply air damper and wait x seconds before ramping up) or a more complex sequence of user defined actions executed by the SLC when the associated user defined event is evaluated as TRUE by the SLC. (For example, initiate an economizer mode in a simple AHU cooling application control scheme where there is no BMS. For such an application, the SLC can monitor the relative humidity of the outside air, and if it is below a defined value, the supply air temperature setpoint could be automatically increased. With the adjustable frequency drive monitoring the relative humidity of the outside air and supply air temperature via its analog inputs and controlling the chilled water valve via one of the extended PI(D) loops and an analog output, it would then modulate that valve to maintain a higher supply air temperature). The SLC can often replace the need for other external control equipment. |

Table 6.1: Parameter Groups

| Group | Title | Function |
|-------|---------------------------|--|
| 14- | Special Functions | Parameters used to configure special functions of the adjustable frequency drive including: setting of the switching frequency to reduce audible noise from the motor (sometimes required for fan applications); kinetic back-up function (especially useful for critical applications in semi-conductor installations where performance under line power dip/line power loss is important); line imbalance protection; automatic reset (to avoid the need for a manual reset of alarms); energy optimization parameters (which typically do not need changing but enable fine tuning of this automatic function (if necessary) ensuring the adjustable frequency drive and motor combination operate at their optimum efficiency at full and partial load conditions) and auto-derating functions (which enable the adjustable frequency drive to continue operation at reduced performance under extreme operating conditions ensuring maximum up time). |
| 15- | FC Information | Parameters providing operating data and other drive information including: operating and running hour counters; kWh counter; resetting of the running and kWh counters; alarm/fault log (where the past 10 alarms are logged along with any associated value and time) and drive and option card identification parameters such as code number and software version. |
| 16- | Data Readouts | Read only parameters which display the status/value of many operating variables which can be displayed on the LCP or viewed in this parameter group. These parameters can be particularly useful during commissioning when interfacing with a BMS via a high level interface. |
| 18- | Info & Readouts | Read-only parameters which display the last 10 preventative maintenance log items, actions and time and the value of analog inputs and outputs on the analog I/O option card which can be particularly useful during commissioning when interfacing with a BMS via a high level interface. |
| 20- | FC Closed-loop | Parameters used to configure the closed-loop PI(D) controller which controls the speed of the pump, fan or compressor in closed-loop mode including: defining where each of the three possible feedback signals come from (e.g., which analog input or the BMS HLI); conversion factor for each of the feedback signals (e.g., where a pressure signal is used for indication of flow in an AHU or converting from pressure to temperature in a compressor application); engineering unit for the reference and feedback (e.g., Pa, kPa, m Wg, in Wg, bar, m3/s, m3/h, °C, °F, etc.); the function (e.g., sum, difference, average, minimum or maximum) used to calculate the resulting feedback for single zone applications or the control philosophy for multi-zone applications; programming of the setpoint(s) and manual or auto-tuning of the PI(D) loop. |
| 21- | Extended Closed-loop | Parameters used to configure the three extended closed-loop PI(D) controllers which, for example, can be used to control external servos (e.g., chilled water valve to maintain supply air temperature in a VAV system) including: engineering unit for the reference and feedback of each controller (e.g., °C, °F, etc.); defining the range of the reference/setpoint for each controller; defining where each of the references/setpoints and feedback signals come from (e.g., which analog input or the BMS HLI); programming of the setpoint and manual or auto-tuning of each of the PI(D) controllers. |
| 22- | Application Functions | Parameters used to monitor, protect and control pumps, fans and compressors including: no flow detection and protection of pumps (including auto-setup of this function); dry pump protection; end of curve detection and protection of pumps; sleep mode (especially useful for cooling tower and booster pump sets); broken belt detection (typically used for fan applications to detect no air flow instead of using a Δp switch installed across the fan); short cycle protection of compressors and pump flow compensation of setpoint (especially useful for secondary chilled water pump applications where the Δp sensor has been installed close to the pump and not across the furthest most significant load(s) in the system; using this function can compensate for the sensor installation and help to achieve maximum energy savings). |
| 23- | Time-based Functions | Time based parameters including: those used to initiate daily or weekly actions based on the built-in real time clock (e.g., change of setpoint for night set back mode or start/stop of the pump/fan/compressor start/stop of a external equipment); preventative maintenance functions which can be based on running or operating hour time intervals or on specific dates and times; energy log (especially useful in retrofit applications or where information of the actual historical load (kW) on the pump/fan/compressor is of interest); trending (especially useful in retrofit or other applications where there is an interest to log operating power, current, frequency or speed of the pump/fan/compressor for analysis and a payback counter). |
| 24- | Application Functions 2 | Parameters used to set up fire mode and/or to control a bypass contactor/starter if designed into the system. |
| 25- | Cascade Controller | Parameters used to configure and monitor the built-in pump cascade controller (typically used for pump booster sets). |
| 26- | Analog I/O Option MCB 109 | Parameters used to configure the Analog I/O option (MCB109) including: definition of the analog input types (e.g., voltage, Pt1000 or Ni1000) and scaling and definition of the analog output functions and scaling. |

Parameter descriptions and selections are displayed on the graphic (GLCP) or numeric (NLCP) display. (See the relevant section for details.) Access the parameters by pressing the [Quick Menu] or [Main Menu] button on the control panel. The quick menu is used primarily for commissioning the unit at start-up by providing the parameters necessary to start operation. The main menu provides access to all the 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 HVAC applications but if other special functions are required, they must be programmed as explained in parameter group 5 or 6.

6.1.2 Quick Menu Mode

Parameter Data

The graphical display (GLCP) provides access to all parameters listed under the quick menus. The numeric display (NLCP) only provides access to the quick set-up parameters. To set parameters using the [Quick Menu] button - enter or change parameter data or settings in accordance with the following procedure:

1. Press Quick Menu button
2. Use the [▲] and [▼] buttons to find the parameter you want to change
3. Press [OK].
4. Use [▲] and [▼] buttons to select the correct parameter setting
5. Press [OK].
6. To move to a different digit within a parameter setting, use the [◀] and [▶] buttons
7. Highlighted area indicates digit selected for change
8. Press [Cancel] button to disregard change, or press [OK] to accept change and enter the new setting

Example of Changing Parameter Data

Assume parameter 22-60 is set to [Off]. However, you want to monitor the fan belt condition - non-broken or broken - according to the following procedure:

1. Press Quick Menu key
2. Choose Function Set-ups with the [▼] button
3. Press [OK].
4. Choose Application Settings with the [▼] button
5. Press [OK].
6. Press [OK] again for Fan Functions
7. Choose Broken Belt Function by pressing [OK]
8. With [▼] button, choose [2] Trip

The adjustable frequency drive will now trip if a broken fan belt is detected.

Select [My Personal Menu] to display personal parameters:

Select [My Personal Menu] to display only the parameters, which have been pre-selected and programmed as personal parameters. For example, an AHU or pump OEM may have pre-programmed personal parameters 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 programmed in this menu.

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 readouts. The information is shown as graphs.

Only display parameters selected in par. 0-20 *Display Line 1.1 Small* and par. 0-24 *Display Line 3 Large* can be viewed. It is possible to store up to 120 samples in the memory for later reference.

Efficient Parameter Set-up for HVAC Applications:

The parameters can easily be set up for the vast majority of the HVAC applications only by using the [Quick Set-up] option.

After pressing [Quick Menu], the different choices in the quick menu are listed. See also illustration 6.1 below and tables Q3-1 to Q3-4 in the following *Function Set-ups* section.

Example of using the Quick Set-up option:
Assume you want to set the ramp-down time to 100 seconds!

- 1. Select [Quick Set-up]. The first par. 0-01 *Language* in Quick Set-up appears
- 2. Press [▼] repeatedly until par. 3-42 *Ramp 1 Ramp-down Time* appears with the default setting of 20 seconds
- 3. Press [OK].
- 4. Use the [◀] button to highlight the third digit before the comma
- 5. Change '0' to '1' by using the [▲] button
- 6. Use the [▶] button to highlight the digit '2'
- 7. Change '2' to '0' with the [▼] button
- 8. Press [OK].

The new ramp-down time is now set to 100 seconds.
It is recommended to do the set-up in the order listed.

6



NOTE!
A complete description of the function is found in the parameter sections of this manual.

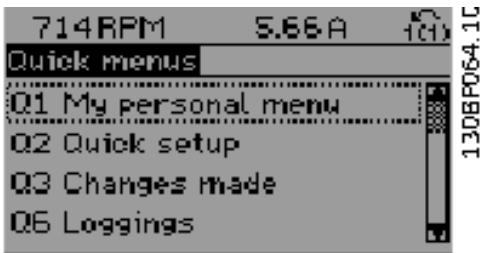


Figure 6.1: Quick Menu view.

The Quick Set-up menu gives access to the 13 most important set-up parameters of the adjustable frequency drive. After programming, the adjustable frequency drive will, in most cases, be ready for operation. The 13 (see footnote) Quick Set-up parameters are shown in the table below. A complete description of the function is given in the parameter description sections of this manual.

| Par. | [Units] |
|---|---------|
| par. 0-01 <i>Language</i> | |
| par. 1-20 <i>Motor Power [kW]</i> | [kW] |
| par. 1-21 <i>Motor Power [HP]</i> | [HP] |
| par. 1-22 <i>Motor Voltage</i> | [V] |
| par. 1-23 <i>Motor Frequency</i> | [Hz] |
| par. 1-24 <i>Motor Current</i> | [A] |
| par. 1-25 <i>Motor Nominal Speed</i> | [RPM] |
| par. 1-28 <i>Motor Rotation Check</i> | [Hz] |
| par. 3-41 <i>Ramp 1 Ramp-up Time</i> | [s] |
| par. 3-42 <i>Ramp 1 Ramp-down Time</i> | [s] |
| par. 4-11 <i>Motor Speed Low Limit [RPM]</i> | [RPM] |
| par. 4-12 <i>Motor Speed Low Limit [Hz]</i> | [Hz] |
| par. 4-13 <i>Motor Speed High Limit [RPM]</i> | [RPM] |
| par. 4-14 <i>Motor Speed High Limit [Hz]</i> | [Hz] |
| par. 3-19 <i>Jog Speed [RPM]</i> | [RPM] |
| par. 3-11 <i>Jog Speed [Hz]</i> | [Hz] |
| par. 5-12 <i>Terminal 27 Digital Input</i> | |
| par. 5-40 <i>Function Relay</i> | |

Table 6.2: Quick Set-up parameters

*The display showing depends on choices made in par. 0-02 *Motor Speed Unit* and par. 0-03 *Regional Settings*. The default settings of par. 0-02 *Motor Speed Unit* and par. 0-03 *Regional Settings* depend on which region of the world the adjustable frequency drive is supplied to but can be re-programmed as required.

** par. 5-40 *Function Relay*, is an array, where one may choose between Relay1 [0] or Relay2 [1]. Standard setting is Relay1 [0] with the default choice Alarm [9].

See the parameter description later in this chapter under Function Set-up parameters.

For detailed information about settings and programming, please see the *Programming Guide, MG.11.CX.YY*

x=version number

y=language



NOTE!

If [No Operation] is selected in par. 5-12 *Terminal 27 Digital Input*, no connection to +24 V on terminal 27 is necessary to enable start.
If [Coast Inverse] (factory default value) is selected in par. 5-12 *Terminal 27 Digital Input*, a connection to +24 V is necessary to enable start.

0-01 Language

Option:

Function:

Defines the language to be used in the display.

The adjustable frequency drive 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] Deutsch Part of Language packages 1 - 4

[2] Francais Part of Language package 1

[3] Dansk Part of Language package 1

[4] Spanish Part of Language package 1

[5] Italiano Part of Language package 1

[6] Svenska Part of Language package 1

[7] Nederlands Part of Language package 1

[10] Chinese Language package 2

[20] Suomi Part of Language package 1

[22] English US Part of Language package 4

[27] Greek Part of Language package 4

[28] Bras.port 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] Trad.Chinese Part of Language package 2

[43] Bulgarian Part of Language package 3

[44] Srpski Part of Language package 3

[45] Romanian Part of Language package 3

[46] Magyar Part of Language package 3

[47] Czech Part of Language package 3

[48] Polski Part of Language package 4

[49] Russian Part of Language package 3

[50] Thai Part of Language package 2

[51] Bahasa Indonesia Part of Language package 2

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.

1-21 Motor Power [HP]

Range:

4.00 hp* [0.09 - 3000.00 hp]

Function:

Enter the nominal motor power in HP according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit.

This parameter 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:

50. Hz* [20 - 1000 Hz]

Function:

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 *Motor Speed High Limit [RPM]* and par. 3-03 *Maximum Reference* to the 87 Hz application.



NOTE!

This parameter cannot be adjusted while the motor is running.

1-24 Motor Current

Range:

7.20 A* [0.10 - 10000.00 A]

Function:

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



NOTE!

This parameter cannot be adjusted while the motor is running.

1-25 Motor Nominal Speed

Range:

1420. RPM* [100 - 60000 RPM]

Function:



NOTE!

This parameter cannot be changed while the motor is running.

1-28 Motor Rotation Check

Option:

Function:

Following installation and connection of the motor, this function allows the correct motor rotation direction to be verified. Enabling this function overrides any bus commands or digital inputs, except External Interlock and Safe Stop (if included).

[0] * OFF

Motor Rotation Check is not active.

[1] Enabled

Motor Rotation Check is enabled. Once enabled, display shows:

"Please Note! Motor may run in wrong direction".

6

Pressing [OK], [Back] or [Cancel] will dismiss the message and display a new message: "Press [Hand on] to start the motor. Press [Cancel] to abort". Pressing [Hand on] starts the motor at 5 Hz in forward direction and the display shows: "Motor is running. Check if motor rotation direction is correct. Press [Off] to stop the motor". Pressing [Off] stops the motor and resets par. 1-28 *Motor Rotation Check*. If motor rotation direction is incorrect, two motor phase cables should be interchanged. **IMPORTANT:**



Line power must be removed before disconnecting motor phase cables.

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 overvoltage 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*.

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

4-14 Motor Speed High Limit [Hz]

Range:

50/60.0 [par. 4-12 - par. 4-19 Hz]
Hz*

Function:

Enter the maximum limit for motor speed. The Motor Speed High Limit can be set to correspond to the manufacturer's recommended maximum of the motor shaft. The Motor Speed High Limit must exceed the in par. 4-12 *Motor Speed Low Limit [Hz]*. 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.



NOTE!
Max. output frequency cannot exceed 10% of the inverter switching frequency (par. 14-01 *Switching Frequency*).

4-12 Motor Speed Low Limit [Hz]

| Range: | Function: |
|--------------------------|---|
| 0 Hz* [0 - par. 4-14 Hz] | Enter the minimum limit for motor speed. The motor speed low limit can be set to correspond to the minimum output frequency of the motor shaft. The Speed Low Limit must not exceed the setting in par. 4-14 <i>Motor Speed High Limit [Hz]</i> . |

4-13 Motor Speed High Limit [RPM]

| Range: | Function: |
|-------------------------------------|--|
| 1500. RPM* [par. 4-11 - 60000. RPM] | Enter the maximum limit for motor speed. The Motor Speed High Limit can be set to correspond to the manufacturer's maximum rated motor. The Motor Speed High Limit must exceed the setting in par. 4-11 <i>Motor Speed Low Limit [RPM]</i> . Only par. 4-11 <i>Motor Speed Low Limit [RPM]</i> or par. 4-12 <i>Motor Speed Low Limit [Hz]</i> will be displayed, depending on other parameters in the main menu, and depending on default settings dependant on global location. |



NOTE!
The output frequency value of the adjustable frequency drive must not exceed a value higher than 1/10 of the switching frequency.



NOTE!
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]*.

4-11 Motor Speed Low Limit [RPM]

| Range: | Function: |
|----------------------------|---|
| 0 RPM* [0 - par. 4-13 RPM] | Enter the minimum limit for motor speed. The Motor Speed Low Limit can be set to correspond to the manufacturer's recommended minimum motor speed. The Motor Speed Low Limit must not exceed the setting in par. 4-13 <i>Motor Speed High Limit [RPM]</i> . |

3-11 Jog Speed [Hz]

| Range: | Function: |
|-------------------------------|---|
| 10.0 Hz* [0.0 - par. 4-14 Hz] | The jog speed is a fixed output speed at which the adjustable frequency drive is running when the jog function is activated. See also par. 3-80 <i>Jog Ramp Time</i> . |

6.1.3 Function Set-ups

The Function set-up provides quick and easy access to all parameters required for the majority of applications including most VAV and CAV supply and return fans, cooling tower fans, primary, secondary and condenser water pumps and other pump, fan and compressor applications.

How to access Function set-up - example

6



Figure 6.2: Step 1: Turn on the adjustable frequency drive (yellow LED lights)

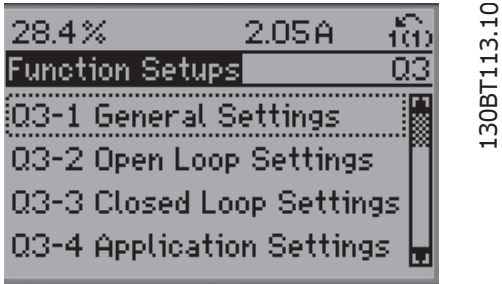


Figure 6.5: Step 4: Function set-ups choices appear. Choose 03-1 General Settings. Press [OK].

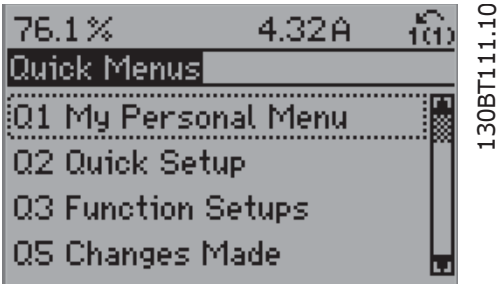


Figure 6.3: Step 2: Press the [Quick Menus] button (quick menu choices appear).

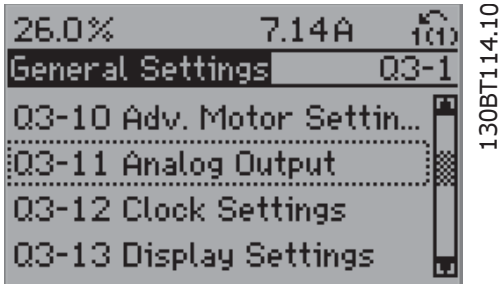


Figure 6.6: Step 5: Use the up/down navigation keys to scroll down to , i.e., 03-11 Analog Outputs. Press [OK].

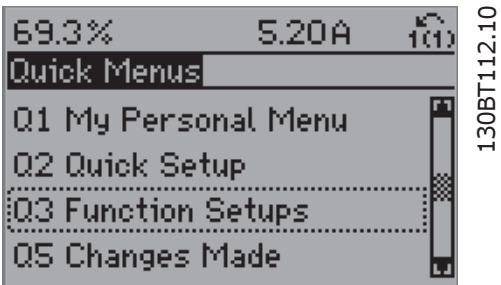


Figure 6.4: Step 3: Use the up/down navigation keys to scroll down to Function set-ups. Press [OK].

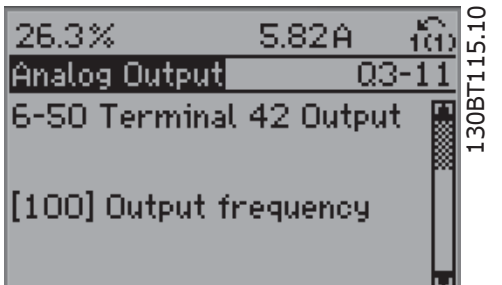
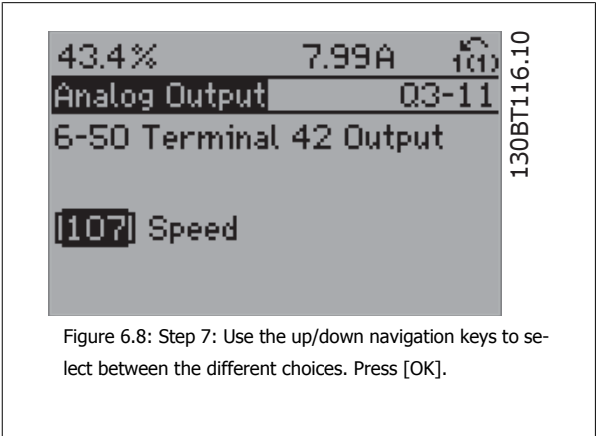


Figure 6.7: Step 6: Choose par. 6-50. Press [OK].



Function Set-ups parameters
The Function Set-ups parameters are grouped in the following way:

| Q3-1 General Settings | | | |
|---|---|---------------------------------------|---|
| Q3-10 Adv. Motor Settings | Q3-11 Analog Output | Q3-12 Clock Settings | Q3-13 Display Settings |
| par. 1-90 <i>Motor Thermal Protection</i> | par. 6-50 <i>Terminal 42 Output</i> | par. 0-70 <i>Set Date and Time</i> | par. 0-20 <i>Display Line 1.1 Small</i> |
| par. 1-93 <i>Thermistor Source</i> | par. 6-51 <i>Terminal 42 Output Min Scale</i> | par. 0-71 <i>Date Format</i> | par. 0-21 <i>Display Line 1.2 Small</i> |
| par. 1-29 <i>Automatic Motor Adaptation (AMA)</i> | par. 6-52 <i>Terminal 42 Output Max Scale</i> | par. 0-72 <i>Time Format</i> | par. 0-22 <i>Display Line 1.3 Small</i> |
| par. 14-01 <i>Switching Frequency</i> | | par. 0-74 <i>DST/Summertime</i> | par. 0-23 <i>Display Line 2 Large</i> |
| par. 4-53 <i>Warning Speed High</i> | | par. 0-76 <i>DST/Summertime Start</i> | par. 0-24 <i>Display Line 3 Large</i> |
| | | par. 0-77 <i>DST/Summertime End</i> | par. 0-37 <i>Display Text 1</i> |
| | | | par. 0-38 <i>Display Text 2</i> |
| | | | par. 0-39 <i>Display Text 3</i> |

| Q3-2 Open-loop Settings | |
|--|---|
| Q3-20 Digital Reference | Q3-21 Analog Reference |
| par. 3-02 <i>Minimum Reference</i> | par. 3-02 <i>Minimum Reference</i> |
| par. 3-03 <i>Maximum Reference</i> | par. 3-03 <i>Maximum Reference</i> |
| par. 3-10 <i>Preset Reference</i> | par. 6-10 <i>Terminal 53 Low Voltage</i> |
| par. 5-13 <i>Terminal 29 Digital Input</i> | par. 6-11 <i>Terminal 53 High Voltage</i> |
| par. 5-14 <i>Terminal 32 Digital Input</i> | par. 6-12 <i>Terminal 53 Low Current</i> |
| par. 5-15 <i>Terminal 33 Digital Input</i> | par. 6-13 <i>Terminal 53 High Current</i> |
| | par. 6-14 <i>Terminal 53 Low Ref./Feedb. Value</i> |
| | par. 6-15 <i>Terminal 53 High Ref./Feedb. Value</i> |

Q3-3 Closed-loop Settings

| Q3-30 Single Zone Int. Setpoint | Q3-31 Single Zone Ext. Setpoint | Q3-32 Multi Zone / Adv |
|---|---|---|
| par. 1-00 <i>Configuration Mode</i> | par. 1-00 <i>Configuration Mode</i> | par. 1-00 <i>Configuration Mode</i> |
| par. 20-12 <i>Reference/Feedback Unit</i> | par. 20-12 <i>Reference/Feedback Unit</i> | par. 3-15 <i>Reference 1 Source</i> |
| par. 20-13 <i>Minimum Reference/Feedb.</i> | par. 20-13 <i>Minimum Reference/Feedb.</i> | par. 3-16 <i>Reference 2 Source</i> |
| par. 20-14 <i>Maximum Reference/Feedb.</i> | par. 20-14 <i>Maximum Reference/Feedb.</i> | par. 20-00 <i>Feedback 1 Source</i> |
| par. 6-22 <i>Terminal 54 Low Current</i> | par. 6-10 <i>Terminal 53 Low Voltage</i> | par. 20-01 <i>Feedback 1 Conversion</i> |
| par. 6-24 <i>Terminal 54 Low Ref./Feedb. Value</i> | par. 6-11 <i>Terminal 53 High Voltage</i> | par. 20-02 <i>Feedback 1 Source Unit</i> |
| par. 6-25 <i>Terminal 54 High Ref./Feedb. Value</i> | par. 6-12 <i>Terminal 53 Low Current</i> | par. 20-03 <i>Feedback 2 Source</i> |
| par. 6-26 <i>Terminal 54 Filter Time Constant</i> | par. 6-13 <i>Terminal 53 High Current</i> | par. 20-04 <i>Feedback 2 Conversion</i> |
| par. 6-27 <i>Terminal 54 Live Zero</i> | par. 6-14 <i>Terminal 53 Low Ref./Feedb. Value</i> | par. 20-05 <i>Feedback 2 Source Unit</i> |
| par. 6-00 <i>Live Zero Timeout Time</i> | par. 6-15 <i>Terminal 53 High Ref./Feedb. Value</i> | par. 20-06 <i>Feedback 3 Source</i> |
| par. 6-01 <i>Live Zero Timeout Function</i> | par. 6-22 <i>Terminal 54 Low Current</i> | par. 20-07 <i>Feedback 3 Conversion</i> |
| par. 20-21 <i>Setpoint 1</i> | par. 6-24 <i>Terminal 54 Low Ref./Feedb. Value</i> | par. 20-08 <i>Feedback 3 Source Unit</i> |
| par. 20-81 <i>PID Normal/ Inverse Control</i> | par. 6-25 <i>Terminal 54 High Ref./Feedb. Value</i> | par. 20-12 <i>Reference/Feedback Unit</i> |
| par. 20-82 <i>PID Start Speed [RPM]</i> | par. 6-26 <i>Terminal 54 Filter Time Constant</i> | par. 20-13 <i>Minimum Reference/Feedb.</i> |
| par. 20-83 <i>PID Start Speed [Hz]</i> | par. 6-27 <i>Terminal 54 Live Zero</i> | par. 20-14 <i>Maximum Reference/Feedb.</i> |
| par. 20-93 <i>PID Proportional Gain</i> | par. 6-00 <i>Live Zero Timeout Time</i> | par. 6-10 <i>Terminal 53 Low Voltage</i> |
| par. 20-94 <i>PID Integral Time</i> | par. 6-01 <i>Live Zero Timeout Function</i> | par. 6-11 <i>Terminal 53 High Voltage</i> |
| par. 20-70 <i>Closed-loop Type</i> | par. 20-81 <i>PID Normal/ Inverse Control</i> | par. 6-12 <i>Terminal 53 Low Current</i> |
| par. 20-71 <i>Tuning Mode</i> | par. 20-82 <i>PID Start Speed [RPM]</i> | par. 6-13 <i>Terminal 53 High Current</i> |
| par. 20-72 <i>PID Output Change</i> | par. 20-83 <i>PID Start Speed [Hz]</i> | par. 6-14 <i>Terminal 53 Low Ref./Feedb. Value</i> |
| par. 20-73 <i>Minimum Feedback Level</i> | par. 20-93 <i>PID Proportional Gain</i> | par. 6-15 <i>Terminal 53 High Ref./Feedb. Value</i> |
| par. 20-74 <i>Maximum Feedback Level</i> | par. 20-94 <i>PID Integral Time</i> | par. 6-16 <i>Terminal 53 Filter Time Constant</i> |
| par. 20-79 <i>PID Auto Tuning</i> | par. 20-70 <i>Closed-loop Type</i> | par. 6-17 <i>Terminal 53 Live Zero</i> |
| | par. 20-71 <i>Tuning Mode</i> | par. 6-20 <i>Terminal 54 Low Voltage</i> |
| | par. 20-72 <i>PID Output Change</i> | par. 6-21 <i>Terminal 54 High Voltage</i> |
| | par. 20-73 <i>Minimum Feedback Level</i> | par. 6-22 <i>Terminal 54 Low Current</i> |
| | par. 20-74 <i>Maximum Feedback Level</i> | par. 6-23 <i>Terminal 54 High Current</i> |
| | par. 20-79 <i>PID Auto Tuning</i> | par. 6-24 <i>Terminal 54 Low Ref./Feedb. Value</i> |
| | | par. 6-25 <i>Terminal 54 High Ref./Feedb. Value</i> |
| | | par. 6-26 <i>Terminal 54 Filter Time Constant</i> |
| | | par. 6-27 <i>Terminal 54 Live Zero</i> |
| | | par. 6-00 <i>Live Zero Timeout Time</i> |
| | | par. 6-01 <i>Live Zero Timeout Function</i> |
| | | par. 4-56 <i>Warning Feedback Low</i> |
| | | par. 4-57 <i>Warning Feedback High</i> |
| | | par. 20-20 <i>Feedback Function</i> |
| | | par. 20-21 <i>Setpoint 1</i> |
| | | par. 20-22 <i>Setpoint 2</i> |
| | | par. 20-81 <i>PID Normal/ Inverse Control</i> |
| | | par. 20-82 <i>PID Start Speed [RPM]</i> |
| | | par. 20-83 <i>PID Start Speed [Hz]</i> |
| | | par. 20-93 <i>PID Proportional Gain</i> |
| | | par. 20-94 <i>PID Integral Time</i> |
| | | par. 20-70 <i>Closed-loop Type</i> |
| | | par. 20-71 <i>Tuning Mode</i> |
| | | par. 20-72 <i>PID Output Change</i> |
| | | par. 20-73 <i>Minimum Feedback Level</i> |
| | | par. 20-74 <i>Maximum Feedback Level</i> |
| | | par. 20-79 <i>PID Auto Tuning</i> |

| Q3-4 Application Settings | | |
|--|---|--|
| Q3-40 Fan Functions | Q3-41 Pump Functions | Q3-42 Compressor Functions |
| par. 22-60 <i>Broken Belt Function</i> | par. 22-20 <i>Low Power Auto Set-up</i> | par. 1-03 <i>Torque Characteristics</i> |
| par. 22-61 <i>Broken Belt Torque</i> | par. 22-21 <i>Low Power Detection</i> | par. 1-71 <i>Start Delay</i> |
| par. 22-62 <i>Broken Belt Delay</i> | par. 22-22 <i>Low Speed Detection</i> | par. 22-75 <i>Short Cycle Protection</i> |
| par. 4-64 <i>Semi-Auto Bypass Set-up</i> | par. 22-23 <i>No-Flow Function</i> | par. 22-76 <i>Interval between Starts</i> |
| par. 1-03 <i>Torque Characteristics</i> | par. 22-24 <i>No-Flow Delay</i> | par. 22-77 <i>Minimum Run Time</i> |
| par. 22-22 <i>Low Speed Detection</i> | par. 22-40 <i>Minimum Run Time</i> | par. 5-01 <i>Terminal 27 Mode</i> |
| par. 22-23 <i>No-Flow Function</i> | par. 22-41 <i>Minimum Sleep Time</i> | par. 5-02 <i>Terminal 29 Mode</i> |
| par. 22-24 <i>No-Flow Delay</i> | par. 22-42 <i>Wake-up Speed [RPM]</i> | par. 5-12 <i>Terminal 27 Digital Input</i> |
| par. 22-40 <i>Minimum Run Time</i> | par. 22-43 <i>Wake-up Speed [Hz]</i> | par. 5-13 <i>Terminal 29 Digital Input</i> |
| par. 22-41 <i>Minimum Sleep Time</i> | par. 22-44 <i>Wake-up Ref./FB Difference</i> | par. 5-40 <i>Function Relay</i> |
| par. 22-42 <i>Wake-up Speed [RPM]</i> | par. 22-45 <i>Setpoint Boost</i> | par. 1-73 <i>Flying Start</i> |
| par. 22-43 <i>Wake-up Speed [Hz]</i> | par. 22-46 <i>Maximum Boost Time</i> | par. 1-86 <i>Trip Speed Low [RPM]</i> |
| par. 22-44 <i>Wake-up Ref./FB Difference</i> | par. 22-26 <i>Dry Pump Function</i> | par. 1-87 <i>Trip Speed Low [Hz]</i> |
| par. 22-45 <i>Setpoint Boost</i> | par. 22-27 <i>Dry Pump Delay</i> | |
| par. 22-46 <i>Maximum Boost Time</i> | par. 22-80 <i>Flow Compensation</i> | |
| par. 2-10 <i>Brake Function</i> | par. 22-81 <i>Square-linear Curve Approximation</i> | |
| par. 2-16 <i>AC Brake Max. Current</i> | par. 22-82 <i>Work Point Calculation</i> | |
| par. 2-17 <i>Over-voltage Control</i> | par. 22-83 <i>Speed at No-Flow [RPM]</i> | |
| par. 1-73 <i>Flying Start</i> | par. 22-84 <i>Speed at No-Flow [Hz]</i> | |
| par. 1-71 <i>Start Delay</i> | par. 22-85 <i>Speed at Design Point [RPM]</i> | |
| par. 1-80 <i>Function at Stop</i> | par. 22-86 <i>Speed at Design Point [Hz]</i> | |
| par. 2-00 <i>DC Hold/Preheat Current</i> | par. 22-87 <i>Pressure at No-Flow Speed</i> | |
| par. 4-10 <i>Motor Speed Direction</i> | par. 22-88 <i>Pressure at Rated Speed</i> | |
| | par. 22-89 <i>Flow at Design Point</i> | |
| | par. 22-90 <i>Flow at Rated Speed</i> | |
| | par. 1-03 <i>Torque Characteristics</i> | |
| | par. 1-73 <i>Flying Start</i> | |

See also *Programming Guide* for a detailed description of the Function Set-ups parameter groups.

1-00 Configuration Mode

Option:

Function:

[0] * Open-loop

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 adjustable frequency drive 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 set-ups accessed by pressing the [Quick Menu] button.



NOTE!

This parameter cannot be changed when the motor is running.



NOTE!

When set for closed-loop, the commands reversing and start reversing will not reverse the direction of the motor.

1-03 Torque Characteristics

| Option: | Function: |
|-----------------------------|---|
| [0] Compressor torque | <i>Compressor</i> [0]: For speed control of screw and scroll compressors. Provides a voltage which is optimized for a constant torque load characteristic of the motor in the entire range down to 10 Hz. |
| [1] Variable torque | <i>Variable Torque</i> [1]: For speed control of centrifugal pumps and fans. Also to be used when controlling more than one motor from the same adjustable frequency drive (multiple condenser fans or cooling tower fans, for example). Provides a voltage that is optimized for a squared torque load characteristic of the motor. |
| [2] Auto Energy Optim. CT | <i>Auto Energy Optimization Compressor</i> [2]: For optimum energy-efficient speed control of screw and scroll compressors. Provides a voltage that is optimized for a constant torque load characteristic of the motor in the entire range down to 15 Hz. In addition, the AEO feature will adapt the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimal performance, the motor power factor cos-phi must be set correctly. This value is set in par. 14-43 <i>Motor Cos-Phi</i> . The parameter has a default value that is automatically adjusted when the motor data is programmed. These settings will typically ensure optimum motor voltage but if the motor power factor cos phi requires tuning, an AMA function can be carried out using par. 1-29 <i>Automatic Motor Adaptation (AMA)</i> . It is very rarely necessary to adjust the motor power factor parameter manually. |
| [3] * Auto Energy Optim. VT | <i>Auto Energy Optimization VT</i> [3]: For optimum energy-efficient speed control of centrifugal pumps and fans. Provides a voltage that is optimized for a squared torque load characteristic of the motor. In addition, the AEO feature will adapt the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimal performance, the motor power factor cos-phi must be set correctly. This value is set in par. 14-43 <i>Motor Cos-Phi</i> . The parameter has a default value and is automatically adjusted when the motor data is programmed. These settings will typically ensure optimum motor voltage but if the motor power factor cos phi requires tuning, an AMA function can be carried out using par. 1-29 <i>Automatic Motor Adaptation (AMA)</i> . It is very rarely necessary to adjust the motor power factor parameter manually. |

1-29 Automatic Motor Adaptation (AMA)

| Option: | Function: |
|-------------------------|---|
| | The AMA function optimizes dynamic motor performance by automatically optimizing the advanced motor parameters par. 1-30 <i>Stator Resistance (Rs)</i> to par. 1-35 <i>Main Reactance (Xh)</i> while the motor is stationary. |
| [0] * Off | No function |
| [1] Enable complete AMA | performs AMA of the stator resistance R_s , the rotor resistance R_r , the stator leakage reactance X_1 , the rotor leakage reactance X_2 and the main reactance X_h . |
| [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 adjustable frequency drive 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 adjustable frequency drive is ready for operation.

Note:

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



NOTE!
It is important to set motor par. 1-2* Motor Data correctly, since these form part of the AMA algorithm. An AMA must be performed to achieve optimum dynamic motor performance. It may take up to 10 min., depending on the motor power rating.



NOTE!
Avoid generating external torque during AMA



NOTE!
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 the default setting.
This parameter cannot be adjusted while the motor is running.



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

See section Automatic Motor Adaptation - application example.

1-71 Start Delay

| Range: | Function: |
|------------------------|---|
| 0.0 s* [0.0 - 120.0 s] | The function selected in par. 1-80 Function at Stop is active in the delay period. Enter the time delay required before commencing acceleration. |

1-73 Flying Start

| Option: | Function: |
|----------------|---|
| | This function makes it possible to catch a motor that is spinning freely due to a line drop-out. When par. 1-73 Flying Start is enabled, par. 1-71 Start Delay has no function. Search direction for flying start is linked to the setting in par. 4-10 Motor Speed Direction. Clockwise [0]: Flying start search in clockwise direction. If not successful, a DC brake is carried out. Both Directions [2]: The flying start will first make a search in the direction determined by the last reference (direction). If unable to find the speed, it will search in the other direction. If not successful, a DC brake will be activated in the time set in par. 2-02 DC Braking Time. Start will then take place from 0 Hz. |
| [0] * Disabled | Select Disable [0] if this function is not required |
| [1] Enabled | Select Enable [1] to enable the adjustable frequency drive to "catch" and control a spinning motor. |

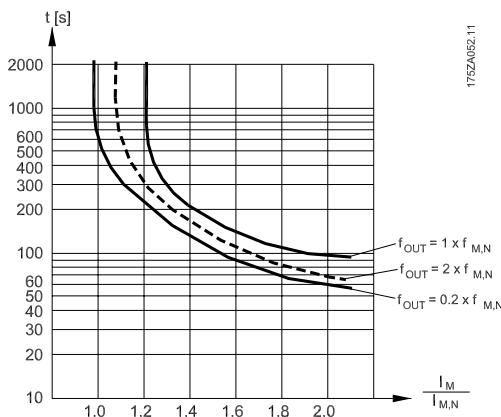
1-80 Function at Stop

| Option: | Function: |
|---------------------------|--|
| | Select the adjustable frequency drive function after a stop command or after the speed is ramped down to the settings in par. 1-81 Min Speed for Function at Stop [RPM]. |
| [0] * Coast | Leaves motor in free mode. |
| [1] DC Hold/Motor Preheat | Energizes motor with a DC holding current (see par. 2-00 DC Hold/Preheat Current). |

1-90 Motor Thermal Protection

| Option: | Function: |
|---------|---|
| | <p>The adjustable frequency drive determines the motor temperature for motor protection in two different ways:</p> <ul style="list-style-type: none">• Via a thermistor sensor connected to one of the analog or digital inputs (par. 1-93 <i>Thermistor Source</i>).• Via calculation (ETR = Electronic Thermal Relay) of the thermal load, based on the actual load and time. The calculated thermal load is compared with the rated motor current $I_{M,N}$ and the rated motor frequency $f_{M,N}$. The calculations estimate the need for a lower load at lower speed due to less cooling from the fan incorporated in the motor. |
| [0] | No protection |
| [1] | Thermistor warning |
| [2] | Thermistor trip |
| [3] | ETR warning 1 |
| [4] * | ETR trip 1 |
| [5] | ETR warning 2 |
| [6] | ETR trip 2 |
| [7] | ETR warning 3 |
| [8] | ETR trip 3 |
| [9] | ETR warning 4 |
| [10] | ETR trip 4 |

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



NOTE!

Danfoss recommends using 24 V DC as the thermistor supply voltage.

1-93 Thermistor Source

Option:

Function:

Select the input to which the thermistor (PTC sensor) should be connected. An analog input option [1] or [2] cannot be selected if the analog input is already in use as a reference source (selected in par. 3-15 *Reference 1 Source*, par. 3-16 *Reference 2 Source* or par. 3-17 *Reference 3 Source*). When using MCB112, choice [0] *None* must always be selected.

- [0] * None
- [1] Analog input 53
- [2] Analog input 54
- [3] Digital input 18
- [4] Digital input 19
- [5] Digital input 32
- [6] Digital input 33



NOTE!

This parameter cannot be adjusted while the motor is running.



NOTE!

Digital inputs should be set to "No operation" - see par. 5-1*.

2-00 DC Hold/ Preheat Current

Range:

Function:

- 50 %* [0 - 160. %]

Enter a value for holding current as a percentage of the rated motor current $I_{M,N}$ set in par. 1-24 *Motor Current*. 100% DC holding current corresponds to $I_{M,N}$. This parameter holds the motor (holding torque) or pre-heats the motor. This parameter is active if [1] DC hold/Preheat is selected in par. 1-80 *Function at Stop*.



NOTE!

The maximum value depends on the rated motor current.

NOTE!

Avoid 100% current for too long, as it may damage the motor. It may damage the motor.

2-10 Brake Function

Option:

Function:

- [0] * Off
- [1] Resistor brake
- [2] AC brake

No brake resistor installed.

Brake resistor incorporated in the system, for dissipation of surplus braking energy as heat. Connecting a brake resistor allows a higher DC link voltage during braking (generating operation). The resistor brake function is only active in adjustable frequency drives with an integral dynamic brake.

2-17 Over-voltage Control

| Option: | Function: |
|---------------|--|
| | Overvoltage control (OVC) reduces the risk of the adjustable frequency drive tripping due to an overvoltage on the DC link caused by generative power from the load. |
| [0] Disabled | No OVC required. |
| [2] * Enabled | Activates OVC. |



NOTE!
The ramp time is automatically adjusted to avoid tripping of the adjustable frequency drive.

3-02 Minimum Reference

| Range: | Function: |
|---|---|
| 0.000 Ref- [-999999.999 - par. 3-03 ReferenceFeed-ceFeedbackUnit] backUnit* | Enter the desired minimum value for the remote reference. The Minimum Reference value and unit matches the configuration choice made in par. 1-00 <i>Configuration Mode</i> and par. 20-12 <i>Reference/Feedback Unit</i> , respectively. |



NOTE!
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: | Function: |
|---|--|
| 50.000 Ref- [par. 3-02 - 999999.999 ReferenceFeed-ceFeedbackUnit] backUnit* | Enter the maximum acceptable value for the remote reference. The Maximum Reference value and unit matches the configuration choice made in par. 1-00 <i>Configuration Mode</i> and par. 20-12 <i>Reference/Feedback Unit</i> , respectively. |



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

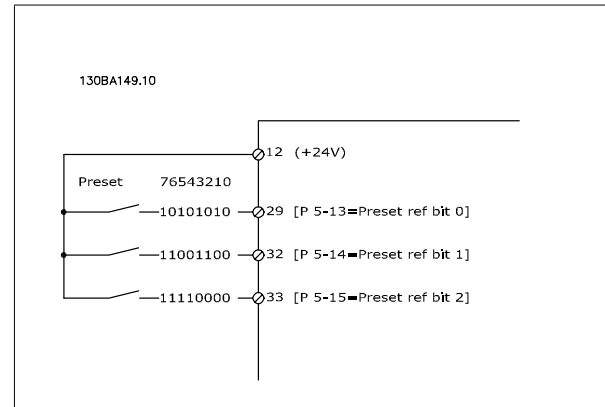
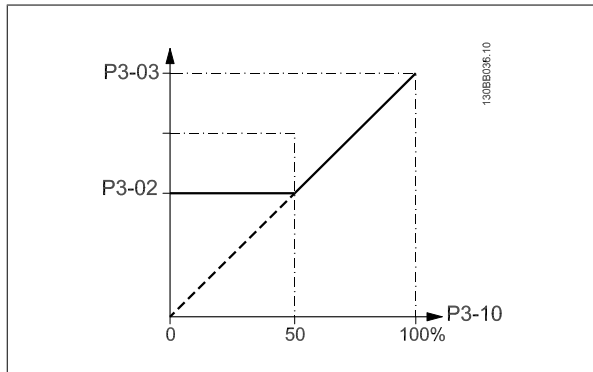
3-10 Preset Reference

Array [8]

Range:

Function:

0.00 %* [-100.00 - 100.00 %]



3-15 Reference 1 Source

Option:

Function:

Select the reference input to be used for the first reference signal. par. 3-15 *Reference 1 Source*, par. 3-16 *Reference 2 Source* and par. 3-17 *Reference 3 Source* define up to three different reference signals. The sum of these reference signals defines the actual reference.

This parameter cannot be adjusted while the motor is running.

- [0] No function
- [1] * Analog input 53
- [2] Analog input 54
- [7] Pulse input 29
- [8] Pulse input 33
- [20] Digital pot.meter
- [21] Analog input X30/11
- [22] Analog input X30/12
- [23] Analog Input X42/1
- [24] Analog Input X42/3
- [25] Analog Input X42/5
- [30] Ext. Closed-loop 1
- [31] Ext. Closed-loop 2
- [32] Ext. Closed-loop 3

3-16 Reference 2 Source

Option:

Function:

Select the reference input to be used for the second reference signal. par. 3-15 *Reference 1 Source*, par. 3-16 *Reference 2 Source* and par. 3-17 *Reference 3 Source* define up to three different reference signals. The sum of these reference signals defines the actual reference.

This parameter cannot be adjusted while the motor is running.

| | |
|--------|---------------------|
| [0] | No function |
| [1] | Analog input 53 |
| [2] | Analog input 54 |
| [7] | Pulse input 29 |
| [8] | Pulse input 33 |
| [20] * | Digital pot.meter |
| [21] | Analog input X30/11 |
| [22] | Analog input X30/12 |
| [23] | Analog Input X42/1 |
| [24] | Analog Input X42/3 |
| [25] | Analog Input X42/5 |
| [30] | Ext. Closed-loop 1 |
| [31] | Ext. Closed-loop 2 |
| [32] | Ext. Closed-loop 3 |

4-10 Motor Speed Direction

Option:

Function:

Selects the motor speed direction required.
Use this parameter to prevent unwanted reversing.

| | | |
|-------|-----------------|---|
| [0] | Clockwise | Only operation in a clockwise direction will be allowed. |
| [2] * | Both directions | Operation in both a clockwise and anti-clockwise direction will be allowed. |



NOTE!

The setting in par. 4-10 *Motor Speed Direction* has impact on the Flying Start in par. 1-73 *Flying Start*.

4-53 Warning Speed High

Range:

Function:

par. 4-13 [par. 4-52 - par. 4-13 RPM]
RPM*

Enter the n_{HIGH} value. When the motor speed exceeds this limit (n_{HIGH}), the display reads SPEED HIGH. The signal outputs can be programmed to produce a status signal on terminal 27 or 29, and on relay output 01 or 02. Program the upper signal limit of the motor speed, n_{HIGH} , within the normal working range of the adjustable frequency drive. Refer to the drawing in this section.



NOTE!

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]*.

If a different value is needed in par. 4-53 *Warning Speed High*, it must be set after programming of par. 4-13 *Motor Speed High Limit [RPM]*.

| 4-56 Warning Feedback Low | | |
|--|--|--|
| Range: | Function: | |
| -999999.99 [-999999.999 - par. 4-57 ProcessCtrlUnit] | Enter the lower feedback limit. When the feedback falls below this limit, the display reads Feedb Low. The signal outputs can be programmed to produce a status signal on terminal 27 or 29, and on relay output 01 or 02. | |

| 4-57 Warning Feedback High | | |
|---|---|--|
| Range: | Function: | |
| 999999.999 [par. 4-56 - 999999.999 ProcessCtrlUnit] | Enter the upper feedback limit. When the feedback exceeds this limit, the display reads Feedb High. The signal outputs can be programmed to produce a status signal on terminal 27 or 29, and on relay output 01 or 02. | |

| 4-64 Semi-Auto Bypass Set-up | | |
|------------------------------|--|--|
| Option: | Function: | |
| [0] * OFF | No function | |
| [1] Enabled | Starts the semi-automatic bypass set-up and continue with the procedure described above. | |

| 5-01 Terminal 27 Mode | | |
|-----------------------|--|--|
| Option: | Function: | |
| [0] * Input | Defines terminal 27 as a digital input. | |
| [1] Output | Defines terminal 27 as a digital output. | |

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

| 5-02 Terminal 29 Mode | | |
|-----------------------|--|--|
| Option: | Function: | |
| [0] * Input | Defines terminal 29 as a digital input. | |
| [1] Output | Defines terminal 29 as a digital output. | |

This parameter cannot be adjusted while the motor is running.

6.1.4 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 adjustable frequency drive. All digital inputs can be set to the following functions:

| Digital input function | Select | Terminal |
|-------------------------|--------|--------------------------|
| No operation | [0] | All *terminal 19, 32, 33 |
| Reset | [1] | All |
| Coast inverse | [2] | 27 |
| Coast and reset inverse | [3] | All |
| DC brake inverse | [5] | All |
| Stop inverse | [6] | All |
| External interlock | [7] | All |
| Start | [8] | All *terminal 18 |
| Latched start | [9] | All |
| Reversing | [10] | All |
| Start reversing | [11] | All |
| Jog | [14] | All *terminal 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 |
| Slow | [22] | All |
| Set-up select bit 0 | [23] | All |
| Set-up select bit 1 | [24] | All |
| Pulse input | [32] | terminal 29, 33 |
| Ramp bit 0 | [34] | All |
| Line failure inverse | [36] | All |
| Fire mode | [37] | All |
| Run Permissive | [52] | All |
| Hand start | [53] | All |
| Auto-start | [54] | All |
| 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] | All |
| Reset Maintenance Word | [78] | All |
| Lead Pump Start | [120] | All |
| Lead Pump Alternation | [121] | All |
| Pump 1 Interlock | [130] | All |
| Pump 2 Interlock | [131] | All |
| Pump 3 Interlock | [132] | All |

5-12 Terminal 27 Digital Input

Option:

Function:

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

[0] * No operation

5-13 Terminal 29 Digital Input

Option:

Function:

Same options and functions as par. 5-1*.

[14] * Jog

5-14 Terminal 32 Digital Input

Option:

Function:

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

[0] * No operation

5-15 Terminal 33 Digital Input

| Option: | Function: |
|-------------------------|---|
| [0] * No operation | Same options and functions as par. 5-1* Digital Inputs. |

5-40 Function Relay

Array [8]
(Relay 1 [0], Relay 2 [1]
Option MCB 105: Relay 7 [6], Relay 8 [7] and Relay 9 [8])

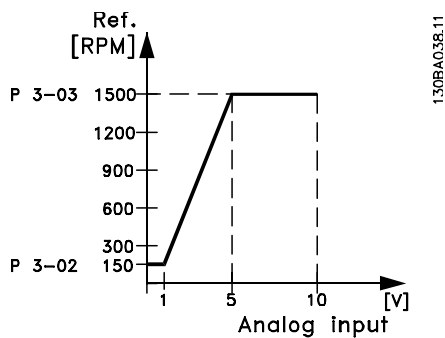
| Option: | Function: |
|-------------------------|---|
| [0] * No Operation | Array [8] (Relay 1 [0], Relay 2 [1] Option MCB 105: Relay 7 [6], Relay 8 [7] and Relay 9 [8]) |

6-00 Live Zero Timeout Time

| Range: | Function: |
|-----------------------|--|
| 10 s* [1 - 99 s] | Enter the Live Zero Timeout time period. Live Zero Timeout Time is active for analog inputs, (i.e., terminal 53 or terminal 54), allocated to current and 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 <i>Terminal 53 Low Voltage</i> , par. 6-12 <i>Terminal 53 Low Current</i> , par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period longer than the time set in par. 6-00 <i>Live Zero Timeout Time</i> , the function selected in par. 6-01 <i>Live Zero Timeout Function</i> will be activated. |

6-01 Live Zero Timeout Function

| Option: | Function: |
|------------------------|--|
| | Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i> , par. 6-12 <i>Terminal 53 Low Current</i> , par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i> . If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows: 1. par. 6-01 <i>Live Zero Timeout Function</i> 2. par. 8-04 <i>Control Timeout Function</i> The output frequency of the adjustable frequency drive can be: <ul style="list-style-type: none">• [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

| Range: | Function: |
|------------------------------|--|
| 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

| Range: | Function: |
|--------------------------------|---|
| 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

| Range: | Function: |
|---|---|
| 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

| Range: | Function: |
|--|---|
| 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> . |

6-16 Terminal 53 Filter Time Constant

| Range: | Function: |
|-----------------------------|---|
| 0.001 s* [0.001 - 10.000 s] | Enter the time constant. This is a first-order digital low pass filter time constant for suppressing electrical noise in terminal 53. A high time constant value improves damping, but also increases the time delay through the filter. This parameter cannot be adjusted while the motor is running. |

6-17 Terminal 53 Live Zero

| Option: | Function: |
|---------|--|
| | This parameter makes it possible to disable the Live Zero monitoring. For example, this is to be used if the analog outputs are used as part of a de-central I/O system (e.g., when not used as part of any adjustable frequency drive related control functions, but for feeding a building management system with data). |
| [0] | Disabled |
| [1] * | Enabled |

6-20 Terminal 54 Low Voltage**Range:**

0.07 V* [0.00 - par. 6-21 V]

Function:Enter the low voltage value. This analog input scaling value should correspond to the low reference/feedback value, set in par. 6-24 *Terminal 54 Low Ref./Feedb. Value*.**6-21 Terminal 54 High Voltage****Range:**

10.00 V* [par. 6-20 - 10.00 V]

Function:Enter the high voltage value. This analog input scaling value should correspond to the high reference/feedback value set in par. 6-25 *Terminal 54 High Ref./Feedb. Value*.**6-24 Terminal 54 Low Ref./ Feedb. Value****Range:**

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

Function:Enter the analog input scaling value that corresponds to the low voltage/low current value set in par. 6-20 *Terminal 54 Low Voltage* and par. 6-22 *Terminal 54 Low Current*.**6-25 Terminal 54 High Ref./ Feedb. Value****Range:**

100.000 N/ A* [-999999.999 - 999999.999 N/A]

Function:Enter the analog input scaling value that corresponds to the high voltage/high current value set in par. 6-21 *Terminal 54 High Voltage* and par. 6-23 *Terminal 54 High Current*.**6-26 Terminal 54 Filter Time Constant****Range:**

0.001 s* [0.001 - 10.000 s]

Function:

Enter the time constant. This is a first-order digital low pass filter time constant for suppressing electrical noise in terminal 54. A high time constant value improves damping, but also increases the time delay through the filter.

This parameter cannot be adjusted while the motor is running.

6-27 Terminal 54 Live Zero**Option:****Function:**

This parameter makes it possible to disable the Live Zero monitoring. For example, this to be used if the analog outputs are used as part of a de-central I/O system (e.g., when used not as part of any adjustable frequency drive related control functions, but for feeding a building management system with data).

[0] Disabled

[1] * Enabled

6-50 Terminal 42 Output**Option:****Function:**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 frequency : 0-100 Hz

[101] Reference : Minimum reference - Maximum reference

[102] Feedback : -200% to +200% of par. 20-14

[103] Motor current : 0 - Inverter Max. Current (par. 16-37)

[104] Torque rel to limit : 0 - Torque limit (par. 4-16)

| | | |
|-------|----------------------------|--|
| [105] | Torq relate to rated | : 0 - Motor rated torque |
| [106] | Power | : 0 - Motor rated power |
| [107] | Speed | : 0 - Speed High Limit (par. 4-13 and par. 4-14) |
| [113] | Ext. Closed-loop 1 | 0 - 100% |
| [114] | Ext. Closed-loop 2 | 0 - 100% |
| [115] | Ext. Closed-loop 3 | 0 - 100% |
| [130] | Output freq. 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.% lim 4-20 mA | :0 - Torque limit (par. 4-16) |
| [135] | Torq.% nom 4-20 mA | :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% |
| [140] | Bus ctrl. 4-20 mA | 0 - 100% |
| [141] | Bus ctrl t.o. | 0 - 100% |
| [142] | Bus ctrl 4-20mA t.o. | 0 - 100% |
| [143] | Ext. Closed-loop 1 4-20 mA | 0 - 100% |
| [144] | Ext. Closed-loop 2 4-20 mA | 0 - 100% |
| [145] | Ext. Closed-loop 3 4-20 mA | 0 - 100% |

NOTE!

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: | Function: |
|---------------------------|---|
| 0.00 %* [0.00 - 200.00 %] | Scale for the minimum output (0 or 4 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 <i>Terminal 42 Output</i> . |

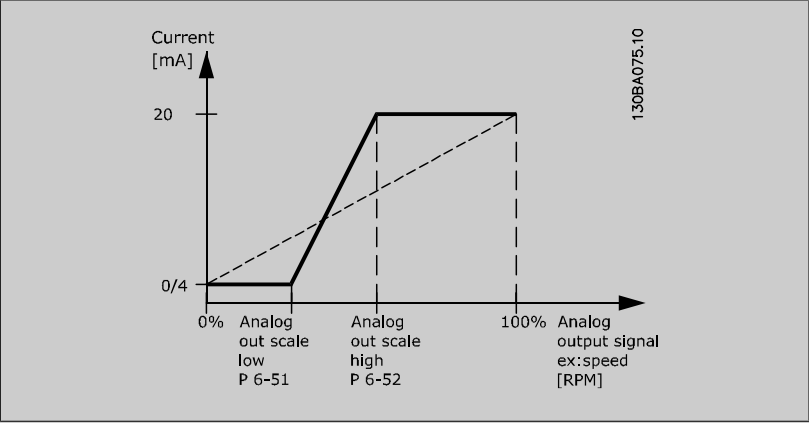
6-52 Terminal 42 Output Max Scale

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:

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

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

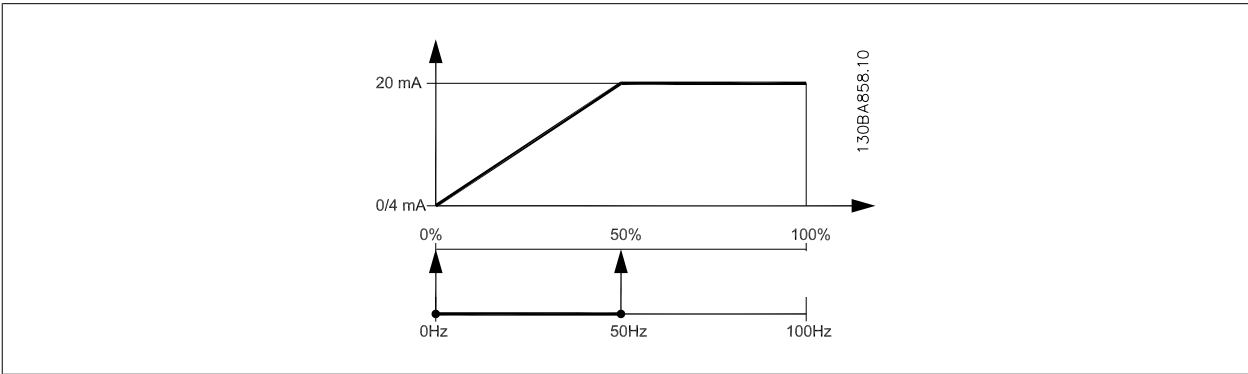
EXAMPLE 1:

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%



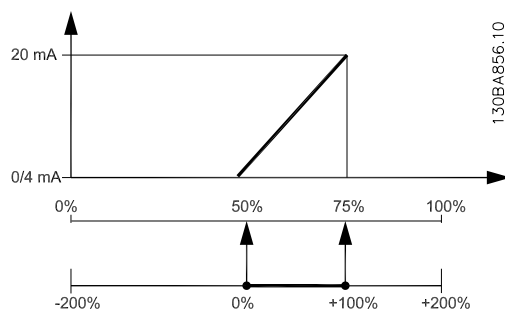
EXAMPLE 2:

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%



6

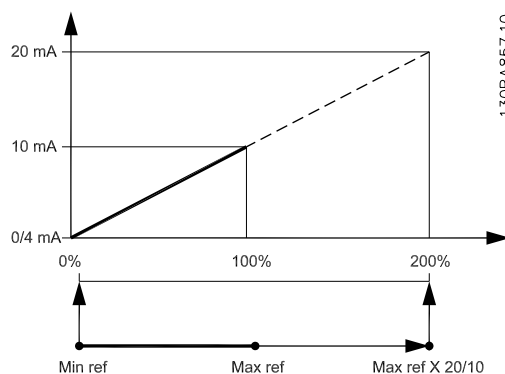
EXAMPLE 3:

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%).



14-01 Switching Frequency

Option:

Function:

Select the inverter switching frequency. Changing the switching frequency can help to reduce acoustic noise from the motor.



NOTE!

The output frequency value of the adjustable frequency drive must never exceed 1/10 of the switching frequency. When the motor is running, adjust the switching frequency in par. 14-01 *Switching Frequency* until the motor is as noiseless as possible. See also par. 14-00 *Switching Pattern* and the section *Derating*.

| | |
|-------|----------|
| [0] | 1.0 kHz |
| [1] | 1.5 kHz |
| [2] | 2.0 kHz |
| [3] | 2.5 kHz |
| [4] | 3.0 kHz |
| [5] | 3.5 kHz |
| [6] | 4.0 kHz |
| [7] * | 5.0 kHz |
| [8] | 6.0 kHz |
| [9] | 7.0 kHz |
| [10] | 8.0 kHz |
| [11] | 10.0 kHz |
| [12] | 12.0 kHz |
| [13] | 14.0 kHz |
| [14] | 16.0 kHz |

20-00 Feedback 1 Source

Option:

Function:

Up to three different feedback signals can be used to provide the feedback signal for the adjustable frequency drive's PID controller.

This parameter defines which input will be used as the source of the first feedback signal.

Analog input X30/11 and Analog input X30/12 refer to inputs on the optional general purpose I/O board.

| | |
|-------|---------------------|
| [0] | No function |
| [1] | Analog input 53 |
| [2] * | Analog input 54 |
| [3] | Pulse input 29 |
| [4] | Pulse input 33 |
| [7] | Analog input X30/11 |
| [8] | Analog input X30/12 |
| [9] | Analog Input X42/1 |
| [10] | Analog Input X42/3 |
| [11] | Analog Input X42/5 |
| [100] | Bus feedback 1 |
| [101] | Bus feedback 2 |

[102] Bus feedback 3

**NOTE!**

If a feedback is not used, its source must be set to *No Function* [0]. par. 20-20 *Feedback Function* determines how the three possible feedbacks will be used by the PID controller.

20-01 Feedback 1 Conversion

| Option: | Function: |
|-----------------------------|---|
| | This parameter allows a conversion function to be applied to Feedback 1. |
| [0] * Linear | <i>Linear</i> [0] has no effect on the feedback. |
| [1] Square root | <i>Square root</i> [1] is commonly used when a pressure sensor is used to provide flow feedback (($flow \propto \sqrt{pressure}$)). |
| [2] Pressure to temperature | <p><i>Pressure to temperature</i> [2] is used in compressor applications to provide temperature feedback using a pressure sensor. The temperature of the refrigerant is calculated using the following formula:</p> $Temperature = \frac{A2}{(\ln(Pe + 1) - A1)} - A3$ <p>where A1, A2 and A3 are refrigerant-specific constants. The refrigerant must be selected in par. 20-30 <i>Refrigerant</i>. par. 20-21 <i>Setpoint 1</i> through par. 20-23 <i>Setpoint 3</i> allow the values of A1, A2 and A3 to be entered for a refrigerant that is not listed in par. 20-30 <i>Refrigerant</i>.</p> |

20-03 Feedback 2 Source

| Option: | Function: |
|-------------------------|--|
| | See par. 20-00 <i>Feedback 1 Source</i> for details. |
| [0] * No function | |
| [1] Analog input 53 | |
| [2] Analog input 54 | |
| [3] Pulse input 29 | |
| [4] Pulse input 33 | |
| [7] Analog input X30/11 | |
| [8] Analog input X30/12 | |
| [9] Analog Input X42/1 | |
| [10] Analog Input X42/3 | |
| [11] Analog Input X42/5 | |
| [100] Bus feedback 1 | |
| [101] Bus feedback 2 | |
| [102] Bus feedback 3 | |

20-04 Feedback 2 Conversion

| Option: | Function: |
|-----------------------------|--|
| | See par. 20-01 <i>Feedback 1 Conversion</i> for details. |
| [0] * Linear | |
| [1] Square root | |
| [2] Pressure to temperature | |

20-06 Feedback 3 Source

| Option: | Function: |
|---------|--|
| | See par. 20-00 <i>Feedback 1 Source</i> for details. |

- [0] * No function
- [1] Analog input 53
- [2] Analog input 54
- [3] Pulse input 29
- [4] Pulse input 33
- [7] Analog input X30/11
- [8] Analog input X30/12
- [9] Analog Input X42/1
- [10] Analog Input X42/3
- [11] Analog Input X42/5
- [100] Bus feedback 1
- [101] Bus feedback 2
- [102] Bus feedback 3

20-07 Feedback 3 Conversion

| Option: | Function: |
|---------|--|
| | See par. 20-01 <i>Feedback 1 Conversion</i> for details. |

- [0] * Linear
- [1] Square root
- [2] Pressure to temperature

20-20 Feedback Function

| Option: | Function: |
|---------|--|
| | This parameter determines how the three possible feedbacks will be used to control the output frequency of the adjustable frequency drive. |

- [0] Sum

Sum [0] sets up the PID controller to use the sum of Feedback 1, Feedback 2 and Feedback 3 as the feedback.



NOTE!
Any unused feedbacks must be set to *No Function* in par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source*, or par. 20-06 *Feedback 3 Source*.

The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID controller's setpoint reference.

- [1] Difference

Difference [1] sets up the PID controller to use the difference between Feedback 1 and Feedback 2 as the feedback. Feedback 3 will not be used with this selection. Only Setpoint 1 will be used. The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID controller's setpoint reference.
- [2] Average

Average [2] sets up the PID controller to use the average of Feedback 1, Feedback 2 and Feedback 3 as the feedback.



NOTE!
Any unused feedbacks must be set to *No Function* in par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source*, or par. 20-06 *Feedback 3 Source*. The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID Controller's setpoint reference.

[3] * Minimum

Minimum [3] sets up the PID controller to compare Feedback 1, Feedback 2 and Feedback 3 and use the lowest value as the feedback.



NOTE!
Any unused feedbacks must be set to *No Function* in par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source*, or par. 20-06 *Feedback 3 Source*. Only setpoint 1 will be used. The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID controller's setpoint reference.

[4] Maximum

Maximum [4] sets up the PID controller to compare Feedback 1, Feedback 2 and Feedback 3 and use the highest value as the feedback.



NOTE!
Any unused feedbacks must be set to *No Function* in par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source*, or par. 20-06 *Feedback 3 Source*.

Only Setpoint 1 will be used. The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID controller's setpoint reference.

[5] Multi Setpoint Min

Multi-setpoint minimum [5] sets up the PID controller to calculate the difference between Feedback 1 and Setpoint 1, Feedback 2 and Setpoint 2, and Feedback 3 and Setpoint 3. It will use the feedback/setpoint pair in which the feedback is the farthest below its corresponding setpoint reference. If all feedback signals are above their corresponding setpoints, the PID controller will use the feedback/setpoint pair in which the difference between the feedback and setpoint is the least.



NOTE!
If only two feedback signals are used, the feedback that is not to be used must be set to *No Function* in par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source* or par. 20-06 *Feedback 3 Source*. Note that each setpoint reference will be the sum of its respective parameter value (par. 20-21 *Setpoint 1*, par. 20-22 *Setpoint 2* and par. 20-23 *Setpoint 3*) and any other references that are enabled (see par. group 3-1*).

[6] Multi Setpoint Max

Multi-setpoint maximum [6] sets up the PID controller to calculate the difference between Feedback 1 and Setpoint 1, Feedback 2 and Setpoint 2, and Feedback 3 and Setpoint 3. It will use the feedback/setpoint pair in which the feedback is farthest above its corresponding setpoint reference. If all feedback signals are below their corresponding setpoints, the PID controller will use the feedback/setpoint pair in which the difference between the feedback and the setpoint reference is the least.



NOTE!

If only two feedback signals are used, the feedback that is not to be used must be set to *No Function* in par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source* or par. 20-06 *Feedback 3 Source*. Note that each setpoint reference will be the sum of its respective parameter value (par. 20-21 *Setpoint 1*, par. 20-22 *Setpoint 2* and par. 20-23 *Setpoint 3*) and any other references that are enabled (see par. group 3-1*).



NOTE!

Any unused feedback must be set to "No function" in its Feedback Source parameter: par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source* or par. 20-06 *Feedback 3 Source*.

The feedback resulting from the function selected in par. 20-20 *Feedback Function* will be used by the PID controller to control the output frequency of the adjustable frequency drive. This feedback can also: be shown on the adjustable frequency drive's display, be used to control an adjustable frequency drive's analog output, and be transmitted over various serial communication protocols.

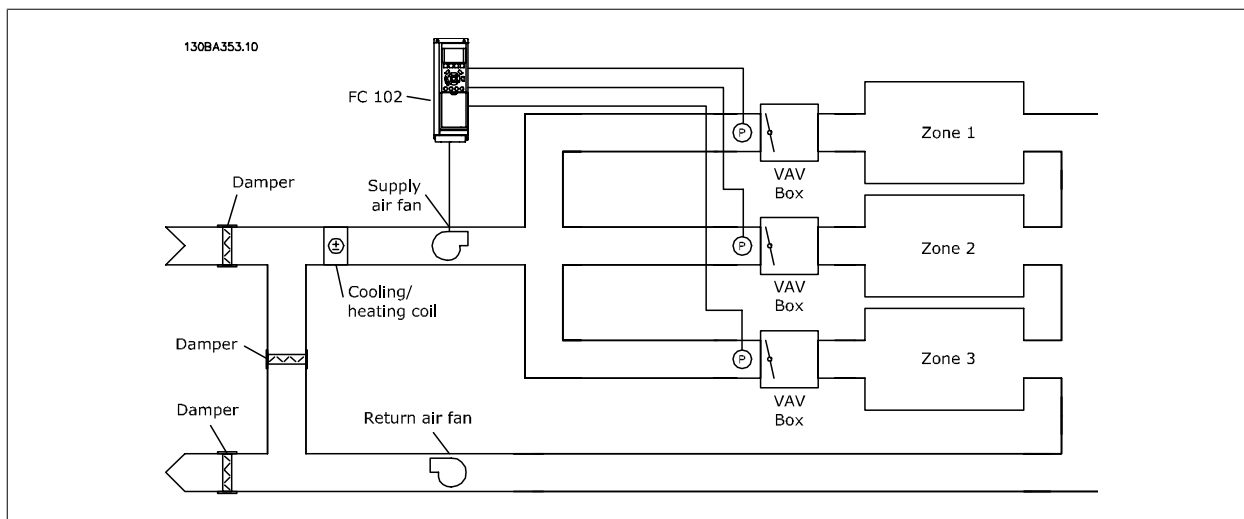
The adjustable frequency drive can be configured to handle multi-zone applications. Two different multi-zone applications are supported:

- Multi-zone, single setpoint
- Multi-zone, multi setpoint

The difference between the two is illustrated by the following examples:

Example 1: Multi-zone, single setpoint

In an office building, a VAV (variable air volume) system must ensure a minimum pressure at selected VAV boxes. Due to the varying pressure losses in each duct, the pressure at each VAV box cannot be assumed to be the same. The minimum pressure required is the same for all VAV boxes. This control method can be set up by setting par. 20-20 *Feedback Function* to option [3], Minimum, and entering the desired pressure in par. 20-21 *Setpoint 1*. The PID controller will increase the speed of the fan if any one feedback is below the setpoint, and decrease the speed of the fan if all feedbacks are above the setpoint.



Example 2: Multi-zone, multi setpoint

The previous example can be used to illustrate the use of multi-zone, multi-setpoint control. If the zones require different pressures for each VAV box, each setpoint may be specified in par. 20-21 *Setpoint 1*, par. 20-22 *Setpoint 2* and par. 20-23 *Setpoint 3*. By selecting *Multi-setpoint minimum*, [5], in par. 20-20 *Feedback Function*, the PID controller will increase the speed of the fan if any one of the feedbacks is below its setpoint and decrease the speed of the fan if all feedbacks are above their individual setpoints.

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 adjustable frequency drive's PID controller. See the description of par. 20-20 *Feedback Function*.



NOTE!

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

20-22 Setpoint 2

Range:

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

Function:

Setpoint 2 is used in closed-loop mode to enter a setpoint reference that may be used by the adjustable frequency drive's PID controller. See the description of *Feedback Function*, par. 20-20 *Feedback Function*.



NOTE!

The 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

Function:

Normal[0] causes the adjustable frequency drive'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.

[1] Inverse

Inverse[1] causes the adjustable frequency drive's output frequency to increase when the feedback is greater than the setpoint reference. This is common for temperature-controlled cooling applications, such as cooling towers.

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 that set in par. 20-14 *Maximum Reference/Feedb.*, the PID controller will try to change the output speed equal to that 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:

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

NOTE!

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.

22-21 Low Power Detection

Option:

[0] * Disabled

[1] Enabled

Function:

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:

[0] * Disabled

[1] Enabled

Function:

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:

[0] * OFF

[1] Sleep Mode

[2] Warning

[3] Alarm

Function:

Common actions for low power detection and low speed detection (Individual selections not possible).

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

The adjustable frequency drive trips and the 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 remain detected to activate signal for actions. If detection disappears before the timer runs out, 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 adjustable frequency drive trips and the motor stays stopped until reset.

22-40 Minimum Run Time

| Range: | Function: |
|-------------------|---|
| 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

| Range: | Function: |
|-------------------|--|
| 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]

| Range: | Function: |
|------------------------------------|---|
| 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). 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. Set the reference speed at which sleep mode should be canceled. |

22-60 Broken Belt Function

| Option: | Function: |
|-------------|--|
| | Selects the action to be performed if the broken belt condition is detected. |
| [0] * OFF | |
| [1] Warning | |
| [2] Trip | |

22-61 Broken Belt Torque

| Range: | Function: |
|-------------------|--|
| 10 %* [0 - 100 %] | Sets the broken belt torque as a percentage of the rated motor torque. |

22-62 Broken Belt Delay

| Range: | Function: |
|------------------|---|
| 10 s [0 - 600 s] | Sets the time for which the broken belt conditions must be active before carrying out the action selected in par. 22-60 <i>Broken Belt Function</i> . |

22-75 Short Cycle Protection

| Option: | Function: |
|----------------|---|
| [0] * Disabled | Timer set in par. 22-76 <i>Interval between Starts</i> is disabled. |
| [1] Enabled | Timer set in par. 22-76 <i>Interval between Starts</i> is enabled. |

22-76 Interval between Starts

| Range: | Function: |
|--|--|
| par. 22-77 [par. 22-77 - 3600 s] s* | Sets the time desired as the minimum time between two starts. Any normal start command (Start/Jog/Freeze) will be disregarded until the timer has expired. |

22-77 Minimum Run Time

| Range: | Function: |
|-------------------------|--|
| 0 s* [0 - par. 22-76 s] | Sets the time desired as minimum run time after a normal start command (Start/Jog/Freeze). Any normal stop command will be disregarded until the set time has expired. The timer will start counting following a normal start command (Start/Jog/Freeze). The timer will be overridden by a coast (inverse) or an external interlock command. |



NOTE!
Does not work in cascade mode.

6.1.5 Main Menu Mode

Both the GLCP and NLCP provide access to main menu mode. Select main menu mode by pressing the [Main Menu] key. Illustration 6.2 shows the resulting readout, 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.

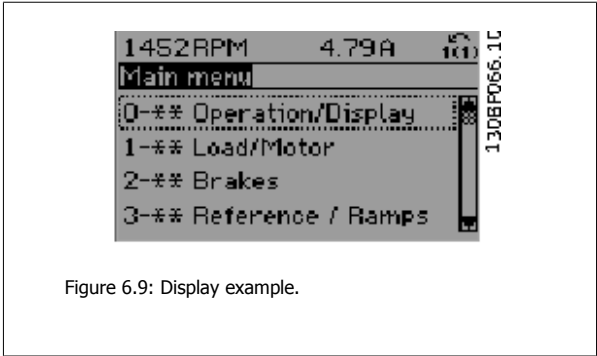


Figure 6.9: Display example.

Each parameter has a name and number which remain the same regardless of the programming mode. In 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.

6.1.6 Parameter Selection

In main menu mode, the parameters are divided into groups. Select a parameter group using 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 Ser. Com. Bus |
| 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 6.3: Parameter groups.

After selecting a parameter group, choose a parameter using the navigation keys.

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

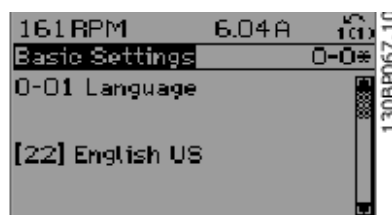


Figure 6.10: Display example.

6.1.7 Changing Data

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

6.1.8 Changing a Text Value

If the selected parameter is a text value, it can be changed by using 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].



Figure 6.11: Display example.

6.1.9 Changing a Group of Numeric Data Values

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

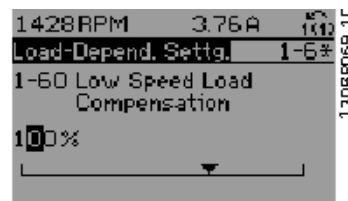


Figure 6.12: Display example.

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



Figure 6.13: Display example.

6.1.10 Changing Data Values, Step-by-Step

Certain parameters can be changed step-by-step or by an infinite number of variables. 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 using an infinite number of variables.

6.1.11 Readout 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.

6.2 Parameter lists

6.2.1 Main Menu Structure

Parameters for the adjustable frequency drive are grouped into various parameter groups for easy selection of the correct parameters for optimized operation of the adjustable frequency drive.

The vast majority of applications can be programmed using the Quick Menu button and selecting the parameters under Quick Set-up and Function Set-ups.

Descriptions and default settings of parameters may be found under the section Parameter Lists at the back of this manual.

| | |
|------------------------|--|
| 0-xx Operation/Display | 10-xx CAN Serial Communication BusAO-## Analog I/O Options |
| 1-xx Load/Motor | 11-xx LonWorks |
| 2-xx Brakes | 13-xx Smart Logic ControllerPB-## Profibus |
| 3-xx Reference/Ramps | 14-xx Special Functions |
| 4-xx Limits/ Warnings | 15-xx Adjustable Frequency Drive InformationBN-## BACnet |
| 5-xx Digital In/Out | 16-xx Data Readouts |
| 6-xx Analog In/Out | 18-xx Info & Readouts |
| 8-xx Comm. and Options | 20-xx Adjustable Frequency Drive Closed-loopLG-## Logs & I/O Opt. Status |
| 9-xx Profibus | 21-xx Ext. Closed-loop |
| | 22-xx Application Functions |
| | 23-xx Time-based Functions |
| | 24-xx Application Functions 2 |
| | 25-xx Cascade Controller |
| | 26-xx Analog I/O Option MCB 109 |

6.2.2 0- * * Operation and Display

| Par. No. # | Parameter description | Default value (SR = Size related) | 4 set-up | Change during operation | Conversion Index | Type |
|-------------------------------|----------------------------------|--------------------------------------|-------------|-------------------------|------------------|------------|
| 0-0* Basic Settings | | | | | | |
| 0-01 | Language | [0] English | 1 set-up | TRUE | - | Uint8 |
| 0-02 | Motor Speed Unit | [1] Hz | 2 set-ups | FALSE | - | Uint8 |
| 0-03 | Regional Settings | [0] International | 2 set-ups | FALSE | - | Uint8 |
| 0-04 | Operating State at Power-up | [0] Resume | All set-ups | TRUE | - | Uint8 |
| 0-05 | Local Mode Unit | [0] As Motor Speed Unit | 2 set-ups | FALSE | - | Uint8 |
| 0-1* Set-up Operations | | | | | | |
| 0-10 | Active Set-up | [1] Set-up 1 | 1 set-up | TRUE | - | Uint8 |
| 0-11 | Programming Set-up | [9] Active Set-up | All set-ups | TRUE | - | Uint8 |
| 0-12 | This Set-up Linked to | [0] Not linked | All set-ups | FALSE | - | Uint8 |
| 0-13 | Readout: Linked Set-ups | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 0-14 | Readout: Prog. Set-ups / Channel | 0 N/A | All set-ups | TRUE | 0 | Int32 |
| 0-2* LCP Display | | | | | | |
| 0-20 | Display Line 1.1 Small | 1602 | All set-ups | TRUE | - | Uint16 |
| 0-21 | Display Line 1.2 Small | 1614 | All set-ups | TRUE | - | Uint16 |
| 0-22 | Display Line 1.3 Small | 1610 | All set-ups | TRUE | - | Uint16 |
| 0-23 | Display Line 2 Large | 1613 | All set-ups | TRUE | - | Uint16 |
| 0-24 | Display Line 3 Large | 1502 | All set-ups | TRUE | - | Uint16 |
| 0-25 | My Personal Menu | ExpressionLimit | 1 set-up | TRUE | 0 | Uint16 |
| 0-3* LCP Cust. Readout | | | | | | |
| 0-30 | Custom Readout Unit | [1] % | All set-ups | TRUE | - | Uint8 |
| 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] |
| 0-4* LCP Keypad | | | | | | |
| 0-40 | [Hand on] Key on LCP | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 0-41 | [Off] Key on LCP | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 0-42 | [Auto on] Key on LCP | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 0-43 | [Reset] Key on LCP | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 0-44 | [Off/Reset] Key on LCP | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 0-45 | [Drive Bypass] Key on LCP | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 0-5* Copy/ Save | | | | | | |
| 0-50 | LCP Copy | [0] No copy | All set-ups | FALSE | - | Uint8 |
| 0-51 | Set-up Copy | [0] No copy | All set-ups | FALSE | - | Uint8 |

| Par. No. # | Parameter description | Default value (SR = Size related) | 4 set-up | Change during operation | Conversion index | Type |
|------------|--------------------------------------|--------------------------------------|-------------|-------------------------|------------------|------------|
| 0-6* | Password | | | | | |
| 0-60 | Main Menu Password | 100 N/A | 1 set-up | TRUE | 0 | Uint16 |
| 0-61 | Access to Main Menu w/o Password | [0] Full access | 1 set-up | TRUE | - | Uint8 |
| 0-65 | Personal Menu Password | 200 N/A | 1 set-up | TRUE | 0 | Uint16 |
| 0-66 | Access to Personal Menu w/o Password | [0] Full access | 1 set-up | TRUE | - | Uint8 |
| 0-7* | Clock Settings | | | | | |
| 0-70 | Set Date and Time | ExpressionLimit | All set-ups | TRUE | 0 | TimeOfDay |
| 0-71 | Date Format | null | 1 set-up | TRUE | - | Uint8 |
| 0-72 | Time Format | null | 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] |

6.2.3 1- * Load / Motor

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion Index | Type |
|----------------------------------|--------------------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 1-0* General Settings | | | | | | |
| 1-00 | Configuration Mode | null | All set-ups | TRUE | - | Uint8 |
| 1-03 | Torque Characteristics | [3] Auto Energy Optim. VT | All set-ups | TRUE | - | Uint8 |
| 1-2* Motor Data | | | | | | |
| 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 |
| 1-3* Addl. Motor Data | | | | | | |
| 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 |
| 1-5* Load-Indep. Setting | | | | | | |
| 1-50 | Motor Magnetization at Zero Speed | 100 % | All set-ups | TRUE | 0 | Uint16 |
| 1-51 | Min Speed Normal Magnetizing [RPM] | ExpressionLimit | All set-ups | TRUE | 67 | Uint16 |
| 1-52 | Min Speed Normal Magnetizing [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Uint16 |
| 1-6* Load-Depend. Settng. | | | | | | |
| 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 |
| 1-7* Start Adjustments | | | | | | |
| 1-71 | Start Delay | 0.0 s | All set-ups | TRUE | -1 | Uint16 |
| 1-73 | Flying Start | [0] Disabled | All set-ups | FALSE | - | Uint8 |
| 1-8* Stop Adjustments | | | | | | |
| 1-80 | Function at Stop | [0] Coast | All set-ups | TRUE | - | Uint8 |
| 1-81 | Min Speed for Function at Stop [RPM] | ExpressionLimit | All set-ups | TRUE | 67 | Uint16 |
| 1-82 | Min Speed for Function at Stop [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Uint16 |
| 1-86 | Trip Speed Low [RPM] | 0 RPM | All set-ups | TRUE | 67 | Uint16 |
| 1-87 | Trip Speed Low [Hz] | 0.0 Hz | All set-ups | TRUE | -1 | Uint16 |
| 1-9* Motor Temperature | | | | | | |
| 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 |

6.2.4 2- * Brakes

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|------------------------------------|-----------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 2-0* DC Brake | | | | | | |
| 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 |
| 2-1* Brake Energy Function. | | | | | | |
| 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 |

6.2.5 3- * Reference / Ramps

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion Index | Type |
|--------------------------------|---------------------------|--------------------------------------|-------------|-------------------------|------------------|-------|
| 3-0* Reference Limits | | | | | | |
| 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 | null | All set-ups | TRUE | - | UInt8 |
| 3-1* References | | | | | | |
| 3-10 | Preset Reference | 0.00 % | All set-ups | TRUE | -2 | Int16 |
| 3-11 | Jog Speed [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Int16 |
| 3-13 | Reference Site | [0] Linked to Hand / Auto | All set-ups | TRUE | - | UInt8 |
| 3-14 | Preset Relative Reference | 0.00 % | All set-ups | TRUE | -2 | Int32 |
| 3-15 | Reference 1 Source | [1] Analog input 53 | All set-ups | TRUE | - | UInt8 |
| 3-16 | Reference 2 Source | [20] Digital pot.meter | 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 | Int16 |
| 3-4* Ramp 1 | | | | | | |
| 3-41 | Ramp 1 Ramp-up Time | ExpressionLimit | All set-ups | TRUE | -2 | Int32 |
| 3-42 | Ramp 1 Ramp-down Time | ExpressionLimit | All set-ups | TRUE | -2 | Int32 |
| 3-5* Ramp 2 | | | | | | |
| 3-51 | Ramp 2 Ramp-up Time | ExpressionLimit | All set-ups | TRUE | -2 | Int32 |
| 3-52 | Ramp 2 Ramp-down Time | ExpressionLimit | All set-ups | TRUE | -2 | Int32 |
| 3-8* Other Ramps | | | | | | |
| 3-80 | Jog Ramp Time | ExpressionLimit | All set-ups | TRUE | -2 | Int32 |
| 3-81 | Quick Stop Ramp Time | ExpressionLimit | 2 set-ups | TRUE | -2 | Int32 |
| 3-9* Digital Pot. meter | | | | | | |
| 3-90 | Step Size | 0.10 % | All set-ups | TRUE | -2 | Int16 |
| 3-91 | Ramp Time | 1.00 s | All set-ups | TRUE | -2 | Int32 |
| 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 | 1.000 N/A | All set-ups | TRUE | -3 | TimD |

6.2.6 4- * Limits / Warnings

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|---------------------------|------------------------------|--------------------------------------|-------------|-------------------------|------------------|-------|
| 4-1* Motor Limits | | | | | | |
| 4-10 | Motor Speed Direction | [2] Both directions | All set-ups | FALSE | - | Unt8 |
| 4-11 | Motor Speed Low Limit [RPM] | ExpressionLimit | All set-ups | TRUE | 67 | Unt16 |
| 4-12 | Motor Speed Low Limit [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Unt16 |
| 4-13 | Motor Speed High Limit [RPM] | ExpressionLimit | All set-ups | TRUE | 67 | Unt16 |
| 4-14 | Motor Speed High Limit [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Unt16 |
| 4-16 | Torque Limit Motor Mode | 110.0 % | All set-ups | TRUE | -1 | Unt16 |
| 4-17 | Torque Limit Generator Mode | 100.0 % | All set-ups | TRUE | -1 | Unt16 |
| 4-18 | Current Limit | ExpressionLimit | All set-ups | TRUE | -1 | Unt32 |
| 4-19 | Max Output Frequency | ExpressionLimit | All set-ups | FALSE | -1 | Unt16 |
| 4-5* Adj. Warnings | | | | | | |
| 4-50 | Warning Current Low | 0.00 A | All set-ups | TRUE | -2 | Unt32 |
| 4-51 | Warning Current High | ImaxVLT (P1637) | All set-ups | TRUE | -2 | Unt32 |
| 4-52 | Warning Speed Low | 0 RPM | All set-ups | TRUE | 67 | Unt16 |
| 4-53 | Warning Speed High | outputSpeedHighLimit (P413) | All set-ups | TRUE | 67 | Unt16 |
| 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 ProcessCtrlUnit | All set-ups | TRUE | -3 | Int32 |
| 4-57 | Warning Feedback High | 999999,999 ProcessCtrlUnit | All set-ups | TRUE | -3 | Int32 |
| 4-58 | Missing Motor Phase Function | [1] On | All set-ups | TRUE | - | Unt8 |
| 4-6* Speed Bypass | | | | | | |
| 4-60 | Bypass Speed From [RPM] | ExpressionLimit | All set-ups | TRUE | 67 | Unt16 |
| 4-61 | Bypass Speed From [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Unt16 |
| 4-62 | Bypass Speed To [RPM] | ExpressionLimit | All set-ups | TRUE | 67 | Unt16 |
| 4-63 | Bypass Speed To [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Unt16 |
| 4-64 | Semi-Auto Bypass Set-up | [0] OFF | All set-ups | FALSE | - | Unt8 |

6.2.7 5- * Digital In / Out

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion Index | Type |
|------------------------------|---------------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 5-0* Digital I/O mode | | | | | | |
| 5-00 | Digital I/O Mode | [0] PNP - Active at 24 V | 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 |
| 5-1* Digital Inputs | | | | | | |
| 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 | [14] Jog | 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 |
| 5-3* Digital Outputs | | | | | | |
| 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 |
| 5-4* Relays | | | | | | |
| 5-40 | Function Relay | null | All set-ups | TRUE | - | Uint8 |
| 5-41 | On Delay, Relay | 0.01 s | All set-ups | TRUE | -2 | Uint16 |
| 5-42 | Off Delay, Relay | 0.01 s | All set-ups | TRUE | -2 | Uint16 |
| 5-5* Pulse Input | | | | | | |
| 5-50 | Term. 29 Low Frequency | 100 Hz | All set-ups | 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 |

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|----------------------------|--------------------------------------|------------------|-------------|-------------------------|------------------|--------|
| 5-6* Pulse Output | | | | | | |
| 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 |
| 5-9* Bus Controlled | | | | | | |
| 5-90 | Digital & Relay Bus Control | 0 N/A | All set-ups | TRUE | 0 | Uint32 |
| 5-93 | Pulse Out #27 Bus Control | 0.00 % | All set-ups | TRUE | -2 | N2 |
| 5-94 | Pulse Out #27 Timeout Preset | 0.00 % | 1 set-up | TRUE | -2 | Uint16 |
| 5-95 | Pulse Out #29 Bus Control | 0.00 % | All set-ups | TRUE | -2 | N2 |
| 5-96 | Pulse Out #29 Timeout Preset | 0.00 % | 1 set-up | TRUE | -2 | Uint16 |
| 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 |

6.2.8 6- * Analog In / Out

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion Index | Type |
|----------------------------------|--------------------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 6-0* Analog I / O Mode | | | | | | |
| 6-00 | Live Zero Timeout Time | 10 s | All set-ups | TRUE | 0 | Uint8 |
| 6-01 | Live Zero Timeout Function | [0] Off | All set-ups | TRUE | - | Uint8 |
| 6-02 | Fire Mode Live Zero Timeout Function | [0] Off | All set-ups | TRUE | - | Uint8 |
| 6-1* Analog Input 53 | | | | | | |
| 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 |
| 6-2* Analog Input 54 | | | | | | |
| 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 |
| 6-3* Analog Input X30/ 11 | | | | | | |
| 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 |
| 6-4* Analog Input X30/ 12 | | | | | | |
| 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 |

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|------------|--------------------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 6-5* | Analog Output 42 | | | | | |
| 6-50 | Terminal 42 Output | null | All set-ups | TRUE | - | Uint8 |
| 6-51 | Terminal 42 Output Min Scale | 0.00 % | All set-ups | TRUE | -2 | Int16 |
| 6-52 | Terminal 42 Output Max Scale | 100.00 % | All set-ups | TRUE | -2 | Int16 |
| 6-53 | Terminal 42 Output Bus Control | 0.00 % | All set-ups | TRUE | -2 | N2 |
| 6-54 | Terminal 42 Output Timeout Preset | 0.00 % | 1 set-up | TRUE | -2 | Uint16 |
| 6-6* | Analog Output X30/8 | | | | | |
| 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 |

6.2.9 8- * * Communication and Options

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion Index | Type |
|---------------------------------|------------------------------|--------------------------------------|-------------|-------------------------|------------------|------------|
| 8-0* General Settings | | | | | | |
| 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 |
| 8-1* Control Settings | | | | | | |
| 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 |
| 8-3* FC Port Settings | | | | | | |
| 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 | Max Inter-Char Delay | ExpressionLimit | 1 set-up | TRUE | -5 | UInt16 |
| 8-4* FC MC protocol set | | | | | | |
| 8-40 | Telegram selection | [1] Standard telegram 1 | 2 set-ups | TRUE | - | UInt8 |
| 8-5* Digital/ Bus | | | | | | |
| 8-50 | Coasting Select | [3] Logic OR | All set-ups | TRUE | - | UInt8 |
| 8-52 | 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 | Reverse 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 |
| 8-7* BACnet | | | | | | |
| 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 | "Startup 1 am" | [0] Send at power-up | 1 set-up | TRUE | - | UInt8 |
| 8-75 | Initialization Password | ExpressionLimit | 1 set-up | TRUE | 0 | VisStr[20] |
| 8-8* FC Port Diagnostics | | | | | | |
| 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 Count | 0 N/A | All set-ups | TRUE | 0 | UInt32 |
| 8-83 | Slave Error Count | 0 N/A | All set-ups | TRUE | 0 | UInt32 |
| 8-89 | Diagnostics Count | 0 N/A | 1 set-up | TRUE | 0 | UInt32 |
| 8-9* Bus Jog | | | | | | |
| 8-90 | Bus Jog 1 Speed | 100 RPM | All set-ups | TRUE | 67 | UInt16 |
| 8-91 | Bus Jog 2 Speed | 200 RPM | All set-ups | TRUE | 67 | UInt16 |
| 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 |

6.2.10 9- * * Profibus

| Par. No. # | Parameter description | Default value (SR = Size related) | 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 | V2 |
| 9-63 | Actual Baud Rate | [255] No baud rate found | All set-ups | TRUE | - | Uint8 |
| 9-64 | Device Identification | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-65 | Profile Number | 0 N/A | All set-ups | TRUE | 0 | OctStr[2] |
| 9-67 | Control Word 1 | 0 N/A | All set-ups | TRUE | 0 | V2 |
| 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 |

6.2.11 10- ** CAN Fieldbus

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion Index | Type |
|-------------------------------|--------------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 10-0* Common Settings | | | | | | |
| 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 |
| 10-1* DeviceNet | | | | | | |
| 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 |
| 10-2* COS Filters | | | | | | |
| 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 |
| 10-3* Parameter Access | | | | | | |
| 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 | 120 N/A | 1 set-up | TRUE | 0 | Uint16 |
| 10-39 | DeviceNet F Parameters | 0 N/A | All set-ups | TRUE | 0 | Uint32 |

6.2.12 11-* LonWorks

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|------------|-----------------------|--------------------------------------|-------------|-------------------------|------------------|-----------|
| 11-0* | LonWorks ID | | | | | |
| 11-00 | Neuron ID | 0 N/A | All set-ups | TRUE | 0 | OctStr[6] |
| 11-1* | LON Functions | | | | | |
| 11-10 | Drive Profile | [0] VSD profile | All set-ups | TRUE | - | Uint8 |
| 11-15 | LON Warning Word | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 11-17 | XIF Revision | 0 N/A | All set-ups | TRUE | 0 | VisStr[5] |
| 11-18 | LonWorks Revision | 0 N/A | All set-ups | TRUE | 0 | VisStr[5] |
| 11-2* | LON Param. Access | | | | | |
| 11-21 | Store Data Values | [0] Off | All set-ups | TRUE | - | Uint8 |

6.2.13 13- ** Smart Logic Controller

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion Index | Type |
|---------------------------|-----------------------|--------------------------------------|-------------|-------------------------|------------------|-------|
| 13-0* SLC Settings | | | | | | |
| 13-00 | SL Controller Mode | null | 2 set-ups | TRUE | - | UInt8 |
| 13-01 | Start Event | null | 2 set-ups | TRUE | - | UInt8 |
| 13-02 | Stop Event | null | 2 set-ups | TRUE | - | UInt8 |
| 13-03 | Reset SLC | [0] Do not reset SLC | All set-ups | TRUE | - | UInt8 |
| 13-1* Comparators | | | | | | |
| 13-10 | Comparator Operand | null | 2 set-ups | TRUE | - | UInt8 |
| 13-11 | Comparator Operator | null | 2 set-ups | TRUE | - | UInt8 |
| 13-12 | Comparator Value | ExpressionLimit | 2 set-ups | TRUE | -3 | Int32 |
| 13-2* Timers | | | | | | |
| 13-20 | SL Controller Timer | ExpressionLimit | 1 set-up | TRUE | -3 | TimD |
| 13-4* Logic Rules | | | | | | |
| 13-40 | Logic Rule Boolean 1 | null | 2 set-ups | TRUE | - | UInt8 |
| 13-41 | Logic Rule Operator 1 | null | 2 set-ups | TRUE | - | UInt8 |
| 13-42 | Logic Rule Boolean 2 | null | 2 set-ups | TRUE | - | UInt8 |
| 13-43 | Logic Rule Operator 2 | null | 2 set-ups | TRUE | - | UInt8 |
| 13-44 | Logic Rule Boolean 3 | null | 2 set-ups | TRUE | - | UInt8 |
| 13-5* States | | | | | | |
| 13-51 | SL Controller Event | null | 2 set-ups | TRUE | - | UInt8 |
| 13-52 | SL Controller Action | null | 2 set-ups | TRUE | - | UInt8 |

6.2.14 14-* * Special Functions

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|------------|-------------------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 14-0* | Inverter Switching | | | | | |
| 14-00 | Switching Pattern | [0] 60 AVM | 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 |
| 14-1* | Mains On/ Off | | | | | |
| 14-10 | Line Failure | [0] No function | All set-ups | FALSE | - | Uint8 |
| 14-11 | Line Voltage at Line Fault | ExpressionLimit | All set-ups | TRUE | 0 | Uint16 |
| 14-12 | Function at Mains Imbalance | [0] Trip | All set-ups | TRUE | - | Uint8 |
| 14-2* | Reset Functions | | | | | |
| 14-20 | Reset Mode | null | 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 |
| 14-3* | Current Limit Ctrl. | | | | | |
| 14-30 | Current Lim Cont, Proportional Gain | 100 % | All set-ups | FALSE | 0 | Uint16 |
| 14-31 | Current Lim Cont, Integration Time | 0.020 s | All set-ups | FALSE | -3 | Uint16 |
| 14-4* | Energy Optimizing | | | | | |
| 14-40 | VT Level | 66 % | All set-ups | FALSE | 0 | Uint8 |
| 14-41 | AEO Minimum Magnetization | ExpressionLimit | All set-ups | TRUE | 0 | Uint8 |
| 14-42 | Minimum AEO Frequency | 10 Hz | All set-ups | TRUE | 0 | Uint8 |
| 14-43 | Motor Cos-Phi | ExpressionLimit | All set-ups | TRUE | -2 | Uint16 |
| 14-5* | Environment | | | | | |
| 14-50 | RFI 1 | [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 |
| 14-6* | Auto Derate | | | | | |
| 14-60 | Function at Overtemperature | [0] Trip | All set-ups | TRUE | - | Uint8 |
| 14-61 | Function at Inverter Overload | [0] Trip | All set-ups | TRUE | - | Uint8 |
| 14-62 | Inv. Overload Derate Current | 95 % | All set-ups | TRUE | 0 | Uint16 |

6.2.15 15- ** FC Information

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|------------|-----------------------------|--------------------------------------|-------------|-------------------------|------------------|------------|
| 15-0* | Operating Data | | | | | |
| 15-00 | Operating Hours | 0 h | All set-ups | FALSE | 74 | Uint32 |
| 15-01 | Running Hours | 0 h | All set-ups | FALSE | 74 | Uint32 |
| 15-02 | kWh Counter | 0 kWh | All set-ups | FALSE | 75 | Uint32 |
| 15-03 | Power-ups | 0 N/A | All set-ups | FALSE | 0 | Uint32 |
| 15-04 | Over Temps | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 15-05 | Over Volts | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 15-06 | Reset kWh Counter | [0] Do not reset | All set-ups | TRUE | - | Uint8 |
| 15-07 | Reset Running Hours Counter | [0] Do not reset | All set-ups | TRUE | - | Uint8 |
| 15-08 | Number of Starts | 0 N/A | All set-ups | FALSE | 0 | Uint32 |
| 15-1* | Data Log Settings | | | | | |
| 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 |
| 15-2* | Historic Log | | | | | |
| 15-20 | Historic Log: Event | 0 N/A | All set-ups | FALSE | 0 | Uint8 |
| 15-21 | Historic Log: Value | 0 N/A | All set-ups | FALSE | 0 | Uint32 |
| 15-22 | Historic Log: Time | 0 ms | All set-ups | FALSE | -3 | Uint32 |
| 15-23 | Historic Log: Date and Time | ExpressionLimit | All set-ups | FALSE | 0 | TimeOfDay |
| 15-3* | Alarm Log | | | | | |
| 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 |
| 15-4* | Drive Identification | | | | | |
| 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 | Adj Freq Dr 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 Num. | 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 | Adj Freq Dr Serial No. | 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 (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|------------|---------------------------|--------------------------------------|-------------|-------------------------|------------------|------------|
| 15-6* | Option Ident | | | | | |
| 15-60 | Option Mounted | 0 N/A | All set-ups | FALSE | 0 | VisStr[30] |
| 15-61 | Option SW Version | 0 N/A | All set-ups | FALSE | 0 | VisStr[20] |
| 15-62 | Option Ordering No | 0 N/A | All set-ups | FALSE | 0 | VisStr[8] |
| 15-63 | Option Serial No | 0 N/A | All set-ups | FALSE | 0 | VisStr[18] |
| 15-70 | Option in Slot A | 0 N/A | All set-ups | FALSE | 0 | VisStr[30] |
| 15-71 | Slot A Option SW Version | 0 N/A | All set-ups | FALSE | 0 | VisStr[20] |
| 15-72 | Option in Slot B | 0 N/A | All set-ups | FALSE | 0 | VisStr[30] |
| 15-73 | Slot B Option SW Version | 0 N/A | All set-ups | FALSE | 0 | VisStr[20] |
| 15-74 | Option in Slot C0 | 0 N/A | All set-ups | FALSE | 0 | VisStr[30] |
| 15-75 | Slot C0 Option SW Version | 0 N/A | All set-ups | FALSE | 0 | VisStr[20] |
| 15-76 | Option in Slot C1 | 0 N/A | All set-ups | FALSE | 0 | VisStr[30] |
| 15-77 | Slot C1 Option SW Version | 0 N/A | All set-ups | FALSE | 0 | VisStr[20] |
| 15-9* | Parameter Info | | | | | |
| 15-92 | Defined Parameters | 0 N/A | All set-ups | FALSE | 0 | Unit16 |
| 15-93 | Modified Parameters | 0 N/A | All set-ups | FALSE | 0 | Unit16 |
| 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 | Unit16 |

6.2.16 16- ** Data Readouts

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion Index | Type |
|--------------------------------|-----------------------|--------------------------------------|-------------|-------------------------|------------------|-------|
| 16-0* General Status | | | | | | |
| 16-00 | Control Word | 0 N/A | All set-ups | FALSE | 0 | V2 |
| 16-01 | Reference [Unit] | 0.000 ReferenceFeedbackUnit | All set-ups | FALSE | -3 | Int32 |
| 16-02 | Reference % | 0.0 % | All set-ups | FALSE | -1 | Int16 |
| 16-03 | Status Word | 0 N/A | All set-ups | FALSE | 0 | V2 |
| 16-05 | Main Actual Value [%] | 0.00 % | All set-ups | FALSE | -2 | N2 |
| 16-09 | Custom Readout | 0.00 CustomReadoutUnit | All set-ups | FALSE | -2 | Int32 |
| 16-1* Motor Status | | | | | | |
| 16-10 | Power [kW] | 0.00 kW | All set-ups | FALSE | 1 | Int32 |
| 16-11 | Power [hp] | 0.00 hp | All set-ups | FALSE | -2 | Int32 |
| 16-12 | Motor voltage | 0.0 V | All set-ups | FALSE | -1 | Int16 |
| 16-13 | Frequency | 0.0 Hz | All set-ups | FALSE | -1 | Int16 |
| 16-14 | Motor Current | 0.00 A | All set-ups | FALSE | -2 | Int32 |
| 16-15 | Frequency [%] | 0.00 % | All set-ups | FALSE | -2 | N2 |
| 16-16 | Torque [Nm] | 0.0 Nm | All set-ups | FALSE | -1 | Int32 |
| 16-17 | Speed [RPM] | 0 RPM | All set-ups | FALSE | 67 | Int32 |
| 16-18 | Motor Thermal | 0 % | All set-ups | FALSE | 0 | Int8 |
| 16-22 | Torque [%] | 0 % | All set-ups | FALSE | 0 | Int16 |
| 16-3* Drive Status | | | | | | |
| 16-30 | DC Link Voltage | 0 V | All set-ups | FALSE | 0 | Int16 |
| 16-32 | Brake Energy /s | 0.000 kW | All set-ups | FALSE | 0 | Int32 |
| 16-33 | Brake Energy /2 min | 0.000 kW | All set-ups | FALSE | 0 | Int32 |
| 16-34 | Heatsink Temp. | 0 °C | All set-ups | FALSE | 100 | Int8 |
| 16-35 | Inverter Thermal | 0 % | All set-ups | FALSE | 0 | Int8 |
| 16-36 | Inv. Nom. Current | ExpressionLimit | All set-ups | FALSE | -2 | Int32 |
| 16-37 | Inv. Max. Current | ExpressionLimit | All set-ups | FALSE | -2 | Int32 |
| 16-38 | SL Controller State | 0 N/A | All set-ups | FALSE | 0 | Int8 |
| 16-39 | Control Card Temp. | 0 °C | All set-ups | FALSE | 100 | Int8 |
| 16-40 | Logging Buffer Full | [0] No | All set-ups | TRUE | - | Int8 |
| 16-5* Ref. & Feedb. | | | | | | |
| 16-50 | External Reference | 0.0 N/A | All set-ups | FALSE | -1 | Int16 |
| 16-52 | Feedback [Unit] | 0.000 ProcessCtrlUnit | All set-ups | FALSE | -3 | Int32 |
| 16-53 | Digi Pot Reference | 0.00 N/A | All set-ups | FALSE | -2 | Int16 |
| 16-54 | Feedback 1 [Unit] | 0.000 ProcessCtrlUnit | All set-ups | FALSE | -3 | Int32 |
| 16-55 | Feedback 2 [Unit] | 0.000 ProcessCtrlUnit | All set-ups | FALSE | -3 | Int32 |
| 16-56 | Feedback 3 [Unit] | 0.000 ProcessCtrlUnit | All set-ups | FALSE | -3 | Int32 |
| 16-58 | PID Output [%] | 0.0 % | All set-ups | TRUE | -1 | Int16 |

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|------------|----------------------------|--------------------------------------|-------------|-------------------------|------------------|-------|
| 16-6* | Inputs & Outputs | | | | | |
| 16-60 | Digital Input | 0 N/A | All set-ups | FALSE | 0 | Unt16 |
| 16-61 | Terminal 53 Switch Setting | [0] Current | All set-ups | FALSE | - | Unt8 |
| 16-62 | Analog Input 53 | 0.000 N/A | All set-ups | FALSE | -3 | Int32 |
| 16-63 | Terminal 54 Switch Setting | [0] Current | All set-ups | FALSE | - | Unt8 |
| 16-64 | Analog Input 54 | 0.000 N/A | All set-ups | FALSE | -3 | Int32 |
| 16-65 | Analog Output 42 [mA] | 0.000 N/A | All set-ups | FALSE | -3 | Int16 |
| 16-66 | Digital Output [bin] | 0 N/A | All set-ups | FALSE | 0 | Int16 |
| 16-67 | Pulse Input #29 [Hz] | 0 N/A | All set-ups | FALSE | 0 | Int32 |
| 16-68 | Pulse Input #33 [Hz] | 0 N/A | All set-ups | FALSE | 0 | Int32 |
| 16-69 | Pulse Output #27 [Hz] | 0 N/A | All set-ups | FALSE | 0 | Int32 |
| 16-70 | Pulse Output #29 [Hz] | 0 N/A | All set-ups | FALSE | 0 | Int32 |
| 16-71 | Relay Output [bin] | 0 N/A | All set-ups | FALSE | 0 | Int16 |
| 16-72 | Counter A | 0 N/A | All set-ups | TRUE | 0 | Int32 |
| 16-73 | Counter B | 0 N/A | All set-ups | TRUE | 0 | Int32 |
| 16-75 | Analog In X30/11 | 0.000 N/A | All set-ups | FALSE | -3 | Int32 |
| 16-76 | Analog In X30/12 | 0.000 N/A | All set-ups | FALSE | -3 | Int32 |
| 16-77 | Analog Out X30/8 [mA] | 0.000 N/A | All set-ups | FALSE | -3 | Int16 |
| 16-8* | Fieldbus & FC Port | | | | | |
| 16-80 | Fieldbus CTW 1 | 0 N/A | All set-ups | FALSE | 0 | V2 |
| 16-82 | Fieldbus REF 1 | 0 N/A | All set-ups | FALSE | 0 | N2 |
| 16-84 | Comm. Option Status | 0 N/A | All set-ups | FALSE | 0 | V2 |
| 16-85 | FC Port CTW 1 | 0 N/A | All set-ups | FALSE | 0 | V2 |
| 16-86 | FC Port REF 1 | 0 N/A | All set-ups | FALSE | 0 | N2 |
| 16-9* | Diagnosis Readouts | | | | | |
| 16-90 | Alarm Word | 0 N/A | All set-ups | FALSE | 0 | Unt32 |
| 16-91 | Alarm word 2 | 0 N/A | All set-ups | FALSE | 0 | Unt32 |
| 16-92 | Warning Word | 0 N/A | All set-ups | FALSE | 0 | Unt32 |
| 16-93 | Warning word 2 | 0 N/A | All set-ups | FALSE | 0 | Unt32 |
| 16-94 | Ext. Status Word | 0 N/A | All set-ups | FALSE | 0 | Unt32 |
| 16-95 | Ext. Status Word 2 | 0 N/A | All set-ups | FALSE | 0 | Unt32 |
| 16-96 | Maintenance Word | 0 N/A | All set-ups | FALSE | 0 | Unt32 |

6.2.17 18- * * Info & Readouts

| Par. No. # | Parameter description | Default value (SR = Size related) | 4 set-up | Change during operation | Conversion index | Type |
|------------|--------------------------------|--------------------------------------|-------------|-------------------------|------------------|-----------|
| 18-0* | Maintenance Log | | | | | |
| 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 |
| 18-1* | Fire Mode Log | | | | | |
| 18-10 | Fire Mode Log: Event | 0 N/A | All set-ups | FALSE | 0 | Uint8 |
| 18-11 | Fire Mode Log: Time | 0 s | All set-ups | FALSE | 0 | Uint32 |
| 18-12 | Fire Mode Log: Date and Time | ExpressionLimit | All set-ups | FALSE | 0 | TimeOfDay |
| 18-3* | Inputs & Outputs | | | | | |
| 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 |

6.2.18 20-* FC Closed-loop

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|------------|-----------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 20-0* | Feedback | | | | | |
| 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 |
| 20-13 | Minimum Reference/Feedb. | 0.000 ProcessCtrlUnit | All set-ups | TRUE | -3 | Int32 |
| 20-14 | Maximum Reference/Feedb. | 100.000 ProcessCtrlUnit | All set-ups | TRUE | -3 | Int32 |
| 20-2* | Feedback & Setpoint | | | | | |
| 20-20 | Feedback Function | [3] Minimum | 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 |
| 20-3* | Feedback Adv. Conv. | | | | | |
| 20-30 | Refrigerant | [0] R22 | All set-ups | TRUE | - | Uint8 |
| 20-31 | User-defined Refrigerant A1 | 10.0000 N/A | All set-ups | TRUE | -4 | Uint32 |
| 20-32 | User-defined Refrigerant A2 | -2250.00 N/A | All set-ups | TRUE | -2 | Int32 |
| 20-33 | User-defined Refrigerant A3 | 250.000 N/A | All set-ups | TRUE | -3 | Uint32 |
| 20-7* | PID Auto Tuning | | | | | |
| 20-70 | Closed-loop Type | [0] Auto | 2 set-ups | TRUE | - | Uint8 |
| 20-71 | Tuning Mode | [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 Auto Tuning | [0] Disabled | All set-ups | TRUE | - | Uint8 |
| 20-8* | PID Basic Settings | | | | | |
| 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 |
| 20-9* | PID Controller | | | | | |
| 20-91 | PID Anti Windup | [1] On | All set-ups | TRUE | - | Uint8 |
| 20-93 | PID Proportional Gain | 0.50 N/A | All set-ups | TRUE | -2 | Uint16 |
| 20-94 | PID Integral Time | 20.00 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 |

6.2.19 21-** Ext. Closed-loop

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion Index | Type |
|------------|-------------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 21-0* | Ext. PID Auto-tuning | | | | | |
| 21-00 | Closed-loop Type | [0] Auto | 2 set-ups | TRUE | - | Uint8 |
| 21-01 | Tuning Mode | [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 |
| 21-1* | Ext. CL 1 Ref. / Fb. | | | | | |
| 21-10 | Ext. 1 Ref./Feedback Unit | [1] % | 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 |
| 21-2* | Ext. CL 1 PID | | | | | |
| 21-20 | Ext. 1 Normal/Inverse Control | [0] Normal | All set-ups | TRUE | - | Uint8 |
| 21-21 | Ext. 1 Proportional Gain | 0.01 N/A | All set-ups | TRUE | -2 | Uint16 |
| 21-22 | Ext. 1 Integral Time | 10000.00 s | All set-ups | TRUE | -2 | Int32 |
| 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 |
| 21-3* | Ext. CL 2 Ref. / Fb. | | | | | |
| 21-30 | Ext. 2 Ref./Feedback Unit | [1] % | 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 |
| 21-4* | Ext. CL 2 PID | | | | | |
| 21-40 | Ext. 2 Normal/Inverse Control | [0] Normal | All set-ups | TRUE | - | Uint8 |
| 21-41 | Ext. 2 Proportional Gain | 0.01 N/A | All set-ups | TRUE | -2 | Uint16 |
| 21-42 | Ext. 2 Integral Time | 10000.00 s | All set-ups | TRUE | -2 | Int32 |
| 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 (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|------------------------------|-------------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 21-5* Ext. 1. CL 3 Ref./ Fb. | | | | | | |
| 21-50 | Ext. 3 Ref./Feedback Unit | [1] % | 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 |
| 21-6* Ext. 1. CL 3 PID | | | | | | |
| 21-60 | Ext. 3 Normal/Inverse Control | [0] Normal | All set-ups | TRUE | - | Uint8 |
| 21-61 | Ext. 3 Proportional Gain | 0.01 N/A | All set-ups | TRUE | -2 | Uint16 |
| 21-62 | Ext. 3 Integral Time | 10000.00 s | All set-ups | TRUE | -2 | Int32 |
| 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 |

6.2.20 22- ** Application Functions

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion Index | Type |
|------------------------------------|----------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 22-0* Miscellaneous | | | | | | |
| 22-00 | External Interlock Delay | 0 s | All set-ups | TRUE | 0 | Uint16 |
| 22-2* No-Flow Detection | | | | | | |
| 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 |
| 22-3* No-Flow Power Tuning | | | | | | |
| 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 |
| 22-4* Sleep Mode | | | | | | |
| 22-40 | Minimum Run Time | 10 s | All set-ups | TRUE | 0 | Uint16 |
| 22-41 | Minimum Sleep Time | 10 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 |
| 22-5* End of Curve | | | | | | |
| 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 |
| 22-6* Broken Belt Detection | | | | | | |
| 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 |

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|------------|-----------------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 22-7* | Short Cycle Protection | | | | | |
| 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 |
| 22-8* | Flow Compensation | | | | | |
| 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 | 99999,999 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 |

6.2.21 23- ** Time-based Functions

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|------------|---------------------------|--------------------------------------|-------------|-------------------------|------------------|-----------------|
| 23-0* | Timed Actions | | | | | |
| 23-00 | ON Time | ExpressionLimit | 2 set-ups | TRUE | 0 | TimeOfDayWoDate |
| 23-01 | ON Action | [0] DISABLED | 2 set-ups | TRUE | - | Uint8 |
| 23-02 | OFF Time | ExpressionLimit | 2 set-ups | TRUE | 0 | TimeOfDayWoDate |
| 23-03 | OFF Action | [0] DISABLED | 2 set-ups | TRUE | - | Uint8 |
| 23-04 | Occurrence | [0] All days | 2 set-ups | TRUE | - | Uint8 |
| 23-1* | Maintenance | | | | | |
| 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 |
| 23-1* | Maintenance Reset | | | | | |
| 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] |
| 23-5* | Energy Log | | | | | |
| 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 |
| 23-6* | Trending | | | | | |
| 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 |
| 23-8* | Payback Counter | | | | | |
| 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 |

6.2.22 24-* Application Functions 2

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|------------|----------------------------|--------------------------------------|-------------|-------------------------|------------------|--------|
| 24-0* | Fire Mode | | | | | |
| 24-00 | Fire Mode Function | [0] Disabled | 2 set-ups | TRUE | - | Uint8 |
| 24-01 | Fire Mode Configuration | [0] Open-loop | All set-ups | TRUE | - | Uint8 |
| 24-02 | Fire Mode Unit | null | All set-ups | TRUE | - | Uint8 |
| 24-03 | Fire Mode Min Reference | ExpressionLimit | All set-ups | TRUE | -3 | Int32 |
| 24-04 | Fire Mode Max Reference | ExpressionLimit | All set-ups | TRUE | -3 | Int32 |
| 24-05 | Fire Mode Preset Reference | 0.00 % | All set-ups | TRUE | -2 | Int16 |
| 24-06 | Fire Mode Reference Source | [0] No function | All set-ups | TRUE | - | Uint8 |
| 24-07 | Fire Mode Feedback Source | [0] No function | All set-ups | TRUE | - | Uint8 |
| 24-09 | Fire Mode Alarm Handling | [1] Trip at Critical Alarms | 2 set-ups | FALSE | - | Uint8 |
| 24-1* | Drive Bypass | | | | | |
| 24-10 | Bypass Function | [0] Disabled | 2 set-ups | TRUE | - | Uint8 |
| 24-11 | Bypass Delay Time | 0 s | 2 set-ups | TRUE | 0 | Uint16 |

6.2.23 25- ** Cascade Controller

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion index | Type |
|-----------------------------------|-----------------------------|--------------------------------------|-------------|-------------------------|------------------|-----------------|
| 25-0* System Settings | | | | | | |
| 25-00 | Cascade Controller | [0] Disabled | 2 set-ups | FALSE | - | Uint8 |
| 25-02 | Motor Start | [0] Direct on Line | 2 set-ups | FALSE | - | Uint8 |
| 25-04 | Pump Cycling | [0] Disabled | All set-ups | TRUE | - | Uint8 |
| 25-05 | Fixed Lead Pump | [1] Yes | 2 set-ups | FALSE | - | Uint8 |
| 25-06 | Number Of Pumps | 2 N/A | 2 set-ups | FALSE | 0 | Uint8 |
| 25-2* Bandwidth Settings | | | | | | |
| 25-20 | Staging Bandwidth | 10 % | 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 De-staging 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 | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 25-28 | Stage Function Time | 15 s | All set-ups | TRUE | 0 | Uint16 |
| 25-29 | Destage Function | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 25-30 | Destage Function Time | 15 s | All set-ups | TRUE | 0 | Uint16 |
| 25-4* Staging Settings | | | | | | |
| 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 | De-staging 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 | De-staging Speed [RPM] | 0 RPM | All set-ups | TRUE | 67 | Uint16 |
| 25-47 | De-staging Speed [Hz] | 0.0 Hz | All set-ups | TRUE | -1 | Uint16 |
| 25-5* Alternation Settings | | | | | | |
| 25-50 | Lead Pump Alternation | [0] OFF | 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] |
| 25-54 | Alternation Predefined Time | ExpressionLimit | All set-ups | TRUE | 0 | TimeOfDayWoDate |
| 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 Line 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 |
|------------|-----------------------|------------------|-------------|-------------------------|------------------|------------|
| 25-8* | Status | | | | | |
| 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 | Unit8 |
| 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 | Unit32 |
| 25-85 | Relay ON Time | 0 h | All set-ups | TRUE | 74 | Unit32 |
| 25-86 | Reset Relay Counters | [0] Do not reset | All set-ups | TRUE | - | Unit8 |
| 25-9* | Service | | | | | |
| 25-90 | Pump Interlock | [0] Off | All set-ups | TRUE | - | Unit8 |
| 25-91 | Manual Alternation | 0 N/A | All set-ups | TRUE | 0 | Unit8 |

6.2.24 26- ** Analog I / O Option MCB 109

| Par. No. # | Parameter description | Default value (SR = Size related) | 4-set-up | Change during operation | Conversion Index | Type |
|------------------------------------|---------------------------------------|--------------------------------------|-------------|-------------------------|------------------|-------|
| 26-0* Analog I / O Mode | | | | | | |
| 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 |
| 26-1* Analog Input X42/ 1 | | | | | | |
| 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 | Int16 |
| 26-17 | Term. X42/1 Live Zero | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 26-2* Analog Input X42/ 3 | | | | | | |
| 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 | Int16 |
| 26-27 | Term. X42/3 Live Zero | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 26-3* Analog Input X42/ 5 | | | | | | |
| 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 | Int16 |
| 26-37 | Term. X42/5 Live Zero | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 26-4* Analog Output X42/ 7 | | | | | | |
| 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 Output Bus Control | 0.00 % | All set-ups | TRUE | -2 | N2 |
| 26-44 | Terminal X42/7 Output Timeout Preset | 0.00 % | 1 set-up | TRUE | -2 | Int16 |
| 26-5* Analog Output X42/ 9 | | | | | | |
| 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 Output Bus Control | 0.00 % | All set-ups | TRUE | -2 | N2 |
| 26-54 | Terminal X42/9 Output Timeout Preset | 0.00 % | 1 set-up | TRUE | -2 | Int16 |
| 26-6* Analog Output X42/ 11 | | | | | | |
| 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 Output Bus Control | 0.00 % | All set-ups | TRUE | -2 | N2 |
| 26-64 | Terminal X42/11 Output Timeout Preset | 0.00 % | 1 set-up | TRUE | -2 | Int16 |

7 General Specifications

Line power supply (L1, L2, L3):

| | |
|---|---|
| Supply voltage | 380–480 V $\pm 10\%$ |
| Supply voltage | 525–690 V $\pm 10\%$ |
| Supply frequency | 50/60 Hz |
| Max. imbalance temporary between line phases | 3.0% of rated supply voltage |
| True Power Factor (λ) | ≥ 0.9 nominal at rated load |
| Displacement Power Factor ($\cos\phi$) 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 the VLT AQUA Drive's nominal torque.*

Cable lengths and cross-sections:

| | |
|--|--|
| Max. motor cable length, shielded/armored | VLT AQUA Drive: 492 ft [150 m] |
| Max. motor cable length, unshielded/unarmored | VLT AQUA Drive: 984 ft [300 m] |
| Max. cross-section to motor, line power, load sharing and brake * | |
| Maximum cross-section to control terminals, rigid wire | 0.0023 in ² [1.5 mm ²]/16 AWG (2 x 0.00112 ² in [0.75 mm ²]) |
| Maximum cross-section to control terminals, flexible cable | 0.0016 in ² [1 mm ²]/18 AWG |
| Maximum cross-section to control terminals, cable with enclosed core | 0.0008 in ² [0.5 mm ²]/20 AWG |
| Minimum cross-section to control terminals | 0.00039 in ² [0.25 mm ²] |

** See Line Power Supply tables for more information!*

Digital inputs:

| | |
|----------------------------------|---|
| Programmable digital inputs | 4 (6) |
| Terminal number | 18, 19, 27 ¹⁾ , 29 ¹⁾ , 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 _i | approx. 4 k |

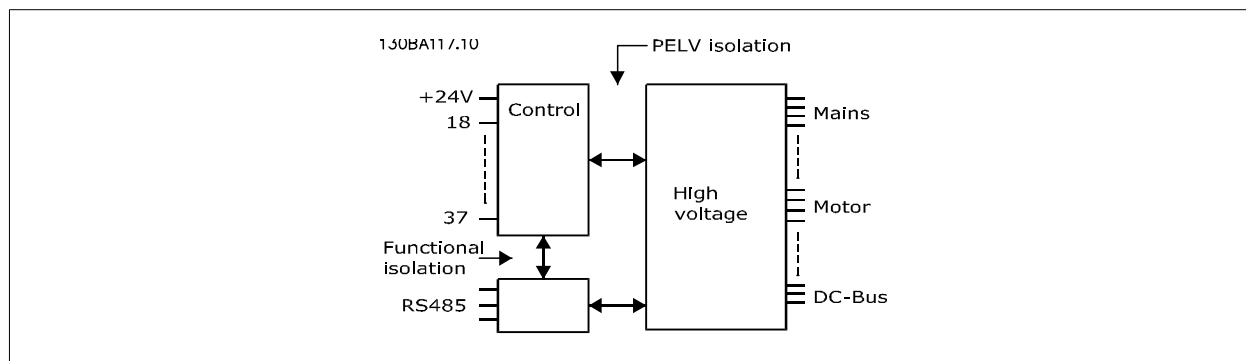
All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

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 Ω |
| Max. voltage | ± 20 V |
| Current mode | Switch S201/switch S202 = ON (I) |
| Current level | 0/4 to 20 mA (scaleable) |
| Input resistance, R_i | approx. 200 Ω |
| Max. current | 30 mA |
| Resolution for analog inputs | 10 bit (+ sign) |
| Accuracy of analog inputs | Max. error 0.5% of full scale |
| Bandwidth | : 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 Ω |
| 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 Ω |
| 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 ¹⁾ |
| Voltage level at digital/frequency output | 0–24 V |
| Max. output current (sink or source) | 40 mA |
| Max. load at frequency output | 1 kΩ |
| Max. capacitive load at frequency output | 10 nF |
| Minimum output frequency at frequency output | 0 Hz |
| Maximum output frequency at frequency output | 32 kHz |
| Accuracy of frequency output | Max. error: 0.1% of full scale |
| Resolution of frequency outputs | 12 bit |

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

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

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

1) IEC 60947 part 4 and 5

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

2) Overvoltage Category II

3) UL applications 300 V AC 2A

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 ¹⁾ |
| - with full output power, typical EFF2 motors | max. 50 ° C ¹⁾ |
| - at full continuous adjustable frequency drive output current | max. 45 ° C ¹⁾ |

¹⁾ For more information on derating see the Design Guide, section on Special Conditions.

| | |
|---|------------------------------------|
| Minimum ambient temperature during full-scale operation | 32°F [0°C] |
| Minimum ambient temperature at reduced performance | 14°F [-10°C] |
| Temperature during storage/transport | -13°–+°149/°158°F [-25°–+65°/70°C] |
| Maximum altitude above sea level without derating | 3280 ft [1000 m] |
| Maximum altitude above sea level with derating | 9842 ft [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 |
| EMC standards, Immunity | EN 61800-3, EN 61000-6-1/2, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6 |

See section on special conditions!

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 |



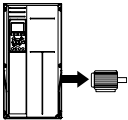
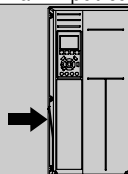
Connection to PC is carried out via a standard host/device USB cable.

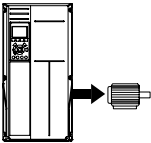
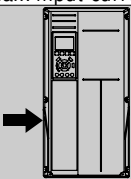
The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

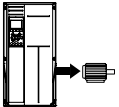
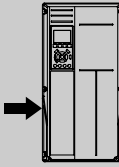
The USB connection is not galvanically isolated from protection ground. Only use an isolated laptop/PC as the connection to the USB connector on a VLT AQUA Drive or an isolated USB cable/drive.

Protection and Features:

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the adjustable frequency drive trips if the temperature reaches 203°F ± 41°F [95°C ± 5°C]. An overload temperature cannot be reset until the temperature of the heatsink is below 158°F ± 41°F [70°C ± 5°C] (Guideline - these temperatures may vary for different power sizes, enclosures, etc.). VLT AQUA Drive has an auto-derating function to prevent its heatsink reaching 203°F [95°C].
- The adjustable frequency drive is protected against short-circuits on motor terminals U, V, W.
- If a line phase is missing, the adjustable frequency drive trips or issues a warning (depending on the load).
- Monitoring of the intermediate circuit voltage ensures that the adjustable frequency drive trips if the intermediate circuit voltage is too low or too high.
- The adjustable frequency drive is protected against ground faults on motor terminals U, V, W.

| Line Power Supply 3 x 380–480 V AC | | 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 |
| | Output current | | | | | |
| | 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 |
| | Max. input current | | | | | |
| | Continuous (at 400 V) [A] | 204 | 251 | 304 | 381 | 463 |
| | Continuous (at 460/480 V) [A] | 183 | 231 | 291 | 348 | 427 |
| | Max. cable size, line power motor, brake and load share [mm ² (AWG ²)] | 2 x 70 (2 x 2/0) | 2 x 70 (2 x 2/0) | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) |
| | Max. external pre-fuses [A] ¹ | 300 | 350 | 400 | 500 | 600 |
| | Estimated power loss at rated max. load [W] ⁴ , 400 V | 3234 | 3782 | 4213 | 5119 | 5893 |
| | Estimated power loss at rated max. load [W] ⁴ , 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 ⁴ | 0.98 | | | | |
| | Output frequency | 0–800 Hz | | | | |
| | Heatsink overtemp. trip | 185°F [85°C] | 194°F [90°C] | 221°F [105°C] | 221°F [105°C] | 239°F [115°C] |
| | Power card ambient trip | 140°F [60°C] | | | | |

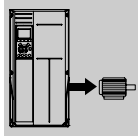
| Line Power Supply 3 x 380–480 V AC | | | | | |
|---|---|-----------------------|-----------------------|-----------------------|-----------------------|
| | | P315 | P355 | P400 | P450 |
|  | Typical Shaft output at 400 V [kW] | 315 | 355 | 400 | 450 |
| | Typical Shaft output at 460 V [HP] | 450 | 500 | 600 | 600 |
| | Enclosure IP21 | E1 | E1 | E1 | E1 |
| | Enclosure IP54 | E1 | E1 | E1 | E1 |
| | Enclosure IP00 | E2 | E2 | E2 | E2 |
| | Output current | | | | |
| | 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 |
| Max. input current | | | | | |
|  | Continuous (at 400 V) [A] | 590 | 647 | 733 | 787 |
| | Continuous (at 460/480 V) [A] | 531 | 580 | 667 | 718 |
| | Max. cable size, line power, motor and load share [mm ² (AWG ²)] | 4x240 (4x500 mcm) | 4x240 (4x500 mcm) | 4x240 (4x500 mcm) | 4x240 (4x500 mcm) |
| | Max. cable size, brake [mm ² (AWG ²)] | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) |
| | Max. external pre-fuses [A] ¹ | 700 | 900 | 900 | 900 |
| | Estimated power loss at rated max. load [W] ⁴ , 400 V | 6790 | 7701 | 8879 | 9670 |
| | Estimated power loss at rated max. load [W] ⁴ , 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 ⁴⁾ | 0.98 | | | |
| | Output frequency | 0–600 Hz | | | |
| | Heatsink overtemp. trip | 203°F [95°C] | | | |
| | Power card ambient trip | 154°F [68°C] | | | |

| Line Power Supply 3 x 380–480 V AC | | | | | | | |
|---|--|-------------------|------------|------------|------------|---------------------|------------|
| | | 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 |
|  | Output current | | | | | | |
| | 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 |
| | Max. input current | | | | | | |
| | 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 ² (AWG ²)] | 8x150 (8x300 mcm) | | | | 12x150 (12x300 mcm) | |
| | Max. cable size, line power [mm ² (AWG ²)] | 8x240 (8x500 mcm) | | | | | |
| | Max. cable size, loadsharing [mm ² (AWG ²)] | 4x120 (4x250 mcm) | | | | | |
| | Max. cable size, brake [mm ² (AWG ²)] | 4x185 (4x350 mcm) | | | | 6x185 (6x350 mcm) | |
| | Max. external pre-fuses [A] ¹ | 1600 | | 2000 | | 2500 | |
| | Est. power loss at rated max. load [W] ⁴ , 400 V, F1 & F2 | 10647 | 12338 | 13201 | 15436 | 18084 | 20358 |
| | Est. power loss at rated max. load [W] ⁴ , 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 ⁴ | 0.98 | | | | | |
| | Output frequency | 0–600 Hz | | | | | |
| | Heatsink overtemp. trip | 203°F [95°C] | | | | | |
| | Power card ambient trip | 154°F [68°C] | | | | | |

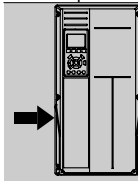
Line Power Supply 3 x 525–690 V AC

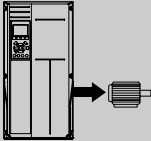
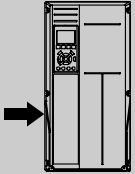
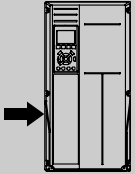
| | P45K | P55K | P75K | P90K | P110 |
|------------------------------------|------|------|------|------|------|
| Typical Shaft output at 550 V [kW] | 37 | 45 | 55 | 75 | 90 |
| Typical Shaft output at 575 V [HP] | 50 | 60 | 75 | 100 | 125 |
| Typical Shaft output at 690 V [kW] | 45 | 55 | 75 | 90 | 110 |
| Enclosure IP21 | D1 | D1 | D1 | D1 | D1 |
| Enclosure IP54 | D1 | D1 | D1 | D1 | D1 |
| Enclosure IP00 | D2 | D2 | D2 | D2 | D2 |

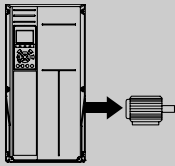
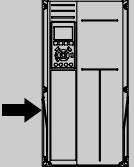
Output current

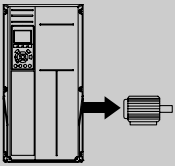
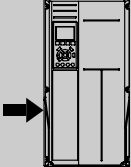
| | | | | | | |
|---|---|----|----|-----|-----|-----|
|  | Continuous (at 550 V) [A] | 56 | 76 | 90 | 113 | 137 |
| | Intermittent (60 sec overload) (at 550 V) [A] | 62 | 84 | 99 | 124 | 151 |
| | Continuous (at 575/690 V) [A] | 54 | 73 | 86 | 108 | 131 |
| | Intermittent (60 sec overload) (at 575/690 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 |
| | | | | | | |

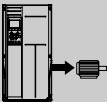
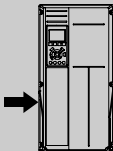
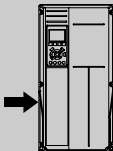
Max. input current

| | | | | | | |
|--|--|--------------|------|------|------|------|
|  | 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, line power, motor, load share and brake [mm ² (AWG)] | 2x70 (2x2/0) | | | | |
| | Max. external pre-fuses [A] ¹ | 125 | 160 | 200 | 200 | 250 |
| | Estimated power loss at rated max. load [W] ⁴ , 575 V | 1398 | 1645 | 1827 | 2157 | 2533 |
| | Estimated power loss at rated max. load [W] ⁴ , 690 V | 1458 | 1717 | 1913 | 2262 | 2662 |
| | Weight, enclosure IP21, IP 54 [kg] | 96 | | | | |
| | Weight, enclosure IP00 [kg] | 82 | | | | |
| | Efficiency ⁴ | 0.97 | 0.97 | 0.98 | 0.98 | 0.98 |
| | Output frequency | 0–600 Hz | | | | |
| | Heatsink overtemp. trip | 185°F [85°C] | | | | |
| | Power card ambient trip | 140°F [60°C] | | | | |

| Line Power Supply 3 x 525–690 V AC | | | | | |
|--|---|------------------|------------------|-----------------------|-----------------------|
| | | 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 |
| Output current | | | | | |
|  | 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 |
| | Max. input current | | | | |
| | 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, line power motor, load share and brake [mm² (AWG)] | 2 x 70 (2 x 2/0) | 2 x 70 (2 x 2/0) | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) |
| | Max. external pre-fuses [A] ₁ | 315 | 350 | 350 | 400 |
| | Estimated power loss at rated max. load [W] ⁴⁾ , 575 V | 2963 | 3430 | 4051 | 4867 |
| | Estimated power loss at rated max. load [W] ⁴⁾ , 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 ⁴⁾ | 0.98 | | | |
| | Output frequency | 0–600 Hz | | | |
| | Heatsink overtemp. trip | 185°F [85°C] | 194°F [90°C] | 230°F [110°C] | 230°F [110°C] |
|  | Power card ambient trip | 140°F [60°C] | | | |
| | | | | | |

| Line Power Supply 3 x 525–690 V AC | | | | |
|--|---|--------------------------|--------------------------|--------------------------|
| | | 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 |
| | Output current | | | |
| | 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/ 690V) [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 |
| | Max. input current | | | |
| | 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, line power, motor and load share [mm ² (AWG)] | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) | 4 x 240 (4 x 500 mcm) |
| | Max. cable size, brake [mm ² (AWG)] | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) |
| Max. external pre-fuses [A] ¹ | | 500 | 550 | 700 |
| Estimated power loss at rated max. load [W] ⁴ , 575 V | | 5493 | 5852 | 6132 |
| Estimated power loss at rated max. load [W] ⁴ , 690 V | | 5821 | 6149 | 6440 |
| Weight, enclosure IP21, IP 54 [kg] | | 151 | 165 | 263 |
| Weight, enclosure IP00 [kg] | | 138 | 151 | 221 |
| Efficiency ⁴⁾ | | 0.98 | | |
| Output frequency | | 0–600 Hz | 0–500 Hz | 0–500 Hz |
| Heatsink overtemp. trip | | 230°F [110°C] | 230°F [110°C] | 185°F [85°C] |
| Power card ambient trip | | 140°F [60°C] | 140°F [60°C] | 154°F [68°C] |

| Line Power Supply 3 x 525–690 V AC | | | | |
|--|---|-----------------------|-----------------------|-----------------------|
| | | 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 |
|  | Output current | | | |
| | 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 |
| | Max. input current | | | |
| | 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, line power, motor and load share [mm ² (AWG)] | 4x240 (4x500 mcm) | 4x240 (4x500 mcm) | 4x240 (4x500 mcm) |
| | Max. cable size, brake [mm ² (AWG)] | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) | 2 x 185 (2 x 350 mcm) |
| | Max. external pre-fuses [A] ¹ | 700 | 900 | 900 |
| | Estimated power loss at rated max. load [W] ⁴ , 575 V | 6903 | 8343 | 9244 |
| | Estimated power loss at rated max. load [W] ⁴ , 690 V | 7249 | 8727 | 9673 |
| | Weight, enclosure IP21, IP 54 [kg] | 263 | 272 | 313 |
| | Weight, enclosure IP00 [kg] | 221 | 236 | 277 |
| | Efficiency ⁴⁾ | 0.98 | | |
| | Output frequency | 0–500 Hz | | |
| | Heatsink overtemp. trip | 185°F [85°C] | | |
| | Power card ambient trip | 154°F [68°C] | | |

| Line Power Supply 3 x 525–690 V AC | | | | | | |
|---|--|-------------------|------------|------------|---------------------|------------|
| | | 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 |
| Output current | | | | | | |
|  | 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 |
| | Max. input current | | | | | |
|  | 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 ² (AWG ²)] | 8x150 (8x300 mcm) | | | 12x150 (12x300 mcm) | |
| | Max. cable size, line power [mm ² (AWG ²)] | 8x240 (8x500 mcm) | | | | |
| | Max. cable size, loadsharing [mm ² (AWG ²)] | 4x120 (4x250 mcm) | | | | |
| | Max. cable size, brake [mm ² (AWG ²)] | 4x185 (4x350 mcm) | | | 6x185 (6x350 mcm) | |
| Max. external pre-fuses [A] ¹⁾ | | 1600 | | | | 2000 |
| Est. power loss at rated max. load [W] ⁴⁾ , 575 V, F1 & F2 | | 10771 | 12272 | 13835 | 15592 | 18281 |
| Est. power loss at rated max. load [W] ⁴⁾ , 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 ⁴⁾ | | 0.98 | | | | |
| Output frequency | | 0–500 Hz | | | | |
| Heatsink overtemp. trip | | 185°F [85°C] | | | | |
| Power card amb. trip | | 154°F [68°C] | | | | |

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

2) American Wire Gauge.

3) Measured using 16.4 ft [5 m] shielded 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 adjustable frequency drive 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%).

8 Warnings and Alarms

A warning or an alarm is signaled by the relevant LED on the front of the adjustable frequency drive 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 adjustable frequency drive 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 serial communication bus.
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



NOTE!

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.

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 the table on the following page).

Alarms that are trip-locked offer additional protection, means that the line power supply must be switched off before the alarm can be reset. After being switched back on, the adjustable frequency drive 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 adjustable frequency drive. 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 | Line phase loss | (X) | (X) | (X) | 14-12 |
| 5 | DC link voltage high | X | | | |
| 6 | DC link voltage low | X | | | |
| 7 | DC overvoltage | X | X | | |
| 8 | DC undervoltage | X | X | | |
| 9 | Inverter overloaded | X | X | | |
| 10 | Motor ETR overtemperature | (X) | (X) | | 1-90 |
| 11 | Motor thermistor overtemperature | (X) | (X) | | 1-90 |
| 12 | Torque limit | X | X | | |
| 13 | Overcurrent | X | X | X | |
| 14 | Ground 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 | Drive overtemperature | 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 | Soft-charge fault | | X | X | |
| 34 | Serial communication bus fault | X | X | | |
| 35 | Out of frequency ranges | X | X | | |
| 36 | Line 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 Overtemperature | X | X | X | |
| 66 | Heatsink Temperature Low | X | | | |
| 67 | Option Configuration has Changed | | X | | |
| 68 | Safe Stop Activated | | X ¹⁾ | | |
| 69 | Pwr. Card Temp | | X | X | |
| 70 | Illegal Adjustable Frequency Drive configuration | | | X | |
| 71 | PTC 1 Safe Stop | X | X ¹⁾ | | |
| 72 | Dangerous Failure | | | X ¹⁾ | |
| 73 | Safe Stop Auto Restart | | | | |
| 79 | Illegal PS config | | X | X | |
| 80 | Drive Initialized 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 8.1: 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 8.2: 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 original event that caused an alarm cannot damage the adjustable frequency drive or cause dangerous conditions. A trip lock is an action that occurs in conjunction with an alarm, which may cause damage to the adjustable frequency drive or connected parts. A trip lock situation can only be reset by 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 | Ground Fault | Ground 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 | Overcurrent | Overcurrent | 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 undervolt | DC undervolt | Output Freq Low |
| 11 | 00000800 | 2048 | DC overvolt | DC overvolt | Brake Check OK |
| 12 | 00001000 | 4096 | Short Circuit | DC Voltage Low | Braking Max |
| 13 | 00002000 | 8192 | Soft-charge Fault | DC Voltage High | Braking |
| 14 | 00004000 | 16384 | Line ph. Loss | Line 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 | 10 V 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 | Ser. Com. Bus Fault | Ser. Com. Bus Fault | |
| 23 | 00800000 | 8388608 | 24 V Supply Low | 24V Supply Low | |
| 24 | 01000000 | 16777216 | Line failure | Line failure | |
| 25 | 02000000 | 33554432 | 1.8 V 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 Initialized | Unused | |
| 30 | 40000000 | 1073741824 | Safe Stop | Unused | |

Table 8.3: Description of Alarm Word, Warning Word and Extended Status Word

The alarm words, warning words and extended status words can be read out via serial bus or optional serial communication bus for diagnosis. See also par. 16-90 *Alarm Word*, par. 16-92 *Warning Word* and par. 16-94 *Ext. Status Word*.

8.1.1 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 Ω .

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).

Make sure 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 adjustable frequency drive. 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 line voltage imbalance is too high. This message also appears for a fault in the input rectifier on the adjustable frequency drive. Options are programmed at parameter 14-12, Function at Mains Imbalance

Troubleshooting: Check the supply voltage and supply currents to the adjustable frequency drive.

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 adjustable frequency drive 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 adjustable frequency drive is still active.

WARNING/ ALARM 7, DC overvoltage

If the intermediate circuit voltage exceeds the limit, the adjustable frequency drive 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 undervoltage

If the intermediate circuit voltage (DC) drops below the undervoltage limit, the adjustable frequency drive checks if a 24 V backup supply is connected. If no 24 V backup supply is connected, the adjustable frequency drive trips after a fixed time delay. The time delay varies with unit size.

Troubleshooting:

Make sure that the supply voltage matches the adjustable frequency drive voltage.

Perform Input voltage test

Perform soft charge and rectifier circuit test

WARNING/ ALARM 9, Inverter overloaded

The adjustable frequency drive 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 adjustable frequency drive *cannot* be reset until the counter is below 90%.

The fault is that the adjustable frequency drive 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 adjustable frequency drive 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 the motor is overheating.

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 overtemp

The thermistor or the thermistor connection is disconnected. Select whether the adjustable frequency drive should give a warning or an alarm when the counter reaches 100% in par. 1-90 *Motor Thermal Protection*.

Troubleshooting:

Check if the motor is overheating.

Check if the motor is mechanically overloaded.

Make sure 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, Overcurrent

The inverter peak current limit (approx. 200% of the rated current) is exceeded. The warning lasts about 1.5 sec. Then the adjustable frequency drive 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 adjustable frequency drive. Check if the motor shaft can be turned.

Make sure that the motor size matches the adjustable frequency drive.

Incorrect motor data in parameters 1-20 through 1-25.

ALARM 14, Ground fault

There is a discharge from the output phases to ground, either in the cable between the adjustable frequency drive and the motor or in the motor itself.

Troubleshooting:

Turn off the adjustable frequency drive and remove the ground fault.

Measure the resistance to ground of the motor leads and the motor with a megohmmeter to check for ground 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 adjustable frequency drive and remove the short circuit.

WARNING/ ALARM 17, Control word timeout

There is no communication to the adjustable frequency drive.

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 adjustable frequency drive ramps down until it trips, while giving an alarm.

Troubleshooting:

Check the connections on the serial communication cable.

Increase par. 8-03 *Control Word Timeout Time*

Check the 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 adjustable frequency drive still works, but without the brake function. Turn off the adjustable frequency drive 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 energy is higher than 90%. If *Trip [2]* has been selected in par. 2-13 *Brake Power Monitoring*, the adjustable frequency drive cuts out and issues this alarm, when the dissipated braking energy 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 adjustable frequency drive 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 adjustable frequency drive 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 adjustable frequency drive and the motor is missing.

Turn off the adjustable frequency drive and check motor phase U.

ALARM 31, Motor phase V missing

Motor phase V between the adjustable frequency drive and the motor is missing.

Turn off the adjustable frequency drive and check motor phase V.

ALARM 32, Motor phase W missing

Motor phase W between the adjustable frequency drive and the motor is missing.

Turn off the adjustable frequency drive 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 serial communication bus 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 adjustable frequency drive is lost and par. 14-10 *Line Failure* is NOT set to OFF. Check the fuses to the adjustable frequency drive

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 timeout reading EEPROM data |
| 514 | Communication timeout reading EEPROM data |
| 515 | Application Orientated Control cannot recognize the EEPROM data |
| 516 | Cannot write to EEPROM because a write command is on progress |
| 517 | Write command is under timeout |
| 518 | Failure in the EEPROM |
| 519 | Missing or invalid barcode data in EEPROM |
| 783 | Parameter value outside of min/max limits |
| 1024-1279 | A can message 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 |
| 2049 | Motor Orientated Control data not transferred correctly |
| 2064-2072 | Power data restarted |
| 2080-2088 | H081x: option in slot x has restarted |
| 2096-2104 | H082x: option in slot x has issued a power-up wait |
| 2304 | H083x: option in slot x has issued a legal power-up wait |
| 2305 | Could not read any data from power EEPROM |
| 2314 | Missing SW version from power unit |
| 2315 | Missing power unit data from power unit |
| 2316 | Missing SW version from power unit |
| 2324 | Missing io_statepage from power unit |
| 2325 | Power card configuration is determined to be incorrect at power-up |
| 2326 | A power card has stopped communicating while main power is applied |
| 2327 | Power card configuration is determined to be incorrect after the delay for power cards to register |
| 2330 | Too many power card locations have been registered as present |
| 2561 | Power size information between the power cards does not match |
| 2562 | No communication from DSP to ATACD |
| 2816 | No communication from ATACD to DSP (state running) |
| 2817 | Stack overflow control board module |
| 2818 | Scheduler slow tasks |
| 2819 | Fast tasks |
| 2820 | Parameter thread |
| 2821 | LCP Stack overflow |
| 2822 | Serial port overflow |
| 2836 | USB port overflow |
| 3072-5122 | cflistMempool to small |
| 5123 | Parameter value is outside its limits |
| 5124 | Option in slot A: Hardware incompatible with control board hardware |
| 5125 | Option in slot B: Hardware incompatible with control board hardware |
| 5126 | Option in slot C0: Hardware incompatible with control board hardware |
| 5376-6231 | Option in slot C1: Hardware incompatible with control board hardware |
| | 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, 5 V, +/-18 V. 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 AC line voltage lines, 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 resistances 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 adjustable frequency drive (via serial communication, digital I/O, or by pressing reset button on keypad).

WARNING 61, Tracking error

An error has been detected between the calculated motor speed and the speed measurement from the 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 Overtemperature

Control card overtemperature: The cut-out temperature of the control card is 176°F [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 32°F [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.

Make sure that the filters for the door fans are not blocked.

Make sure 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 setpoint 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 adjustable frequency drive type code must be restored in 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 adjustable frequency drive has a new type code.

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