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11-** LonWorks 99
13-** Smart Logic Controller 100



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# 1. How to Read this Instruction Manual



## 1.1. How to Read this Instruction Manual

### 1.1.1. How to Read this Instruction Manual

VLT® HVAC Drive FC 100 is designed to provide high shaft performance on electrical motors. Please read this manual carefully for proper use. Incorrect handling of the adjustable frequency drive may cause improper operation of the adjustable frequency drive or related equipment, shorten lifetime or cause other problems.

This Instruction Manual will help you get started, install, program, and troubleshoot your VLT® HVAC Drive FC 100.

Chapter 1, How to Read this Instruction Manual
Introduces the manual and informs you about the approvals, symbols, and abbreviations used in therein.

Chapter 2, Safety Instructions and General Warnings
Contains instructions on how to handle the FC 100 correctly.

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

Chapter 4, How to Program
Shows you how to operate and program the FC 100 via the Local Control Panel.

Chapter 5, General Specifications
Contains technical data about the FC 100.

Chapter 6, Troubleshooting
Assists you in solving problems that may occur when using the FC 100.

Available literature for VLT HVAC Drive

- Instruction Manual MG.11.Ax.yy provides the neccessary information for getting the drive up and running.
- Design Guide MG.11.Bx.yy provides all the technical information about the 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
- VLT® 6000 HVAC Application Booklet, MN.60.Ix.yy
- Instruction Manual VLT®HVAC Drive BACnet, MG.11.Dx.yy
- Instruction Manual VLT®HVAC Drive Profibus, MG.33.Cx.yy.
- Instruction Manual VLT®HVAC Drive Device Net, MG.33.Dx.yy
- Instruction Manual VLT® HVAC Drive LonWorks, MG.11.Ex.yy
- Instruction Manual VLT® HVAC Drive High Power, MG.11.Fx.yy

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- Instruction Manual VLT® HVAC Drive Metasys, MG.11.Gx.yy

x = Revision number
yy = Language code

Danfoss Drives technical literature is also available online at www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.

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

## 1.1.2. Approvals

## 1.1.3. Symbols

Symbols used in this Instruction Manual.

NOTE
Indicates something to be noted by the reader.

Indicates a general warning.

Indicates a high-voltage warning.

* Indicates a default setting


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## 1.1.4. Abbreviations

| | |
|---|---|
| Alternating current | AC |
| American wire gauge | AWG |
| Ampere/AMP | A |
| Automatic Motor Adaptation | AMA |
| Current limit | $I_{LIM}$ |
| Degrees Celsius | °C |
| Direct current | DC |
| Drive Dependent | D-TYPE |
| Electro Magnetic Compatibility | EMC |
| Electronic Thermal Relay | ETR |
| drive | FC |
| Gram | g |
| Hertz | Hz |
| Kilohertz | kHz |
| Local Control Panel | LCP |
| Meter | m |
| Millihenry Inductance | mH |
| Milliampere | mA |
| Millisecond | ms |
| Minute | min |
| Motion Control Tool | MCT |
| Nanofarad | nF |
| Newton Meters | Nm |
| Nominal motor current | $I_{M,N}$ |
| Nominal motor frequency | $f_{M,N}$ |
| Nominal motor power | $P_{M,N}$ |
| Nominal motor voltage | $U_{M,N}$ |
| Parameter | par. |
| Protective Extra Low Voltage | PELV |
| Printed Circuit Board | PCB |
| Rated Inverter Output Current | $I_{INV}$ |
| Revolutions Per Minute | RPM |
| Second | s |
| Torque limit | $T_{LIM}$ |
| Volt | V |

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# 2. Safety Instructions and General Warning



## 2.1. Safety Regulations FC 100

### 2.1.1. Disposal Instructions

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

Caution

The adjustable frequency drive DC link capacitors remain charged after power has been disconnected. To avoid the electrical shock hazard, disconnect the adjustable frequency drive from the power supply before carrying out maintenance. Before servicing the adjustable frequency drive, wait the minimum amount of time indicated below:

| | | |
|---|---|---|
| 380-480 V | 150-132 hp [110-200 kW] | 20 minutes |
| | 350-600 hp [250-450 kW] | 40 minutes |
| 525-600 V | 150-350 hp [110-250 kW] | 20 minutes |
| | 450-750 hp [315-560 kW] | 30 minutes |

VLT HVAC Drive
Software version: 2.5x

These instructions can be used for all VLT HVAC adjustable frequency drives with software version 2.5x.
The software version number can be found in parameter 15-43.

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## 2.1.2. High Voltage

The voltage of the adjustable frequency drive is dangerous whenever the adjustable frequency drive is connected to line power. Incorrect installation or operation of the motor or adjustable frequency drive may cause damage to the equipment, serious personal injury or death. The instructions in this manual must therefore be observed, in addition to applicable local and national rules and safety regulations.

Installation at high altitudes
At altitudes higher than 6,500 ft [2 km], please contact Danfoss Drives regarding PELV.

## 2.1.3. Safety Instructions

- Make sure the adjustable frequency drive is properly grounded.
- Protect users against supply voltage.
- Protect the motor against overloading in accordance with national and local regulations.
- Motor overload protection is not included in the default settings. To add this function, set parameter 1-90 *Motor thermal protection* to value *ETR trip* or *ETR warning*. For the North American market: ETR functions provide class 20 motor overload protection, in accordance with NEC.
- The 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.

## 2.1.4. 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, such as load sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic backup.
When using the adjustable frequency drive: wait at least 40 minutes.
A shorter time is allowed only if indicated on the nameplate for the specific unit.


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Leakage Current
The ground leakage current from the adjustable frequency drive exceeds 3.5 mA. To ensure that the ground cable has a good mechanical connection to the ground connection (terminal 95), the cable cross-section must be at least 0.016 in.$^2$ [10 mm$^2$] or have 2 rated ground wires 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 (x=version number).
Protective grounding of the adjustable frequency drive and the use of RCDs must always follow national and local regulations.

## 2.1.5. Before Commencing Repair Work

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

## 2.1.6. Avoid Unintended Start

While the 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.
- An electronic fault, temporary overload, a fault in the line supply, or lost motor connection may cause a stopped motor to start. The adjustable frequency drive with safe stop provides protection against unintended start, if Safe Stop Terminal 37 is deactivated or disconnected.

## 2.1.7. Safe Stop

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 function 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 in the relevant 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!

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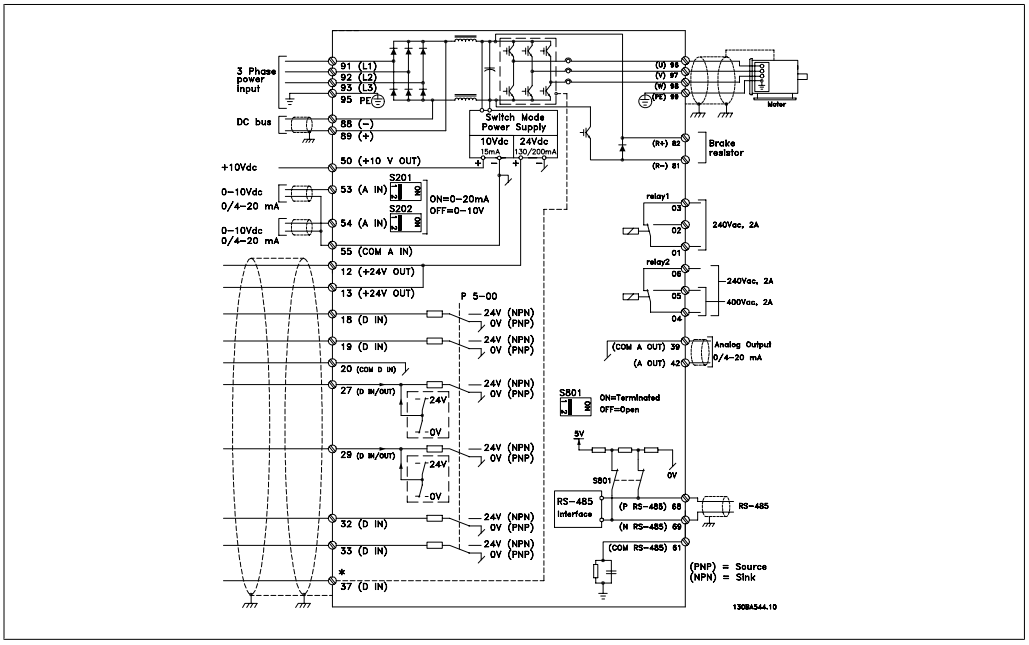
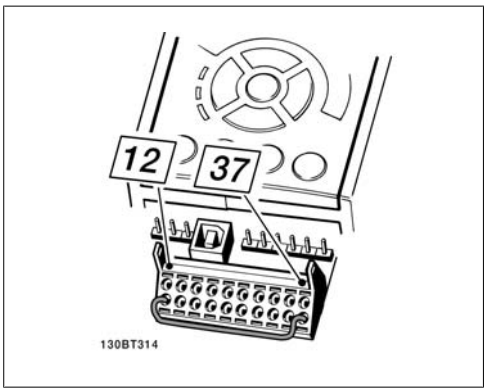



2.1: Diagram showing all electrical terminals. (Terminal 37 present for units with safe stop function only.)

## 2.1.8. Safe Stop Installation

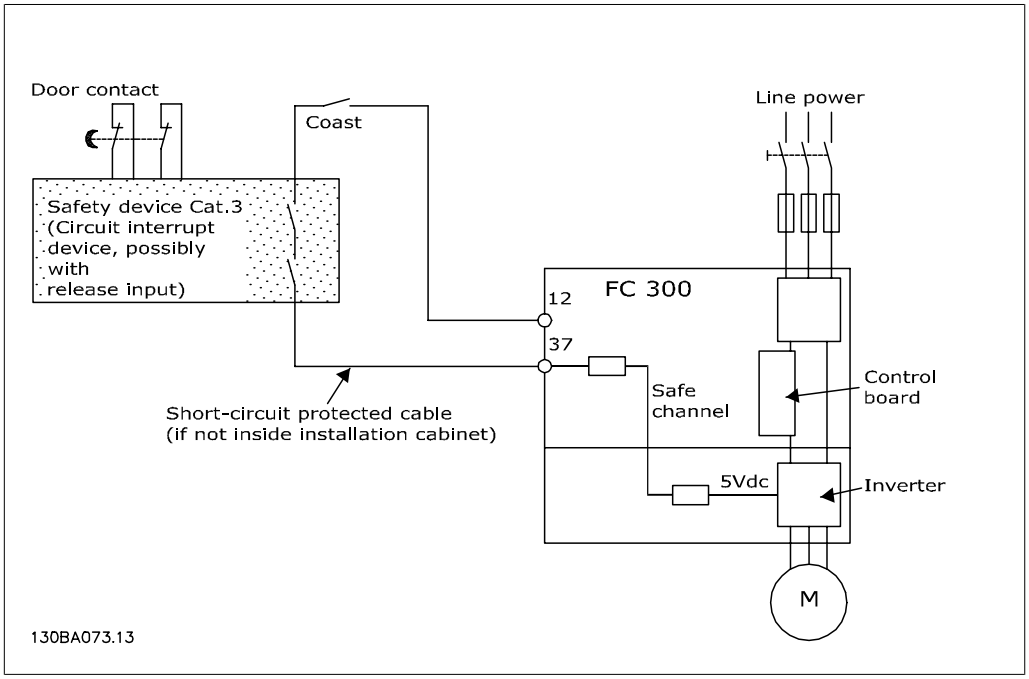
To carry out an installation of a Category 0 Stop (EN60204) in conformity with Safety Category 3 (EN954-1), follow these instructions:

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




2.2: Bridge jumper between terminal 37 and 24 VDC

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




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

## 2.1.9. IT Line

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

# 3. How to Install

## 3.1. How to Get Started

### 3.1.1. About How to Install

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

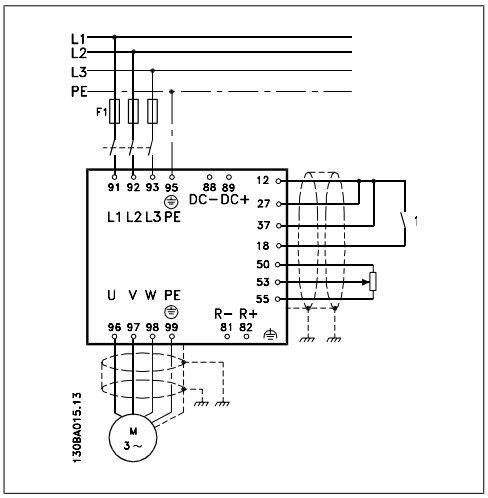
Electrical Installation

- 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 dependent on enclosure type, power range and line voltage.




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

# 3.2. Pre-installation - High Power

## 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.

3

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 cardboard box and keep the adjustable frequency drive on the pallet as long as possible. Remark: The cardboard box cover contains a drilling master for the mounting holes.



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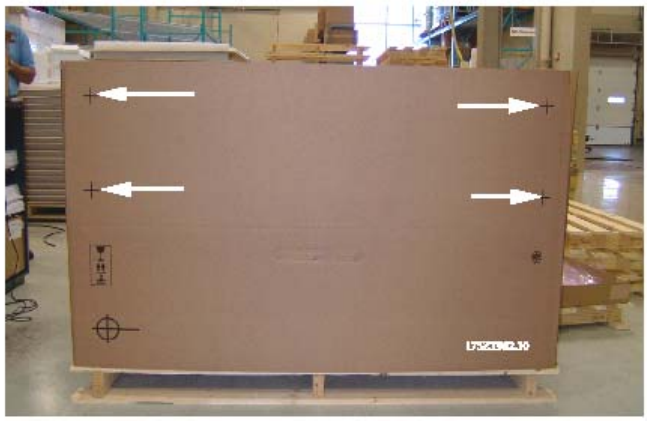
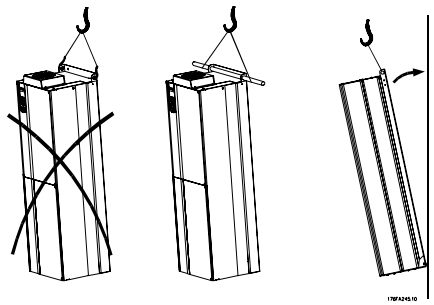


3.2: Mounting Template

## 3.2.4. Lifting

Always lift the adjustable frequency drive using the dedicated lifting holes. Use a bar to avoid bending the lifting holes of the adjustable frequency drive.

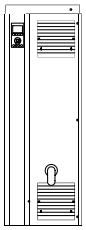
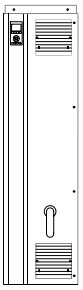
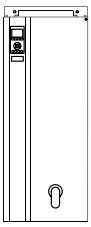
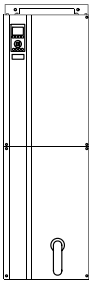


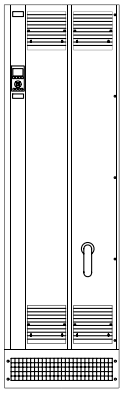
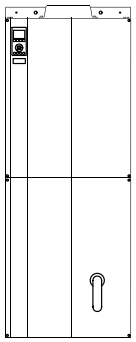
3.3: Recommended lifting method

3

# 3.3. Enclosures

## 3.3.1. Rated Power

| | | D1 | D2 | D3 | D4 |
|---|---|---|---|---|---|
| Enclosure type | |  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 |
| Rated power | | 150-175 hp [110-132 kW] at 400 V (380-480 V) 150-175 hp [110-132 k] at 600 V (525-600 V) | 250-350 hp [160-250 kW] at 400 V (380-480 V) 250-450 hp [160-315 kW] at 600 V (525-600 V) | 150-175 hp [110-132 kW] at 400 V (380-480 V) 150-175 hp [110-132 k] at 600 V (525-600 V) | 250-350 hp [160-250 kW] at 400 V (380-480 V) 250-450 hp [160-315 kW] at 600 V (525-600 V) |

| | | E1 | E2 |
|---|---|---|---|
| Enclosure type | |  130BA483.10 |  130BA480.10 |
| Enclosure protection | IP | 21/54 | 00 |
| | NEMA | Type 1/ Type 12 | Chassis |
| Rated power | | 450-600 hp [315-450 kW] at 400 V (380-480 V)<br>500-750 hp [355-560 kW] at 600 V (525-600 V) | 450-600 hp [315-450 kW] at 400 V (380-480 V)<br>500-750 hp [355-560 kW] at 600 V (525-600 V) |

3

## 3.3.2. Mechanical Dimensions

Mechanical dimensions, D Enclosures

| Frame size | | D1 | | D2 | | D3 | D4 |
|---|---|---|---|---|---|---|---|
| | | 150-200 hp [110-132 kW] (380-480 V) 150-200 hp [110-132 kW] (525-600 V) | | 250-350 hp [160-250 kW] (380-480 V) 250-450 hp [160-315 kW] (525-600 V) | | 150-200 hp [110-132 kW] (380-480 V) 150-200 hp [110-132 kW] (525-600 V) | 250-350 hp [160-250 kW ] (380 - 480 V) 250-450 hp [160-315 kW] (525-600 V) |
| IP NEMA | | 21 Type 1 | 54 Type 12 | 21 Type 1 | 54 Type 12 | 00 Chassis | 00 Chassis |
| Cardboard box size 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 | 45.6 in [1159 mm] | 45.6 in [1159 mm] | 60.6 in [1540 mm] | 60.6 in [1540 mm] | 39.3 in [997 mm] | 50.3 in [1277 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 | 14.7 in [373 mm] | 14.7 in [373 mm] | 14.7 in [373 mm] | 14.7 in [373 mm] | 14.7 in [373 mm] | 14.7 in [373 mm] |
| | Max weight | 229.3 lbs [104 kg] | 229.3 lbs [104 kg] | 332.9 lbs [151 kg] | 332.9 lbs [151 kg] | 200.6 lbs [91 kg] | 304.2 lbs [138 kg] |



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| Mechanical dimensions, E Enclosures | | | | |
|---|---|---|---|---|
| Frame size | | E1 | | E2 |
| | | 450-600 hp [315-450 kW] (380-480 V) 500-750 hp [355-560 kW] (525-600 V) | | 450-600 hp [315-450 kW] (380-480 V) 500-750 hp [355-560 kW] (525-600 V) |
| IP<br>NEMA | | 21<br>Type 12 | 54<br>Type 12 | 00<br>Chassis |
| Cardboard box size Shipping dimensions | Height | 33.1 in [840 mm] | 33.1 in [840 mm] | 32.7 in [831 mm] |
| | Width | 86.5 in [2197 mm] | 86.5 in [2197 mm] | 67.1 in [1705 mm] |
| | Depth | 29 in [736 mm] | 29 in [736 mm] | 29 in [736 mm] |
| Drive dimensions | Height | 78.7 in [2000 mm] | 78.7 in [2000 mm] | 59 in [1499 mm] |
| | Width | 23.6 in [600 mm] | 23.6 in [600 mm] | 23 in [585 mm] |
| | Depth | 19.5 in [494 mm] | 19.5 in [494 mm] | 19.5 in [494 mm] |
| | Max weight | 690 lbs [313 kg] | 690 lbs [313 kg] | 611 lbs [277 kg] |

# 3.4. 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.

## 3.4.1. Tools Needed

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

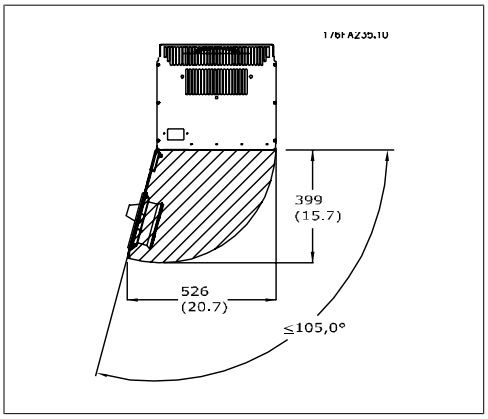
- Drill with 0.39 or 0.47 in [10 or 12 mm] drill.
- Tape measure
- Wrench with relevant metric sockets (7-17 mm)
- Extensions to wrench
- Sheet metal punch for conduits or cable glands in IP 21 and IP 54 units
- Lifting bar to lift the unit (rod or tube Ø 0.75 in [20 mm]) able to lift minimum 880 lbs [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 enclosure in IP 21 and IP 54 enclosure types.

## 3.4.2. General Considerations

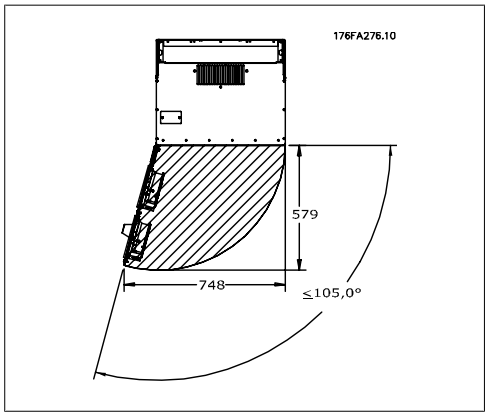
Space

Ensure proper clearance 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 enable opening the door of the panel.

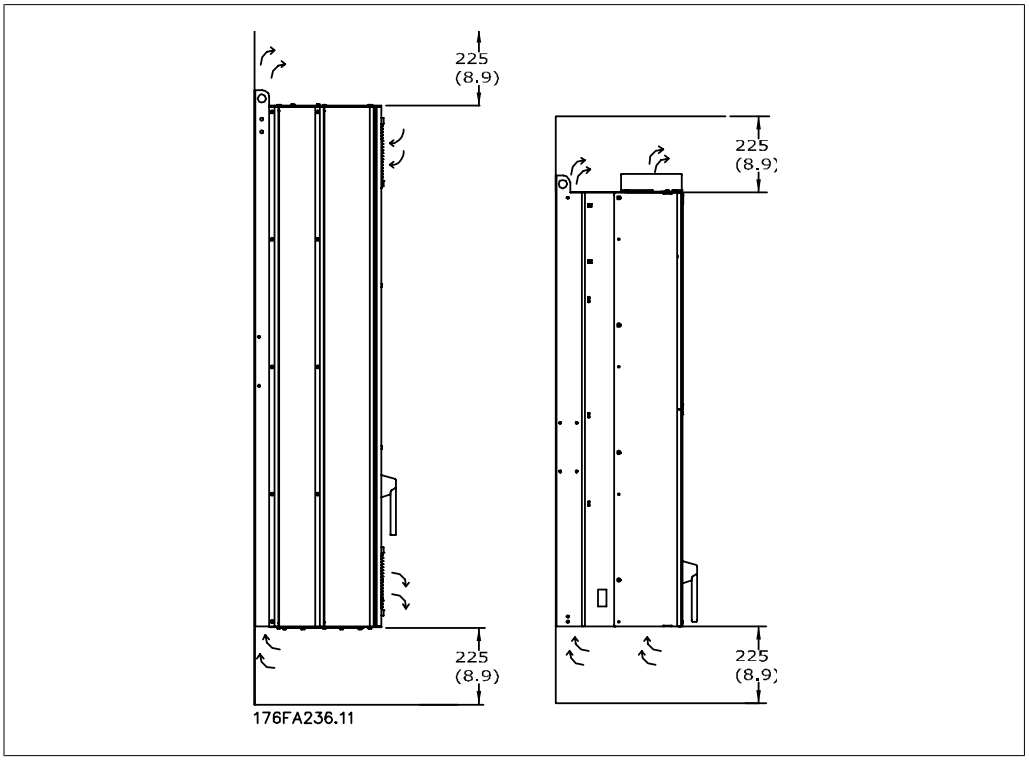




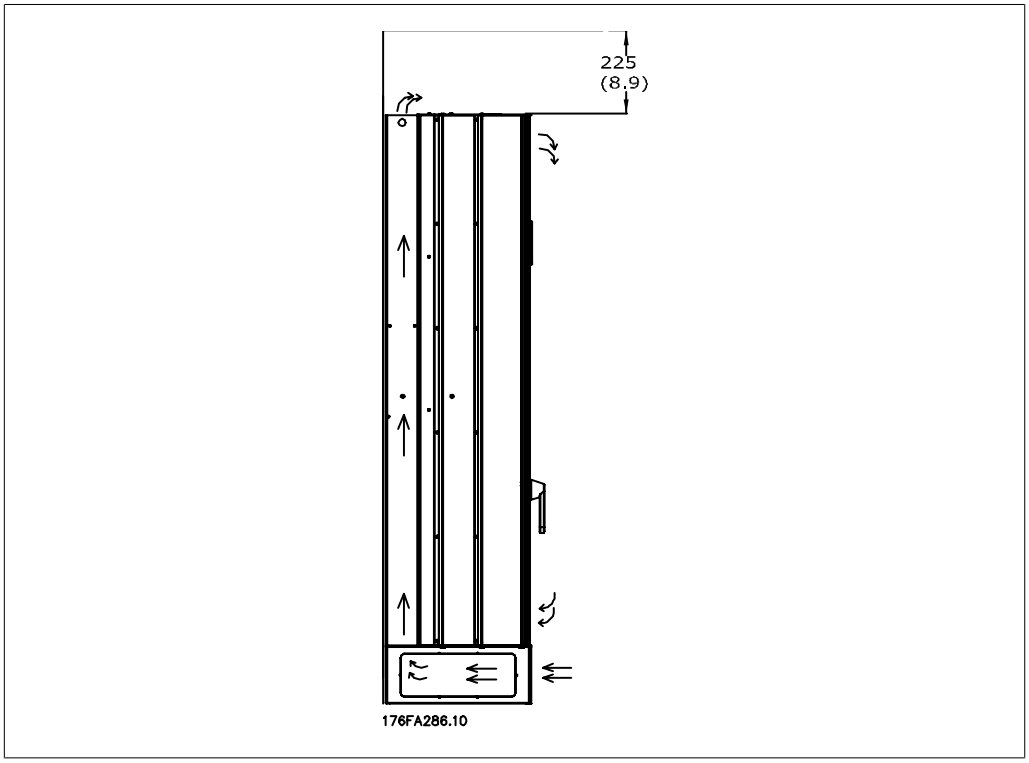

3.4: Space in front of IP 21/IP 54 enclosure type D1 and D2.




3.5: Space in front of IP 21/IP 54 enclosure type E1.




3.6: Airflow direction and necessary space for cooling
Left: Enclosure IP 21/IP 54, D1 and D2.
Right: Enclosure IP 00, D3, D4 and E2.




3.7: Airflow direction and necessary space for cooling - Enclosure IP 21/IP 54, E1

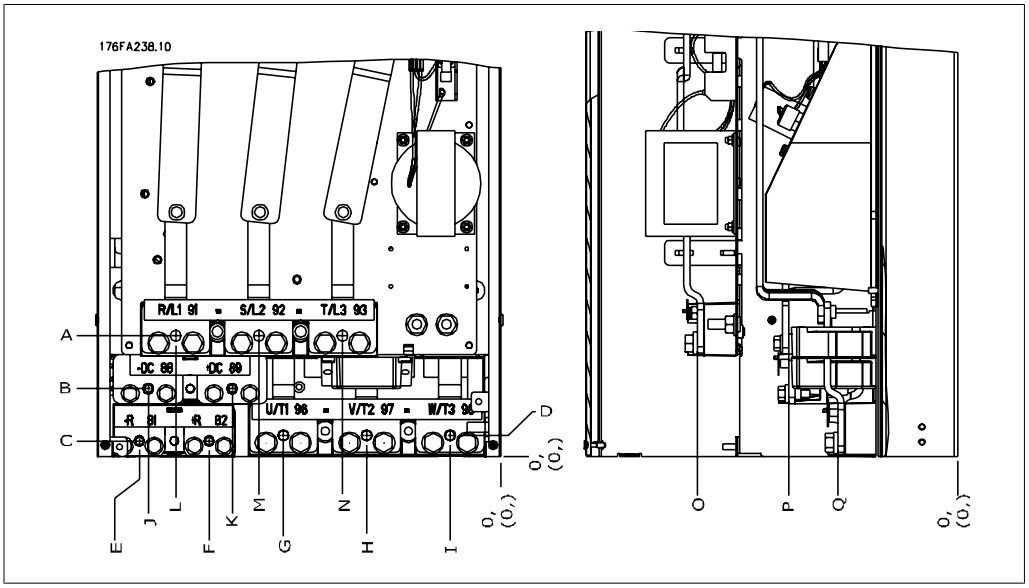
Wire access

Ensure that proper cable access is present including the necessary bending allowance. Since the IP 00 enclosure is open, the bottom cables must be attached to the back panel of the enclosure where the adjustable frequency drive is mounted, i.e., by using cable clamps.

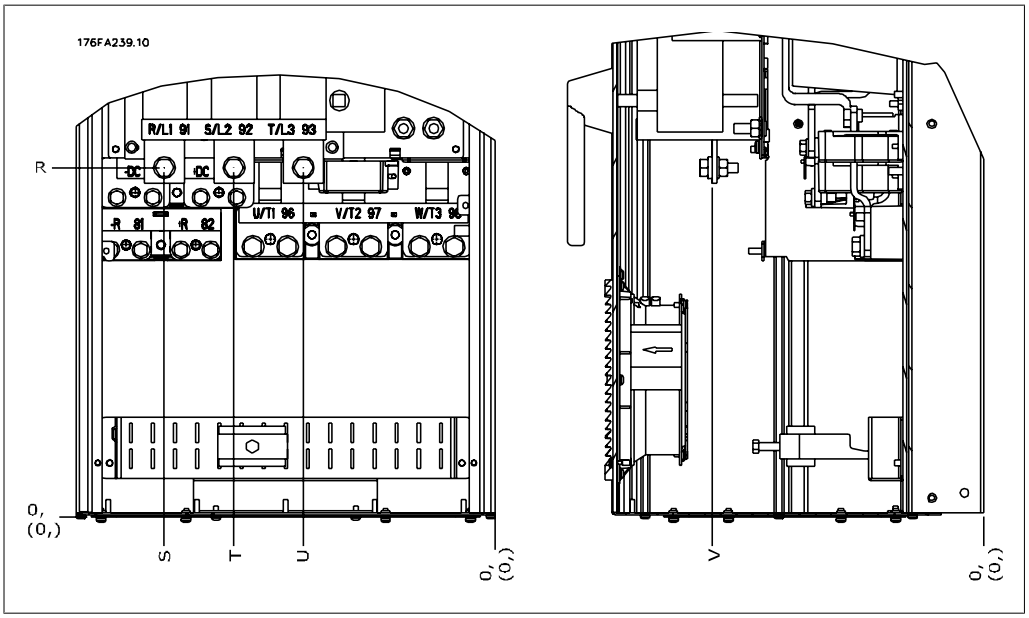
Terminal locations
(D1 and D2 enclosures)

Take the following terminal positions into consideration when you design for cable access.

3




3.8: Position of power connections




3.9: Position of power connections - Disconnect

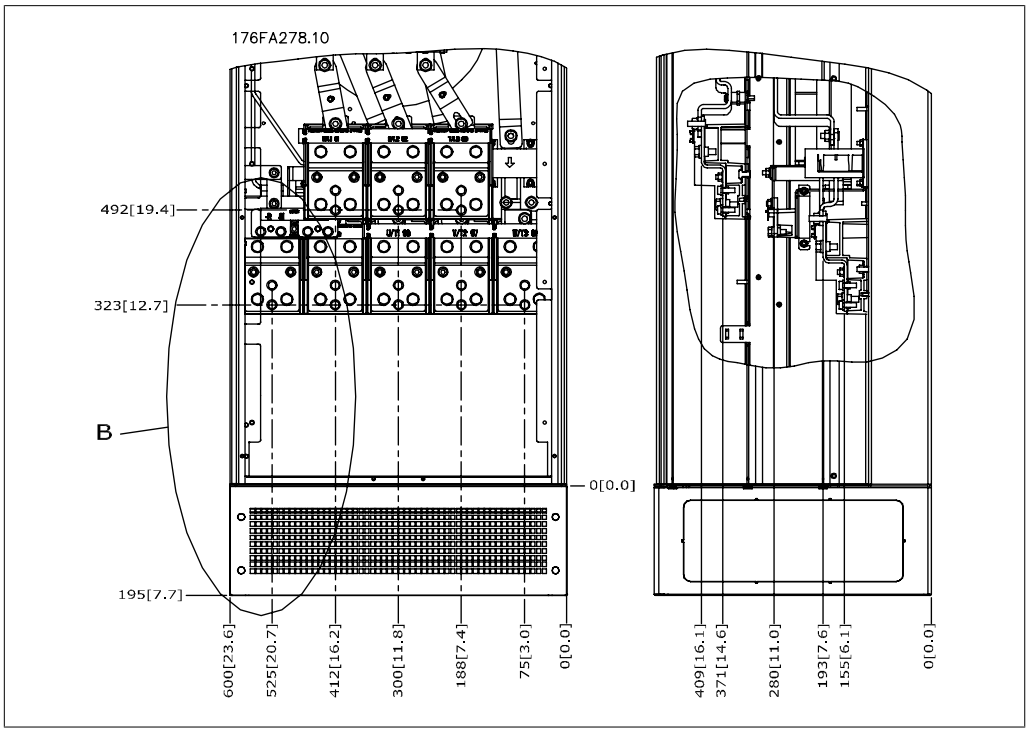
Be aware that the power cables are heavy and hard to bend. Give thought to the optimum position of the adjustable frequency drive for ensuring easy installation of the cables.

| | IP 21 (NEMA 1) / IP 54 (NEMA 12) | | IP 00 / Chassis | |
|---|---|---|---|---|
| | Enclosure D1 | Enclosure D2 | Enclosure D3 | Enclosure D4 |
| A | 277 (10.9) | 379 (14.9) | 119 (4.7) | 122 (4.8) |
| B | 227 (8.9) | 326 (12.8) | 68 (2.7) | 68 (2.7) |
| C | 173 (6.8) | 273 (10.8) | 15 (0.6) | 16 (0.6) |
| D | 179 (7.0) | 279 (11.0) | 20.7 (0.8) | 22 (0.8) |
| E | 370 (14.6) | 370 (14.6) | 363 (14.3) | 363 (14.3) |
| F | 300 (11.8) | 300 (11.8) | 293 (11.5) | 293 (11.5) |
| G | 222 (8.7) | 226 (8.9) | 215 (8.4) | 218 (8.6) |
| H | 139 (5.4) | 142 (5.6) | 131 (5.2) | 135 (5.3) |
| I | 55 (2.2) | 59 (2.3) | 48 (1.9) | 51 (2.0) |
| J | 354 (13.9) | 361 (14.2) | 347 (13.6) | 354 (13.9) |
| K | 284 (11.2) | 277 (10.9) | 277 (10.9) | 270 (10.6) |
| L | 334 (13.1) | 334 (13.1) | 326 (12.8) | 326 (12.8) |
| M | 250 (9.8) | 250 (9.8) | 243 (9.6) | 243 (9.6) |
| N | 167 (6.6) | 167 (6.6) | 159 (6.3) | 159 (6.3) |
| O | 261 (10.3) | 260 (10.3) | 261 (10.3) | 261 (10.3) |
| P | 170 (6.7) | 169 (6.7) | 170 (6.7) | 170 (6.7) |
| Q | 120 (4.7) | 120 (4.7) | 120 (4.7) | 120 (4.7) |
| R | 256 (10.1) | 350 (13.8) | 98 (3.8) | 93 (3.7) |
| S | 308 (12.1) | 332 (13.0) | 301 (11.8) | 324 (12.8) |
| T | 252 (9.9) | 262 (10.3) | 245 (9.6) | 255 (10.0) |
| U | 196 (7.7) | 192 (7.6) | 189 (7.4) | 185 (7.3) |
| V | 260 (10.2) | 273 (10.7) | 260 (10.2) | 273 (10.7) |

3.1: Cable positions as shown in the drawings above. Dimensions in inches [mm].

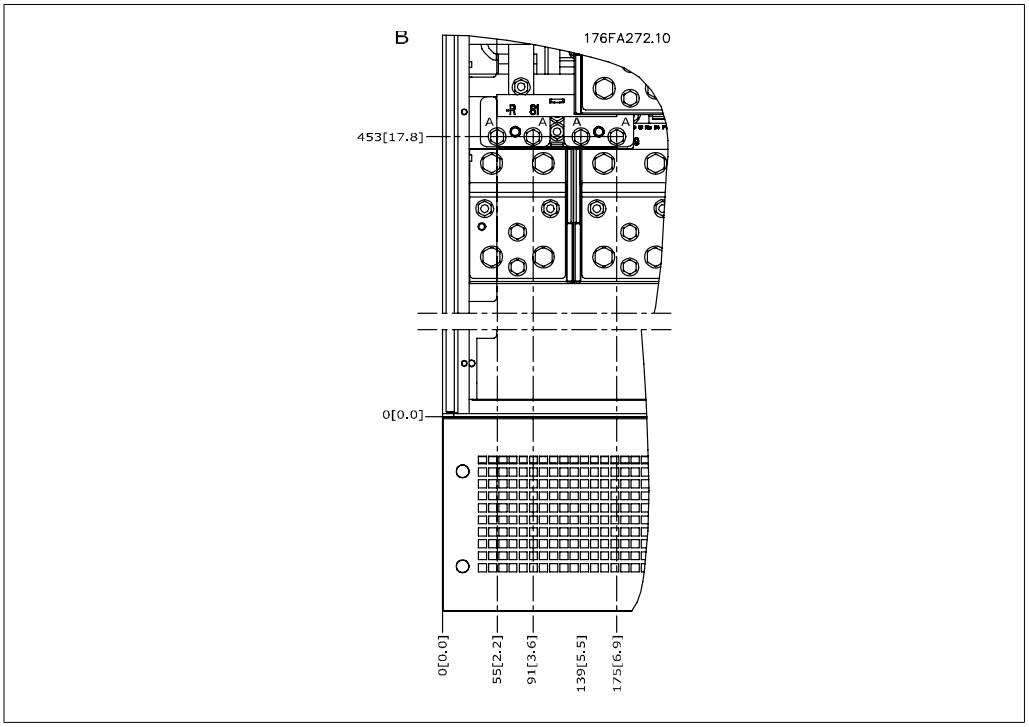
### Terminal locations - E1 enclosures

Give thought to the following terminal positions when designing the cable access.

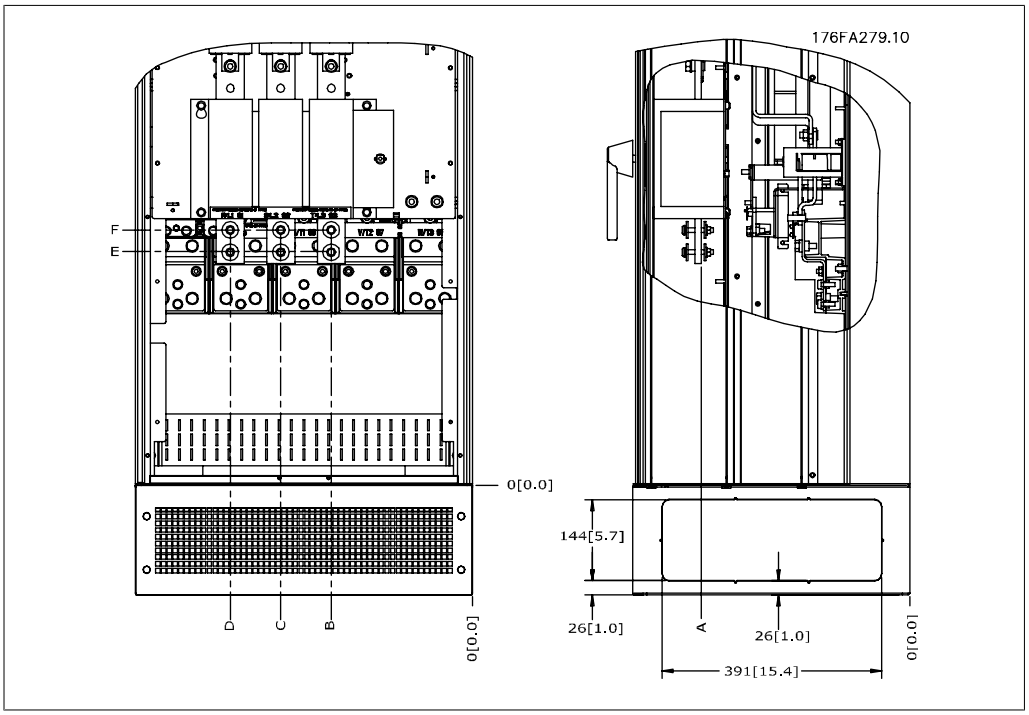



3.10: IP 21 (NEMA Type 1) and IP 54 (NEMA Type 12) enclosure power connection positions

3



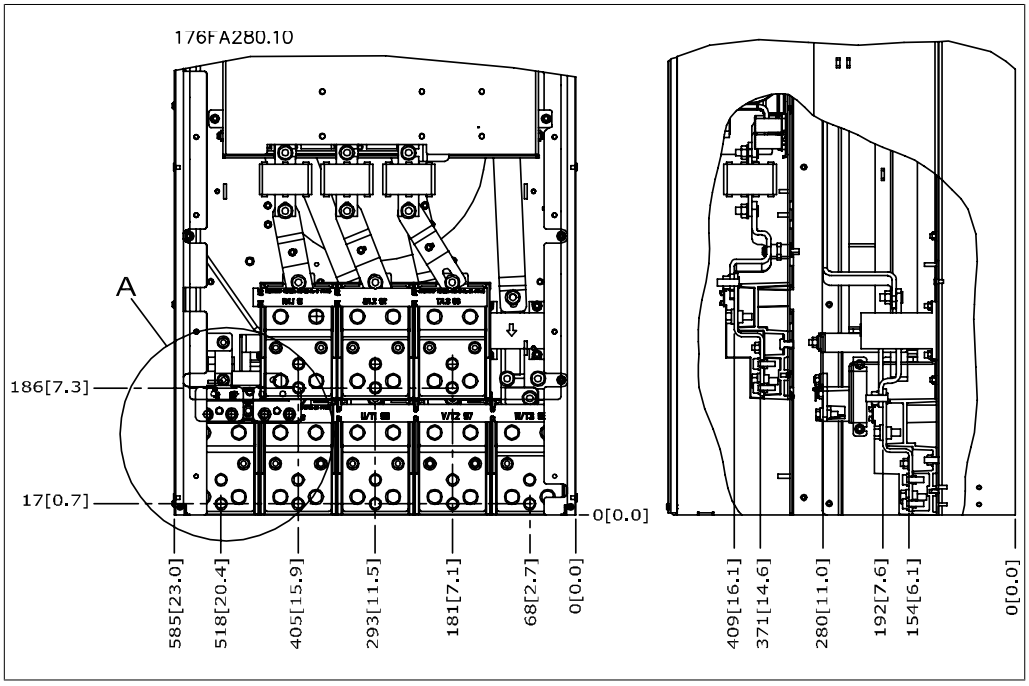

3.11: IP 21 (NEMA type 1) and IP 54 (NEMA type 12) enclosure power connection positions (detail B)



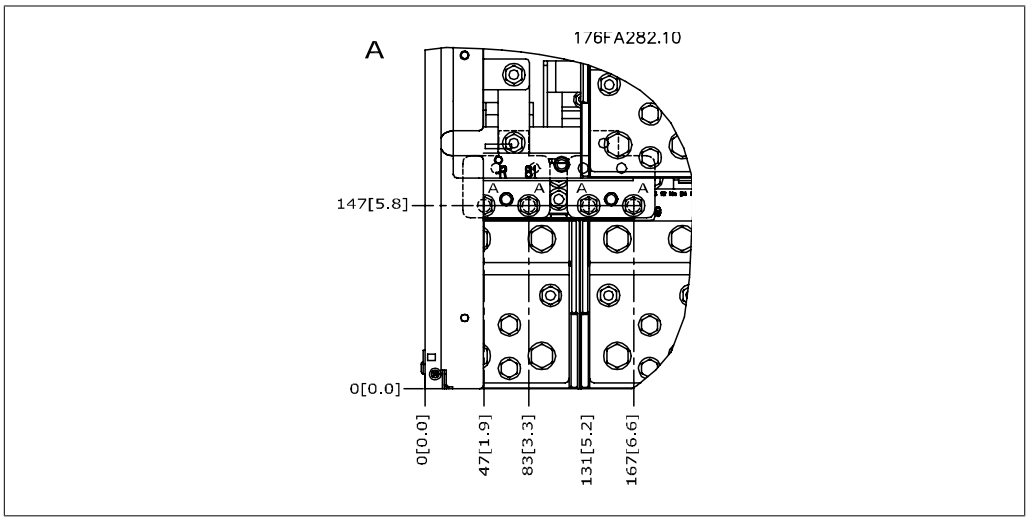

3.12: IP 21 (NEMA type 1) and IP 54 (NEMA type 12) enclosure power connection position of disconnect switch

### Terminal locations - E2 enclosures

Give thought to the following terminal positions when designing the cable access.

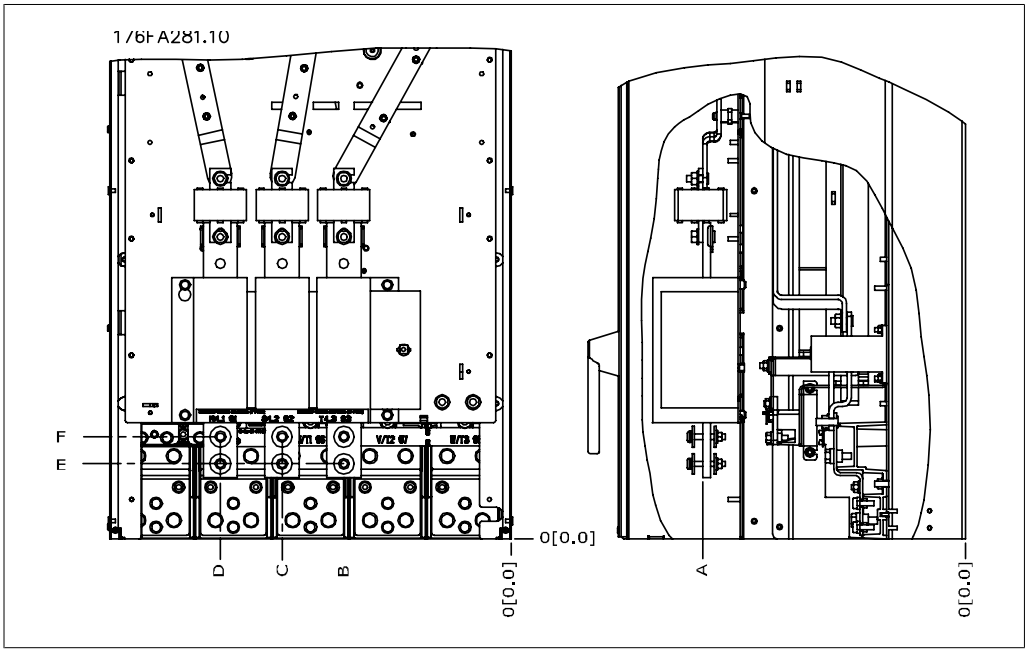



3.13: IP 00 enclosure power connection positions



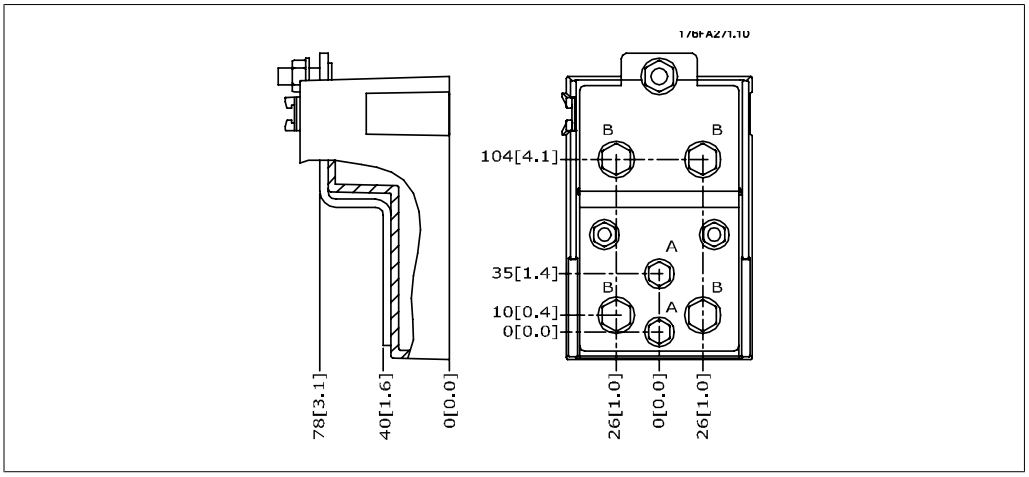

3.14: IP 00 enclosure power connection positions

3

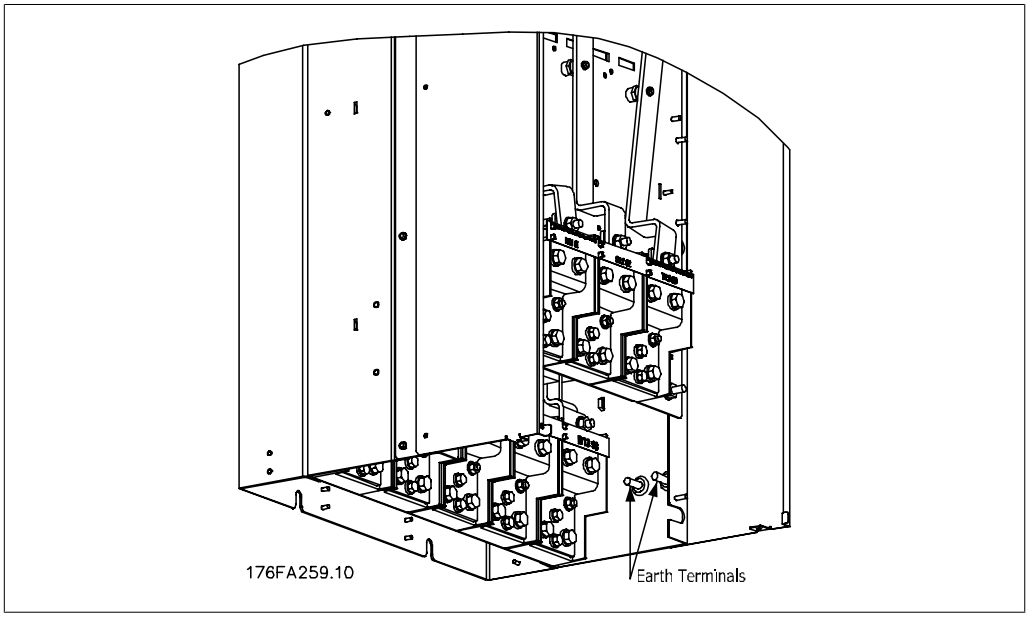



3.15: IP 00 enclosure power connections positions of disconnect switch

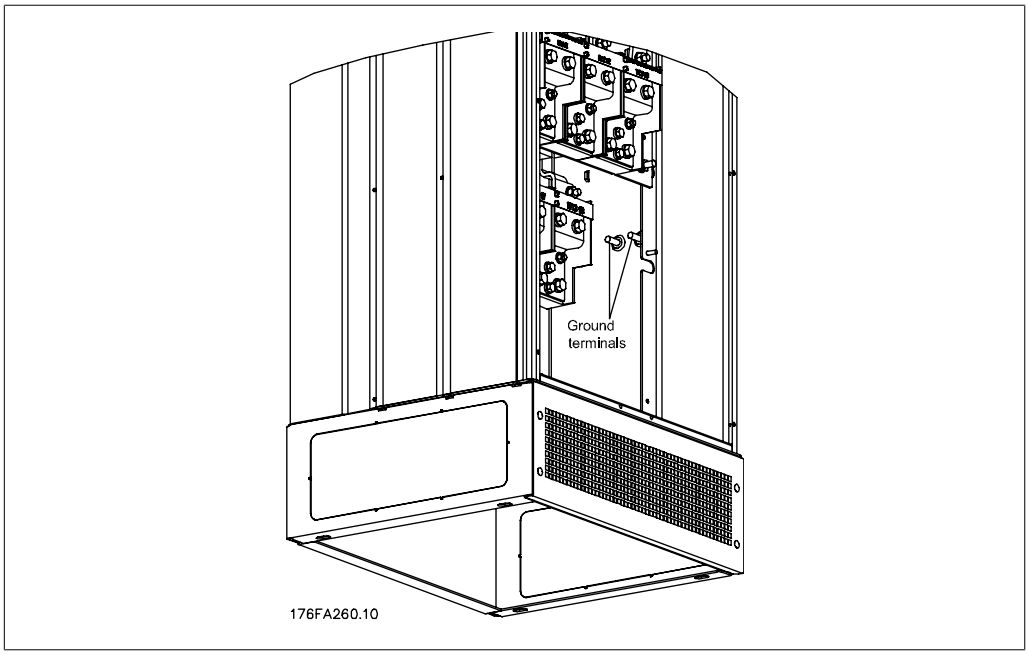
Note that the power cables are heavy and difficult to bend. Give thought to the optimum position of the adjustable frequency drive for ensuring easy installation of the cables.
Each terminal allows for the use of up to 4 cables with cable lugs or the use of standard box lug. Ground is connected to relevant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




3.16: Terminal in details




3.17: Position of ground terminals IP 00




3.18: Position of ground terminals IP 21 (NEMA type 1) and IP 54 (NEMA type 12)

Cooling

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

Airflow

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

3

| Enclosure | | Door fan/ Top fan airflow | Airflow over heat-sink |
|---|---|---|---|
| IP 21 / NEMA 1 & IP 54 / NEMA 12 | D1 and D2 | 6,003 $ft^3/h$ [170 $m^3/h$] (100 cfm) | 27,015 $ft^3/h$ [765 $m^3/h$] (450 cfm) |
| | E1 | 12,006 $ft^3/h$ [340 $m^3/h$] (200 cfm) | 50994 $ft^3/h$ [1444 $m^3/h$] (850 cfm) |
| IP 00 / Chassis | D3 and D4 | 9,005 $ft^3/h$ [255 $m^3/h$] (150 cfm) | 27,015 $ft^3/h$ [765 $m^3/h$] (450 cfm) |
| | E2 | 9,005 $ft^3/h$ [255 $m^3/h$] (150 cfm) | 50994 $ft^3/h$ [1444 $m^3/h$] (850 cfm) |

3.2: Heatsink Air Flow



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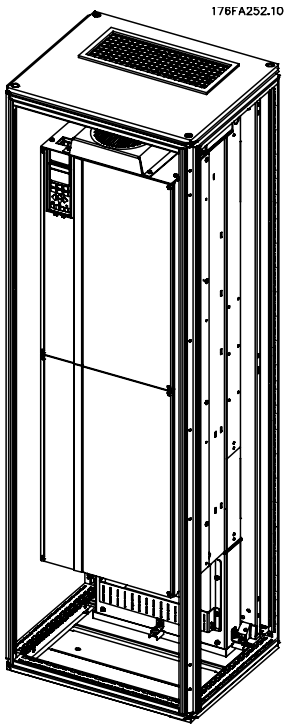
Duct cooling

A dedicated option has been developed to optimize installation of IP00 / Chassis enclosed adjustable frequency drives in Rittal TS8 enclosures utilizing the fan of the adjustable frequency drive for forced cooling.




3.19: Installation of IP 00 in Rittal TS8 enclosure

| Rittal TS8 Enclosure | Frame D3 Kit Part No. | Frame D4 Kit Part No. | Frame E2 Part No. |
|---|---|---|---|
| 70.9 in [1800 mm] | 176F1824 | 176F1823 | Not possible |
| 78.7 in [2000 mm] | 176F1826 | 176F1825 | 176F1850 |
| 86.6 in [2200 mm] | | | 176F0299 |

3.3: Duct Kit Ordering Numbers

Back cooling

Using the channel from the back allows for easy installation in control rooms, for example. The unit mounted at the rear of the enclosure allows for the cooling of the units just as easily as the duct cooling principle. The hot air is ventilated out of the back of the enclosure. This offers a solution in which the hot cooling air from the adjustable frequency drive does not cause the control room to heat up.

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

3.20: Combined use of cooling principles

The above mentioned solution can of course also be combined for an optimized solution in the actual installation.
Please see the Duct Kit Instruction Manual, 175R5640, for further information.

### 3.4.3. Installation in Enclosures - IP 00 / Chassis units

Since the IP 00 version is intended for panel mounting, it is important to know how to install the adjustable frequency drive and use the options available for cooling the units. A detailed description of how to install the adjustable frequency drive in a Rittal TS8 enclosure using the installation kit can be found in a later section of this Installation Guide. This can also be used as a guide for other installations.

### 3.4.4. Installation on the Wall - IP 21 (NEMA 1) and IP 54 (NEMA 12) Units

This only applies for D1 and D2 enclosures.
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.



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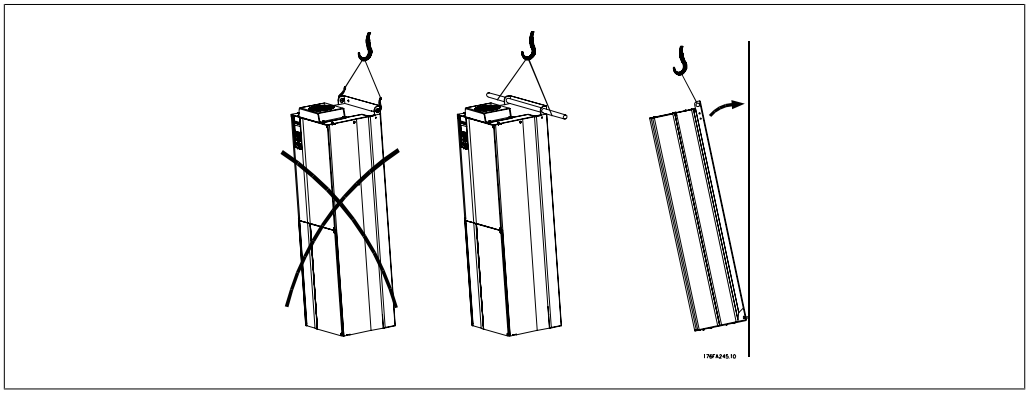


3.21: Lifting method for mounting drive on wall

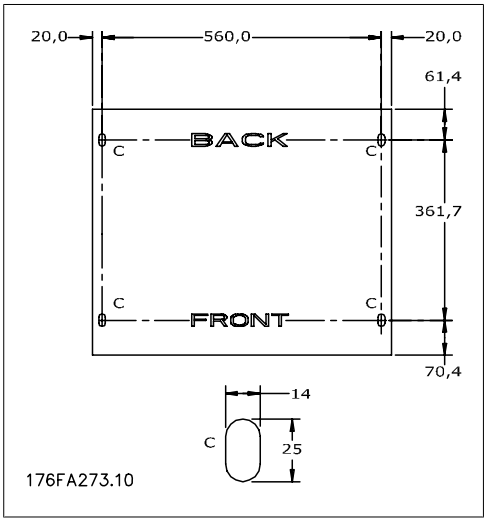
### 3.4.5. Floor Mounting - Pedestal Installation IP 21 (NEMA1) and IP 54 (NEMA12)

IP 21 (NEMA type 1) and IP 54 (NEMA type 12) enclosed adjustable frequency drives can also be installed on a pedestal.
D1 and D2 enclosures
Ordering No. 176F1827
Please see the Pedestal Kit Instruction Manual, 175R5642, for further information.

3.22: Drive on pedestal

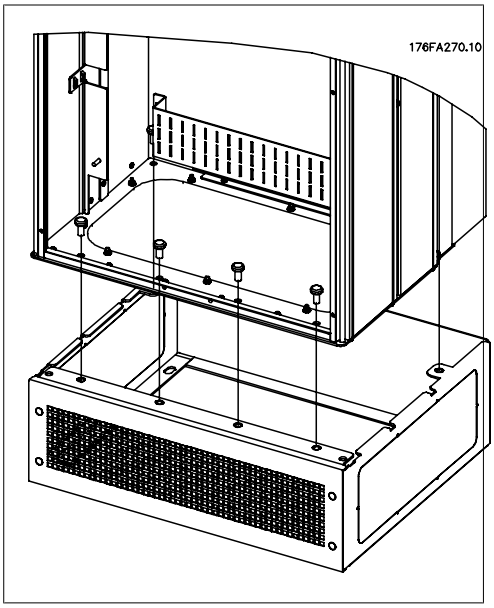
3

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




3.23: Drill master for fixing holes in floor.

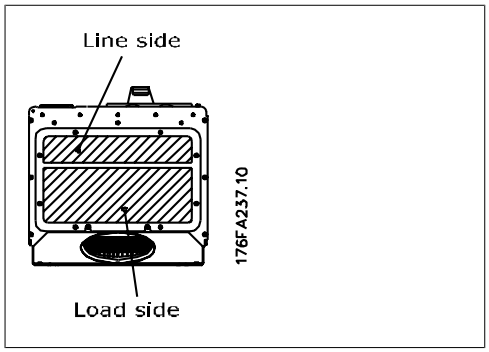
Mount the drive on the pedestal and using the enclosed bolts, attach it to the pedestal, as shown in the illustration.



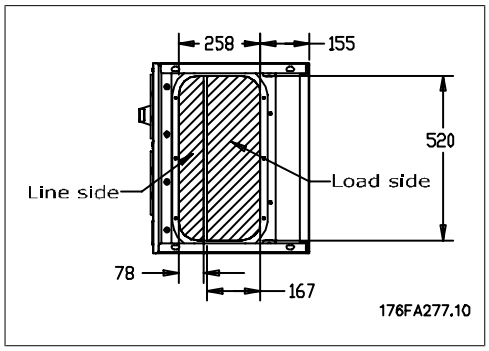

3.24: Mounting the drive to the pedestal

## 3.4.6. Gland/ Conduit Entry - IP 21 (NEMA 1) and IP 54 (NEMA12)

Cables are connected through the gland plate from the bottom. Remove the plate and plan where to place the entry for the glands or conduits. Prepare holes in the marked area on the drawing.
The gland plate must be fitted to the 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, it may trip the unit.

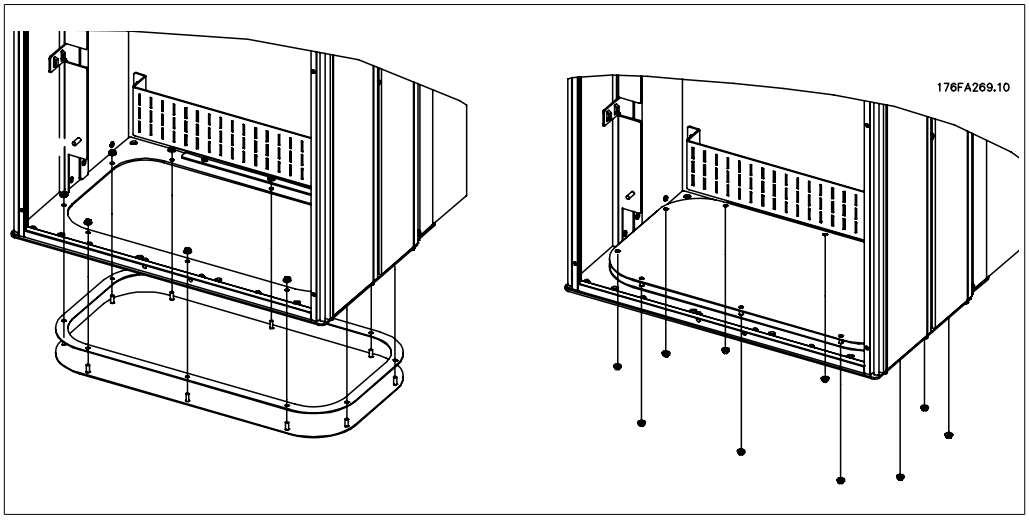



3.25: Cable entry viewed from the bottom of the adjustable frequency drive - Enclosure D1 and D2.




3.26: Cable entry seen from the bottom of the adjustable frequency drive - Enclosure E1.

The bottom plate of the E1 enclosure can be mounted from either in or outside of the enclosure, allowing flexibility in the installation process, i.e., if mounted from the bottom, the glands and cables can be mounted before the adjustable frequency drive is placed on the pedestal.

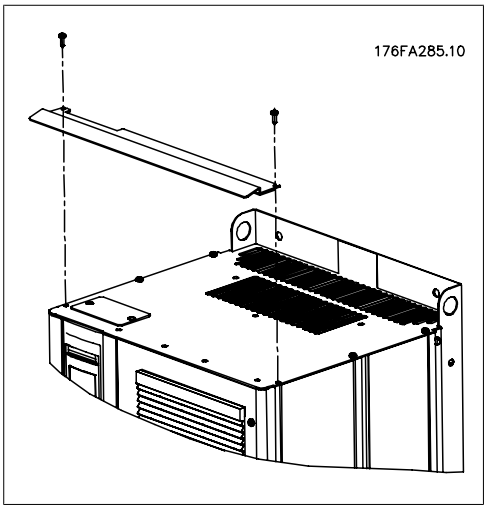



3.27: Mounting of bottom plate, E1 enclosure.

### 3.4.7. IP 21 Drip shield installation (D1 and D2 enclosure)

To comply with the IP 21 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).




3.28: Install the drip shield.

## 3.5. Field Installation of Options

This chapter deals with the installation of IP 00/chassis-enclosed adjustable frequency drives with duct work cooling kits in Rittal enclosures. These kits are designed and tested to be used with Rittal TS8 enclosures 71 in [1,800 mm] (Frame D1 and D2 only) and 79 in [2,000 mm] height, as well as 87 in [2,200 mm] for E2 enclosures. Other enclosure heights are not supported. In addition to the enclosure, an 8 in [200 mm] base/plinth is required.

The minimum enclosure dimension is:

- D1 and D2 frame: Depth 19.7 in [500 mm] and width 23.6 in [600 mm].
- E1 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 be 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.
The duct work shown is for D1 and D2 enclosures. The duct work for E1 enclosures has a different appearance, but is installed in the same way.

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



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Ordering Information

| Rittal TS-8 Enclosure | Frame D3 Kit Part No. | Frame D4 Kit Part No. | Frame E2 Part No. |
|---|---|---|---|
| 70.9 in [1800 mm] | 176F1824 | 176F1823 | Not possible |
| 78.7 in [2000 mm] | 176F1826 | 176F1825 | 176F1850 |
| 86.6 in [2200 mm] | | | 176F0299 |



Kit Contents

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

All fasteners are either:

- 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)

## 3.5.1. Installation of Rittal Enclosures

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

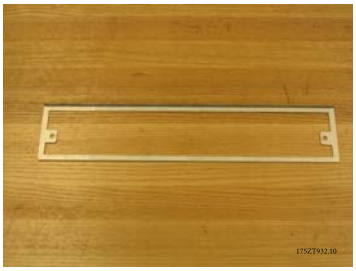
3.29: Templates

3

Install the gasket material on the back openings of the adjustable frequency drive prior to installation on the enclosure's back panel.
Use the template provided with the kit (shown above), and install the adjustable frequency drive on the enclosure's back panel of the Rittal. The template is referenced to the top-left corner of the back panel. Therefore, the template may be used with any size back panel and both the 71 in [1800 mm] and 79 in [2000 mm] high enclosures.

3.30: The openings on the rear not used in this application.

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



3.31: Bottom duct adapter

3.32: Bottom duct adapter with gasket installed



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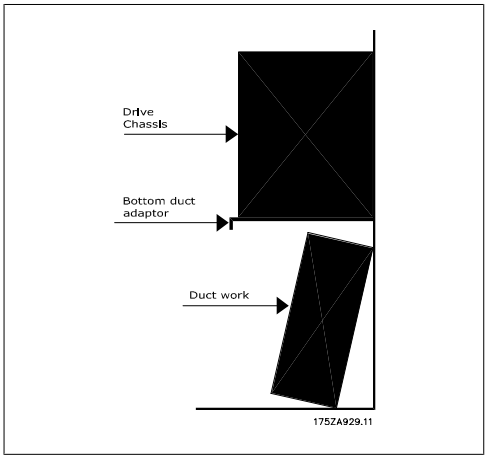
3.33: Bottom duct adapter installed




3.34: Side view

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

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

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

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

3.35: Top of IP 00/Chassis adjustable frequency drive

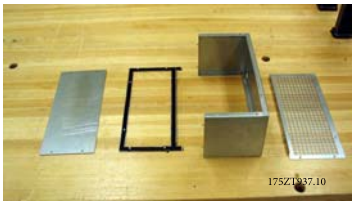
3

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

3.36: Adjustable frequency drive installed in cabinet

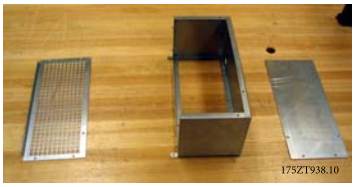
## 3.5.2. Installation of Rittal Enclosures, cont.

The top ductwork cover is composed of the following pieces as shown below. From left to right: 1. top duct closing plate, 2. adjustable frequency drive bracket, 3. duct, 4. duct vented-top cover.




3.37: Top duct assembly

3.38: Top duct work and enclosure top installed



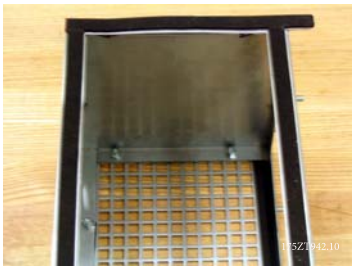

3.39: The top duct work partially assembled with adjustable frequency drive bracket

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

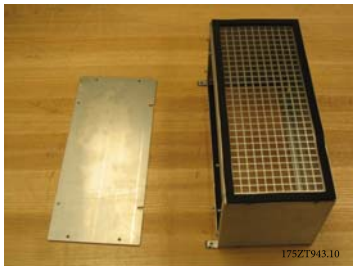
3.40: Rittal enclosure top with cut-out
The standard Rittal enclosure top is cut. The gasket is not used on the cut-out. The gasket is part of the duct work.

3.41: The gasket folds over the edge to form a seal between the duct and the top vented cover.

3.42: Top duct installed



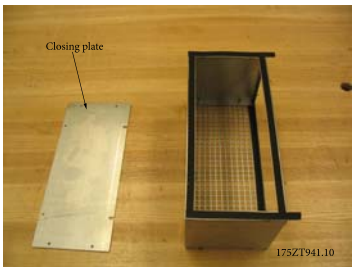
3.43: The gasket applied to both sides of the adjustable frequency drive bracket and duct vented-top cover.




3.44: Top duct ready to be installed on the adjustable frequency drive

3

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




3.45: Top duct assembled with gasket

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

Once the duct work is attached to the adjustable frequency drive, the duct closing plate can be attached. The top duct work assembly is complete.

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

3.46: Top duct installed

3.47: Top duct closing plate with gasket

3.48: Top duct closing plate installed

3.49: Enclosure top installed

3.50: Top view of Rittal enclosure

## 3.5.3. Installation of Rittal Enclosures, cont.

The bottom duct assembly pieces. Refer to the drawing showing the exploded view of the duct work components. The gasket is installed as shown. Assemble the bottom duct without the cover. The assembly includes the mounting of 3 angle brackets on the front and sides of the partially assembled bottom duct. The bottom duct collar is bolted to the duct using 3 - T25 screws in the outermost holes of the brackets. Tighten the screws to compress the gasket.

3.51: Bottom duct work pieces

3.52: Bottom duct work partially assembled

3.53: Completely assembled bottom duct work

3

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

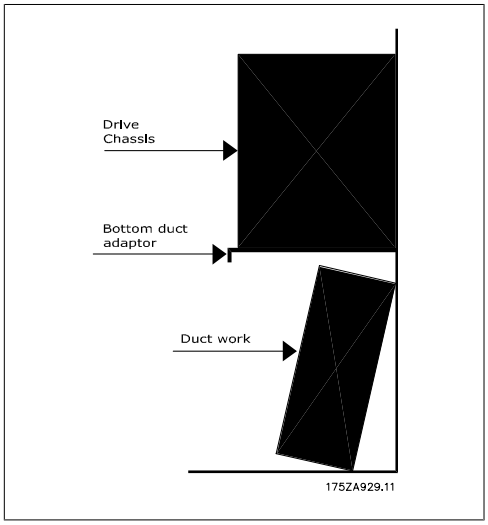
3.54: Temporarily install the duct work to mark the cut-out on the gland.

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

3.55: Enclosure bottom cut-out

3.56: Bottom duct work installed

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




3.57: Installation of bottom duct

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

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

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

3.59: Bottom duct installed.

## 3.5.4. Installation on pedestal

The adjustable frequency drive can also be installed on the floor. A dedicated floor stand is designed for that purpose. It can only be used for units produced after week 50, 2004 (serial number XXXXXG504).



This section describes the installation of a pedestal unit available for the VLT series 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 gland 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 IP 21/NEMA 1 or IP 54/NEMA 12 degrees of enclosure protections.

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

Required Tools:

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

Torques:

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

Kit Contents:

- Pedestal parts
- Instruction Manual

3.60: Drive on pedestal.



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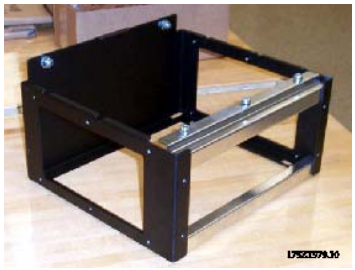
The kit contains a U-shaped piece, a vented front cover, 2 side covers, two front brackets and the required hardware to assemble. See the exploded view of the installation, illustration "Three front screws" (drawing 130BA647).

3.61: Pedestal parts

The pedestal has been partially assembled. Before installing the drive on to the pedestal, it is important to anchor the pedestal to the floor using the four pedestal mounting holes. The holes can accommodate up to M12 bolts (not included in the kit).
CAUTION: The drives are top heavy and may fall over if the pedestal is not anchored to the floor.
The entire assembly may also be supported by using the drive top mounting holes to anchor it to a wall structure.



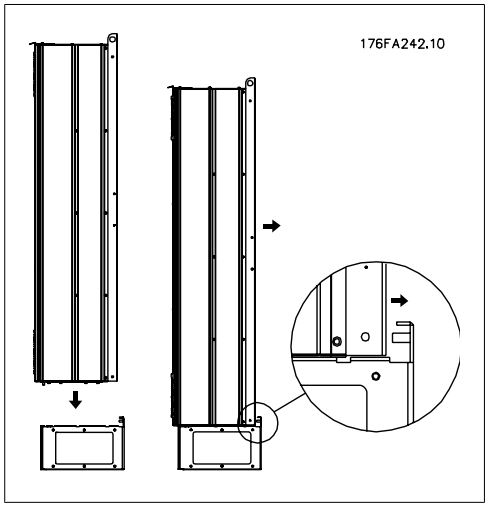
3.62: Pedestal partially assembled

The completely assembled pedestal with vented front cover and two side covers installed. Multiple adjustable frequency drives may be mounted side by side. The interior side closing plates are left off.
NOTE: The front and side cover mounting screws are now recessed M6 Torx socket flat head screws.

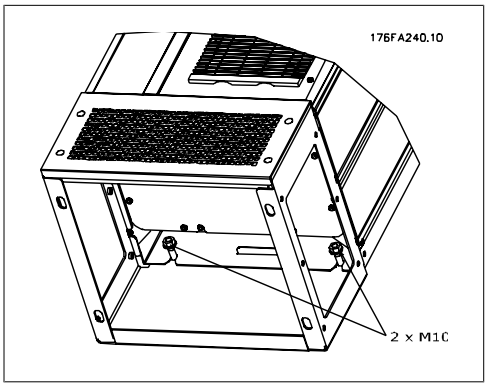
3.63: Final assembled pedestal.

3

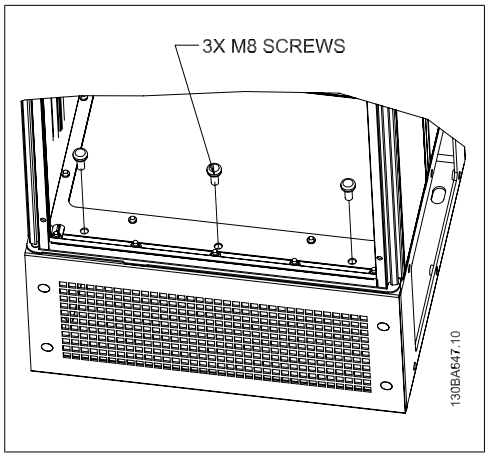
Install the adjustable frequency drive by lowering it onto the pedestal. The adjustable frequency drive must hang over the front of the pedestal to clear the retaining bracket on the rear of the pedestal. After the adjustable frequency drive has been placed on the pedestal, slide the adjustable frequency drive so that it engages with the retaining bracket on the pedestal and mount screws as shown.




3.64: Mount the drive onto pedestal.




3.65: Two nuts at rear side.




3.66: Three front screws.

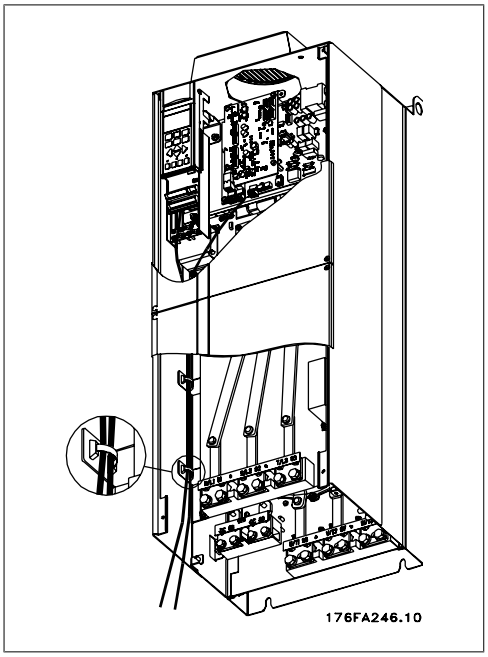
3.67: Frame D2 with pedestal installed

# 3.6. Electrical Installation

## 3.6.1. Control Wires

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.

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




3.68: Wire path for control wiring.

Serial communication bus connection
Connections are made to the relevant options at the control card. For details, see the relevant serial communication bus instructions. The cable must be placed to the left, inside the adjustable frequency drive and tied down together with other control wires.

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

3.69: Top connection for the serial communication bus.

3

Installation of 24 Volt external DC Supply
Torque: 0.5 - 0.6 Nm (5 in-lbs)
Screw size: M3

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

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

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

## 3.6.2. Power Connections

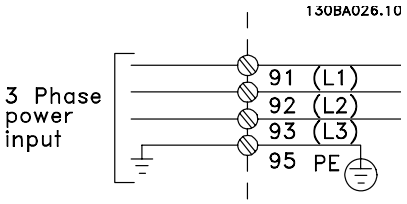
Cabling and Fusing

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 laid out as shown below. Dimensioning of cable cross-sections must be done in accordance with the current ratings and local legislation. See the *Specifications section* for details.

To protect the adjustable frequency drive, the recommended fuses must be used or the unit must have built-in fuses. Recommended fuses are listed in the tables in the fuses section. Always ensure that proper fusing is done according to local regulations.

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



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NOTE
Motor cable must be shielded/armored. The use of an unshielded/unarmored cable is against EMC requirements. 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), as they reduce the shielding effect at higher frequencies. 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.

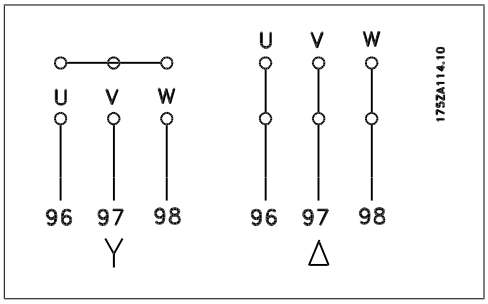
Make the shield connections with the largest possible surface area (cable clamp). This is done by using the supplied installation devices in the adjustable frequency drive.

Cable length and cross-section:
The adjustable frequency drive has been tested with a given length of cable and a given cross-section of that cable. If the cross-section is increased, the cable capacitance - and thus the leakage current - may increase, thereby requiring that the cable length is reduced accordingly. Keep the motor cable as short as possible to reduce the noise level and leakage currents.
Details can be found in the relevant Design Guide.

Switching frequency:
When 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.

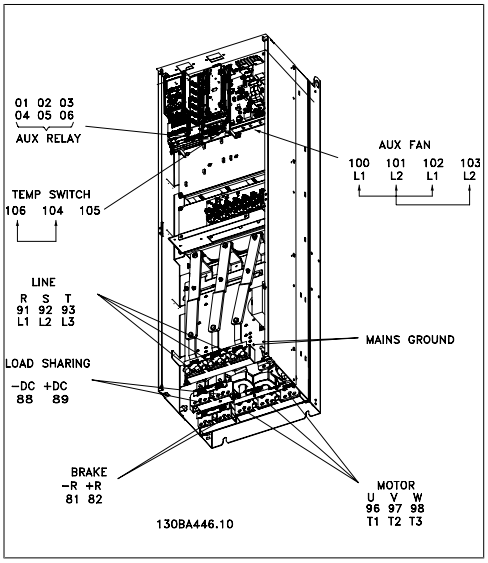
| Term. no. | 96 | 97 | 98 | 99 | |
|---|---|---|---|---|---|
| | U | V | W | PE[1)] | Motor voltage 0-100% of line voltage.<br>3 wires out of motor |
| | U1<br>W2 | V1<br>U2 | W1<br>V2 | PE[1)] | Delta-connected<br>6 wires out of motor |
| | U1 | V1 | W1 | PE[1)] | Star-connected U2, V2, W2<br>U2, V2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

[1)]Protected Ground Connection

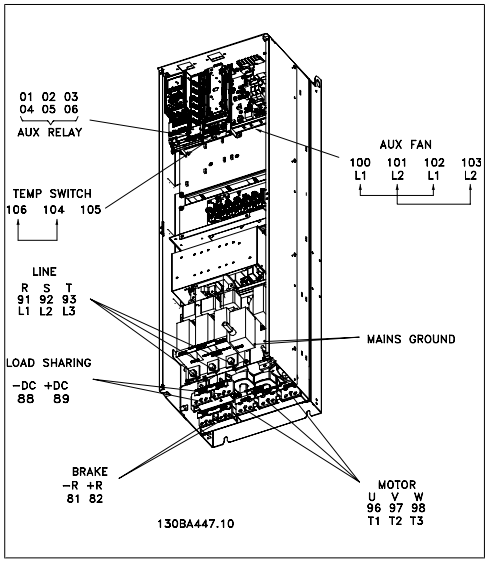



NOTE
In motors without phase insulation paper or other insulation reinforcement suitable for operation with voltage supply (such as an adjustable frequency drive), fit a sine-wave filter on the output of the adjustable frequency drive.

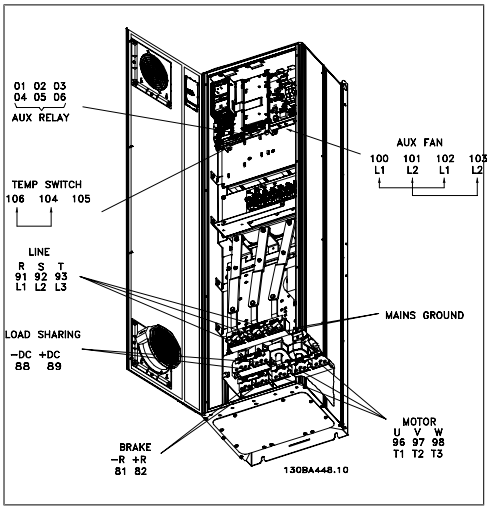
3



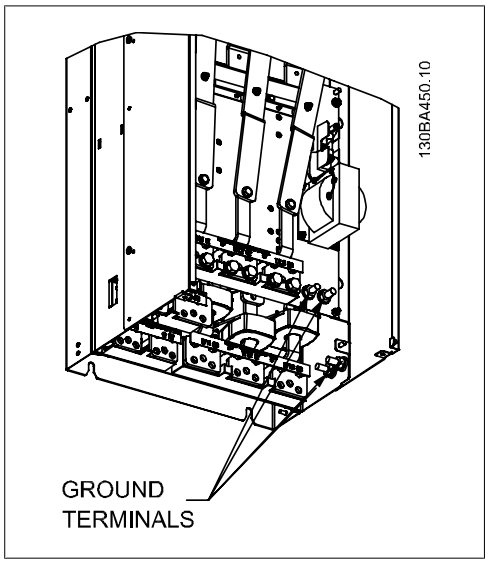

3.70: Compact IP 00 (Chassis), enclosure D3




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




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




3.73: Position of ground terminals IP 00, D enclosures



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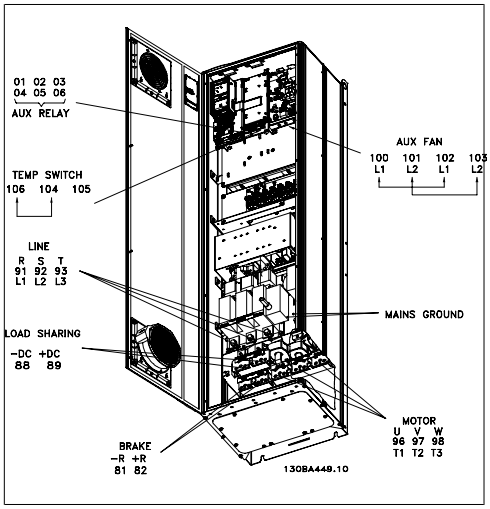
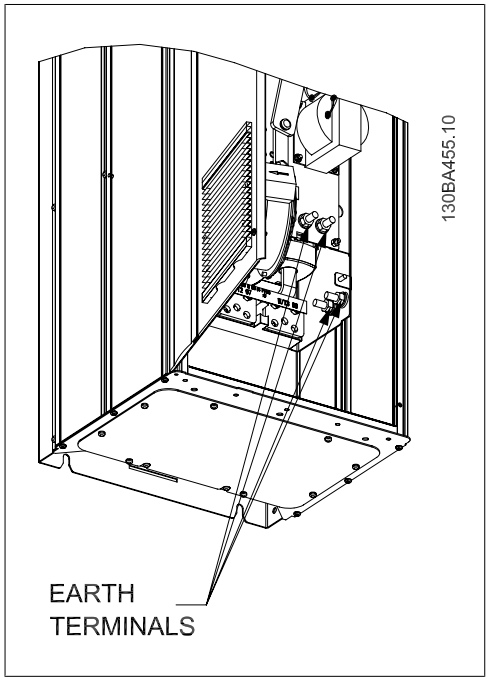
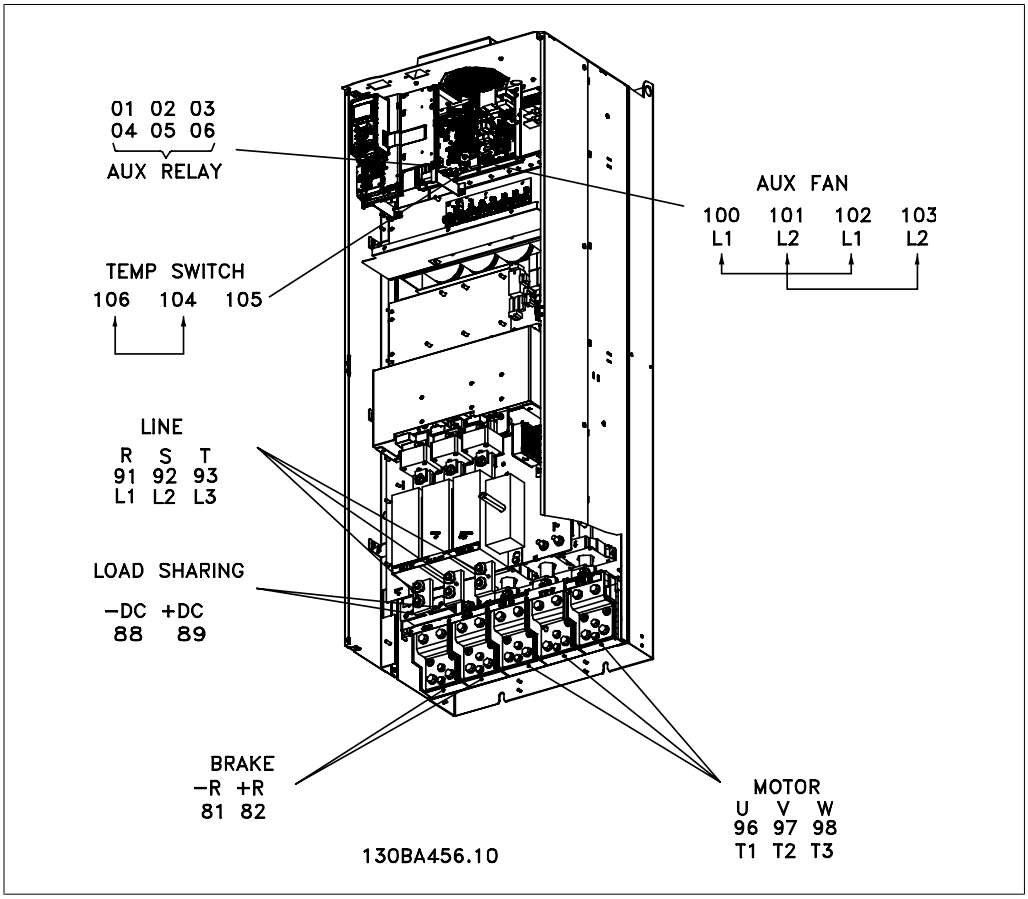



3.74: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12) with disconnect, fuse and RFI filter, enclosure D2

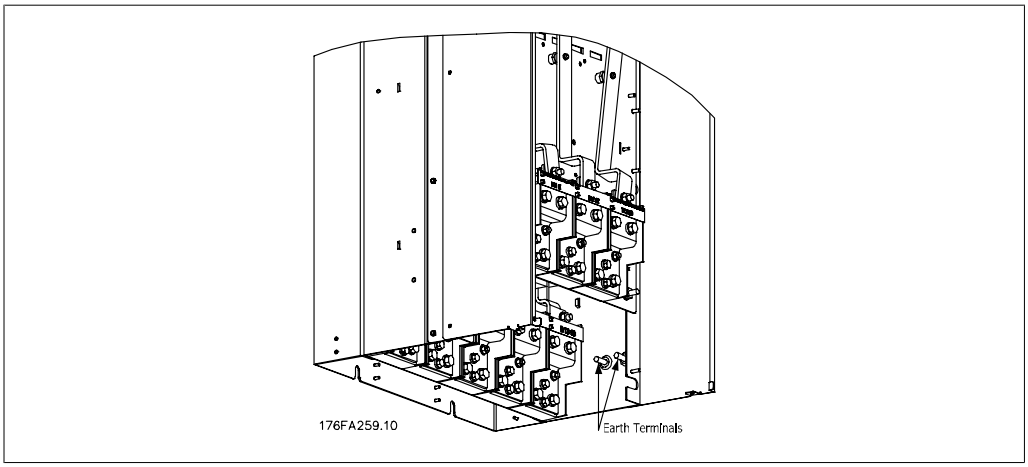



3.75: Position of ground terminals IP 21 (NEMA type 1) and IP 54 (NEMA type 12)

3




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




3.77: Position of ground terminals IP 00, E enclosures



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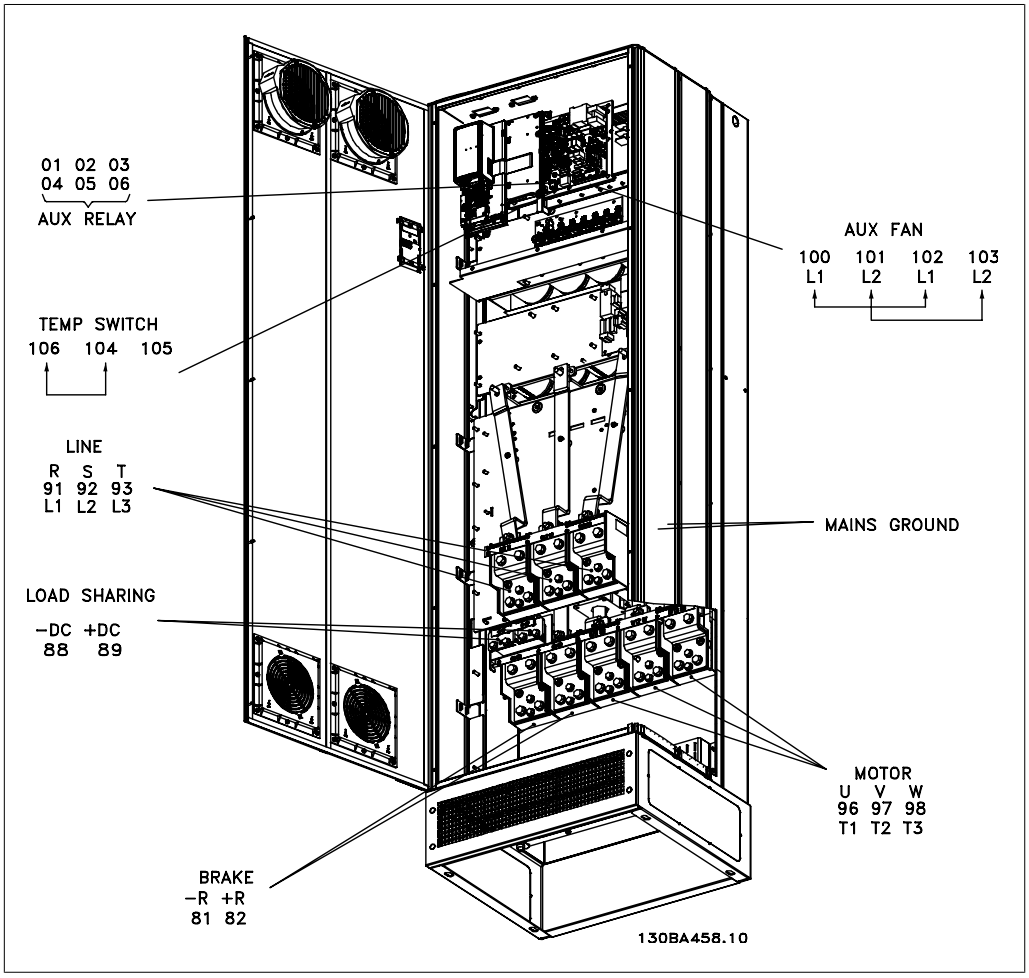



3.78: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12) enclosure E1

## 3.6.3. 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.

## 3.6.4. 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 content may develop in the faulty current.

3

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

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

## 3.6.5. RFI Switch

Line 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, it is recommended that the RFI switch be turned off (OFF) [1] via par. 14-50. For further reference, see IEC 364-3. If 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 to [ON].

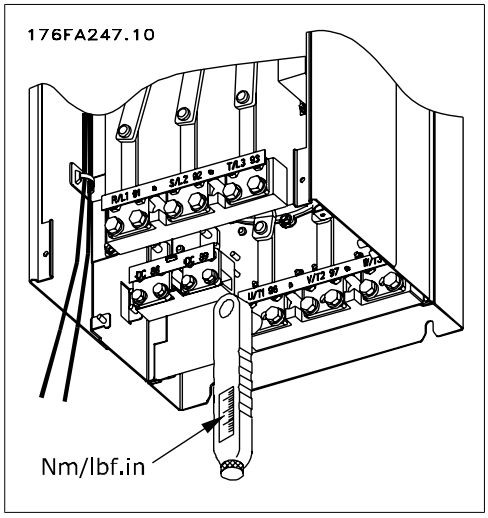
[1] Not required with 525-600/690 V drives; therefore not possible.

In OFF, the internal RFI capacities (filter capacitors) between the chassis and the intermediate circuit are cut off to avoid damage to the intermediate circuit and to reduce the 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).

## 3.6.6. Torque

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




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



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

3.4: Torque for terminals

## 3.6.7. 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 with either cable glands or clamps:

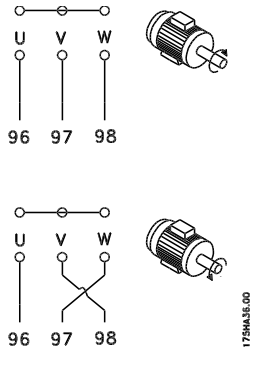
- EMC cable glands: generally available cable glands can be used to ensure an optimum EMC connection.
- EMC cable clamp: Clamps allowing for easy connection are supplied with the adjustable frequency drive.

## 3.6.8. 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 VLT adjustable frequency drive output connected as follows:

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

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




The direction of rotation can be changed by switching two phases in the motor cable or by changing the setting of par. 4-10.

## 3.6.9. Brake Cable

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

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

The connection cable to the brake resistor must be shielded. Connect the shield by means of cable clamps to the conductive back plate 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.

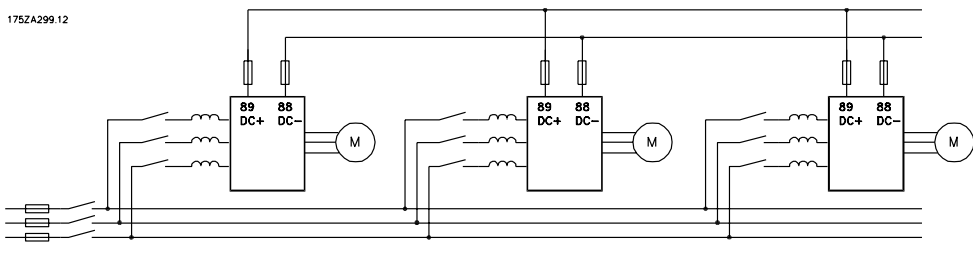
## 3.6.10. Load Sharing

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

| 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 81 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. For further information, please contact Danfoss.




3.80: Load sharing connection



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## 3.6.11. 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.

3.81: Mount the EMC shield.

## 3.6.12. Line connection

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/Earth |

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

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.

## 3.6.13. 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 to the power card.



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

The connector located on the power card provides the 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 LittelFuse KLK-5 or equivalent.

## 3.6.14. Fuses

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

Short-circuit protection
The adjustable frequency drive must be protected against short circuit in order to prevent 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 an internal overcurrent protection that can be used for upstream overload protection (UL applications excluded), see par. 4-18. Moreover, fuses or circuit breakers can be used to provide the overcurrent protection in the installation. Overcurrent protection must always be carried out according to national regulations.

Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 $A_{rms}$ (symmetrical).

Fuse Tables

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

3.5: D enclosures, 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 480 V UL-listed fuse with associated current rating may be used to meet UL requirements.

| Size/ Type | Bussmann E125085 JFHR2 | Amps | SIBA E180276 JFHR2 | Ferraz-Shawmut E76491 JFHR2 |
|---|---|---|---|---|
| P110 | 170M3017 | 315 | 2061032.315 | 6.6URD30D08A0315 |
| P132 | 170M3018 | 350 | 2061032.350 | 6.6URD30D08A0350 |
| P160 | 170M4011 | 350 | 2061032.350 | 6.6URD30D08A0350 |
| P200 | 170M4012 | 400 | 2061032.400 | 6.6URD30D08A0400 |
| P250 | 170M4014 | 500 | 2061032.500 | 6.6URD30D08A0500 |
| P315 | 170M5011 | 550 | 2062032.550 | 6.6URD32D08A0550 |

3.6: D enclosures, 525-600 V

| Size/ Type | Bussmann PN* | Danfoss PN | Rating | Losses (W) |
|---|---|---|---|---|
| P315 | 170M5013 | 20221 | 900 A, 700 V | 120 |
| P355 | 170M6013 | 20221 | 900 A, 700 V | 120 |
| P400 | 170M6013 | 20221 | 900 A, 700 V | 120 |
| P450 | 170M6013 | 20221 | 900A, 700 V | 120 |

3.7: E enclosures, 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.

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

3.8: Additional Fuses for Non-UL Applications, E enclosures, 380-480 V

| Size/ Type | Bussmann PN* | Danfoss PN | Rating | Losses (W) |
|---|---|---|---|---|
| P355 | 170M4017<br>170M5013 | 20220 | 700 A, 700 V | 85 |
| P400 | 170M4017<br>170M5013 | 20220 | 700 A, 700 V | 85 |
| P500 | 170M6013 | 20221 | 900 A, 700 V | 120 |
| P560 | 170M6013 | 20221 | 900 A, 700 V | 120 |

3.9: E enclosures, 525-600 V

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

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

3.10: Additional Fuses for Non-UL ApplicationsE enclosures, 525-600 V

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

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

| Size/ Type | Rating plug catalog # | Amps |
|---|---|---|
| P110 | SRPK800A300 | 300 |
| P132 | SRPK800A350 | 350 |
| P160 | SRPK800A400 | 400 |
| P200 | SRPK800A500 | 500 |
| P250 | SRPK800A600 | 600 |

3.11: D enclosures, 380-480 V

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

| | | |
|---|---|---|
| P110 - P200 | 380-500 V | type gG |
| P250 - P450 | 380-500 V | type gR |

## 3.6.15. Brake Resistor Temperature Switch

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

This input can be used to monitor the temperature of an externally connected brake resistor. If the input between 104 and 106 opens, the adjustable frequency drive will trip on warning/alarm


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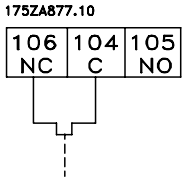
27, "Brake IGBT". If the connection is closed between 104 and 105, the adjustable frequency drive will trip on warning/alarm 27, "Brake IGBT".
Normally closed: 104-106 (factory installed jumper)
Normally open: 104-105

| 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.




## 3.6.16. Access to Control Terminals

All terminals to the control cables are located beneath the LCP, accessed by opening the door of the IP 21/ 54 version or removing the covers of the IP 00 version.

## 3.6.17. Electrical Installation, Control Terminals

To connect the cable to the terminal:

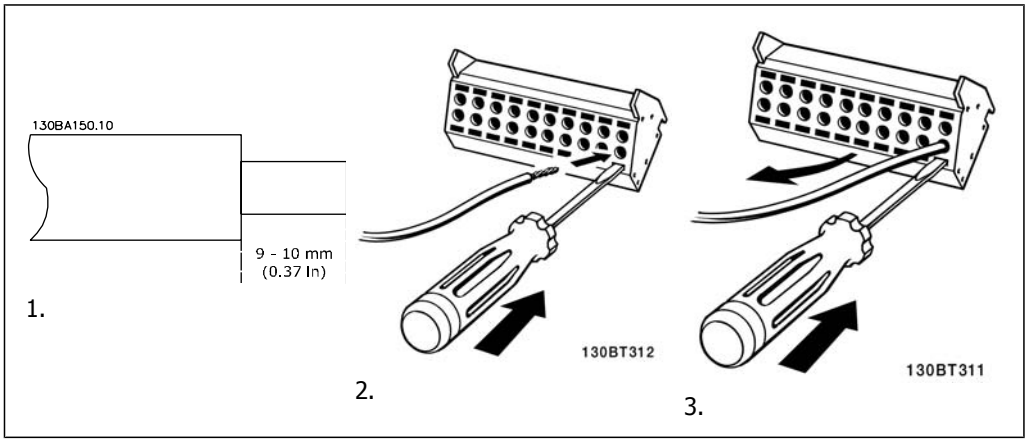
1. Strip insulation of 0.34-0.39 in [9-10 mm]
2. Insert a screwdriver[1)] into the square hole.
3. Insert the cable in the adjacent circular hole.
4. Remove the screwdriver. The cable is now mounted to the terminal.

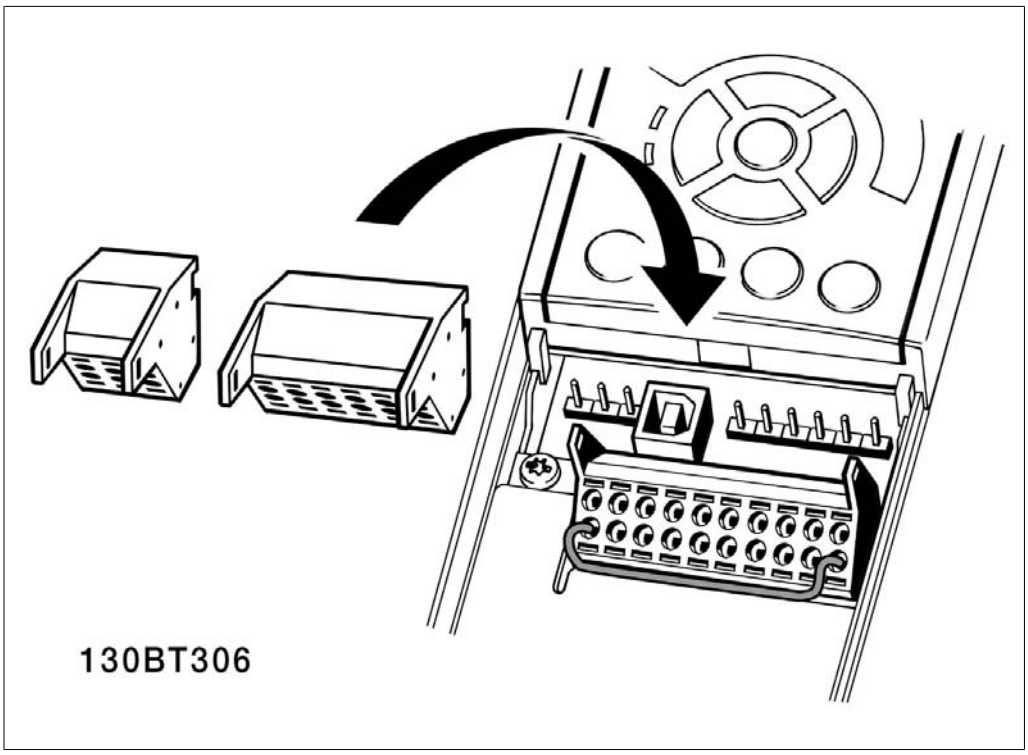
To remove the cable from the terminal:

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

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

3



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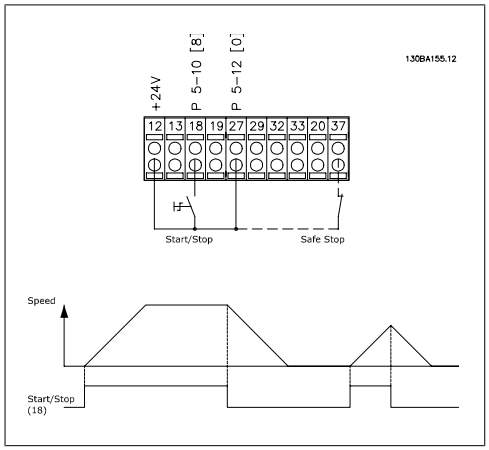
# 3.7. Connection Examples

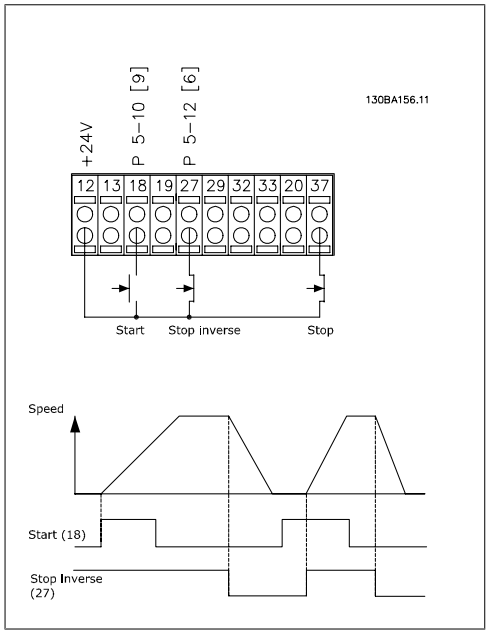
## 3.7.1. Start/ Stop

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




## 3.7.2. Pulse Start/ Stop

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



## 3.7.3. Speed Up/ Slow

Terminals 29/ 32 = Speed up/ Slow: .

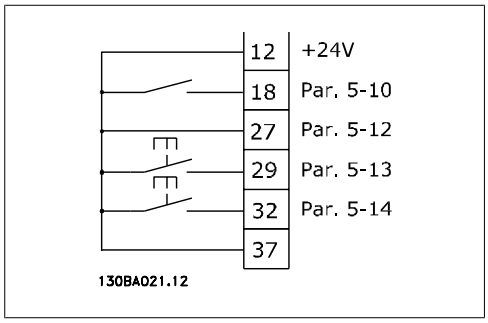
Terminal 18 = Par. 5-10 [9] *Start* (default)

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).




## 3.7.4. Potentiometer Reference

Voltage reference via a potentiometer:

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

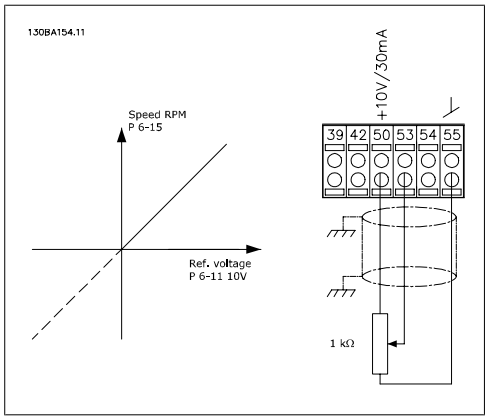
Terminal 53, Low Voltage = 0 Volt

Terminal 53, High Voltage = 10 Volt

Terminal 53, Low Ref./Feedback = 0 RPM

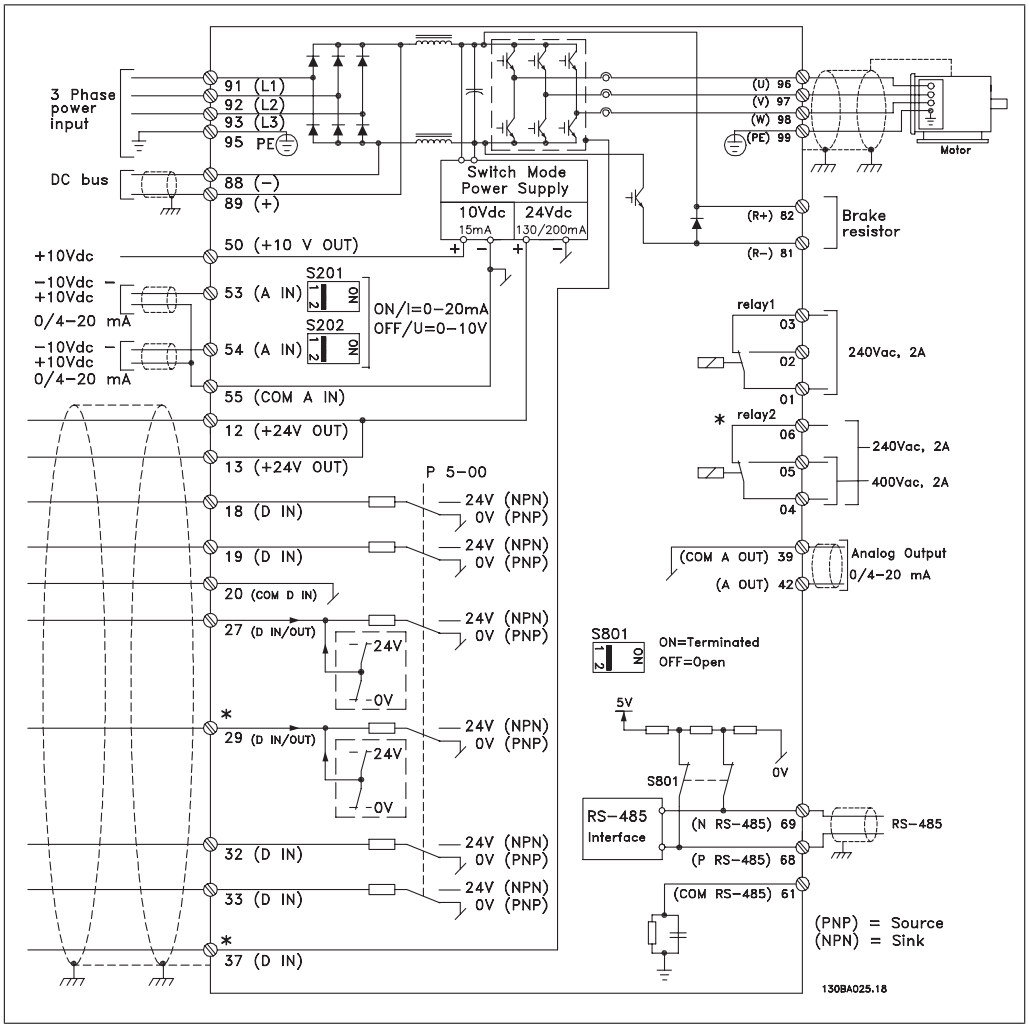
Terminal 53, High Ref./Feedback = 1500 RPM

Switch S201 = OFF (U)



# 3.8. Electrical Installation - continued

## 3.8.1. Electrical Installation, Control Cables




3.82: Diagram showing all electrical terminals without options.
Terminal 37 is the input to be used for Safe Stop. For instructions on safe stop installation, refer to the section *Safe Stop Installation* in the adjustable frequency drive Design Guide. See also sections Safe Stop and Safe Stop Installation.

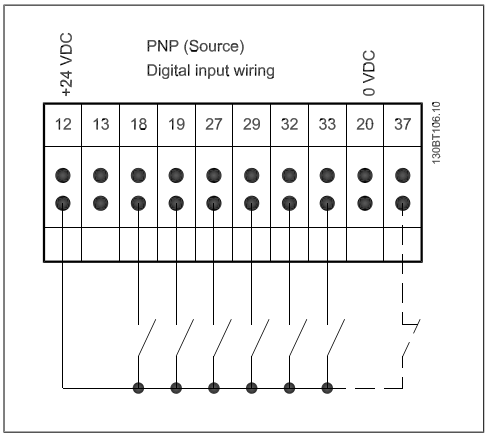
In rare cases, very long control cables and analog signals may, depending on installation, result in 50/60 Hz ground loops due to noise from line supply cables.

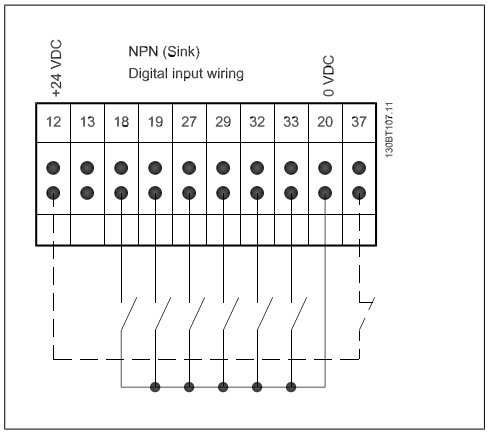
If this occurs, it may be necessary to break the shield or insert a 100 nF capacitor between shield and chassis.

The digital and analog inputs and outputs must be connected separately to the adjustable frequency drive common inputs (terminal 20, 55, 39) to prevent ground currents from both groups

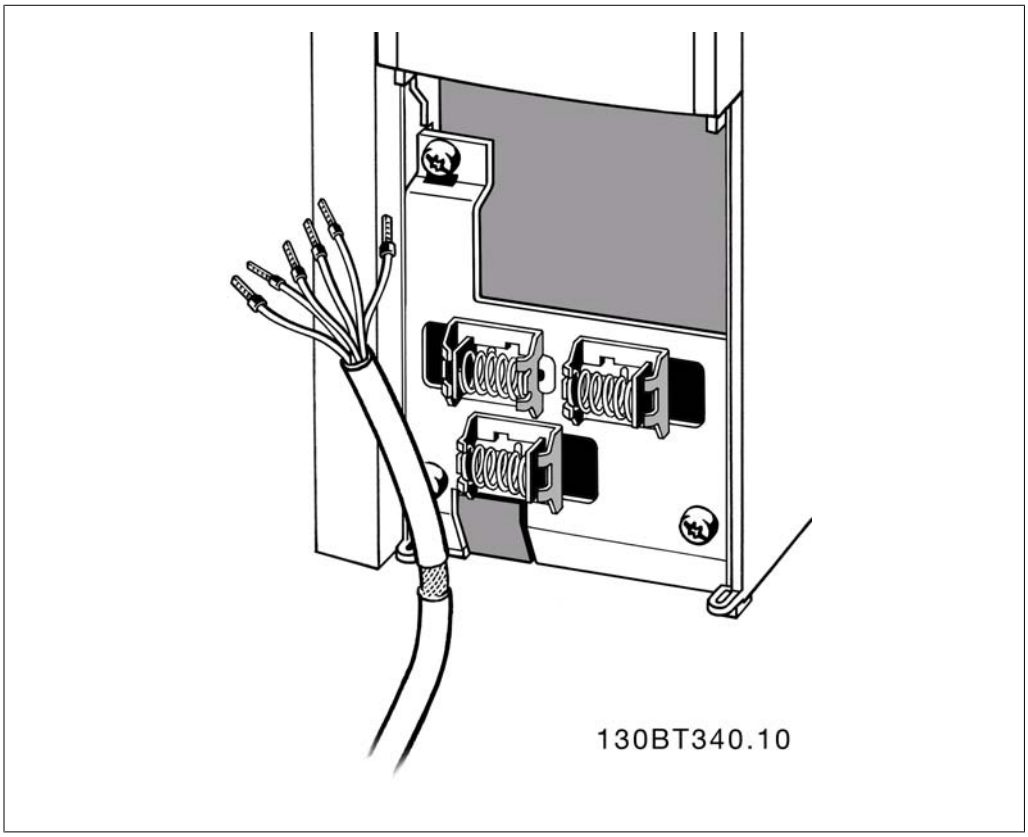
from affecting other groups. For example, switching on the digital input may disturb the analog input signal.

Input polarity of control terminals




NOTE
Control cables must be shielded/armored.



## 3.8.2. Switches S201, S202, and S801

Switches S201 (A53) and S202 (A54) are used to select a current (0-20 mA) or a voltage (-10 to 10 V) configuration 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.*

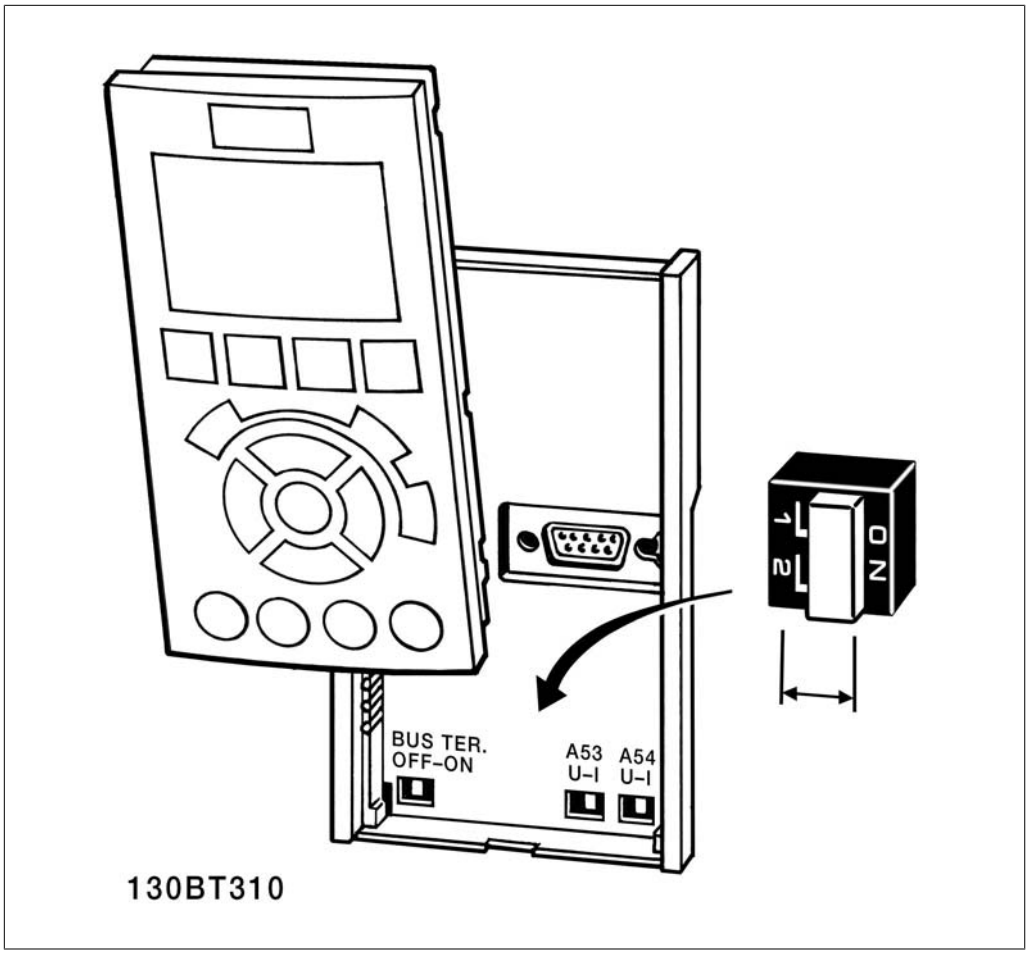
Default setting:

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. Removing the LCP fixture (cradle) when operating the switches is recommended. The switches must not be operated while the adjustable frequency drive is powered.



# 3.9. Final Set-up and Test

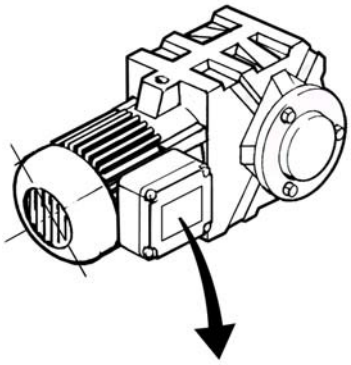
## 3.9.1. Final Set-Up and Test

3

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.



| BAUER D-73734 ESLINGEN | | | | |
|---|---|---|---|---|
| 3 ~ MOTOR NR. 1827421 | | | | 2003 |
| | | | | |
| S/E005A9 | | | | |
| | 1,5 | kW | | |
| $n_2$ 31,5 | /min. | 400 | Y | V |
| $n_1$ 1400 | /min. | | 50 | Hz |
| cos φ 0,80 | | | 3,6 | A |
| | | | | |
| 1,7L | | | | |
| B | IP 65 | H1/1A | | |

130BT307

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

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

Step 3. Activate the Automatic Motor Adaptation (AMA)
Performing an AMA will ensure optimum performance. The AMA measures the values from the motor model equivalent diagram.

1. Connect terminal 37 to terminal 12 (if terminal 37 is available).
2. Connect terminal 27 to terminal 12, or set par. 5-12 to 'No function' (par. 5-12 [0])
3. Activate the AMA par. 1-29.

4. Choose between complete or reduced AMA. If a sine-wave filter is mounted, run only the reduced AMA, or remove the sine-wave filter during the AMA procedure.
5. Press the [OK] key. The display shows "Press [Hand on] to start."
6. Press the [Hand on] key. A progress bar indicates if the AMA is in progress.

Stop the AMA during operation.

1. Press the [OFF] key. The 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 difference that is too large between the motor power size and the adjustable frequency drivepower size.

Step 4. Set speed limit and ramp time

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

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

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

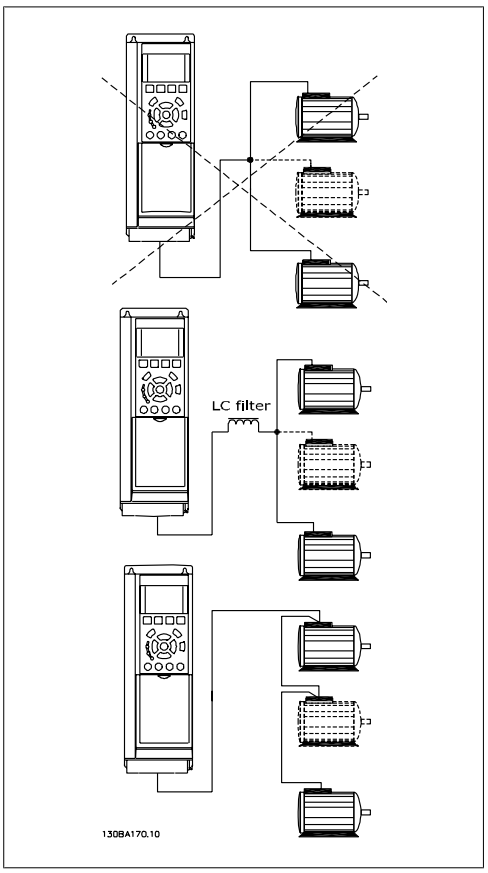
| | |
|---|---|
| Ramp-up Time 1 [s] | par. 3-41 |
| Ramp-down Time 1 [s] | par. 3-42 |

# 3.10. Additional Connections

## 3.10.1. Parallel Connection of Motors

3

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 for 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.

## 3.10.2. 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, $I_{M,N}$* 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.

# 4. How to Program

## 4.1. Graphical (GLCP) and Numerical (NLCP) Display

The easiest way to program the adjustable frequency drive is to use the Graphical Local Control Panel (LCP 102). It is necessary to consult the adjustable frequency drive Design Guide when using the Numeric Local Control Panel (LCP 101).



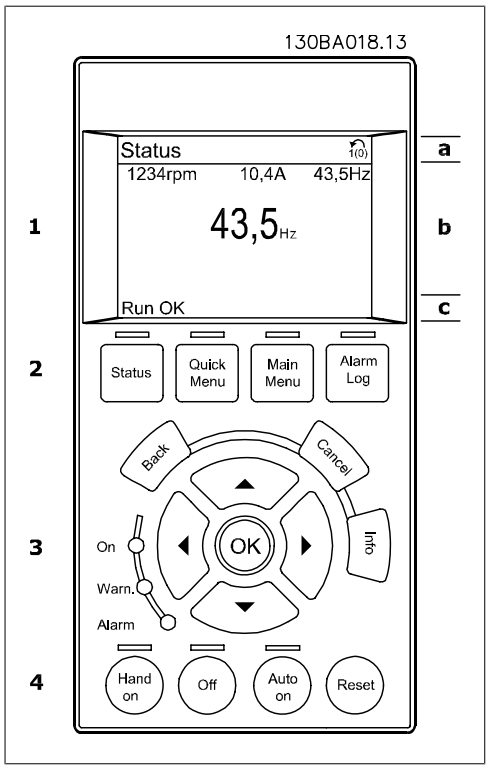
### 4.1.1. How to Program on the Graphical LCP

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

The control panel is divided into four functional groups:

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

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




Display lines:

a. Status line: Status messages displaying icons and graphics.1

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

c. Status line: Status messages displaying text.1

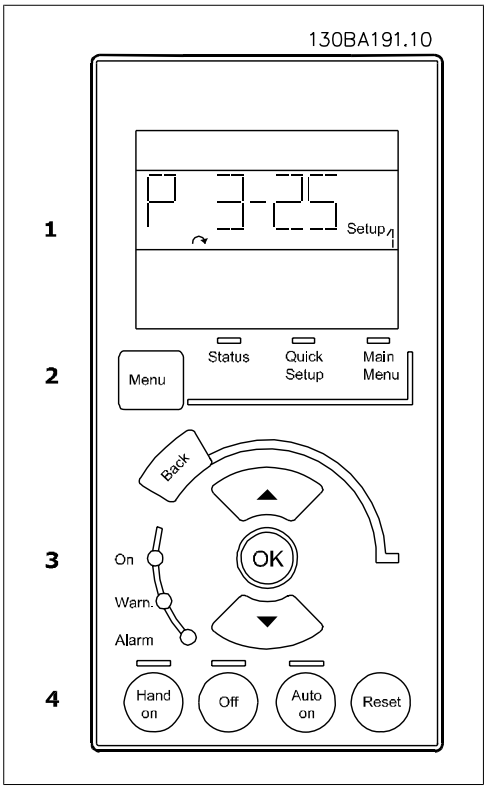
4

## 4.1.2. How to Program on the Numerical Local Control Panel

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

The control panel is divided into four functional groups:

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



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# 4.2. Quick Set-up

## 4.2.1. 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 the 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, Broken Belt Function* is set to [Off]. However, you should still monitor the fan belt condition - non-broken or broken - according to the following procedure:

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

If [No Operation] is selected in *par. 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. Terminal 27 Digital Input*, a connection to +24 V is necessary to enable start.

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 in graphs.

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

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 areas 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.

4

Example of using the Quick Set-up option

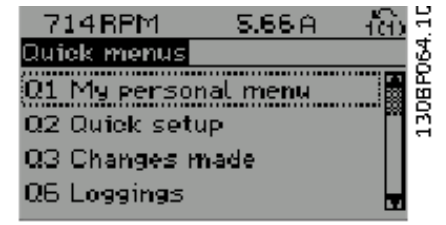
Assume you want to set the ramp-down time to 100 seconds!

1. Press [Quick Set-up]. The first *par. 0-01 Language* in Quick Set-up appears.
2. Press [▼] repeatetly 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 3rd 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.

NOTE
A complete description of the function is found in the parameter sections of this Instruction Manual.




4.1: Quick Menu view.

The QUICK Set-up menu gives access to the 12 most important set-up parameters of the drive. After programming, the drive will, in most cases, be ready for operation. The 12 (see footnote) quick menu parameters are shown in the table below. A complete description of the function is given in the parameter sections of this manual.

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

4.1: Quick Set-up parameters

*The display showing depends on choices made in parameter 0-02 and 0-03. The default setting of parameters 0-02 and 0-03 depends on which region of the world the adjustable frequency drive is supplied to but can be re-programmed as required.

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Parameters for Quick Set-up function:

**0-01 Language**

| Option: | | Function: |
|---|---|---|
| | | Defines the language to be used in the display.<br>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 UK | Part of Language packages 1 - 4 |
| [1] | German | Part of Language packages 1 - 4 |
| [2] | French | Part of Language package 1 |
| [3] | Danish | Part of Language package 1 |
| [4] | Spanish | Part of Language package 1 |
| [5] | Italian | Part of Language package 1 |
| [6] | Swedish | Part of Language package 1 |
| [7] | Dutch | Part of Language package 1 |
| [10] | Chinese | Language package 2 |
| [20] | Finnish | Part of Language package 1 |
| [22] | English US | Part of Language package 4 |
| [27] | Greek | Part of Language package 4 |
| [28] | Portuguese | Part of Language package 4 |
| [36] | Slovenian | Part of Language package 3 |

| | | |
|---|---|---|
| [39] | Korean | Part of Language package 2 |
| [40] | Japanese | Part of Language package 2 |
| [41] | Turkish | Part of Language package 4 |
| [42] | Traditional Chinese | Part of Language package 2 |
| [43] | Bulgarian | Part of Language package 3 |
| [44] | Serbian | Part of Language package 3 |
| [45] | Romanian | Part of Language package 3 |
| [46] | Hungarian | Part of Language package 3 |
| [47] | Czech | Part of Language package 3 |
| [48] | Polish | Part of Language package 4 |
| [49] | Russian | Part of Language package 3 |
| [50] | Thai | Part of Language package 2 |
| [51] | Bahasa Indonesian | Part of Language package 2 |

4

### 1-20 Motor Power [kW]

| Range: | Function: |
|---|---|
| Size related* [0.12-670 hp [0.09 - 500 kW]] | Enter the nominal motor power (in kW) according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit.<br>This parameter cannot be adjusted while the motor is running.<br>Depending on the choices made in par. 0-03 *Regional Settings*, either par. 1-20 or par. 1-21 *Motor Power* is made invisible. |

### 1-21 Motor Power [HP]

| Range: | Function: |
|---|---|
| Size related* [0.09-500 hp] | Enter the nominal motor power (in HP) according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit.<br>This parameter cannot be adjusted while the motor is running.<br>Depending on the choices made in par. 0-03 *Regional Settings*, either par. 1-20 or par. 1-21 *Motor Power* is made invisible. |

### 1-22 Motor Voltage

| Range: | Function: |
|---|---|
| Size related* [10 - 1,000 V] | Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. |


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This parameter cannot be adjusted while the motor is running.

| 1-23 Motor Frequency | |
|---|---|
| Range: | Function: |
| Size related* [20 - 1000 Hz] | Select the motor frequency value from the motor nameplate data. For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. Adapt par. 4-13 *Motor Speed High Limit [RPM)* and par. 3-03 *Maximum Reference* to the 87 Hz application. |

This parameter cannot be adjusted while the motor is running.

| 1-24 Motor Current | |
|---|---|
| Range: | Function: |
| Size related* [0.1 - 10,000 A] | Enter the nominal motor current value from the motor nameplate data. This data is used for calculating motor torque, motor thermal protection, etc. |

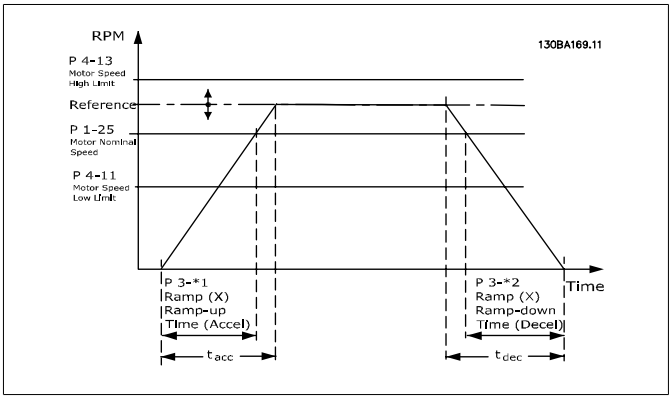
This parameter cannot be adjusted while the motor is running.

| 1-25 Motor Nominal Speed | |
|---|---|
| Range: | Function: |
| Size related* [100 - 60,000 rpm] | Enter the nominal motor speed value from the motor nameplate data. This data is used for calculating automatic motor compensations. |

This parameter cannot be adjusted while the motor is running.

| 3-41 Ramp 1 Ramp-up Time | |
|---|---|
| Range: | Function: |
| 3 s* [1 - 3600 s] | Enter the ramp-up time, i.e., the acceleration time from 0 rpm to the rated motor speed $n_{M,N}$ (par. 1-25). Choose a ramp-up time such that the output current does not exceed the current limit in par. 4-18 during ramping. Enter the ramp-up time, i.e., the acceleration time from 0 rpm to the rated motor speed $n_{M,N}$ (par. 1-25) |

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




4

### 3-42 Ramp 1 Ramp-down Time

| Range: | Function: |
|---|---|
| 3 s* [1 - 3,600 s] | Enter the ramp-down time, i.e., the deceleration time from the rated motor speed $n_{M,N}$ (par. 1-25) to 0 rpm. Choose a ramp-down time so that no overvoltage arises in the inverter due to regenerative operation of the motor, and so that the generated current does not exceed the current limit set in par. 4-18. See ramp-up time in par. 3-41. |

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

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

| Range: | Function: |
|---|---|
| Size re- lated* [0 - 60,000 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 *Motor Speed High Limit [RPM]*. |

### 4-12 Motor Speed Low Limit [Hz]

| Range: | Function: |
|---|---|
| Size re- lated* [0 - 1000 Hz] | Enter the minimum limit for motor speed. The motor speed low limit can be set to correspond to the minimum output frequency of the motor shaft. The Motor Speed Low Limit must not exceed the setting in par. 4-14 *Motor Speed High Limit [Hz]*. |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### 4-13 Motor Speed High Limit [RPM]

| Range: | Function: |
|---|---|
| Size re-lated* [0 - 60,000 rpm] | Enter the maximum limit for motor speed. The Motor Speed High Limit can be set to correspond to the manufacturer's maximum rated motor speed. The Motor Speed High Limit must exceed the setting in par. 4-11 *Motor Speed Low Limit [RPM]*. Only par. 4-11 or 4-12 will be displayed depending on other parameters set in the Main Menu, and depending on default settings specific to global geographical locations. |

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

### 4-14 Motor Speed High Limit [Hz]

| Range: | Function: |
|---|---|
| Size re-lated* [0 - 1000 Hz] | Enter the maximum limit for motor speed. The motor speed high limit can be set to correspond to the manufacturer's recommended maximum frequency of the motor shaft. The Motor Speed High Limit must exceed the setting in par. 4-12 *Motor Speed Low Limit [Hz]*. Only par. 4-11 or 4-12 will be displayed depending on other parameters set in the Main Menu, and depending on default settings specific to global geographical locations. |

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

### 3-11 Jog Speed [Hz]

| Range: | Function: |
|---|---|
| Size re-lated* [0 - 1000 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. |

# 4.3. Parameter Descriptions

## 4.3.1. Parameter Set-up

4

| 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; dymamic/resistor braking and over voltage 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 (MCB108) (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 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 outside air relative humidity, and if it is below a defined value, the supply air temperature setpoint could be automatically increased. With the adjustable frequency drive monitoring the outside air relative humidity and supply air temperature via it's 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. |

4.2: Parameter Groups



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| 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 backup 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 indentification 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 prevantative 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 3 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 3 extended closed-loop PI(D) controllers which, for example, can be used to control external actuators (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 the 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 acoss the furthest most significant load(s) in the system; using this function can compensate for the sensor installation and help to realize the 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 setback mode or start/stop of the pump/fan/compressor start/stop of 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 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.

4

# 4.4. Parameter Options

## 4.4.1. Default settings

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

4-Set-up
'All set-up': the parameter can be set individually in each of the four set-ups, i.e., one single parameter can have four different data values.
'1 set-up': the data value will be the same in all set-ups.

Conversion index
This number refers to a conversion figure used when writing or reading by means of an adjustable frequency drive.

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

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

## 4.4.2. 0-** Operation and Display

| Par. No. # | Parameter description | Default value | 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 | [0] RPM | 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 Custom 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 |

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| Par. No. | # | Parameter description | Default value | 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 | [0] Disabled | 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] |



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## 4.4.3. 1-** Load / Motor

| Par. No. # | Parameter description | Default value | 4 set-up | Change during operation | Conver-sion 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* Adv. 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 Depen. Setting | | | | | | |
| 1-60 | Low Speed Load Compensation | 100 % | All set-ups | TRUE | 0 | Int16 |
| 1-61 | High Speed Load Compensation | 100 % | All set-ups | TRUE | 0 | Int16 |
| 1-62 | Slip Compensation | 0 % | All set-ups | TRUE | 0 | Int16 |
| 1-63 | Slip Compensation Time Constant | 0.10 s | All set-ups | TRUE | -2 | Uint16 |
| 1-64 | Resonance Damping | 100 % | All set-ups | TRUE | 0 | Uint16 |
| 1-65 | Resonance Damping 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 |
| 1-9* 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 |



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## 4.4.4. 2-** Brakes

| Par. No. # | Parameter description | Default value | 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 Funct. | | | | | | |
| 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 | Braking Energy Limit (kW) | ExpressionLimit | All set-ups | TRUE | 0 | Uint32 |
| 2-13 | Braking Energy 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 | Overvoltage Control | [2] Enabled | All set-ups | TRUE | - | Uint8 |



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## 4.4.5. 3-** Reference / Ramps

| Par. No. # | Parameter description | Default value | 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 | [0] Sum | All set-ups | TRUE | - | Uint8 |
| 3-1* | References | | | | | |
| 3-10 | Preset Reference | 0.00 % | All set-ups | TRUE | -2 | Int16 |
| 3-11 | Jog Speed [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Uint16 |
| 3-13 | 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 | Uint16 |
| 3-4* | Ramp 1 | | | | | |
| 3-41 | Ramp 1 Ramp-up Time | ExpressionLimit | All set-ups | TRUE | -2 | Uint32 |
| 3-42 | Ramp 1 Ramp-down Time | ExpressionLimit | All set-ups | TRUE | -2 | Uint32 |
| 3-5* | Ramp 2 | | | | | |
| 3-51 | Ramp 2 Ramp-up Time | ExpressionLimit | All set-ups | TRUE | -2 | Uint32 |
| 3-52 | Ramp 2 Ramp-down Time | ExpressionLimit | All set-ups | TRUE | -2 | Uint32 |
| 3-8* | Other Ramps | | | | | |
| 3-80 | Jog Ramp Time | ExpressionLimit | All set-ups | TRUE | -2 | Uint32 |
| 3-81 | Quick Stop Ramp Time | ExpressionLimit | 2 set-ups | TRUE | -2 | Uint32 |
| 3-9 * | Digital Potentiometer | | | | | |
| 3-90 | Step Size | 0.10 % | All set-ups | TRUE | -2 | Uint16 |
| 3-91 | Ramp Time | 1.00 s | All set-ups | TRUE | -2 | Uint32 |
| 3-92 | Power Restore | [0] Off | All set-ups | TRUE | - | Uint8 |
| 3-93 | Maximum Limit | 100 % | All set-ups | TRUE | 0 | Int16 |
| 3-94 | Minimum Limit | 0 % | All set-ups | TRUE | 0 | Int16 |
| 3-95 | Ramp Delay | 1.000 N/A | All set-ups | TRUE | -3 | TimD |

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## 4.4.6. 4-** Limits / Warnings

| Par. No. # | Parameter description | Default value | 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 | - | Uint8 |
| 4-11 | Motor Speed Low Limit [RPM] | ExpressionLimit | All set-ups | TRUE | 67 | Uint16 |
| 4-12 | Motor Speed Low Limit [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Uint16 |
| 4-13 | Motor Speed High Limit [RPM] | ExpressionLimit | All set-ups | TRUE | 67 | Uint16 |
| 4-14 | Motor Speed High Limit [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Uint16 |
| 4-16 | Torque Limit Motor Mode | 110.0 % | All set-ups | TRUE | -1 | Uint16 |
| 4-17 | Torque Limit Generator Mode | 100.0 % | All set-ups | TRUE | -1 | Uint16 |
| 4-18 | Current Limit | ExpressionLimit | All set-ups | TRUE | -1 | Uint32 |
| 4-19 | Max. Output Frequency | ExpressionLimit | All set-ups | FALSE | -1 | Uint16 |
| 4-5* Adj. Warnings | | | | | | |
| 4-50 | Warning Current Low | 0.00 A | All set-ups | TRUE | -2 | Uint32 |
| 4-51 | Warning Current High | ImaxVLT (P1637) | All set-ups | TRUE | -2 | Uint32 |
| 4-52 | Warning Speed Low | 0 RPM | All set-ups | TRUE | 67 | Uint16 |
| 4-53 | Warning Speed High | outputSpeedHighLimit (P413) | All set-ups | TRUE | 67 | Uint16 |
| 4-54 | Warning Reference Low | -999999.999 N/A | All set-ups | TRUE | -3 | Int32 |
| 4-55 | Warning Reference High | 999999.999 N/A | All set-ups | TRUE | -3 | Int32 |
| 4-56 | Warning Feedback Low | -999999.999 ReferenceFeedbackUnit | All set-ups | TRUE | -3 | Int32 |
| 4-57 | Warning Feedback High | 999999.999 ReferenceFeedbackUnit | All set-ups | TRUE | -3 | Int32 |
| 4-58 | Missing Motor Phase Function | [1] On | All set-ups | TRUE | - | Uint8 |
| 4-6* Speed Bypass | | | | | | |
| 4-60 | Bypass Speed From [RPM] | ExpressionLimit | All set-ups | TRUE | 67 | Uint16 |
| 4-61 | Bypass Speed From [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Uint16 |
| 4-62 | Bypass Speed To [RPM] | ExpressionLimit | All set-ups | TRUE | 67 | Uint16 |
| 4-63 | Bypass Speed To [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Uint16 |
| 4-64 | Semi-Auto Bypass Set-up | [0] Off | All set-ups | FALSE | - | Uint8 |



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## 4.4.7. 5-** Digital In / Out

| Par. No. # | Parameter description | Default value | 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 | [10] Reversing | 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 |

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| 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 |



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## 4.4.8. 6-** Analog In / Out

| Par. No. # | Parameter description | Default value | 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 |

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| Par. No. # | Parameter description | Default value | 4 set-up | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|
| 6-5* | Analog Output 42 | | | | | |
| 6-50 | Terminal 42 Output | [100] Output frequency | 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 |



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## 4.4.9. 8-** Communication and Options

| Par. No. # | Parameter description | Default value | 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 | [0] FC | 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 | Maximum Response Delay | ExpressionLimit | 1 set-up | TRUE | -3 | Uint16 |
| 8-37 | Maximum 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 | Reversing Select | null | All set-ups | TRUE | - | Uint8 |
| 8-55 | Set-up Select | [3] Logic OR | All set-ups | TRUE | - | Uint8 |
| 8-56 | Preset Reference Select | [3] Logic OR | All set-ups | TRUE | - | Uint8 |
| 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 | "I-Am" Service | [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 |

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| Par. No. # | Parameter description | Default value | 4 set-up | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|
| 8-9* | Bus Jog/ Feedback | | | | | |
| 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 |



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## 4.4.10. 9-** Profibus

| Par. No. # | Parameter description | Default value | 4 set-up | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|
| 9-00 | Setpoint | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-07 | Actual Value | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-15 | PCD Write Configuration | ExpressionLimit | 2 set-ups | TRUE | - | Uint16 |
| 9-16 | PCD Read Configuration | ExpressionLimit | 2 set-ups | TRUE | - | Uint16 |
| 9-18 | Node Address | 126 N/A | 1 set-up | TRUE | 0 | Uint8 |
| 9-22 | Telegram Selection | [108] PPO 8 | 1 set-up | TRUE | - | Uint8 |
| 9-23 | Parameters for Signals | 0 | All set-ups | TRUE | - | Uint16 |
| 9-27 | Parameter Edit | [1] Enabled | 2 set-ups | FALSE | - | Uint16 |
| 9-28 | Process Control | [1] Enable cyclic master | 2 set-ups | FALSE | - | Uint8 |
| 9-44 | Fault Message Counter | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-45 | Fault Code | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-47 | Fault Number | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-52 | Fault Situation Counter | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-53 | Profibus Warning Word | 0 N/A | All set-ups | TRUE | 0 | 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 |

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## 4.4.11. 10-** CAN Ser. Com. Bus

| Par. No. # | Parameter description | Default value | 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 |



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## 4.4.12. 11-** LonWorks

| Par. No. # | Parameter description | Default value | 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 |



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## 4.4.13. 13-** Smart Logic Controller

| Par. No. # | Parameter description | Default value | 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 |



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## 4.4.14. 14-** Special Functions

| Par. No. # | Parameter description | Default value | 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* | Line Supply On/Off | | | | | |
| 14-12 | Function at Line Imbalance | [0] Trip | All set-ups | TRUE | - | Uint8 |
| 14-2* | Reset Functions | | | | | |
| 14-20 | Reset Mode | [0] Manual reset | 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 Ctrl, Proportional Gain | 100 % | All set-ups | FALSE | 0 | Uint16 |
| 14-31 | Current Lim Ctrl, Integration Time | 0.020 s | All set-ups | FALSE | -3 | Uint16 |
| 14-4* | Energy Optimizing | | | | | |
| 14-40 | VT Level | 66 % | All set-ups | FALSE | 0 | Uint8 |
| 14-41 | AEO Minimum Magnetization | 40 % | 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 Filter | [1] On | 1 set-up | FALSE | - | Uint8 |
| 14-52 | Fan Control | [0] Auto | All set-ups | TRUE | - | Uint8 |
| 14-53 | Fan Monitor | [1] Warning | All set-ups | TRUE | - | Uint8 |
| 14-6* | 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 |

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## 4.4.15. 15-** FC Information

| Par. No. # | Parameter description | Default value | 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 | Overtemps | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 15-05 | Overvolts | 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 | Adjustable Frequency Drive Ordering No. | 0 N/A | All set-ups | FALSE | 0 | VisStr[8] |
| 15-47 | Power Card Ordering No. | 0 N/A | All set-ups | FALSE | 0 | VisStr[8] |
| 15-48 | LCP ID No | 0 N/A | All set-ups | FALSE | 0 | VisStr[20] |
| 15-49 | SW ID Control Card | 0 N/A | All set-ups | FALSE | 0 | VisStr[20] |
| 15-50 | SW ID Power Card | 0 N/A | All set-ups | FALSE | 0 | VisStr[20] |
| 15-51 | Adjustable Frequency Drive Serial Number | 0 N/A | All set-ups | FALSE | 0 | VisStr[10] |
| 15-53 | Power Card Serial Number | 0 N/A | All set-ups | FALSE | 0 | VisStr[19] |



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| Par. No. # | Parameter description | Default value | 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 | Uint16 |
| 15-93 | Modified Parameters | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 15-99 | Parameter Metadata | 0 N/A | All set-ups | FALSE | 0 | Uint16 |

## 4.4.16. 16-** Data Readouts

| Par. No. # | Parameter description | Default value | 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 | Uint16 |
| 16-13 | Frequency | 0.0 Hz | All set-ups | FALSE | -1 | Uint16 |
| 16-14 | Motor Current | 0.00 A | All set-ups | FALSE | -2 | Int32 |
| 16-15 | Frequency [%] | 0.00 % | All set-ups | FALSE | -2 | N2 |
| 16-16 | Torque [Nm] | 0.0 Nm | All set-ups | FALSE | -1 | Int16 |
| 16-17 | Speed [RPM] | 0 RPM | All set-ups | FALSE | 67 | Int32 |
| 16-18 | Motor Thermal | 0 % | All set-ups | FALSE | 0 | Uint8 |
| 16-22 | Torque [%] | 0 % | All set-ups | FALSE | 0 | Int16 |
| 16-3* | Drive Status | | | | | |
| 16-30 | DC Link Voltage | 0 V | All set-ups | FALSE | 0 | Uint16 |
| 16-32 | Braking Energy /s | 0.000 kW | All set-ups | FALSE | 0 | Uint32 |
| 16-33 | Brake Energy/2 min | 0.000 kW | All set-ups | FALSE | 0 | Uint32 |
| 16-34 | Heatsink Temp. | 32° F [0° C] | All set-ups | FALSE | 100 | Uint8 |
| 16-35 | Inverter Thermal | 0 % | All set-ups | FALSE | 0 | Uint8 |
| 16-36 | Inv. Nom. Current | ExpressionLimit | All set-ups | FALSE | -2 | Uint32 |
| 16-37 | Inv. Max. Current | ExpressionLimit | All set-ups | FALSE | -2 | Uint32 |
| 16-38 | SL Controller State | 0 N/A | All set-ups | FALSE | 0 | Uint8 |
| 16-39 | Control Card Temp. | 32° F [0° C] | All set-ups | FALSE | 100 | Uint8 |
| 16-40 | Logging Buffer Full | [0] No | All set-ups | TRUE | - | Uint8 |
| 16-5* | Ref. & Feedb. | | | | | |
| 16-50 | External Reference | 0.0 N/A | All set-ups | FALSE | -1 | Int16 |
| 16-52 | Feedback [Unit] | 0.000 ProcessCtrlUnit | All set-ups | FALSE | -3 | Int32 |
| 16-53 | DigiPot 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 |


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| Par. No. # | Parameter description | Default value | 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 | Uint16 |
| 16-61 | Terminal 53 Switch Setting | [0] Current | All set-ups | FALSE | - | Uint8 |
| 16-62 | Analog Input 53 | 0.000 N/A | All set-ups | FALSE | -3 | Int32 |
| 16-63 | Terminal 54 Switch Setting | [0] Current | All set-ups | FALSE | - | Uint8 |
| 16-64 | Analog Input 54 | 0.000 N/A | All set-ups | FALSE | -3 | Int32 |
| 16-65 | Analog Output 42 [mA] | 0.000 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* | Ser. Com. Bus & FC Port | | | | | |
| 16-80 | Ser. Com. Bus CTW 1 | 0 N/A | All set-ups | FALSE | 0 | V2 |
| 16-82 | Ser. com. bus REF 1 | 0 N/A | All set-ups | FALSE | 0 | N2 |
| 16-84 | Comm. Option STW | 0 N/A | All set-ups | FALSE | 0 | V2 |
| 16-85 | FC Port CTW 1 | 0 N/A | All set-ups | FALSE | 0 | V2 |
| 16-86 | FC Port REF 1 | 0 N/A | All set-ups | FALSE | 0 | N2 |
| 16-9* | Diagnosis Readouts | | | | | |
| 16-90 | Alarm Word | 0 N/A | All set-ups | FALSE | 0 | Uint32 |
| 16-91 | Alarm Word 2 | 0 N/A | All set-ups | FALSE | 0 | Uint32 |
| 16-92 | Warning Word | 0 N/A | All set-ups | FALSE | 0 | Uint32 |
| 16-93 | Warning Word 2 | 0 N/A | All set-ups | FALSE | 0 | Uint32 |
| 16-94 | Ext. Status Word | 0 N/A | All set-ups | FALSE | 0 | Uint32 |
| 16-95 | Ext. Status Word 2 | 0 N/A | All set-ups | FALSE | 0 | Uint32 |
| 16-96 | Maintenance Word | 0 N/A | All set-ups | FALSE | 0 | Uint32 |

## 4.4.17. 18-** Info & Readouts

| Par. No. # | Parameter description | Default value | 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 |



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## 4.4.18. 20-** FC Closed-loop

| Par. No. # | Parameter description | Default value | 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 |
| 20-2* | 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 | PID Performance | [0] Normal | 2 set-ups | TRUE | - | Uint8 |
| 20-72 | PID Output Change | 0.10 N/A | 2 set-ups | TRUE | -2 | Uint16 |
| 20-73 | Minimum Feedback Level | -999999.000 ProcessCtrlUnit | 2 set-ups | TRUE | -3 | Int32 |
| 20-74 | Maximum Feedback Level | 999999.000 ProcessCtrlUnit | 2 set-ups | TRUE | -3 | Int32 |
| 20-79 | PID 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 |

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## 4.4.19. 21-** Ext. Closed-loop

| Par. No. # | Parameter description | Default value | 4 set-up | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|
| 21-0* | Ext. CL Auto-tuning | | | | | |
| 21-00 | Closed-loop Type | [0] Auto | 2 set-ups | TRUE | - | Uint8 |
| 21-01 | PID Performance | [0] Normal | 2 set-ups | TRUE | - | Uint8 |
| 21-02 | PID Output Change | 0.10 N/A | 2 set-ups | TRUE | -2 | Uint16 |
| 21-03 | Minimum Feedback Level | -999999.000 N/A | 2 set-ups | TRUE | -3 | Int32 |
| 21-04 | Maximum Feedback Level | 999999.000 N/A | 2 set-ups | TRUE | -3 | Int32 |
| 21-09 | PID Auto-tuning | [0] Disabled | All set-ups | TRUE | - | Uint8 |
| 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 | Uint32 |
| 21-23 | Ext. 1 Differentiation Time | 0.00 s | All set-ups | TRUE | -2 | Uint16 |
| 21-24 | Ext. 1 Dif. Gain Limit | 5.0 N/A | All set-ups | TRUE | -1 | Uint16 |
| 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 | Uint32 |
| 21-43 | Ext. 2 Differentiation Time | 0.00 s | All set-ups | TRUE | -2 | Uint16 |
| 21-44 | Ext. 2 Dif. Gain Limit | 5.0 N/A | All set-ups | TRUE | -1 | Uint16 |


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| Par. No. # | Parameter description | Default value | 4 set-up | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|
| 21-5* | Ext. 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. 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 | Uint32 |
| 21-63 | Ext. 3 Differentiation Time | 0.00 s | All set-ups | TRUE | -2 | Uint16 |
| 21-64 | Ext. 3 Dif. Gain Limit | 5.0 N/A | All set-ups | TRUE | -1 | Uint16 |

## 4.4.20. 22-** Application Functions

| Par. No. # | Parameter description | Default value | 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 |
| 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 |


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| Par. No. # | Parameter description | Default value | 4 set-up | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|
| 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 | 999999.999 N/A | All set-ups | TRUE | -3 | Int32 |
| 22-89 | Flow at Design Point | 0.000 N/A | All set-ups | TRUE | -3 | Int32 |
| 22-90 | Flow at Rated Speed | 0.000 N/A | All set-ups | TRUE | -3 | Int32 |

4

## 4.4.21. 23-** Time-based Funtions

| Par. No. # | Parameter description | Default value | 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 |
| 23-5* 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 |



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## 4.4.22. 24-** Application Functions 2

| Par. No. # | Parameter description | Default value | 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, Critical Alarms | 2 set-ups | FALSE | - | Uint8 |
| 24-1* Drive Bypass | | | | | | |
| 24-10 | Drive Bypass Function | [0] Disabled | 2 set-ups | TRUE | - | Uint8 |
| 24-11 | Drive Bypass Delay Time | 0 s | 2 set-ups | TRUE | 0 | Uint16 |

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## 4.4.23. 25-** Cascade Controller

| Par. No. # | Parameter description | Default value | 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 | De-stage Function | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 25-30 | De-stage 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 |


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| 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 | Uint8 |
| 25-83 | Relay Status | 0 N/A | All set-ups | TRUE | 0 | VisStr[4] |
| 25-84 | Pump ON Time | 0 h | All set-ups | TRUE | 74 | Uint32 |
| 25-85 | Relay ON Time | 0 h | All set-ups | TRUE | 74 | Uint32 |
| 25-86 | Reset Relay Counters | [0] Do not reset | All set-ups | TRUE | - | Uint8 |
| 25-9* | Service | | | | | |
| 25-90 | Pump Interlock | [0] Off | All set-ups | TRUE | - | Uint8 |
| 25-91 | Manual Alternation | 0 N/A | All set-ups | TRUE | 0 | Uint8 |

## 4.4.24. 26-** Analog I / O Option MCB 109

| Par. No. # | Parameter description | Default value | 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 | Uint16 |
| 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 | Uint16 |
| 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 | Uint16 |
| 26-37 | Term. X42/5 Live Zero | [1] Enabled | All set-ups | TRUE | - | Uint8 |
| 26-4* | Analog Out 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 Bus Control | 0.00 % | All set-ups | TRUE | -2 | N2 |
| 26-44 | Terminal X42/7 Timeout Preset | 0.00 % | 1 set-up | TRUE | -2 | Uint16 |
| 26-5* | Analog Out 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 Bus Control | 0.00 % | All set-ups | TRUE | -2 | N2 |
| 26-54 | Terminal X42/9 Timeout Preset | 0.00 % | 1 set-up | TRUE | -2 | Uint16 |
| 26-6* | Analog Out 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 Bus Control | 0.00 % | All set-ups | TRUE | -2 | N2 |
| 26-64 | Terminal X42/11 Timeout Preset | 0.00 % | 1 set-up | TRUE | -2 | Uint16 |



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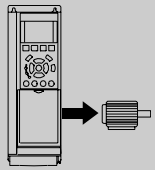
# 5. General Specifications

| Normal overload 110% for 1 minute | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Adjustable frequency drive | P110 | P132 | P160 | P200 | P250 | P315 | P355 | P400 | P450 | | |
| Typical Shaft Output [kW] | 110 | 132 | 160 | 200 | 250 | 315 | 355 | 400 | 450 | | |
| Typical Shaft Output [HP] at 460V | 150 | 200 | 250 | 300 | 350 | 450 | 500 | 550 | 600 | | |
| IP 00 | D3 | D3 | D4 | D4 | D4 | E2 | E2 | E2 | E2 | | |
| IP 21 | D1 | D1 | D2 | D2 | D2 | E1 | E1 | E1 | E1 | | |
| IP 54 | D1 | D1 | D2 | D2 | D2 | E1 | E1 | E1 | E1 | | |
| Output current | | | | | | | | | | | |
| Continuous (3 x 400 V) [A] | 212 | 260 | 315 | 395 | 480 | 600 | 658 | 745 | 800 | | |
| Intermittent (3 x 400 V) [A] | 233 | 286 | 347 | 435 | 528 | 660 | 724 | 820 | 880 | | |
| Continuous (3 x 460-500 V) [A] | 190 | 240 | 302 | 361 | 443 | 540 | 590 | 678 | 730 | | |
| Intermittent (3 x 460-500 V) [A] | 209 | 264 | 332 | 397 | 487 | 594 | 649 | 746 | 803 | | |
| Continuous kVA (400 V AC) [kVA] | 147 | 180 | 218 | 274 | 333 | 416 | 456 | 516 | 554 | | |
| Continuous kVA (460 V AC) [kVA] | 151 | 191 | 241 | 288 | 353 | 430 | 470 | 540 | 582 | | |
| Max. cable size: | | | | | | | | | | | |
| (line power, motor, brake) [mm²/ AWG] [2] | 2x70<br>2x2/0 | | 2x185<br>2x350 mcm | | | 4x240<br>4x500 mcm | | | | | |
| Max. input current | | | | | | | | | | | |
| Continuous (3 x 400 V) [A] | 204 | 251 | 304 | 381 | 463 | 590 | 647 | 733 | 787 | | |
| Continuous (3 x 460/500V) [A] | 183 | 231 | 291 | 348 | 427 | 531 | 580 | 667 | 718 | | |
| Max. pre-fuses[1] [A] | 300 | 350 | 400 | 500 | 600 | 700 | 900 | 900 | 900 | | |
| Environment | | | | | | | | | | | |
| Estimated power loss at rated max. load [W] [4] | 3234 | 3782 | 4213 | 5119 | 5893 | 7630 | 7701 | 8879 | 9428 | | |
| Weight enclosure IP 00 [kg] | 81.9 | 90.5 | 111.8 | 122.9 | 137.7 | 221.4 | 234.1 | 236.4 | 277.3 | | |
| Weight enclosure IP 21 [kg] | 95.5 | 104.1 | 125.4 | 136.3 | 151.3 | 263.2 | 270.0 | 272.3 | 313.2 | | |
| Weight enclosure IP 54 [kg] | 95.5 | 104.1 | 125.4 | 136.3 | 151.3 | 263.2 | 270.0 | 272.3 | 313.2 | | |
| Efficiency [3] | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | | |

[1] For type of fuse, see 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 normal 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). Lower efficiency motors will also add to the power loss in the adjustable frequency drive and vice versa.
If the switching frequency is raised from nominal, the power losses may rise significantly.
LCP and typical control card power consumption values are included. Further options and customer load may add up to 30 W to the losses. (though typically 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%).

Normal overload 110% for 1 minute

| Adjustable frequency drive | | P110 | P132 | P160 | P200 | P250 | P315 | P355 | P400 | P500 | P560 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Typical Shaft Output [kW] | | 110 | 132 | 160 | 200 | 250 | 315 | 355 | 400 | 500 | 560 |
| Typical Shaft Output [HP] at 575 V | | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 | 650 |
| IP 00 | | D3 | D3 | D4 | D4 | D4 | D4 | E2 | E2 | E2 | E2 |
| IP 21 | | D1 | D1 | D2 | D2 | D2 | D2 | E1 | E1 | E1 | E1 |
| IP 54 | | D1 | D1 | D2 | D2 | D2 | D2 | E1 | E1 | E1 | E1 |
| Output current | | | | | | | | | | | |
|  | Continuous (3 x 550 V) [A] | 162 | 201 | 253 | 303 | 360 | 418 | 470 | 523 | 596 | 630 |
| | Intermittent (3 x 550 V) [A] | 178 | 221 | 278 | 333 | 396 | 460 | 517 | 575 | 656 | 693 |
| | Continuous (3 x 575-690V) [A] | 155 | 192 | 242 | 290 | 344 | 400 | 450 | 500 | 570 | 630 |
| | Intermittent (3 x 575-690 V) [A] | 171 | 211 | 266 | 319 | 378 | 440 | 495 | 550 | 627 | 693 |
| | Continuous kVA (550 V AC) [kVA] | 154 | 191 | 241 | 289 | 343 | 398 | 448 | 498 | 568 | 600 |
| | Continuous kVA (575 V AC) [kVA] | 154 | 191 | 241 | 289 | 343 | 398 | 448 | 498 | 568 | 627 |
| | Continuous kVA (690 V AC) [kVA] | 185 | 229 | 289 | 347 | 411 | 478 | 538 | 598 | 681 | 753 |
| | Max. cable size: | | | | | | | | | | |
| | (line power, motor, brake) [mm²/ AWG] [2] | 2x70<br>2x2/0 | | 2x185<br>2x350 mcm | | | | 4x240<br>4x500 mcm | | | |
| Max. input current | | | | | | | | | | | |
| | Continuous (3 x 550 V) [A] | 158 | 198 | 245 | 299 | 355 | 408 | 453 | 504 | 574 | 607 |
| | Continuous (3 x 575 V) [A] | 151 | 189 | 234 | 286 | 339 | 390 | 434 | 482 | 549 | 607 |
| | Continuous (3 x 690 V) [A] | 155 | 197 | 240 | 296 | 352 | 400 | 434 | 482 | 549 | 607 |
| | Max. pre-fuses[1][A] | 225 | 250 | 350 | 400 | 500 | 600 | 700 | 700 | 900 | 900 |
| | Environment | | | | | | | | | | |
| | Estimated power loss at rated max. load [W] [4] | 3114 | 3612 | 4293 | 5156 | 5821 | 6149 | 6449 | 7249 | 8727 | 9673 |
| | Weight enclosure IP 00 [kg] | 81.9 | 90.5 | 111.8 | 122.9 | 137.7 | 151.3 | 221 | 221 | 236 | 277 |
| | Weight enclosure IP 21 [kg] | 95.5 | 104.1 | 125.4 | 136.3 | 151.3 | 164.9 | 263 | 263 | 272 | 313 |
| | Weight enclosure IP 54 [kg] | 95.5 | 104.1 | 125.4 | 136.3 | 151.3 | 164.9 | 263 | 263 | 272 | 313 |
| | Efficiency [3] | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |

[1] For type of fuse, see 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 normal 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). Lower efficiency motors will also add to the power loss in the adjustable frequency drive and vice versa.
If the switching frequency is raised from nominal, the power losses may rise significantly.
LCP and typical control card power consumption values are included. Further options and customer load may add up to 30 W to the losses. (though typically 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%).



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Line power supply (L1, L2, L3)

| Line power supply (L1, L2, L3): | |
|---|---|
| Supply voltage | 380-480 V ±10% |
| Supply voltage | 525-600 V ±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 (cosφ) near unity | (> 0.98) |
| Switching on input supply L1, L2, L3 (power-ups) ≤ enclosure type A | maximum twice/min. |
| Switching on input supply L1, L2, L3 (power-ups) ≥ enclosure type B, C | maximum once/min. |
| Switching on input supply L1, L2, L3 (power-ups) ≥ enclosure type D, E | 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, 480/600 V maximum.*

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| Motor output (U, V, W): | |
|---|---|
| Output voltage | 0 - 100% of supply voltage |
| Output frequency | 0 - 1000 Hz |
| Switching on output | Unlimited |
| Ramp times | 1 - 3600 sec. |

| Torque characteristics: | |
|---|---|
| Starting torque (Constant torque) | maximum 110% for 1 min.* |
| Starting torque | maximum 120% up to 0.5 sec.* |
| Overload torque (Constant torque) | maximum 110% for 1 min.* |

**Percentage relates to the nominal torque for the VLT HVAC Drive.*

| Cable lengths and cross-sections: | |
|---|---|
| Max. motor cable length, shielded/armored | VLT HVAC Drive: 492 ft [150 m] |
| Max. motor cable length, unshielded/unarmored | VLT HVAC 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 0.0012 in.$^2$ [2 x 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 | 0.00078 in.$^2$ [0.5 mm$^2$]/20 AWG |
| Minimum cross-section to control terminals | 0.00039 in.$^2$ [0.25 mm$^2$] |

** See Line Supply tables for more information!*

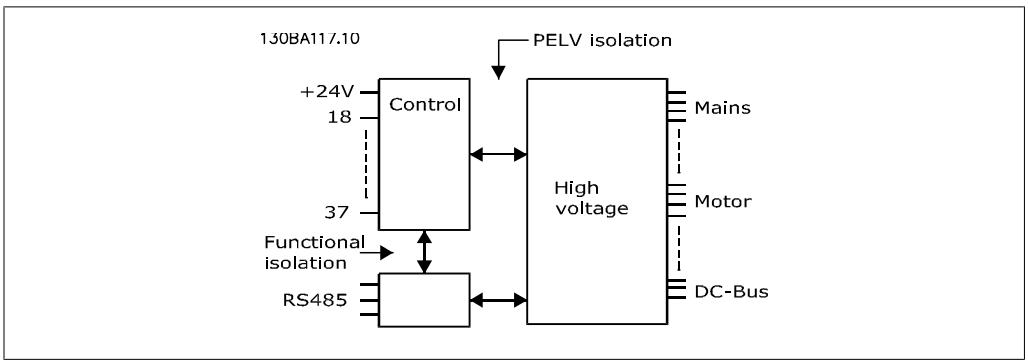
| Digital inputs: | |
|---|---|
| Programmable digital inputs | 4 (6) |
| Terminal number | 18, 19, 27 [1)], 29, 32, 33, |
| Logic | PNP or NPN |
| Voltage level | 0 - 24 V DC |
| Voltage level, logic'0' PNP | < 5 V DC |
| Voltage level, logic'1' PNP | > 10 V DC |
| Voltage level, logic '0' NPN | > 19 V DC |
| Voltage level, logic '1' NPN | < 14 V DC |
| Maximum voltage on input | 28 V DC |
| Input resistance, $R_i$ | approx. 4 kΩ |

*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 kΩ |
| Max. voltage | ± 20 V |
| Current mode | Switch S201/switch S202 = ON (I) |
| Current level | 0/4 to 20 mA (scalable) |
| 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.*



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| 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 kΩ |
| 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. 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 output frequency | 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.*

5

| 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, 1 A |
| Max. terminal load (DC-13)[1)] (Inductive load) | 24 V DC, 0.1 A |
| Relay 02 Terminal number | 4-6 (break), 4-5 (make) |
| Max. terminal load (AC-1)[1)] on 4-5 (NO) (Resistive load) | 240 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, 0.1 A |
| 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).*

| 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*


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| Surroundings: | |
|---|---|
| Enclosure ≤ enclosure type D | IP 00, IP 21, IP 54 |
| Enclosure ≥ enclosure type D, E | IP 21, IP 54 |
| Enclosure kit available ≤ enclosure type D | IP 21/TYPE 1/IP 4X top |
| Vibration test | 1.0 g |
| Max. 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 | Max. 113° F [45° C] (AVM switching mode only!) and max. 104° F [40° C] over a 24 hour period. |
| Ambient temperature | Max. 104° F [40° C] (SFAVM switching mode only!) and max. 95° F [35° C] over a 24 hour period. |

*Derating for high ambient temperature, 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. Use only isolated laptop/PC as connection to the USB connector on VLT HVAC 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 ± 9° F [95° C ± 5° C]. An overload temperature cannot be reset until the temperature of the heatsink is below 158° C ± 9° C [70° C ± 5° C] (Guideline - these temperatures may vary for different power sizes, enclosures, etc.). VLT HVAC drive has an auto-derating function to prevent it's heatsink from 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.




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# 6. Warnings and Alarms

## 6.1. Alarm and Status Messages

### 6.1.1. Alarms and warnings

A warning or an alarm is signaled by the relevant LED on the front of the adjustable frequency drive, 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 HVAC Drive. See *par. 14-20 Reset Mode* in *VLT® HVAC Drive Programming Guide, MG.11Cx.yy*

NOTE
After a manual reset using the [RESET] button on the LCP, the [AUTO ON] button must be pressed to restart the motor.

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

Alarms that are trip-locked offer additional protection; this means that the line 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 parameter 14-20 (Warning: automatic wake-up is possible!)

If a warning and alarm is marked against a code in the table on the following page, this means that either a warning occurs before an alarm, or that 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 parameter 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 | Warn-ing | Alarm/Trip | Alarm/Trip Lock | Parameter Refer-ence |
|---|---|---|---|---|---|
| 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 |
| 25 | Brake resistor short-circuited | X | | | |
| 26 | Brake resistor power limit | (X) | (X) | | 2-13 |
| 27 | Brake chopper short-circuited | X | X | | |
| 28 | Brake check | (X) | (X) | | 2-15 |
| 29 | Power board overtemp. | X | X | X | |
| 30 | Motor phase U missing | (X) | (X) | (X) | 4-58 |
| 31 | Motor phase V missing | (X) | (X) | (X) | 4-58 |
| 32 | Motor phase W missing | (X) | (X) | (X) | 4-58 |
| 33 | Soft-charge fault | | X | X | |
| 34 | Serial communication bus fault | X | X | | |
| 38 | Internal fault | | X | X | |
| 47 | 24 V supply low | X | X | X | |
| 48 | 1.8 V supply low | | X | 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 | | | |
| 61 | Tracking Error | (X) | (X) | | 4-30 |
| 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 | | |
| 80 | Drive Initialized to Default Value | | X | | |

6.1: Alarm/Warning code list

(X) Dependent on parameter

*LED indication*

| | |
|---|---|
| Warning | yellow |
| Alarm | flashing red |
| Trip-locked | yellow and red |



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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 | 24 V 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 | |

6.2: Description of Alarm Word, Warning Word and Extended Status Word

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

WARNING 1, 10 Volts low:
The 10 V voltage from terminal 50 on the control card is below 10 V.
Remove a portion of the load from terminal 50, as the 10 v supply is overloaded. Max. 15 mA or minimum 590 Ω.

WARNING/ ALARM 2, Live zero error:
The signal on terminal 53 or 54 is less than 50% of the value set in par. 6-10, 6-12, 6-20 or 6-22, respectively.

WARNING/ ALARM 3, No motor:
No motor has been connected to the output of the adjustable frequency drive.

WARNING/ ALARM 4, Line phase loss:
A phase is missing on the supply side, or the line voltage imbalance is too high.
This message also appears in case of a fault in the input rectifier on the adjustable frequency drive.
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 overvoltage limit of the control system. The adjustable frequency drive is still active.

WARNING 6, DC link voltage low:
The intermediate circuit voltage (DC) is below the undervoltage limit of the control system. 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 given period of time.

Possible corrections:

Select Overvoltage Control function in par. 2-17

Connect a brake resistor

Extend the ramp time

Activate functions in par. 2-10

Increase par. 14-26

Selecting OVC function will extend the ramp times.

Alarm/warning limits:

| VLT HVAC | 3 x 200-240 V AC [VDC] | 3 x 380-500 V AC [VDC] |
|---|---|---|
| Undervoltage | 185 | 373 |
| Voltage warning low | 205 | 410 |
| Voltage warning high (w/o brake - w/brake) | 390/405 | 810/840 |
| Overvoltage | 410 | 855 |

The voltages stated are the intermediate circuit voltage of the VLT HVAC with a tolerance of ± 5%. The corresponding line voltage is the intermediate circuit voltage (DC link) divided by 1.35.

WARNING/ ALARM 8, DC undervoltage:
If the intermediate circuit voltage (DC) drops below the "voltage warning low" limit (see table above), the adjustable frequency drive checks if 24 V backup supply is connected.
If no 24 V backup supply is connected, the adjustable frequency drive trips after a given period of time, depending on the unit.
To check whether the supply voltage matches the adjustable frequency drive, see *3.2 General Specifications*.

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. You cannot reset the adjustable frequency drive until the counter is below 90%.

The fault is that the adjustable frequency drive has been overloaded by more than nominal current for too long.

WARNING/ ALARM 10, Motor ETR overtemperature:
According to the electronic thermal protection (ETR), the motor is too hot. You can choose if you want the adjustable frequency drive to give a warning or an alarm when the counter reaches 100% in par. 1-90. The fault is that the motor has been overloaded by more than nominal current for too long. Check that the motor par. 1-24 is set correctly.

WARNING/ ALARM 11, Motor thermistor overtemp:
The thermistor or the thermistor connection is disconnected. You can choose if you want the adjustable frequency drive to give a warning or an alarm in par. 1-90. Make sure 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.

WARNING/ ALARM 12, Torque limit:
The torque is higher than the value in par. 4-16 (in motor operation), or the torque is higher than the value in par. 4-17 (in regenerative operation).

WARNING/ ALARM 13, Overcurrent:
The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning will last approximately 8-12 sec., then the adjustable frequency drive trips and issues an alarm. Turn off the adjustable frequency drive and check if the motor shaft can be turned and if the motor size matches the adjustable frequency drive.

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

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



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ALARM 16, Short-circuit:
There is a short-circuit 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 is NOT set to *OFF*.
If par. 8-04 is set to *Stop and Trip*, a warning appears and the adjustable frequency drive ramps down to zero speed, while giving an alarm.
Par. 8-03 *Control Word Timeout Time* could possibly be increased.

WARNING 24, External fan fault:
The fan warning function is an extra protection function that checks if the fan is running/ mounted. The fan warning can be disabled in *Fan Monitor*, par. 14-53, (set to [0] Disabled).

WARNING 25, Brake resistor short-circuited:
The brake resistor is monitored during operation. If it short-circuits, the brake function is disconnected and the warning appears. The 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*).

ALARM/ WARNING 26, Brake resistor power limit:
The power transmitted to the brake resistor is calculated as a percentage, as a mean value over the last 120 s based on the resistance value of the brake resistor (par. 2-11) 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, the adjustable frequency drive cuts out and issues this alarm, when the dissipated braking energy is higher than 100%.

WARNING/ ALARM 27, Brake chopper fault:
The brake transistor is monitored during operation, and if it short-circuits, the brake function disconnects and the warning is issued. 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.

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

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

WARNING/ ALARM 29, Drive overtemperature:
If the enclosure is IP 20 or IP 21/TYPE 1, the cut-out temperature of the heatsink is 203° F +10° F [95° C +5°C]. The temperature fault cannot be reset until the temperature of the heatsink is below 158° F [70° C].

The fault could be a result of:

- Ambient temperature too high
- Motor cable too long

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, Soft-charge fault:
Too many power-ups have occurred within a short time period. See the chapter *General Specifications* for the allowed number of power-ups within one minute.

WARNING/ ALARM 34, Serial communication bus fault:
The serial communication bus on the communication option card is not working.

ALARM 38, Internal fault:
Contact your local Danfoss supplier.

WARNING 47, 24 V supply low:
The external 24 V DC backup power supply may be overloaded, otherwise contact your Danfoss supplier.

ALARM 48, 1.8 V supply low:
Contact your Danfoss supplier.

WARNING 49, Speed limit:
The speed has been limited by range in par. 4-11 and par. 4-13.

ALARM 50, AMA calibration failed:
Contact your Danfoss supplier.

ALARM 51, AMA check Unom and Inom:
The setting of motor voltage, motor current and motor power is presumably wrong. Check the settings.

ALARM 52, AMA low Inom:
The motor current is too low. Check the settings.

ALARM 53, AMA motor too big:
The motor is too big for the AMA to be carried out.

ALARM 54,
AMA motor too small:

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

ALARM 55, AMA par. out of range:
The par. values found from the motor are outside the 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 it is carried out. Please note that repeated runs may heat the motor to a level where the resistances Rs and Rr are increased. In most cases, however, this is not critical.

WARNING/ALARM 58, AMA internal fault:
Contact your Danfoss supplier.

WARNING 59, Current limit:
The current is higher than the value in par. 4-18.

WARNING 62, Output Frequency at Maximum Limit:
The output frequency is limited by the value set in par. 4-19

ALARM 63, Mechanical Brake Low:
The actual motor current has not exceeded the "release brake" current within the "Start delay" time window.

WARNING 64, Voltage Limit:
The load and speed combinations demand 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:
The heatsink temperature is measured as 32° F [0° C]. This could indicate that the temperature sensor is defective and thus the fan speed is increased to the maximum if the power part or the control card is very hot.

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

ALARM 70, Illegal Frequency Configuration:
Current combination of control board and power board is illegal.

ALARM 80, Drive Initialized to Default Value:
Parameter settings are initialized to default setting after a manual (three-finger) reset or via par. 14-22.


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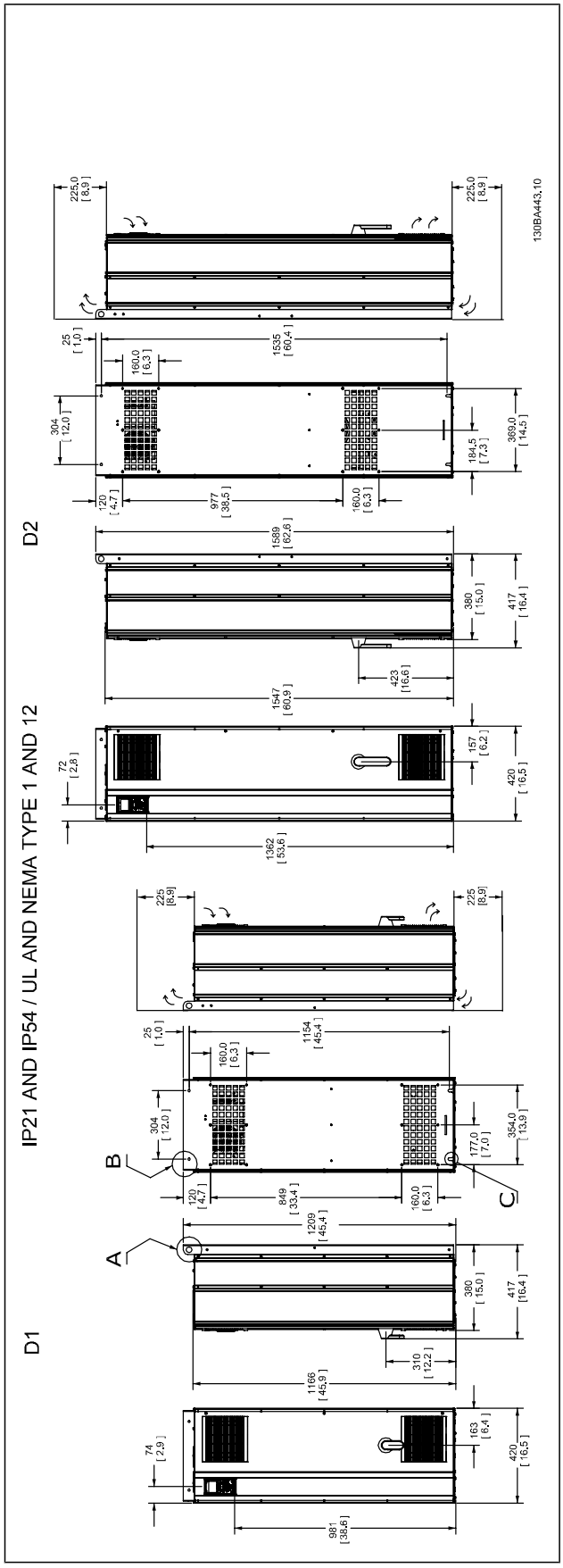
# 7. Annexes

7

## 7.1.1. Mechanical Dimensions



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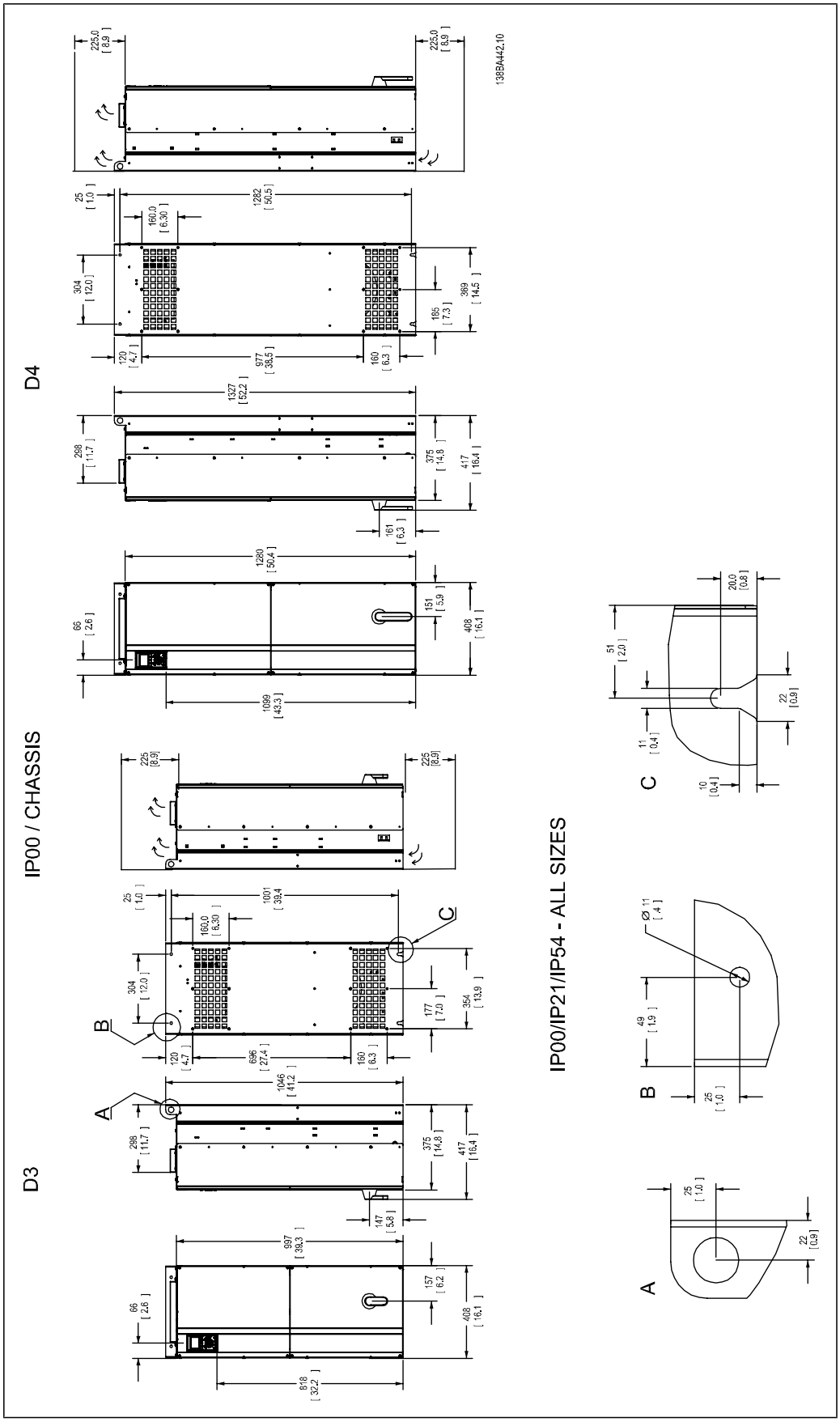
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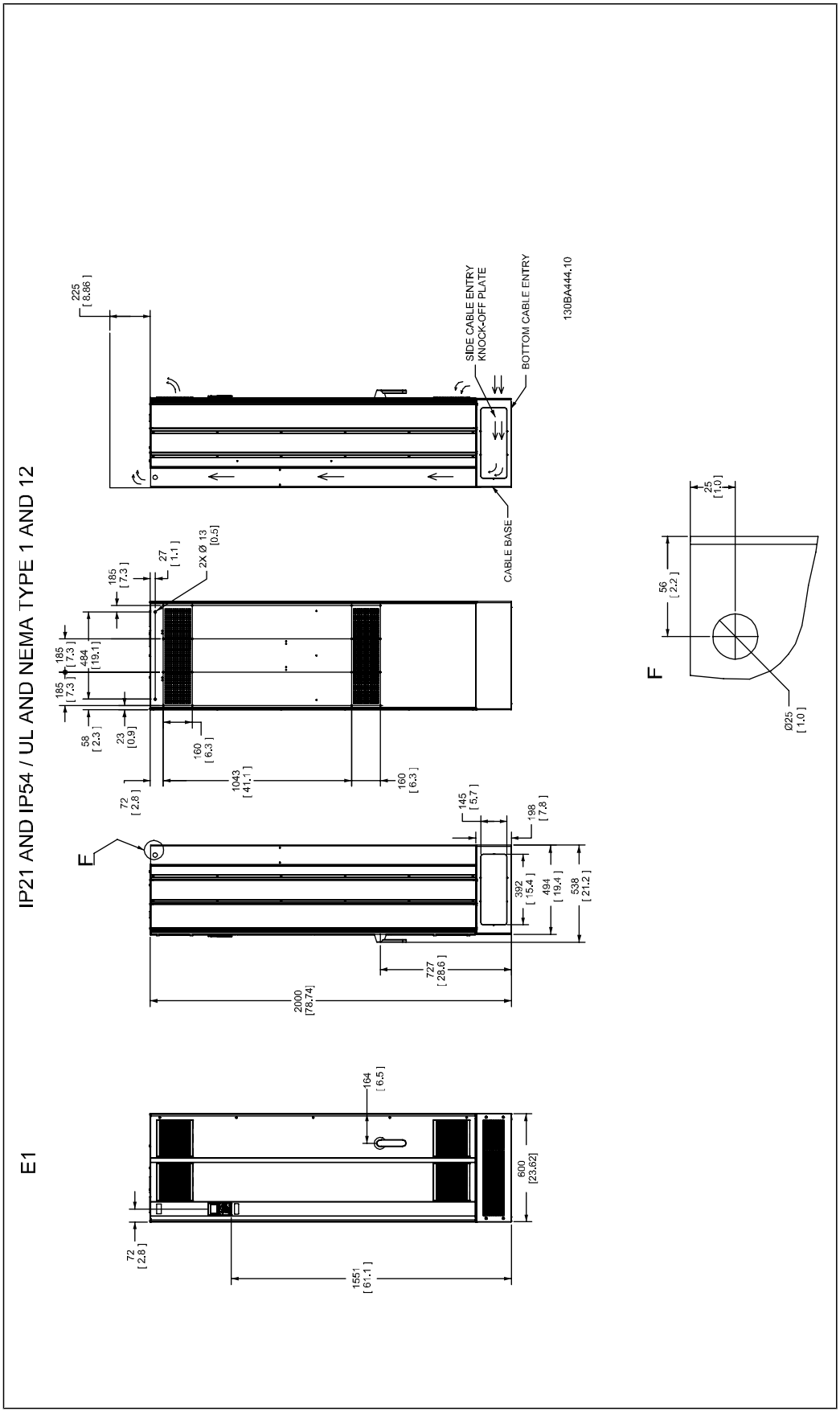
D4
D3
IP00/IP21/IP54 - ALL SIZES
138BA442.10
A
B
C

7



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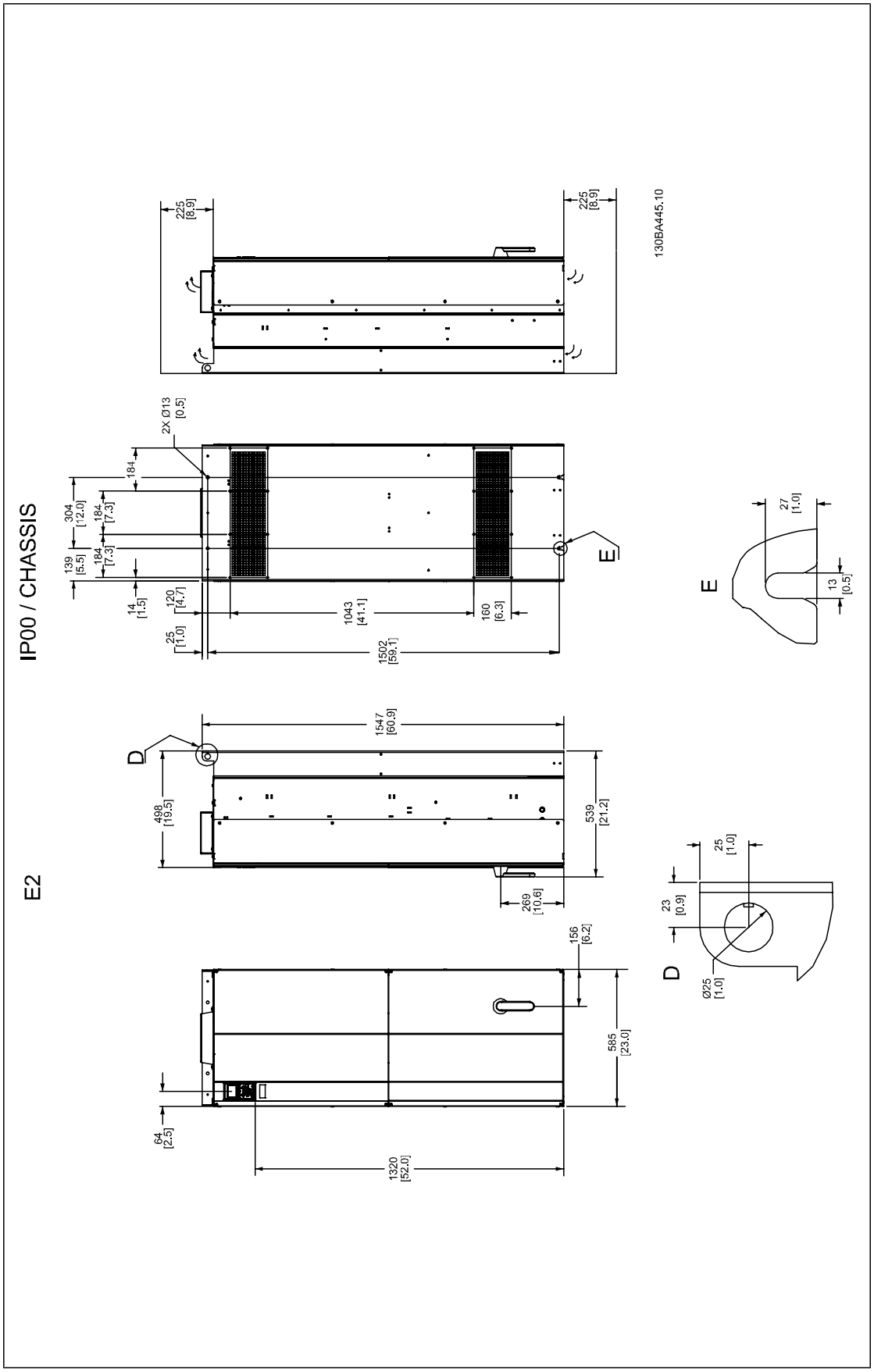
IP00 / CHASSIS
E2
130BA445.10
225 [8.9]
225 [8.9]
2X Ø13 [0.5]
184
304 [12.0]
184 [7.3]
139 [5.5]
184 [7.3]
14 [1.5]
120 [4.7]
25 [1.0]
1043 [41.1]
160 [6.3]
1502 [59.1]
E
27 [1.0]
13 [0.5]
1547 [60.9]
D
498 [19.5]
539 [21.2]
269 [10.6]
156 [6.2]
585 [23.0]
64 [2.5]
1320 [52.0]
25 [1.0]
23 [0.9]
Ø25 [1.0]

Mechanical dimensions, D Enclosures

| Frame size | | | D1 | | D2 | | D3 | D4 |
|---|---|---|---|---|---|---|---|---|
| | | | 150-250 hp [110-160 kW] (380-480 V) 150-250 hp [110-160 kW] (525-600 V) | | 250-350 hp [160-250 kW] (380-480 V) 250-450 hp [160-315 kW] (525-600 V) | | 150-175 hp [110-132 kW] (380-480 V) 150-175 hp [110-132 kW] (525-600 V) | 250-350 hp [160-250 kW ] (380-480 V) 250-450 hp [160-315 kW] (525-600 V) |
| IP NEMA | | | 21 Type 1 | 54 Type 12 | 21 Type 1 | 54 Type 12 | 00 Chassis | 00 Chassis |
| Card-board box size Shipping dimen-sions | 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 di-men-sions | Height | | 45.6 in [1159 mm] | 45.6 in [1159 mm] | 60.6 in [1540 mm] | 60.6 in [1540 mm] | 39.3 in [997 mm] | 50.3 in [1277 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 | | 14.7 in [373 mm] | 14.7 in [373 mm] | 14.7 in [373 mm] | 14.7 in [373 mm] | 14.7 in [373 mm] | 14.7 in [373 mm] |
| | Max weight | | 229.3 lbs [104 kg] | 229.3 lbs [104 kg] | 332. 9 lbs [151 kg] | 332. 9 lbs [151 kg] | 200.6 lbs [91 kg] | 304 lbs [138 kg] |

Mechanical dimensions, E Enclosures

| Frame size | | | E1 | | E2 |
|---|---|---|---|---|---|
| | | | 450-600 hp [315-450 kW] (380-480 V) 500-750 hp [355-560 kW] (525-600 V) | | 450-600 hp [315-450 kW] (380-480 V) 500-750 hp [355-560 kW] (525-600 V) |
| IP NEMA | | | 21 Type 12 | 54 Type 12 | 00 Chassis |
| Cardboard box size Shipping dimensions | Height | | 33.1 in [840 mm] | 33.1 in [840 mm] | 32.7 in [831 mm] |
| | Width | | 86.5 in [2197 mm] | 86.5 in [2197 mm] | 67.1 in [1705 mm] |
| | Depth | | 29 in [736 mm] | 29 in [736 mm] | 29 in [736 mm] |
| Drive dimensions | Height | | 78.7 in [2000 mm] | 78.7 in [2000 mm] | 59 in [1499 mm] |
| | Width | | 23.6 in [600 mm] | 23.6 in [600 mm] | 23 in [585 mm] |
| | Depth | | 19.5 in [494 mm] | 19.5 in [494 mm] | 19.5 in [494 mm] |
| | Max weight | | 690 lbs [313 kg] | 690 lbs [313 kg] | 611 lbs [277 kg] |

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