ENGINEERING TOMORROW

# Operating Guide
# VLT® AutomationDrive FC 361

## 90–315 kW, Enclosure Size J8–J9

www.DanfossDrives.com

## Contents

 

# 1 Introduction

## 1.1 Purpose of the Manual

This operating guide provides information for safe installation and commissioning of the VLT® drives.

The operating guide is intended for use by qualified personnel. To use the unit safely and professionally, read and follow this operating guide. Pay particular attention to the safety instructions and general warnings. Always keep the operating guide with the drive.

VLT® is a registered trademark.

## 1.2 Additional Resources

Other resources are available to understand advanced drive functions and programming.

- The *programming guide* provides greater detail on working with parameters and many application examples.
- The *design guide* provides detailed information about capabilities and functionality to design motor control systems.
- Instructions for operation with optional equipment.

Supplementary publications and manuals are available from Danfoss. See *www.danfoss.com/en/search/?filter=type%3Adocumentation%2Csegment%3Adds* for listings.

## 1.3 Manual and Software Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome. *Table 1.1* shows the version of the manual and the corresponding software version.

| Manual version | Remarks | Software version |
|---|---|---|
| MG06I1xx | First edition. | 1.0x |

**Table 1.1 Manual and Software Version**

## 1.4 Approvals and Certifications

CE

## 1.5 Disposal

Do not dispose of equipment containing electrical components together with domestic waste.
Collect it separately in accordance with local and currently valid legislation.

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# 2 Safety

## 2.1 Safety Symbols

The following symbols are used in this guide:

**⚠WARNING**

**Indicates a potentially hazardous situation that could result in death or serious injury.**

**⚠CAUTION**

**Indicates a potentially hazardous situation that could result in minor or moderate injury. It can also be used to alert against unsafe practices.**

***NOTICE!***

**Indicates important information, including situations that can result in damage to equipment or property.**

## 2.2 Qualified Personnel

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the drive. Only qualified personnel are allowed to install or operate this equipment.

Qualified personnel are defined as trained staff, who are authorized to install, commission, and maintain equipment, systems, and circuits in accordance with pertinent laws and regulations. Also, the personnel must be familiar with the instructions and safety measures described in this manual.

## 2.3 Safety Precautions

**⚠WARNING**

**HIGH VOLTAGE**

**Drives contain high voltage when connected to AC mains input, DC supply, load sharing, or permanent motors. Failure to use qualified personnel to install, start up, and maintain the drive can result in death or serious injury.**

- **Only qualified personnel must install, start up, and maintain the drive.**

**⚠WARNING**

**UNINTENDED START**

**When the drive is connected to the AC mains, DC supply, or load sharing, the motor can start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. The motor can start with an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up Software, or after a cleared fault condition.**

**To prevent unintended motor start:**

- **Press [Off/Reset] on the LCP before programming parameters.**
- **Disconnect the drive from the mains.**
- **Completely wire and assemble the drive, motor, and any driven equipment before connecting the drive to the AC mains, DC supply, or load sharing.**

**⚠WARNING**

**DISCHARGE TIME**

**The drive contains DC-link capacitors, which can remain charged even when the drive is not powered. High voltage can be present even when the warning LED indicator lights are off. Failure to wait the specified time after power has been removed before performing service or repair work can result in death or serious injury.**

- **Stop the motor.**
- **Disconnect AC mains and remote DC-link power supplies, including battery back-ups, UPS, and DC-link connections to other drives.**
- **Disconnect or lock PM motor.**
- **Wait for the capacitors to discharge fully. The minimum waiting time is 20 minutes.**
- **Before performing any service or repair work, use an appropriate voltage measuring device to make sure that the capacitors are fully discharged.**

  

**⚠WARNING**

**LEAKAGE CURRENT HAZARD**

**Leakage currents exceed 3.5 mA. Failure to ground the frequency converter properly can result in death or serious injury.**

- **Ensure the correct grounding of the equipment by a certified electrical installer.**

**⚠WARNING**

**EQUIPMENT HAZARD**

**Contact with rotating shafts and electrical equipment can result in death or serious injury.**

- **Ensure that only trained and qualified personnel install, start up, and maintain the drive.**
- **Ensure that electrical work conforms to national and local electrical codes.**
- **Follow the procedures in this guide.**

**⚠WARNING**

**UNINTENDED MOTOR ROTATION WINDMILLING**

**Unintended rotation of permanent magnet motors creates voltage and can charge the unit, resulting in death, serious injury, or equipment damage.**

- **Ensure that permanent magnet motors are blocked to prevent unintended rotation.**

**⚠WARNING**

**INTERNAL FAILURE HAZARD**

**Under certain circumstances, an internal failure can cause a component to explode. Failure to keep the enclosure closed and properly secured can cause death or serious injury.**

- **Do not operate the drive with the door open or panels off.**
- **Ensure that the enclosure is properly closed and secured during operation.**

**⚠CAUTION**

**HOT SURFACES**

**The drive contains metal components that are still hot even after the drive has been powered off. Failure to observe the high temperature symbol (yellow triangle) on the drive can result in serious burns.**

- **Be aware that internal components, such as busbars, can be extremely hot even after the drive has been powered off.**
- **Exterior areas marked by the high-temperature symbol (yellow triangle) are hot while the drive is in use and immediately after being powered off.**

  

# 3 Product Overview

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## 3.1 Intended Use

The drive is an electronic motor controller that converts AC mains input into a variable AC waveform output. The frequency and voltage of the output are regulated to control the motor speed or torque. The drive is designed to:

- Regulate motor speed in response to system feedback or to remote commands from external controllers.
- Monitor system and motor status.
- Provide motor overload protection.

The drive is designed for industrial and commercial environments in accordance with local laws and standards. Depending on configuration, the drive can be used in standalone applications or form part of a larger system or installation.

***NOTICE!***

**In a residential environment, this product can cause radio interference, in which case supplementary mitigation measures can be required.**

**Foreseeable misuse**

Do not use the drive in applications which are non-compliant with specified operating conditions and environments. Ensure compliance with the conditions specified in *chapter 10 Specifications*.

## 3.2 Power Ratings, Weights, and Dimensions

For enclosure sizes and power ratings of the drives, refer to *Table 3.1*. For more dimensions, see *chapter 10.9 Enclosure Dimensions*.

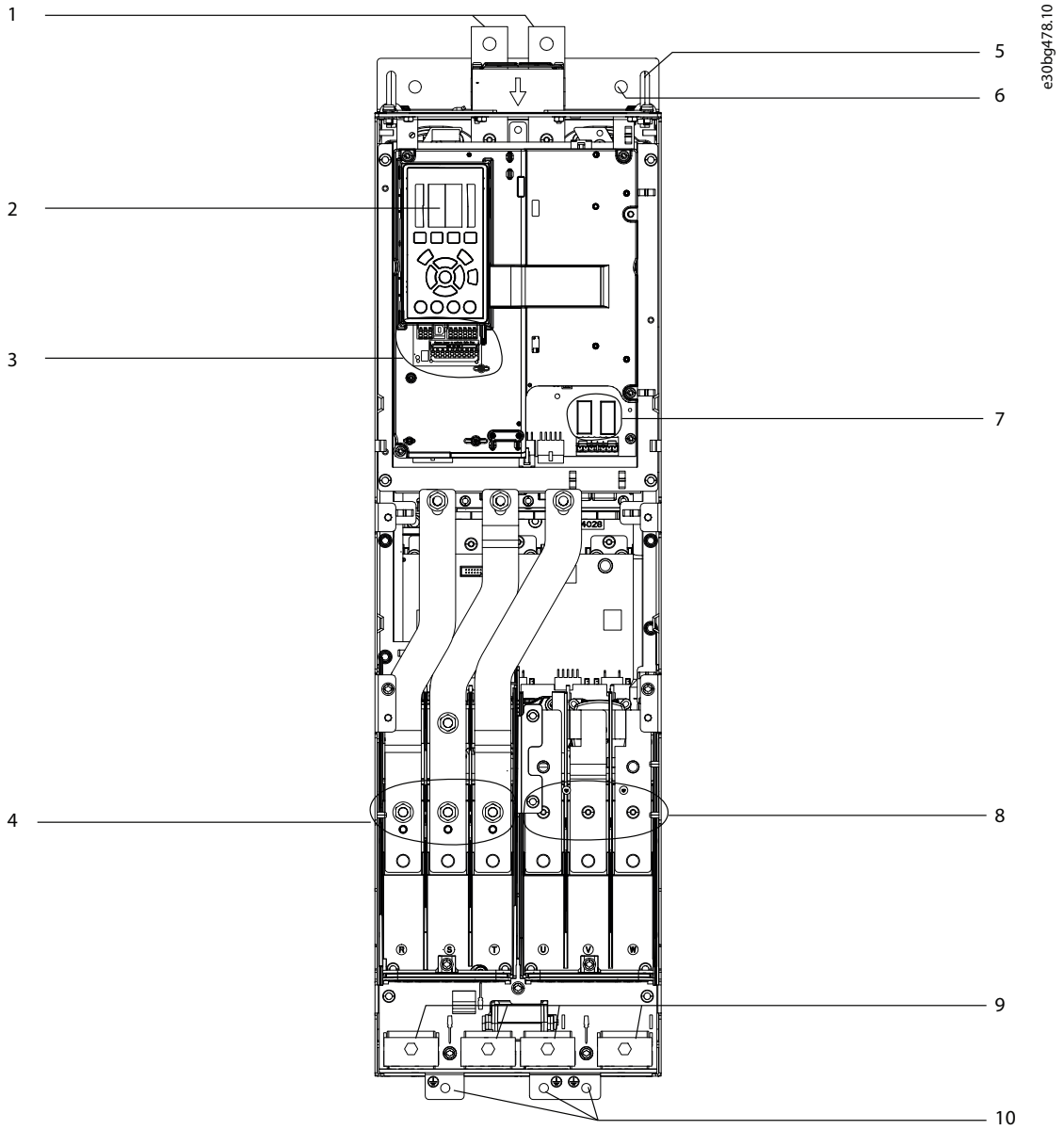
| **Enclosure size** | | **J8** | **J9** |
|---|---|---|---|
| **IP**<br>**NEMA** | | 20<br>Chassis | 20<br>Chassis |
| **Shipping dimensions [mm (in)]** | Height | 587 (23) | 587 (23) |
| | Width | 1230 (48) | 1430 (56) |
| | Depth | 460 (18) | 535 (21) |
| **Drive dimensions [mm (in)]** | Height | 1026.5 (40.4) | 1293.78 (50.9) |
| | Width | 250.0 (9.8) | 350.0 (13.8) |
| | Depth | 375.0 (14.8) | 375.0 (14.8) |
| Maximum weight [kg (lb)] | | 101.2 (223.1) | 168.6 (376.1) |

**Table 3.1 Power Ratings, Weight, and Dimensions, Enclosure Sizes J8–J9, 380–480 V**

## 3.3 Interior View of J8 Drive

*Figure 3.1* shows the J8 components relevant to installation and commissioning.



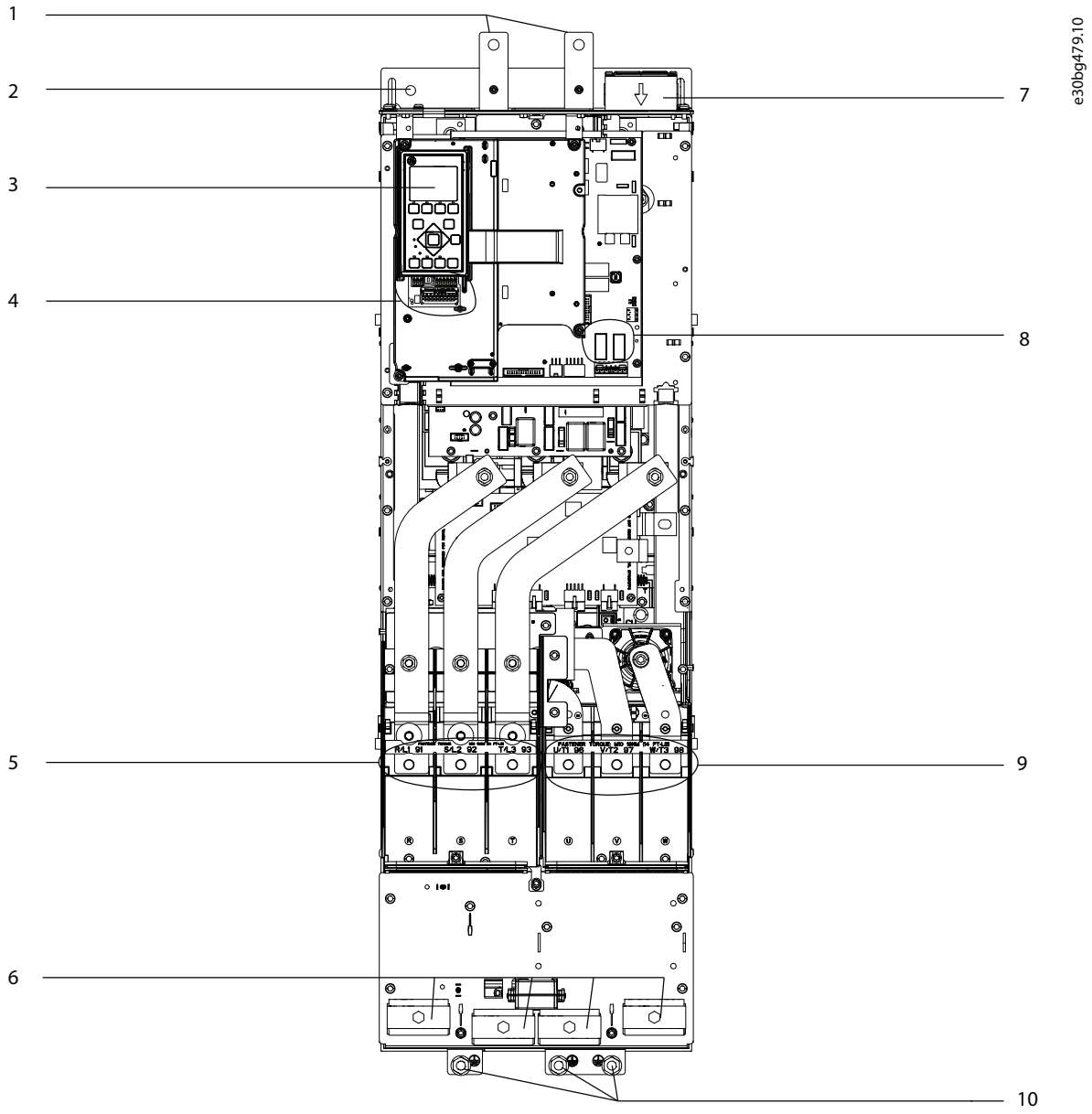

| | | | |
|---|---|---|---|
| 1 | Regen terminals | 6 | Mounting hole |
| 2 | LCP (local control panel) | 7 | Relays 1 and 2 |
| 3 | Control terminals | 8 | Motor output terminals 96 (U), 97 (V), 98 (W) |
| 4 | Mains input terminals 91 (L1), 92 (L2), 93 (L3) | 9 | Cable clamps |
| 5 | Lifting ring | 10 | Ground terminals |

**Figure 3.1 Interior View of J8 Drive**

## 3.4 Interior View of J9 Drive

*Figure 3.2* shows the J9 components relevant to installation and commissioning.



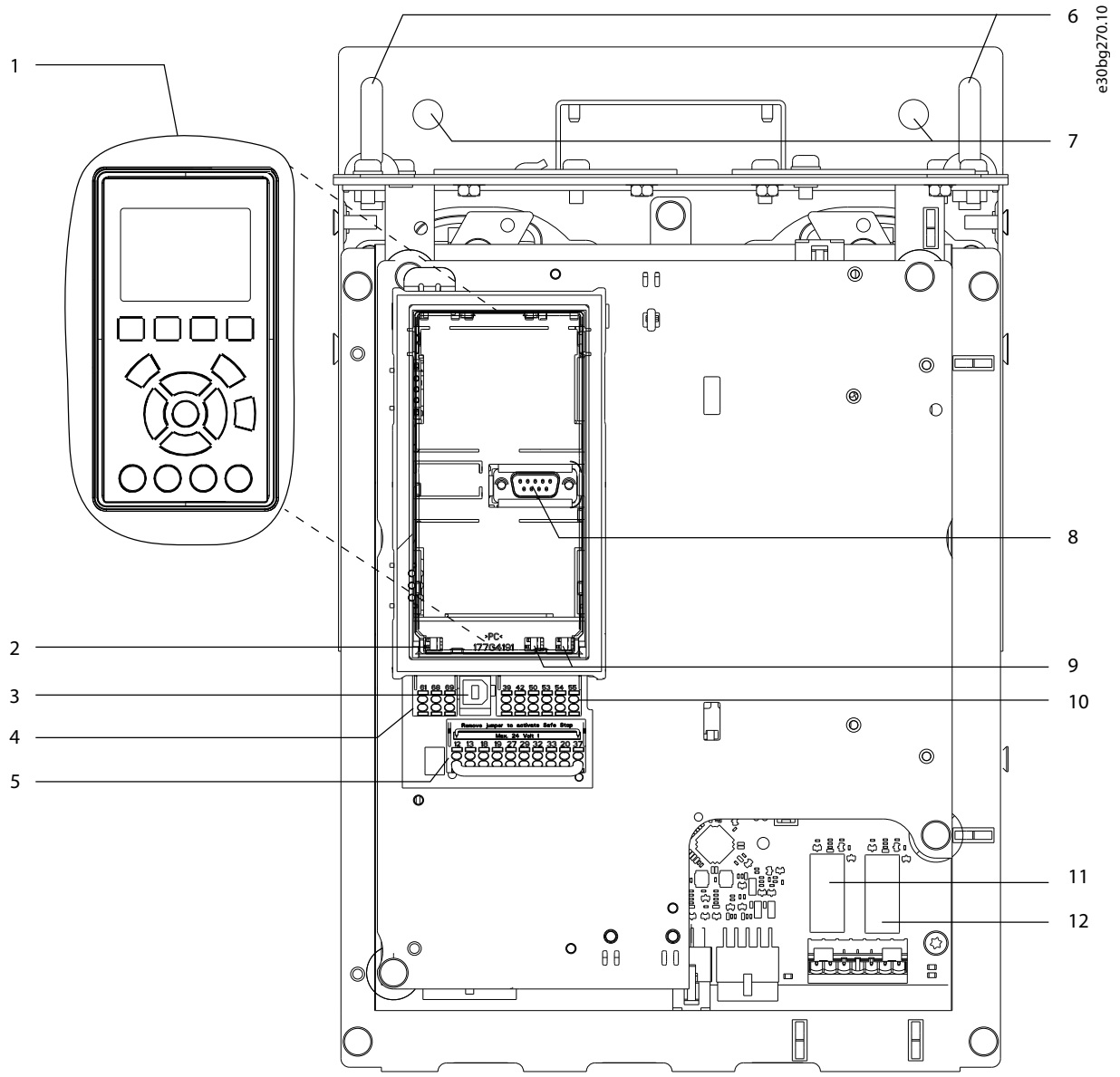

| | | | |
|---|---|---|---|
| 1 | Regen terminals | 6 | Cable clamps |
| 2 | Mounting hole | 7 | Top fan |
| 3 | LCP (local control panel) | 8 | Relays 1 and 2 |
| 4 | Control terminals | 9 | Motor output terminals 96 (U), 97 (V), 98 (W) |
| 5 | Mains input terminals 91 (L1), 92 (L2), 93 (L3) | 10 | Ground terminals |

**Figure 3.2 Interior View of J9 Drive**

## 3.5 View of Control Shelf

The control shelf holds the keypad, known as the local control panel or LCP. The control shelf also includes the control terminals, relays, and various connectors.






| | | | |
|---|---|---|---|
| 1 | Local control panel (LCP) | 7 | Mounting holes |
| 2 | RS485 termination switch | 8 | LCP connector |
| 3 | USB connector | 9 | Analog switches (A53, A54) |
| 4 | RS485 fieldbus connector | 10 | Analog I/O connector |
| 5 | Digital I/O and 24 V supply | 11 | Relay 1 (01, 02, 03) on power card |
| 6 | Lifting rings | 12 | Relay 2 (04, 05, 06) on power card |

**Figure 3.3 View of Control Shelf**

## 3.6 Local Control Panel (LCP)

The local control panel (LCP) is the combined display and keypad on the front of the drive.

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The LCP is used to:

- Control the drive and motor.
- Access drive parameters and program the drive.
- Display operational data, drive status, and warnings.

A numeric local control panel (NLCP) is available as an option. The NLCP operates in a manner similar to the LCP, but there are differences. For details on how to use the NLCP, see the product-specific *programming guide*.

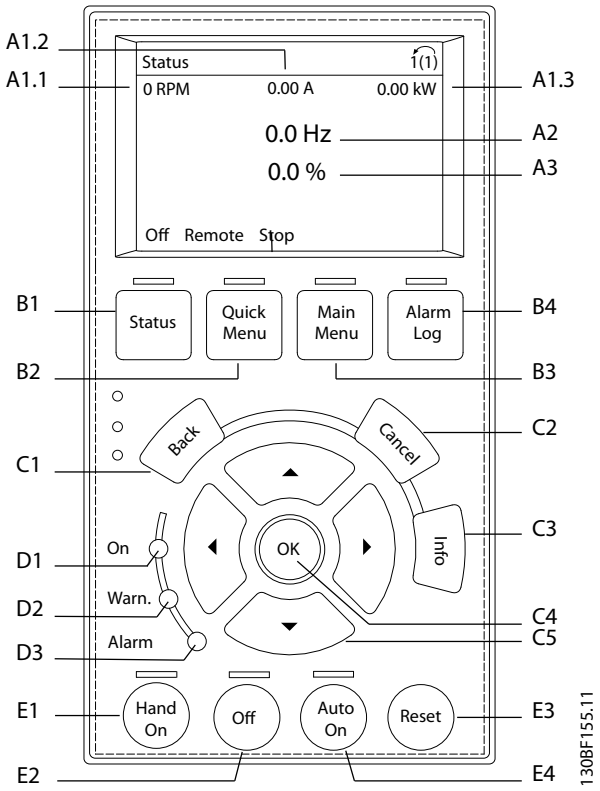


**Figure 3.4 Local Control Panel (LCP)**

**A. Display area**

Each display readout has a parameter associated with it. See *Table 3.2*. The information shown on the LCP can be customized for specific applications. Refer to *chapter 3.7.1.2 Q1 My Personal Menu*.

| Callout | Parameter | Default setting |
|---|---|---|
| A1.1 | *Parameter 0-20 Display Line 1.1 Small* | Speed [RPM] |
| A1.2 | *Parameter 0-21 Display Line 1.2 Small* | Motor current [A] |
| A1.3 | *Parameter 0-22 Display Line 1.3 Small* | Power [kW] |
| A2 | *Parameter 0-23 Display Line 2 Large* | Frequency [Hz] |
| A3 | *Parameter 0-24 Display Line 3 Large* | kWh counter |

**Table 3.2 LCP Display Area**

  

**B. Menu keys**

Menu keys are used to access the menus for setting up parameters, toggling through status display modes during normal operation, and viewing fault log data.

| Callout | Key | Function |
|---|---|---|
| B1 | Status | Shows operational information. |
| B2 | Quick Menu | Allows access to parameters for initial set-up instructions. Also provides detailed application steps. Refer to *chapter 3.7.1.1 Quick Menu Mode*. |
| B3 | Main Menu | Allows access to all parameters. Refer to *chapter 3.7.1.6 Main Menu Mode*. |
| B4 | Alarm Log | Shows a list of current warnings and the last 10 alarms. |

**Table 3.3 LCP Menu Keys**

**C. Navigation keys**

Navigation keys are used for programming functions and moving the display cursor. The navigation keys also provide speed control in local (hand) operation. The display brightness can be adjusted by pressing [Status] and [▲]/[▼] keys.

| Callout | Key | Function |
|---|---|---|
| C1 | Back | Reverts to the previous step or list in the menu structure. |
| C2 | Cancel | Cancels the last change or command as long as the display mode has not changed. |
| C3 | Info | Shows a definition of the selected function. |
| C4 | OK | Accesses parameter groups or enables an option. |
| C5 | ▲ ▼ ◄ ► | Moves between items in the menu. |

**Table 3.4 LCP Navigation Keys**

**D. Indicator lights**

Indicator lights are used to identify the drive status and to provide a visual notification of warning or fault conditions.

| Callout | Indicator | Indicator light | Function |
|---|---|---|---|
| D1 | On | Green | Lights when the drive receives power from the mains voltage or a 24 V external supply. |
| D2 | Warn. | Yellow | Lights when warning conditions are active. Text appears in the display area identifying the problem. |
| D3 | Alarm | Red | Lights during a fault condition. Text appears in the display area identifying the problem. |

**Table 3.5 LCP Indicator Lights**

**E. Operation keys and reset**

The operation keys are found toward the bottom of the local control panel.

| Callout | Key | Function |
|---|---|---|
| E1 | Hand On | Starts the drive in local control. An external stop signal by control input or serial communication overrides the local [Hand On]. |
| E2 | Off | Stops the motor but does not remove power to the drive. |
| E3 | Auto On | Puts the system in remote operational mode so it can respond to an external start command by control terminals or serial communication. |
| E4 | Reset | Resets the drive manually after a fault has been cleared. |

**Table 3.6 LCP Operation Keys and Reset**

  

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## 3.7 LCP Menus

### 3.7.1.1 Quick Menu Mode

The Quick Menu mode provides a list of menus used to configure and operate the drive. Select the Quick Menu mode by pressing the [Quick Menu] key. The resulting readout appears on the LCP display.

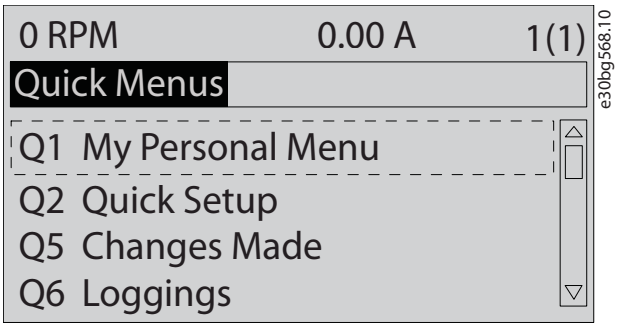



**Figure 3.5 Quick Menu View**

### 3.7.1.2 Q1 My Personal Menu

Use My Personal Menu to determine what is shown in the display area. Refer to *chapter 3.6 Local Control Panel (LCP)*. This menu can also show up to 50 pre-programmed parameters. These 50 parameters are manually entered using *parameter 0-25 My Personal Menu*.

### 3.7.1.3 Q2 Quick Setup

The parameters found in the *Q2 Quick Setup* contain basic system and motor data that are always necessary for configuring the drive. See *chapter 7.2.3 Entering System Information* for the set-up procedures.

### 3.7.1.4 Q5 Changes Made

Select *Q5 Changes Made* for information about:

- The 10 most recent changes.
- Changes made from default setting.

### 3.7.1.5 Q6 Loggings

Use *Q6 Loggings* for fault finding. To get information about the display line readout, select *Loggings*. The information is shown as graphs. Only parameters selected in *parameter 0-20 Display Line 1.1 Small* through *parameter 0-24 Display Line 3 Large* can be viewed. It is possible to store up to 120 samples in the memory for later reference.

| **Q6 Loggings** | |
|---|---|
| *Parameter 0-20 Display Line 1.1 Small* | Speed [RPM] |
| *Parameter 0-21 Display Line 1.2 Small* | Motor Current |
| *Parameter 0-22 Display Line 1.3 Small* | Power [kW] |
| *Parameter 0-23 Display Line 2 Large* | Frequency |
| *Parameter 0-24 Display Line 3 Large* | Reference % |

**Table 3.7 Logging Parameter Examples**

### 3.7.1.6 Main Menu Mode

The *Main Menu* mode lists all the parameter groups available to the drive. Select the Main Menu mode by pressing the [Main Menu] key. The resulting readout appears on the LCP display.

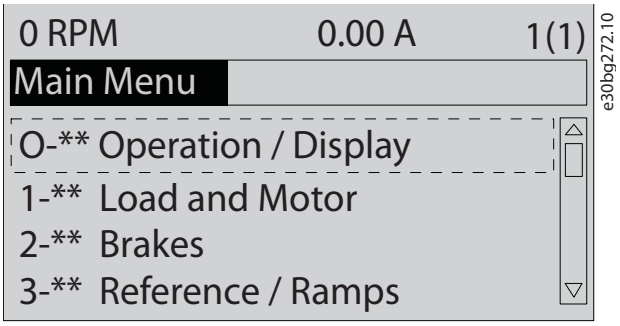



**Figure 3.6 Main Menu View**

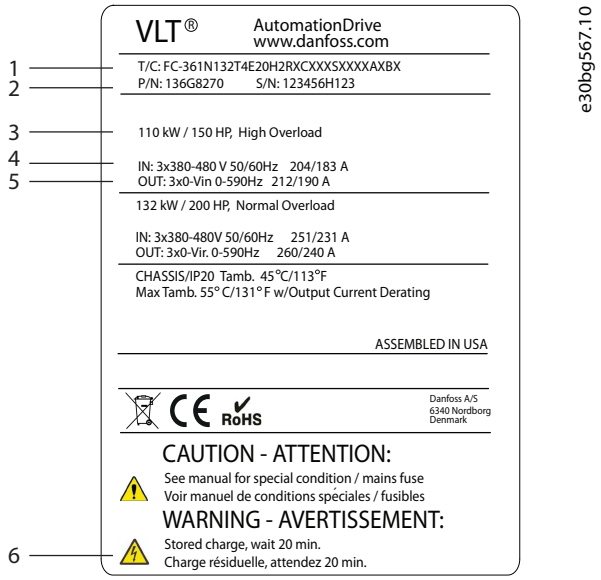
All parameters can be changed in the main menu. Option cards added to the unit enable extra parameters associated with the option device.

# 4 Mechanical Installation

## 4.1 Items Supplied

Items supplied may vary according to product configuration.

- Make sure the items supplied and the information on the nameplate correspond to the order confirmation.
- Check the packaging and the drive visually for damage caused by inappropriate handling during shipment. File any claim for damage with the carrier. Retain damaged parts for clarification.




| | |
|---|---|
| 1 | Type code |
| 2 | Part number and serial number |
| 3 | Power rating |
| 4 | Input voltage, frequency, and current |
| 5 | Output voltage, frequency, and current |
| 6 | Discharge time |

**Figure 4.1 Example Nameplate for Drive Only (J8–J9)**

***NOTICE!***

**LOSS OF WARRANTY**

**Do not remove the nameplate from the drive. Removing the nameplate can result in loss of warranty.**

## 4.2 Tools Needed

**Receiving/unloading**

- I-beam and hooks rated to lift the weight of the drive. Refer to *chapter 3.2 Power Ratings, Weights, and Dimensions*.
- Crane or other lifting aid to place the unit into position.

**Installation**

- Drill with 10 mm (0.39 in) or 12 mm (0.47 in) drill bits.
- Tape measurer.
- Various sizes of Phillips and flat bladed screwdrivers.
- Wrench with relevant metric sockets (7–17 mm/ 0.28–0.67 in).
- Wrench extensions.
- Torx drives (T25 and T50).
- Sheet metal punch for conduits or cable glands.
- I-beam and hooks to lift the weight of the drive. Refer to *chapter 3.2 Power Ratings, Weights, and Dimensions*.
- Crane or other lifting aid to place the drive onto pedestal and into position.

## 4.3 Storage

Store the drive in a dry location. Keep the equipment sealed in its packaging until installation. Refer to *chapter 10.4 Ambient Conditions* for recommended ambient temperature.

Periodic forming (capacitor charging) is not necessary during storage unless storage exceeds 12 months.



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## 4.4 Operating Environment

***NOTICE!***

**In environments with airborne liquids, particles, or corrosive gases, ensure that the IP/type rating of the equipment matches the installation environment. Failure to meet requirements for ambient conditions can reduce the lifetime of the drive. Ensure that requirements for air humidity, temperature, and altitude are met.**

| Voltage [V] | Altitude restrictions |
|---|---|
| 380–480 | At altitudes above 3000 m (9842 ft), contact Danfoss regarding PELV. |

**Table 4.1 Installation at High Altitudes**

For detailed ambient conditions specifications, refer to *chapter 10.4 Ambient Conditions*.

***NOTICE!***

**CONDENSATION**

**Moisture can condense on the electronic components and cause short circuits. Avoid installation in areas subject to frost. Install an optional space heater when the drive is colder than the ambient air. Operating in standby mode reduces the risk of condensation as long as the power dissipation keeps the circuitry free of moisture.**

***NOTICE!***

**EXTREME AMBIENT CONDITIONS**

**Hot or cold temperatures compromise unit performance and longevity.**

- **Do not operate in environments where the ambient temperature exceeds 55 °C (131 °F).**
- **The drive can operate at temperatures down to -10 °C (14 °F). However, proper operation at rated load is only guaranteed at 0 °C (32 °F) or higher.**
- **If temperature exceeds ambient temperature limits, extra air conditioning of the cabinet or installation site is required.**

### 4.4.1 Gases

Aggressive gases, such as hydrogen sulfide, chlorine, or ammonia can damage the electrical and mechanical components. The unit uses conformal-coated circuit boards to reduce the effects of aggressive gases. For conformal-coating class specifications and ratings, see *chapter 10.4 Ambient Conditions*.

### 4.4.2 Dust

When installing the drive in dusty environments, pay attention to the following:

**Periodic maintenance**

When dust accumulates on electronic components, it acts as a layer of insulation. This layer reduces the cooling capacity of the components, and the components become warmer. The hotter environment decreases the life of the electronic components.

Keep the heat sink and fans free from dust buildup. For more service and maintenance information, refer to *chapter 9 Maintenance, Diagnostics, and Troubleshooting*.

**Cooling fans**

Fans provide airflow to cool the drive. When fans are exposed to dusty environments, the dust can damage the fan bearings and cause premature fan failure. Also, dust can accumulate on fan blades causing an imbalance which prevents the fans from properly cooling the unit.

### 4.4.3 Potentially Explosive Atmospheres

**⚠WARNING**

**EXPLOSIVE ATMOSPHERE**

**Do not install the drive in a potentially explosive atmosphere. Install the unit in a cabinet outside of this area. Failure to follow this guideline increases risk of death or serious injury.**

## 4.5 Installation and Cooling Requirements

***NOTICE!***

**MOUNTING PRECAUTIONS**

**Improper mounting can result in overheating and reduced performance. Observe all installation and cooling requirements.**

  

**Installation Requirements**

- Ensure unit stability by mounting vertically to a solid flat surface.
- Ensure that the strength of the mounting location supports the unit weight. Refer to *chapter 3.2 Power Ratings, Weights, and Dimensions*.
- Ensure the mounting location allows access to open the enclosure door. See *chapter 10.9 Enclosure Dimensions*.
- Ensure that there is adequate space around the unit for cooling airflow.
- Place the unit as near to the motor as possible. Keep the motor cables as short as possible. See *chapter 10.5 Cable Specifications*.
- Ensure the location allows for cable entry at the bottom of the unit.

**Cooling and Airflow Requirements**

- Ensure that top and bottom clearance for air cooling is provided. Clearance requirement: 225 mm (9 in).
- Consider derating for temperatures starting between 45 °C (113 °F) and 50 °C (122 °F) and elevation 1000 m (3300 ft) above sea level. See the product-specific *design guide* for detailed information.

The drive uses back-channel cooling to circulate the heat sink cooling air. The cooling duct can carries approximately 90% of the heat out of the back channel of the drive. Redirect the back-channel air from the panel or room by using:

- Duct cooling. Back-channel cooling kits are available to direct the air away from the panel when an IP20/chassis drive is installed in a Rittal enclosure. Use of a kit reduces the heat in the panel and smaller door fans can be specified on the enclosure.
- Cooling out the back (top and base covers). The back-channel cooling air can be ventilated out of the room so that the heat from the back channel is not dissipated into the control room.

  

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***NOTICE!***

**One or more door fans are required on the enclosure to remove heat not contained in the back channel of the drive. The fans also remove any additional losses generated by other components inside the drive.**

Ensure that the fans supply adequate airflow over the heat sink. To select the appropriate number of fans, calculate the total required airflow. The flow rate is shown in *Table 4.2*.

| Enclosure size | Door fan/top fan | Heat sink fan |
|---|---|---|
| J8 | 102 $m^3$/hr (60 CFM) | 420 $m^3$/hr (250 CFM) |
| J9 | 204 $m^3$/hr (120 CFM) | 840 $m^3$/hr (500 CFM) |

**Table 4.2 Airflow**

## 4.6 Lifting the Drive

Always lift the drive using the dedicated eye bolts at the top of the drive. See *Figure 4.2*.

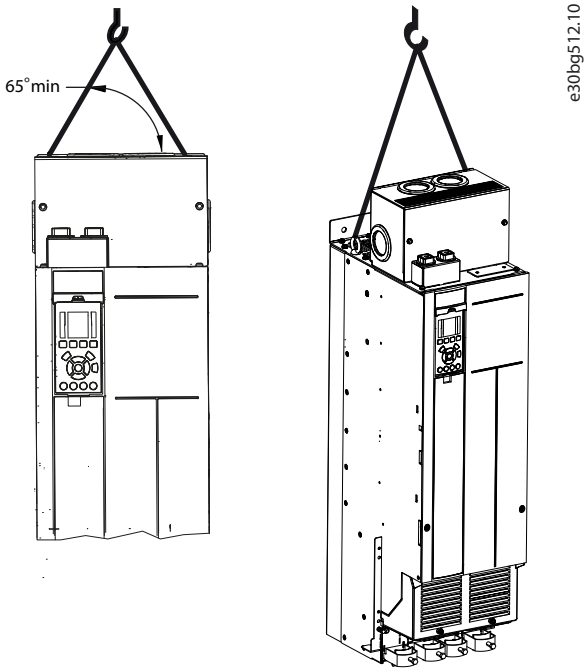



**Figure 4.2 Lifting the Drive**

**⚠WARNING**

**HEAVY LOAD**

**Unbalanced loads can fall or tip over. Failure to take proper lifting precautions increases risk of death, serious injury, or equipment damage.**

- **Move the unit using a hoist, crane, forklift, or other lifting device with the appropriate weight rating. See *chapter 3.2 Power Ratings, Weights, and Dimensions* for the weight of the drive.**
- **Failure to locate the center of gravity and correctly position the load can cause unexpected shifting during lifting and transport. For measurements and center of gravity, see *chapter 10.9 Enclosure Dimensions*.**
- **The angle from the top of the drive module to the lifting cables affects the maximum load force on the cable. This angle must be 65° or greater. Refer to *Figure 4.2*. Attach and dimension the lifting cables properly.**
- **Never walk under suspended loads.**
- **To guard against injury, wear personal protective equipment such as gloves, safety glasses, and safety shoes.**

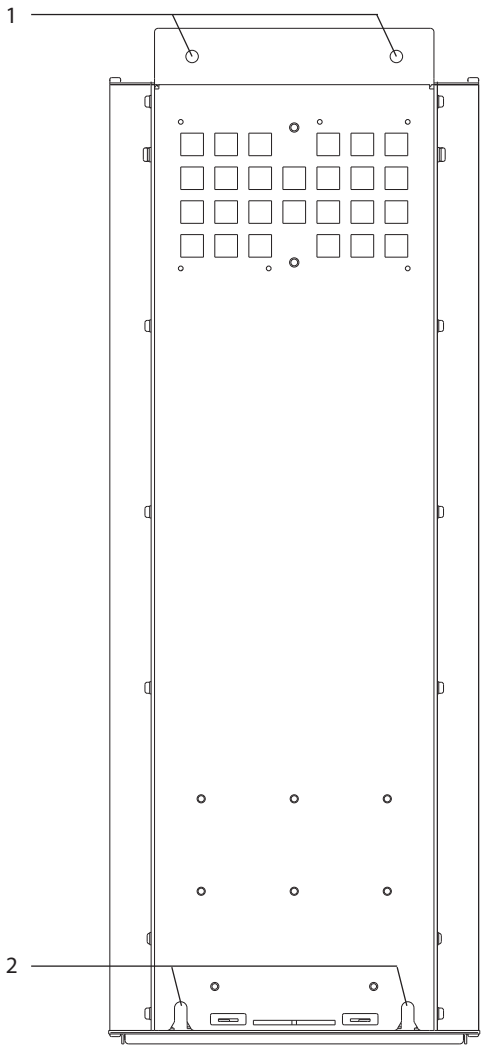
  

## 4.7 Mounting the Drive

**Wall mounting**

J8 and J9 are chassis drives intended to be mounted on a wall or on a mounting plate within an enclosure. To wall mount a drive, use the following steps. Refer to *Figure 4.3*.

1. Fasten 2 M10 bolts in the wall to align with the fastener slots at the bottom of drive.
2. Slide the lower fastener slots in the drive over the M10 bolts.
3. Tip the drive against the wall, and secure the top with 2 M10 bolts in the mounting holes.



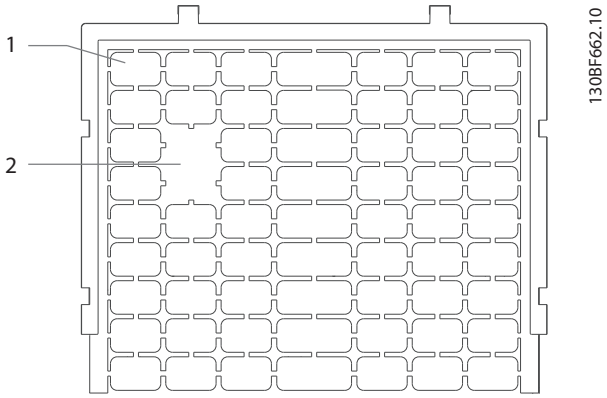

| | |
|---|---|
| 1 | Top mounting holes |
| 2 | Lower fastener slots |

**Figure 4.3 Drive-to-wall Mounting Holes**

**Creating cable openings**

After installing the drive, create cable openings in the gland plate to accommodate the mains and motor cables. The gland plate is required to maintain the drive protection rating.

- Punch out plastic tabs to accommodate the cables. See *Figure 4.4*.




| | |
|---|---|
| 1 | Plastic tabs |
| 2 | Tabs removed for cable access |

**Figure 4.4 Cable Openings in Plastic Gland Plate**

# 5 Electrical Installation

## 5.1 Safety Instructions

See *chapter 2 Safety* for general safety instructions.

**⚠WARNING**

**INDUCED VOLTAGE**

**Induced voltage from output motor cables from different drives that run together can charge equipment capacitors even with the equipment turned off and locked out. Failure to run output motor cables separately or use shielded cables or metal conduits could result in death or serious injury.**

- **Run output motor cables separately or use shielded cables.**
- **Simultaneously lock out all the drives.**

**⚠WARNING**

**SHOCK HAZARD**

**The drive can cause a DC current in the ground conductor and thus result in death or serious injury.**

- **When a residual current-operated protective device (RCD) is used for protection against electrical shock, only an RCD of Type B is allowed on the supply side.**

**Failure to follow the recommendation means that the RCD cannot provide the intended protection.**

***NOTICE!***

**The drive is supplied with Class 20 motor overload protection.**

**Overcurrent protection**

- Additional protective equipment such as short-circuit protection or motor thermal protection between drive and motor is required for applications with multiple motors.
- Input fusing is required to provide short circuit and overcurrent protection. If fuses are not factory-supplied, the installer must provide them. See maximum fuse ratings in *chapter 10.7 Fuses and Circuit Breakers*.

**Wire type and ratings**

- All wiring must comply with local and national regulations regarding cross-section and ambient temperature requirements.
- Power connection wire recommendation: Minimum 75 °C (167 °F) rated copper wire.

See *chapter 10.5 Cable Specifications* for recommended wire sizes and types.

**⚠CAUTION**

**PROPERTY DAMAGE**

**Protection against motor overload is not included in the default setting. To add this function, set *parameter 1-90 Motor Thermal Protection* to *[ETR trip]* or *[ETR warning]*. For the North American market, the ETR function provides class 20 motor overload protection in accordance with NEC. Failure to set *parameter 1-90 Motor Thermal Protection* to *[ETR trip]* or *[ETR warning]* means that motor overload protection is not provided and, if the motor overheats, property damage can occur.**

## 5.2 EMC-compliant Installation

To obtain an EMC-compliant installation, follow the instructions provided in:

- *chapter 5.3 Wiring Schematic*.
- *chapter 5.4 Connecting to Ground*.
- *chapter 5.5 Connecting the Motor*.
- *chapter 5.6 Connecting the AC Mains*.

***NOTICE!***

**TWISTED SHIELD ENDS (PIGTAILS)**

**Twisted shield ends (pigtails) increase the shield impedance at higher frequencies, reducing the shield effect and increasing the leakage current. To avoid twisted shield ends, use integrated shield clamps.**

- For use with relays, control cables, a signal interface, fieldbus, or brake, connect the shield to the enclosure at both ends. If the ground path has high impedance, is noisy, or is carrying current, break the shield connection on 1 end to avoid ground current loops.
- Convey the currents back to the unit using a metal mounting plate. Ensure good electrical contact from the mounting plate through the mounting screws to the drive chassis.

- Use shielded cables for motor output cables. An alternative is unshielded motor cables within metal conduit.

***NOTICE!***

**SHIELDED CABLES**

**If shielded cables or metal conduits are not used, the unit and the installation do not meet regulatory limits on radio frequency (RF) emission levels.**

- Ensure that motor and brake cables are as short as possible to reduce the interference level from the entire system.
- Avoid placing cables with a sensitive signal level alongside motor and brake cables.
- For communication and command/control lines, follow the particular communication protocol standards. For example, USB must use shielded cables, but RS485/ethernet can use shielded UTP or unshielded UTP cables.
- Ensure that all control terminal connections are PELV.

***NOTICE!***

**EMC INTERFERENCE**

**Run cables for mains input, motor wiring, and control wiring in 3 separate metallic conduits. Failure to isolate power, motor, and control cables can result in unintended behavior or reduced performance. Minimum 200 mm (7.9 in) clearance between mains input, motor, and control cables are required.**

***NOTICE!***

**INSTALLATION AT HIGH ALTITUDE**

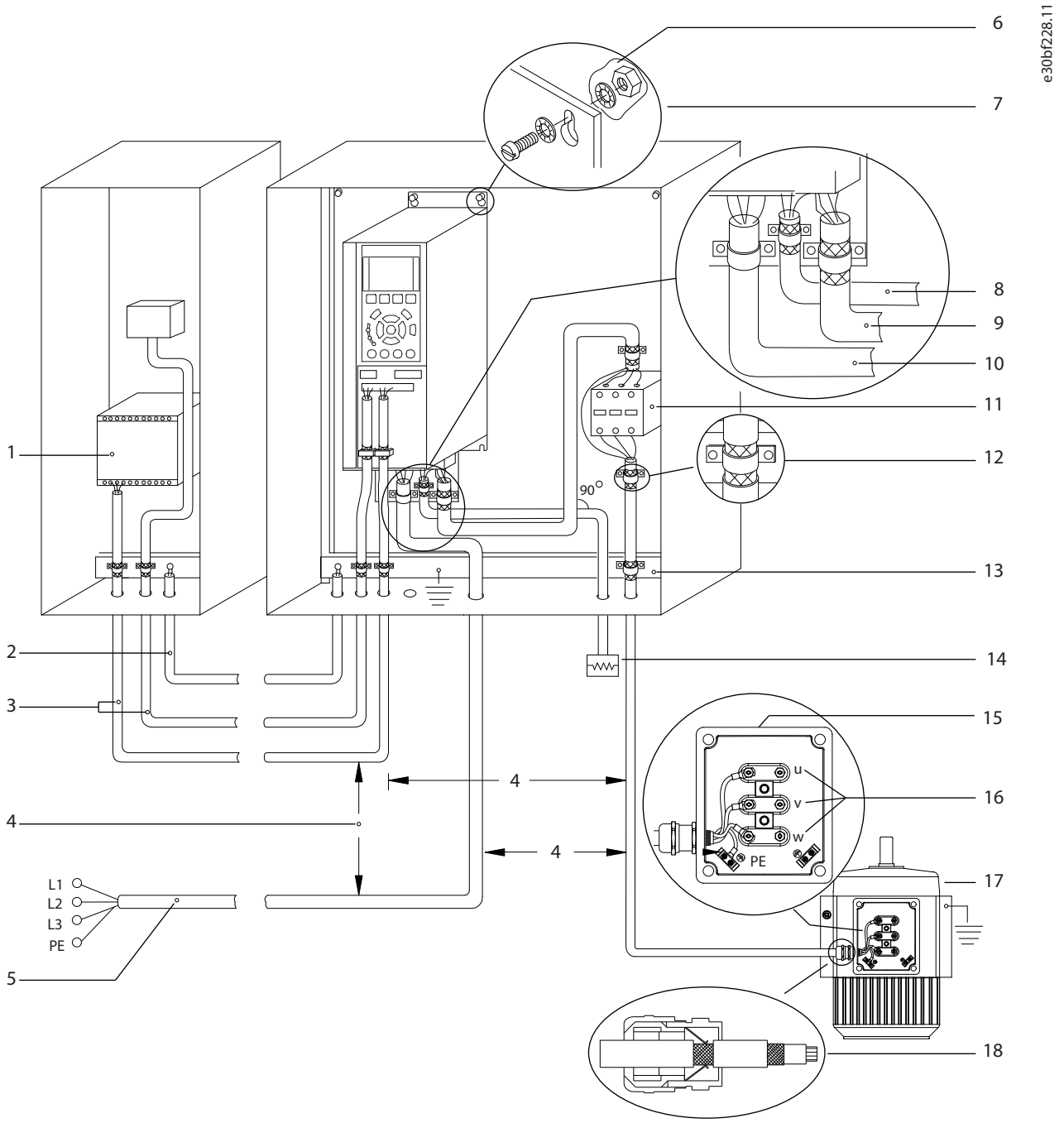
**There is a risk for overvoltage. Isolation between components and critical parts could be insufficient, and not comply with PELV requirements. Reduce the risk for overvoltage by using external protective devices or galvanic isolation.**
**For installations above 2000 m (6500 ft) altitude, contact Danfoss regarding PELV compliance.**

***NOTICE!***

**PELV COMPLIANCE**

**Prevent electric shock by using protective extra low voltage (PELV) electrical supply and complying with local and national PELV regulations.**

5




| | | | |
|---|---|---|---|
| 1 | PLC | 10 | Mains cable (unshielded) |
| 2 | Minimum 16 mm$^2$ (6 AWG) equalizing cable | 11 | Output contactor and similar options |
| 3 | Control cables | 12 | Cable insulation stripped |
| 4 | Required minimum separation of 200 mm (7.9 in) between control cables, motor cables, and mains cables | 13 | Common ground busbar (Follow local and national requirements for enclosure grounding) |
| 5 | Mains supply | 14 | Brake resistor |
| 6 | Bare (unpainted) surface | 15 | Metal box |
| 7 | Star washers | 16 | Connection to motor |
| 8 | Brake cable (shielded) | 17 | Motor |
| 9 | Motor cable (shielded) | 18 | EMC cable gland |

**Figure 5.1 Example of Proper EMC Installation**

## 5.3 Wiring Schematic

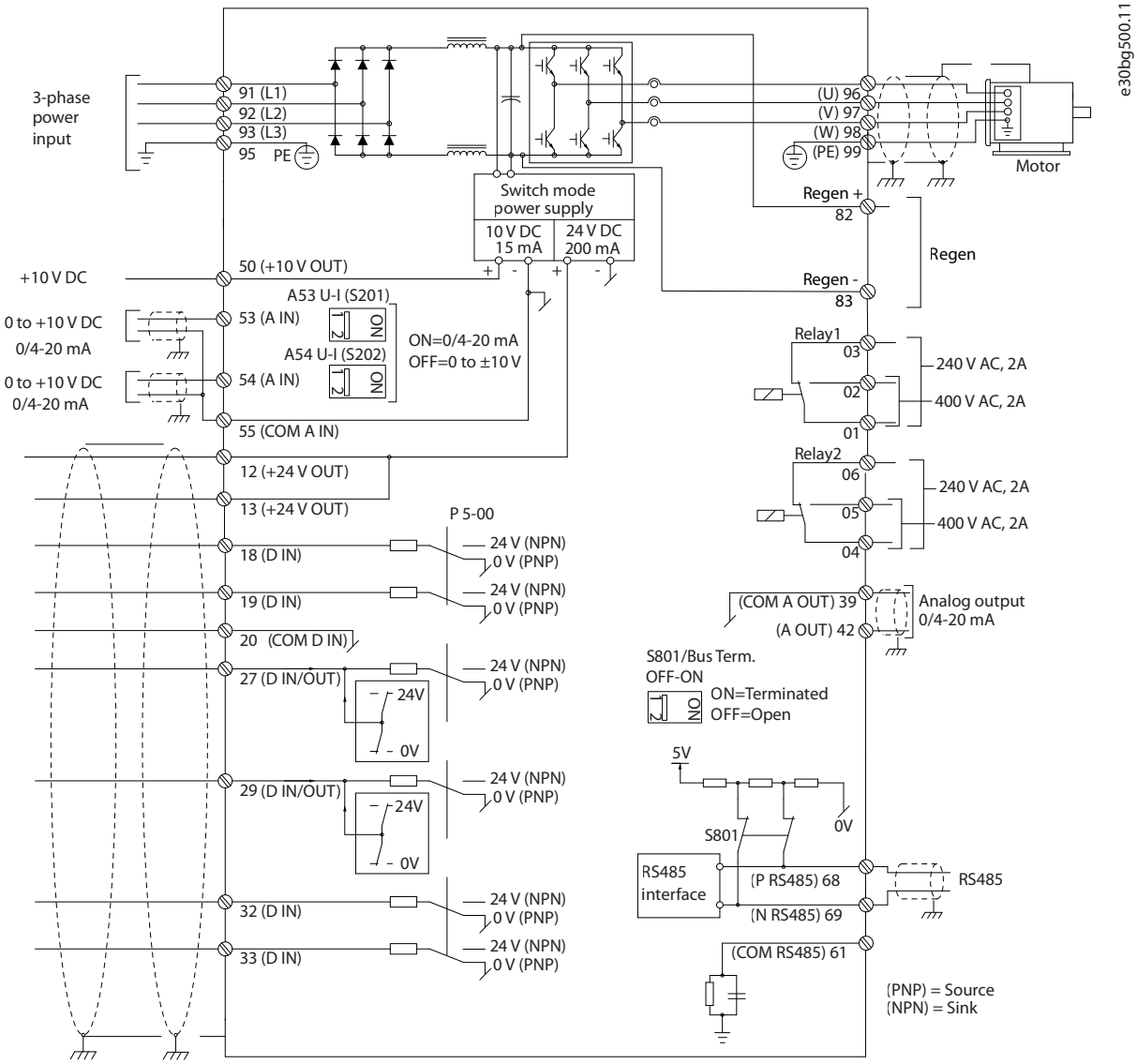



**Figure 5.2 Basic Wiring Schematic**

## 5.4 Connecting to Ground

**⚠WARNING**

**LEAKAGE CURRENT HAZARD**

**Leakage currents exceed 3.5 mA. Failure to ground the drive properly can result in death or serious injury.**

- **Ensure the correct grounding of the equipment by a certified electrical installer.**

5

**For electrical safety**

- Ground the drive in accordance with applicable standards and directives.
- Use a dedicated ground wire for input power, motor power, and control wiring.
- Do not ground 1 drive to another in a daisy chain fashion.
- Keep the ground wire connections as short as possible.
- Follow motor manufacturer wiring requirements.
- Minimum cable cross-section: 10 $mm^2$ (6 AWG) (or 2 rated ground wires terminated separately).
- Tighten the terminals in accordance with the information provided in *chapter 10.8 Fastener Tightening Torques*.

**For EMC-compliant installation**

- Establish electrical contact between the cable shield and the drive enclosure by using metal cable glands or by using the clamps provided on the equipment.
- Reduce burst transient by using high-strand wire.
- Do not use twisted shield ends (pigtails).

***NOTICE!***

**POTENTIAL EQUALIZATION**

**There is a risk of burst transient when the ground potential between the drive and the control system is different. Install equalizing cables between the system components. Recommended cable cross-section: 16 $mm^2$ (5 AWG).**

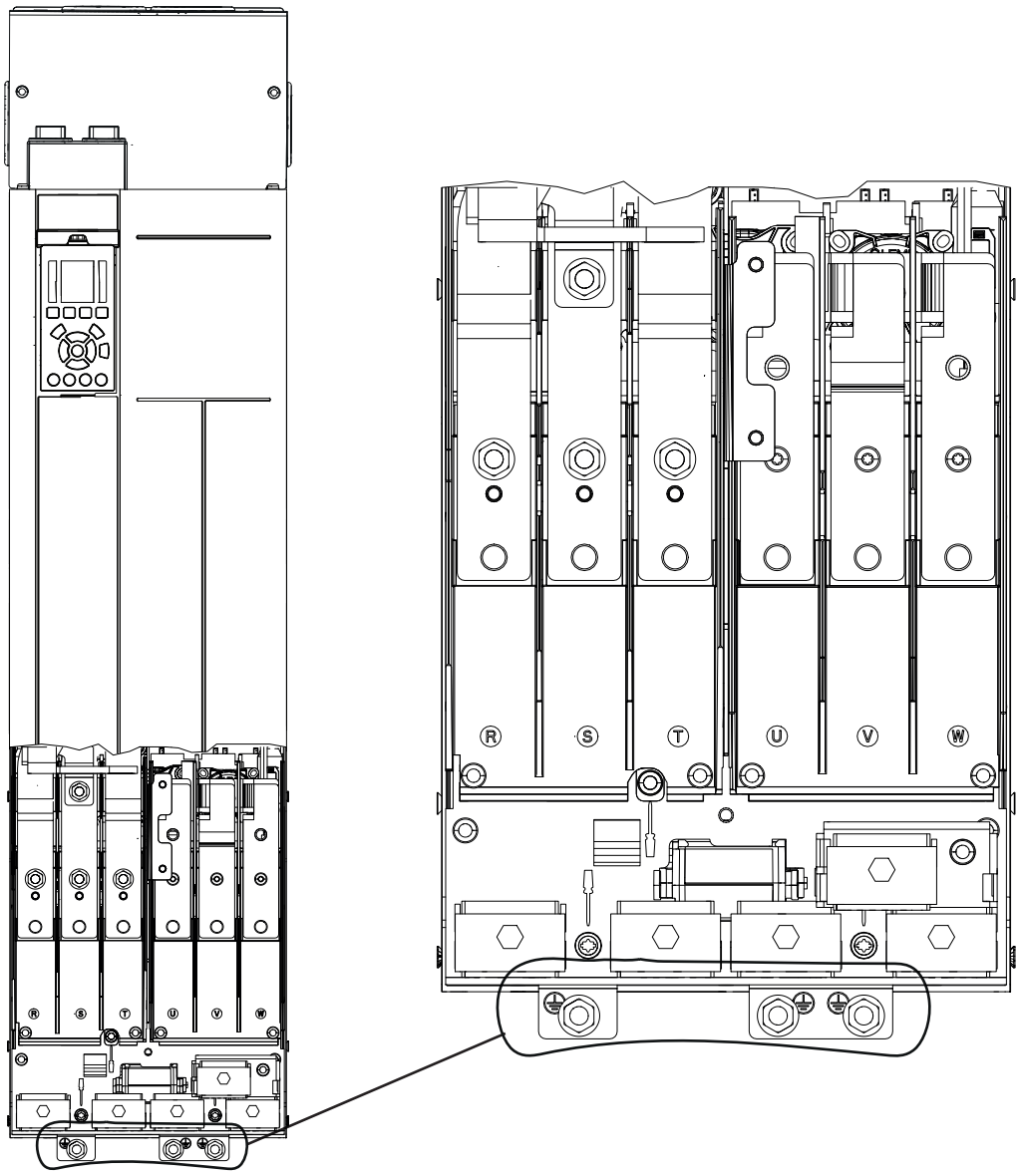



**Figure 5.3 Ground Terminals (J8 shown)**

## 5.5 Connecting the Motor

**⚠WARNING**

**INDUCED VOLTAGE**

**Induced voltage from output motor cables that run together can charge equipment capacitors even with the equipment turned off and locked out. Failure to run output motor cables separately or use shielded cables, or metal conduits could result in death or serious injury.**

5

- Comply with local and national electrical codes for cable sizes. For maximum wire sizes, see *chapter 10.5 Cable Specifications*.
- Follow motor manufacturer wiring requirements.
- Motor wiring knockouts or access panels are provided at the base of IP21 (NEMA1/12) and higher units.
- Do not wire a starting or pole-changing device (for example Dahlander motor or slip ring asynchronous motor) between the drive and the motor.

**Procedure**

1. Strip a section of the outer cable insulation.
2. Position the stripped wire under the cable clamp, establishing mechanical fixation and electrical contact between the cable shield and ground.
3. Connect the ground wire to the nearest grounding terminal in accordance with the grounding instructions provided in *chapter 5.4 Connecting to Ground*, see *Figure 5.4*.
4. Connect the 3-phase motor wiring to terminals 96 (U), 97 (V), and 98 (W), see *Figure 5.4*.
5. Tighten the terminals in accordance with the information provided in *chapter 10.8 Fastener Tightening Torques*.

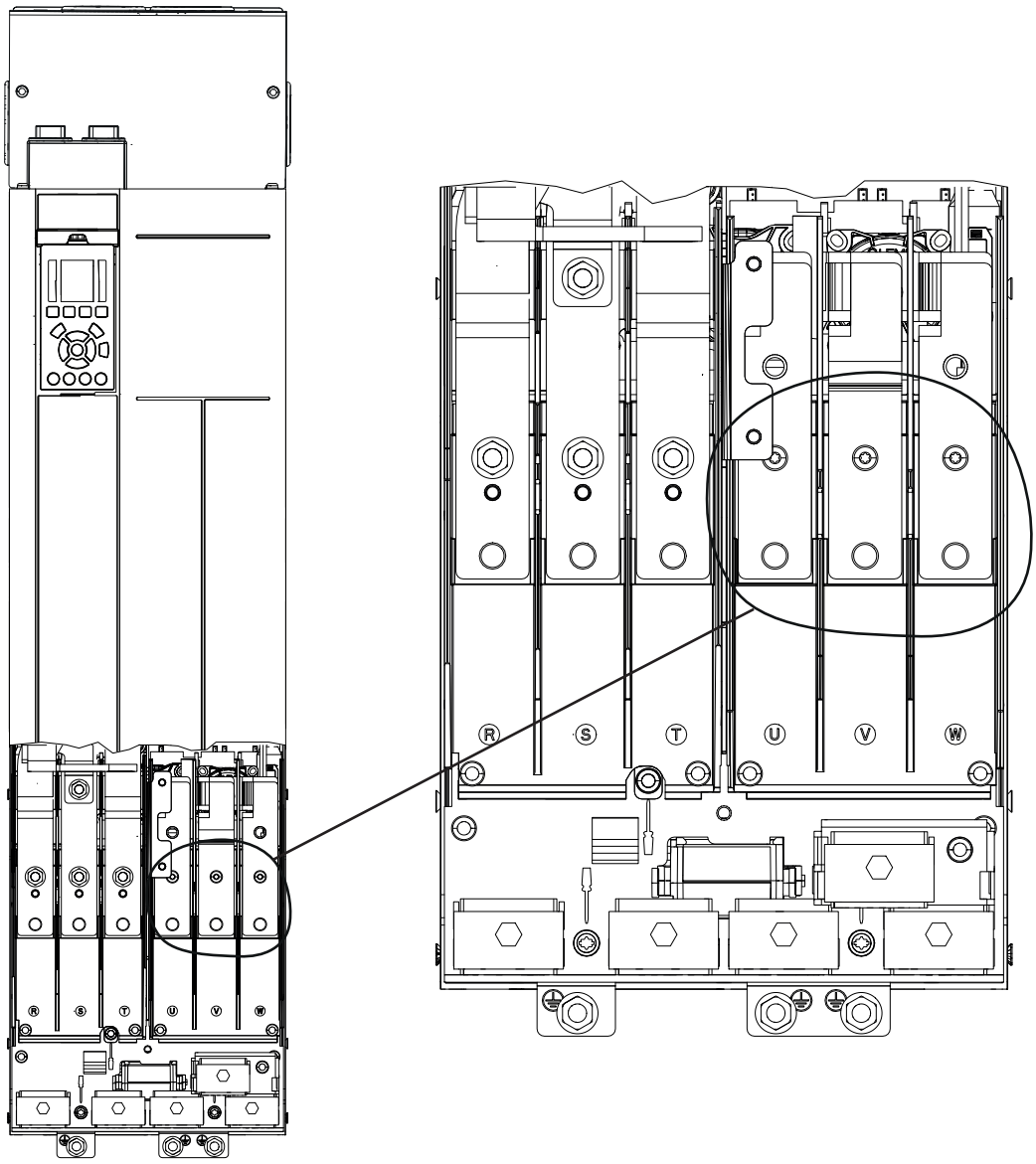



**Figure 5.4 Motor Terminals (J8 shown)**

## 5.6 Connecting the AC Mains

- Size the wiring according to the input current of the drive. For maximum wire sizes, see *chapter 10.1 Electrical Data, 380-480 V*.
- Comply with local and national electrical codes for cable sizes.

**Procedure**

1. Strip a section of the outer cable insulation.
2. Position the stripped wire under the cable clamp, establishing mechanical fixation and electrical contact between the cable shield and ground.
3. Connect the ground wire to the nearest grounding terminal in accordance with the grounding instructions provided in *chapter 5.4 Connecting to Ground*.
4. Connect the 3-phase AC input power wiring to terminals R, S, and T (see *Figure 5.5*).
5. When supplied from an isolated mains source (IT mains or floating delta) or TT/TN-S mains with a grounded leg (grounded delta), ensure that *parameter 14-50 RFI Filter* is set to *[0] Off* to avoid damage to the DC link and to reduce ground capacity currents.
6. Tighten the terminals in accordance with the information provided in *chapter 10.8 Fastener Tightening Torques*.

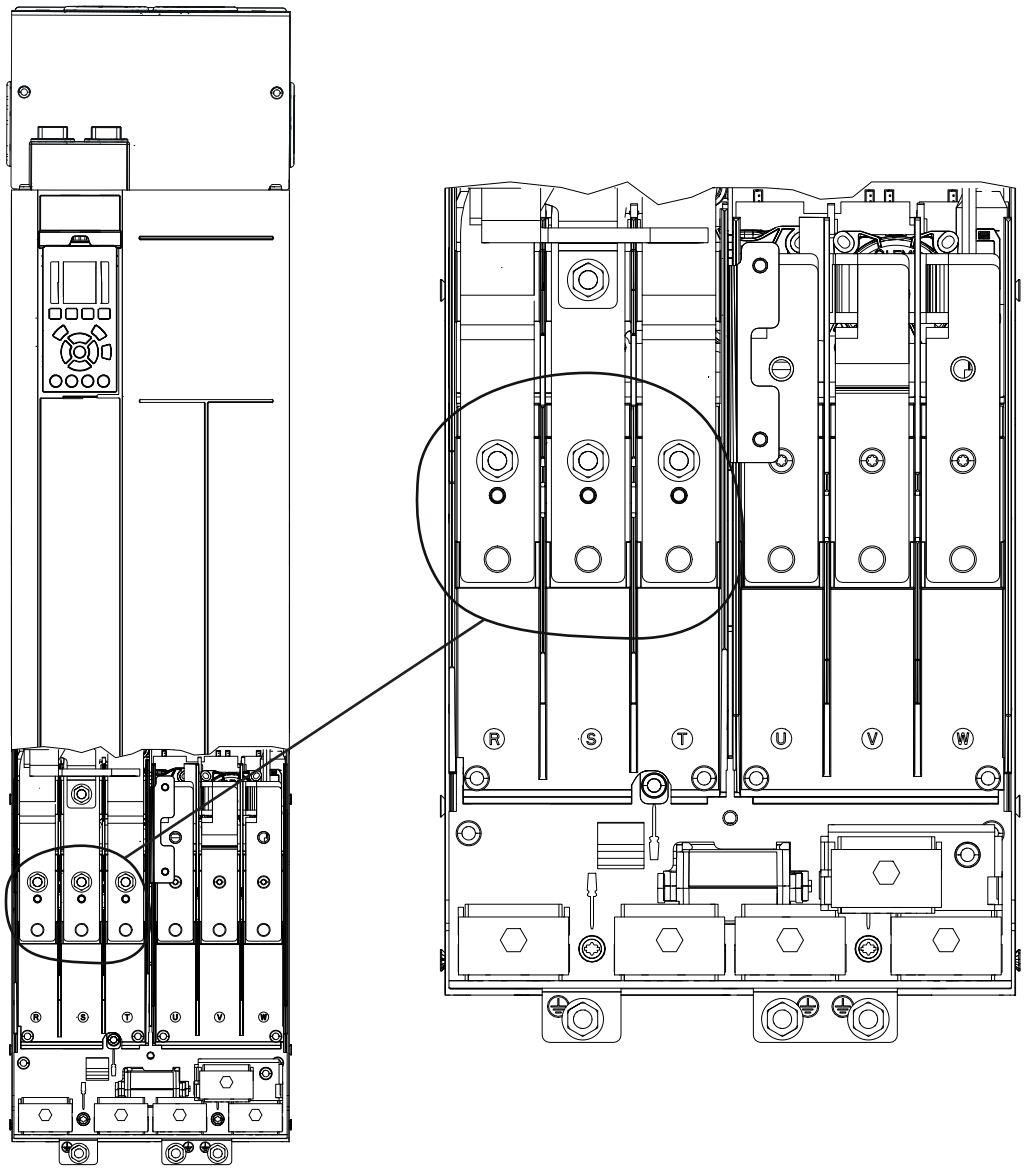
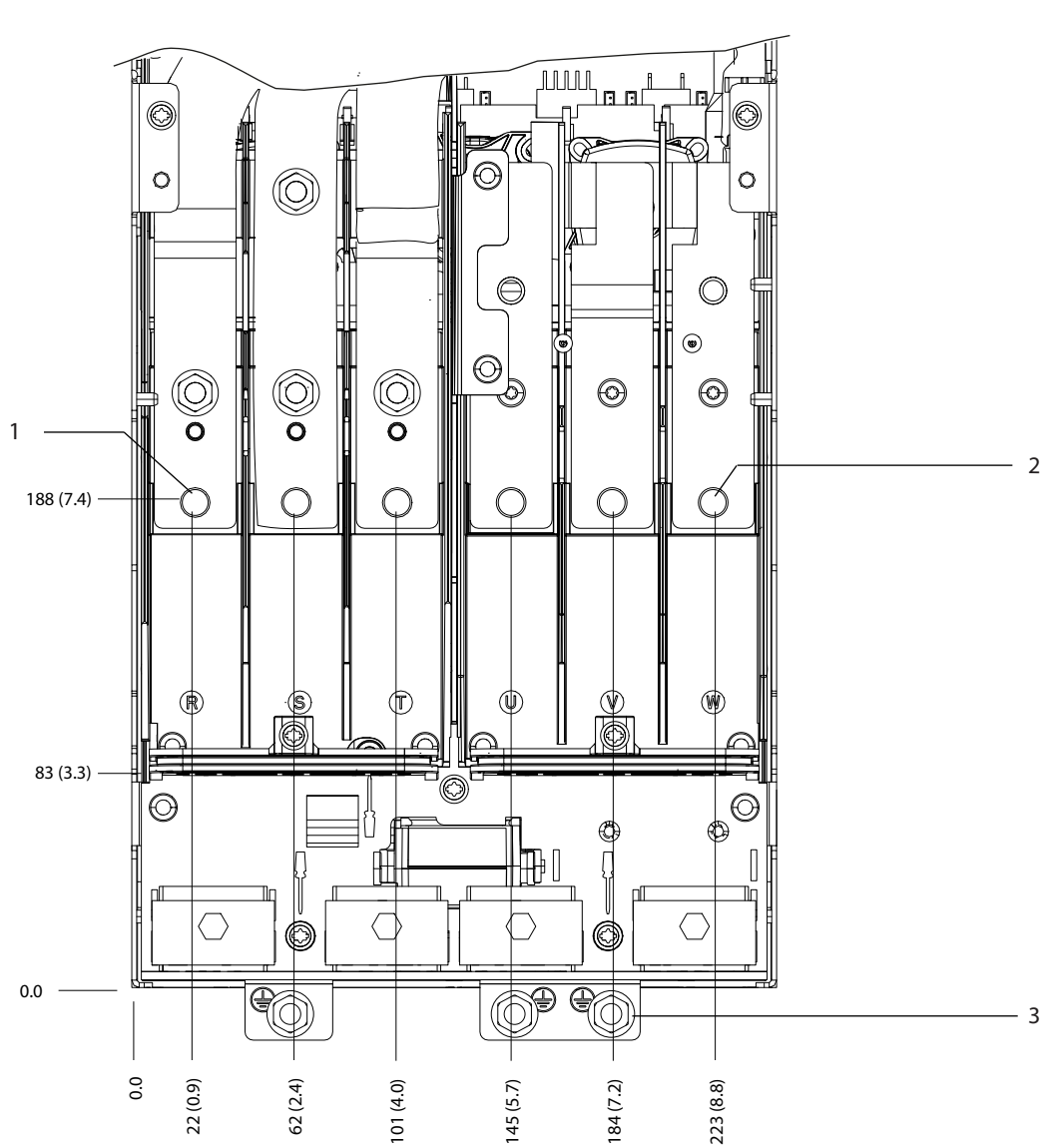



**Figure 5.5 AC Mains Terminals (J8 shown). For a detailed view of terminals, see *chapter 5.7 Terminal Dimensions*.**

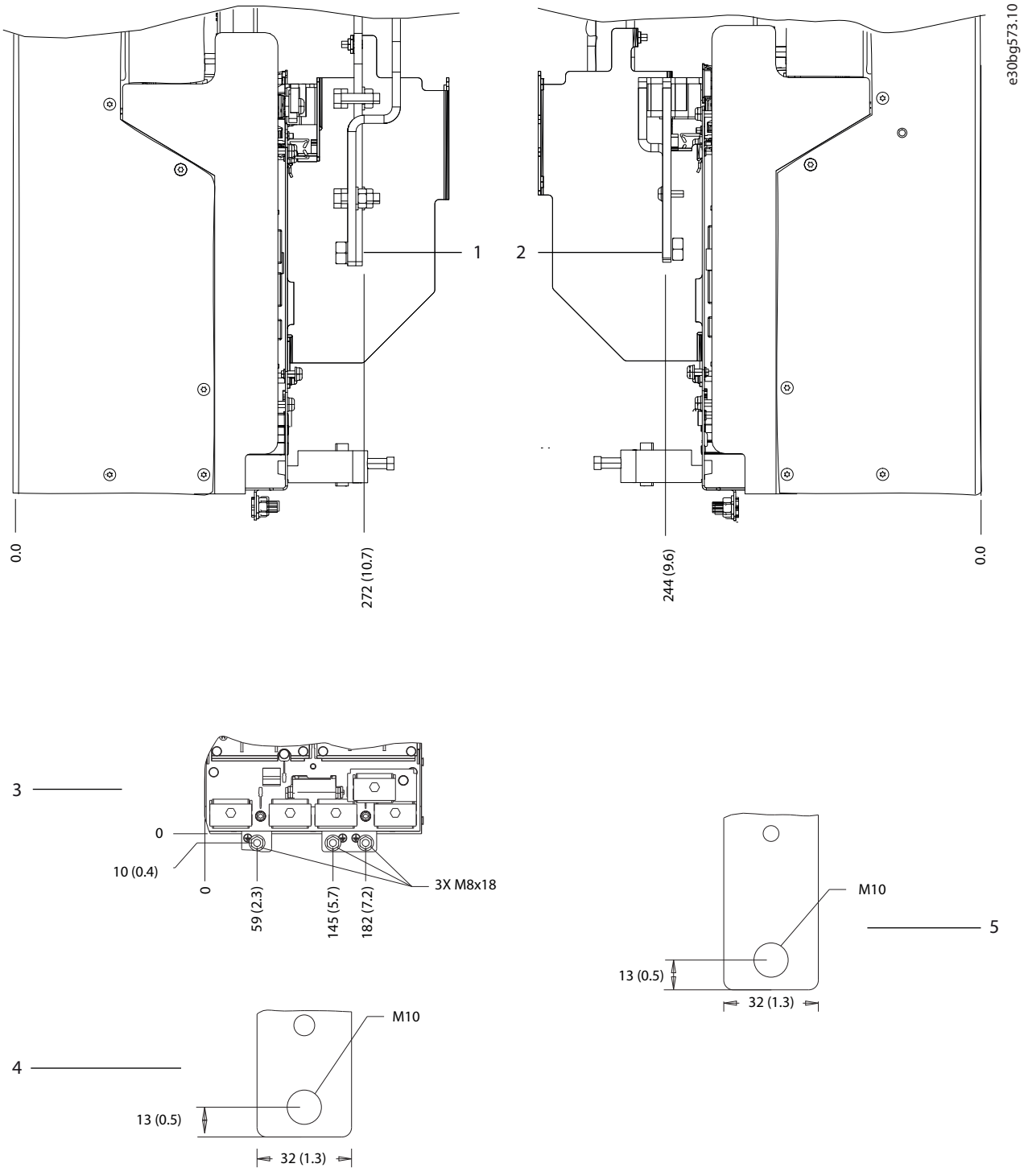
## 5.7 Terminal Dimensions

### 5.7.1 J8 Terminal Dimensions




| | | | |
|---|---|---|---|
| 1 | Mains terminals | 3 | Ground terminals |
| 2 | Motor terminals | | |

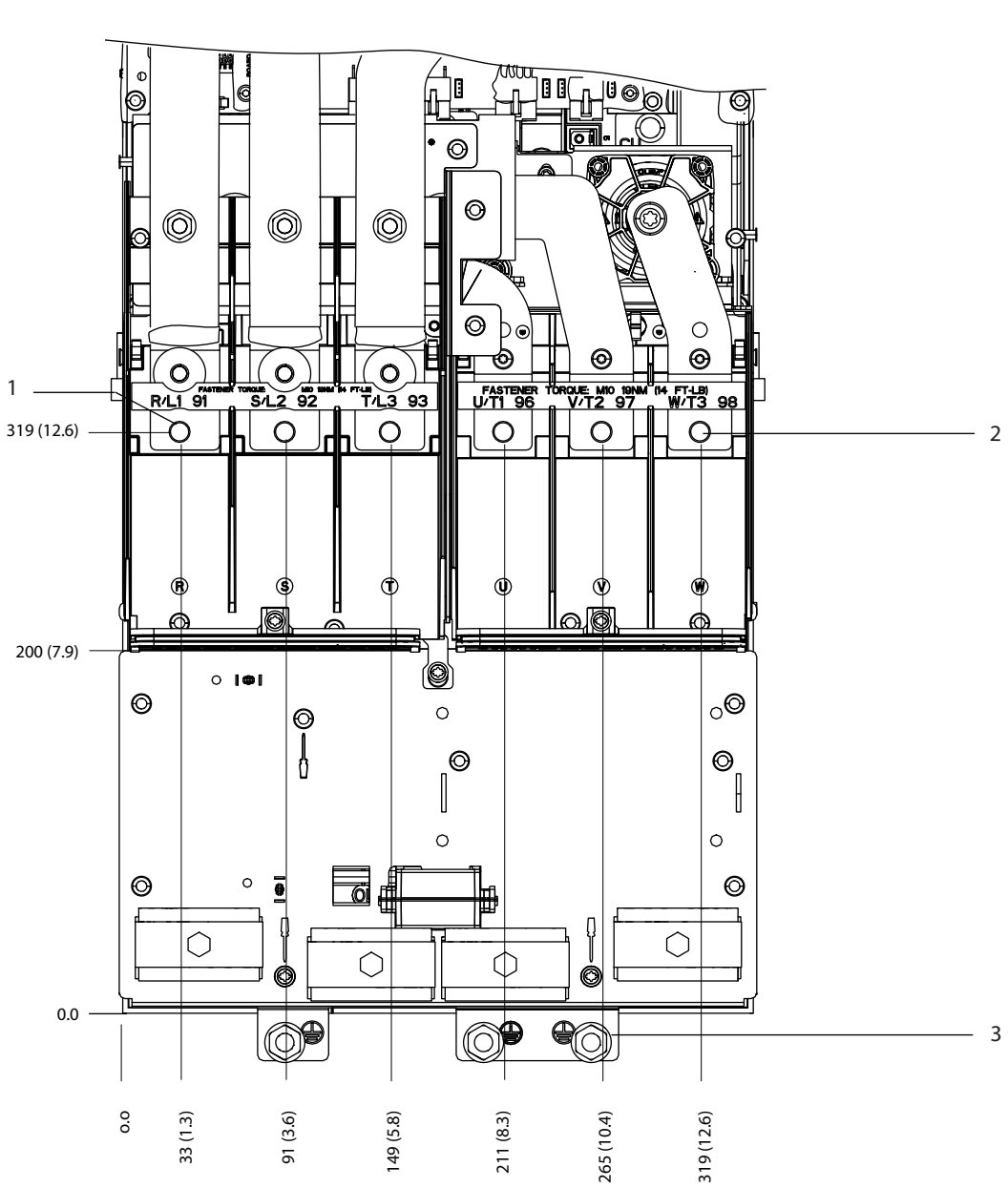
**Figure 5.6 J8 Terminal Dimensions (Front View)**




| | | | |
|---|---|---|---|
| 1 and 4 | Mains terminals | 2 and 5 | Motor terminals |
| 3 | Ground terminals | | |

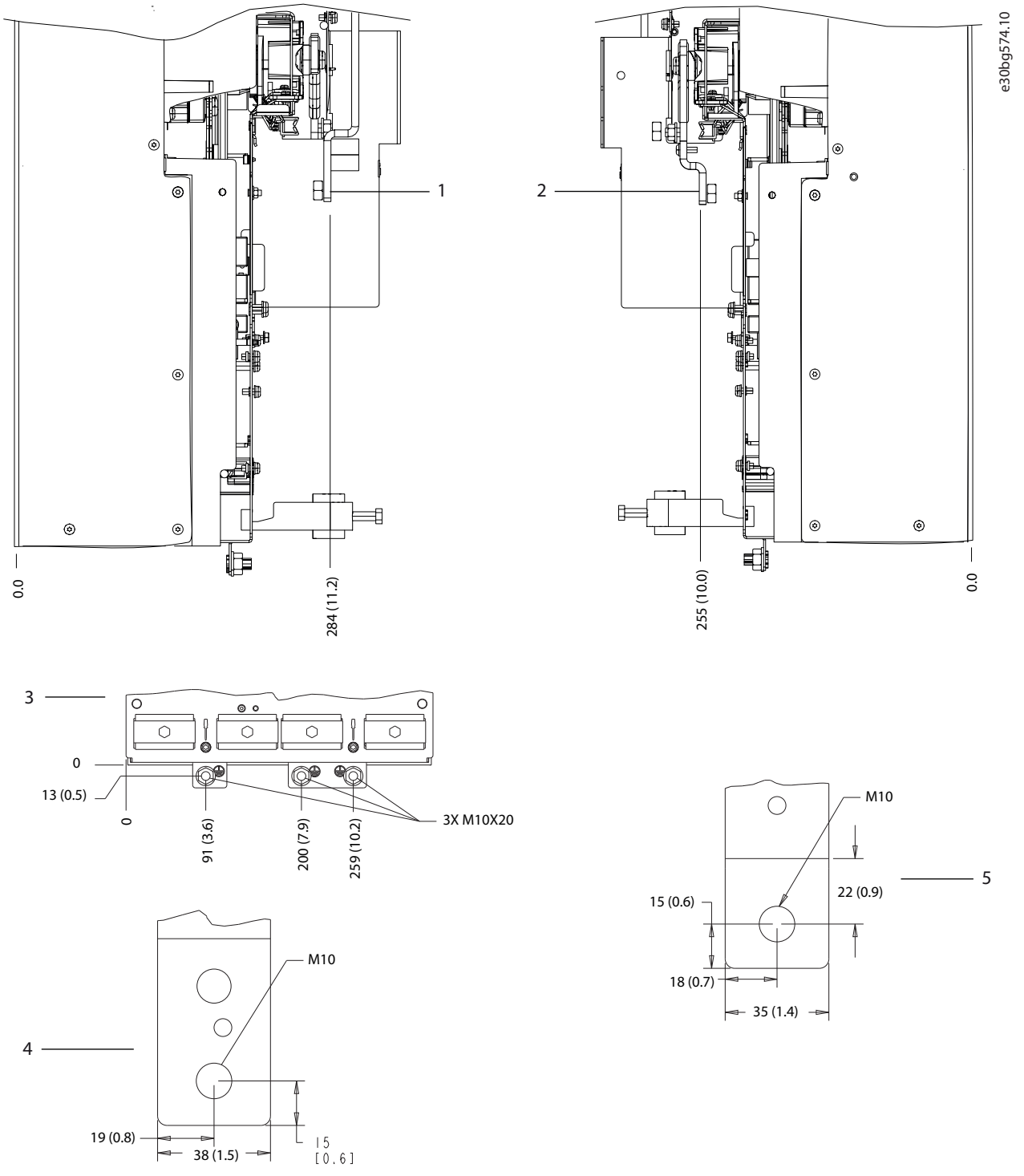
**Figure 5.7 J8 Terminal Dimensions (Side Views)**

## 5.7.2 J9 Terminal Dimensions




| | | | |
|---|---|---|---|
| 1 | Mains terminals | 3 | Ground terminals |
| 2 | Motor terminals | | |

**Figure 5.8 J9 Terminal Dimensions (Front View)**




| | | | |
|---|---|---|---|
| 1 and 4 | Mains terminals | 2 and 5 | Motor terminals |
| 3 | Ground terminals | 4 | Ground terminals |

**Figure 5.9 J9 Terminal Dimensions (Side Views)**

## 5.8 Control Wiring

All terminals to the control cables are inside the drive below the LCP. To access the control terminals, remove the front panel.

### 5.8.1 Control Cable Routing

- Isolate control wiring from high-power components in the drive.
- Tie down all control wires after routing them.
- Connect shields to ensure optimum electrical immunity.
- When the drive is connected to a thermistor, ensure that the thermistor control wiring is shielded and reinforced/double insulated. A 24 V DC supply voltage is recommended.

**Fieldbus connection**
Connections are made to the relevant options on the control card. For more detail, see the relevant fieldbus instruction. The cable must be tied down and routed along with other control wires inside the unit.

### 5.8.2 Control Terminal Types

*Figure 5.10* shows the removable drive connectors. Terminal functions and default settings are summarized in *Table 5.1 – Table 5.3*.

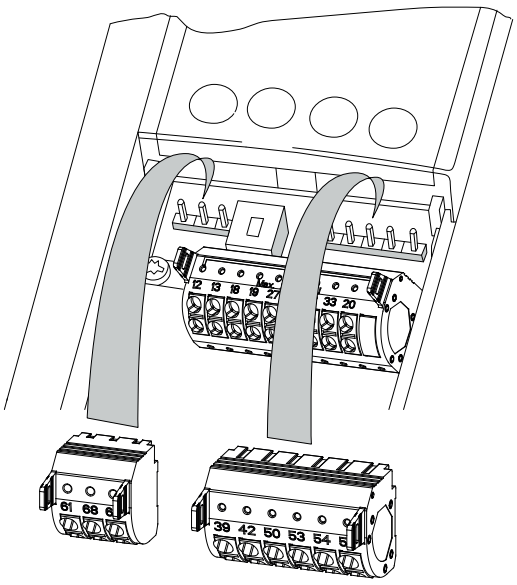
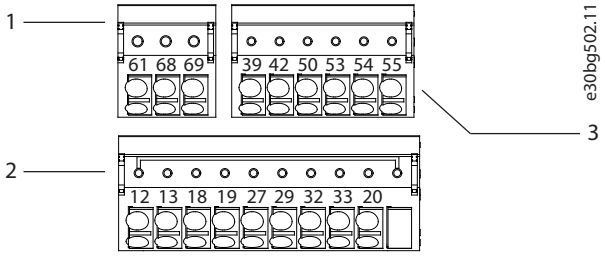



**Figure 5.10 Control Terminal Locations**




| | |
|---|---|
| 1 | Serial communication terminals |
| 2 | Digital input/output terminals |
| 3 | Analog input/output terminals |

**Figure 5.11 Terminal Numbers Located on the Connectors**

| Serial communication terminals | | | |
|---|---|---|---|
| **Terminal** | **Parameter** | **Default setting** | **Description** |
| 61 | – | – | Integrated RC-filter for cable shield. ONLY for connecting the shield in the event of EMC problems. |
| 68 (+) | *Parameter group 8-3* FC Port Settings* | – | RS485 interface. A switch (BUS TER.) is provided on the control card for bus termination resistance. See *Figure 5.16*. |
| 69 (-) | *Parameter group 8-3* FC Port Settings* | – | |
| **Relays** | | | |
| 01, 02, 03 | *Parameter 5-40 Function Relay* [0] | *[0] No operation* | Form C relay output. For AC or DC voltage and resistive or inductive loads. |
| 04, 05, 06 | *Parameter 5-40 Function Relay* [1] | *[0] No operation* | |

**Table 5.1 Serial Communication Terminal Descriptions**

| Digital input/output terminals | | | |
|---|---|---|---|
| **Terminal** | **Parameter** | **Default setting** | **Description** |
| 12, 13 | – | +24 V DC | 24 V DC supply voltage for digital inputs and external transducers. Maximum output current 200 mA for all 24 V loads. |

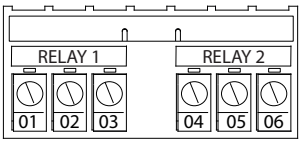
| Digital input/output terminals | | | |
|---|---|---|---|
| **Terminal** | **Parameter** | **Default setting** | **Description** |
| 18 | *Parameter 5-10 Terminal 18 Digital Input* | *[8] Start* | Digital inputs. |
| 19 | *Parameter 5-11 Terminal 19 Digital Input* | *[10] Reversing* | |
| 32 | *Parameter 5-14 Terminal 32 Digital Input* | *[0] No operation* | |
| 33 | *Parameter 5-15 Terminal 33 Digital Input* | *[0] No operation* | |
| 27 | *Parameter 5-12 Terminal 27 Digital Input* | *[2] Coast inverse* | For digital input or output. Default setting is input. |
| 29 | *Parameter 5-13 Terminal 29 Digital Input* | *[14] JOG* | |
| 20 | – | – | Common for digital inputs and 0 V potential for 24 V supply. |

**Table 5.2 Digital Input/Output Terminal Descriptions**

| Analog input/output terminals | | | |
|---|---|---|---|
| **Terminal** | **Parameter** | **Default setting** | **Description** |
| 39 | – | – | Common for analog output. |
| 42 | *Parameter 6-50 Terminal 42 Output* | *[0] No operation* | Programmable analog output. 0–20 mA or 4–20 mA at a maximum of 500 Ω. |
| 50 | – | +10 V DC | 10 V DC analog supply voltage for potentiometer or thermistor. 15 mA maximum. |
| 53 | *Parameter group 6-1* Analog Input 1* | Reference | Analog input. For voltage or current. Switches A53 and A54 select mA or V. |
| 54 | *Parameter group 6-2* Analog Input 2* | Feedback | |
| 55 | – | – | Common for analog input. |

**Table 5.3 Analog Input/Output Terminal Descriptions**

**Relay terminals:**




130BF156.10

**Figure 5.12 Relay 1 and Relay 2 Terminals**

- Relay 1 and relay 2. The location of the outputs depends on the drive configuration. See *chapter 3.5 View of Control Shelf*.
- Terminals on built-in optional equipment. See the manual provided with the equipment option.

5

## 5.8.3 Wiring to Control Terminals

The control terminals are located near the LCP. The control terminal connectors can be unplugged from the drive for convenience when wiring, as shown in *Figure 5.10*. Either solid or flexible wire can be connected to the control terminals. Use the following procedures to connect or disconnect the control wires.

5

***NOTICE!***

**Minimize interference by keeping control wires as short as possible and separate from high-power cables.**

**Connecting wire to control terminals**

1. Strip 10 mm (0.4 in) of the outer plastic layer from the end of the wire.
2. Insert the control wire into the terminal.
   - For a solid wire, push the bare wire into the contact. See *Figure 5.13*.
   - For a flexible wire, open the contact by inserting a small screwdriver into the slot between the terminal holes and push the screwdriver inward. See *Figure 5.14*. Then, insert the stripped wire into the contact, and remove the screwdriver.
3. Pull gently on the wire to ensure that the contact is firmly established. Loose control wiring can be the source of equipment faults or reduced performance.

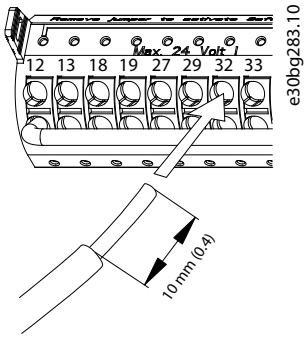



**Figure 5.13 Connecting Solid Control Wires**

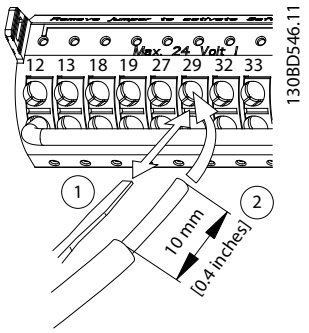



**Figure 5.14 Connecting Flexible Control Wires**

**Disconnecting wires from the control terminals**

1. To open the contact, insert a small screwdriver into the slot between the terminal holes and push the screwdriver inward.
2. Pull gently on the wire to free it from the control terminal contact.

See *chapter 10.5 Cable Specifications* for control terminal wiring sizes and *chapter 8 Wiring Configuration Examples* for typical control wiring connections.

## 5.8.4 Enabling Motor Operation (Terminal 27)

A jumper wire is required between terminal 12 (or 13) and terminal 27 for the drive to operate when using factory default programming values.

- Digital input terminal 27 is designed to receive 24 V DC external interlock command.
- When no interlock device is used, wire a jumper between control terminal 12 (recommended) or 13 to terminal 27. This wire provides an internal 24 V signal on terminal 27.
- When the status line at the bottom of the LCP reads *AUTO REMOTE COAST*, the unit is ready to operate, but is missing an input signal on terminal 27.
- When factory-installed optional equipment is wired to terminal 27, do not remove that wiring.

***NOTICE!***

**The drive cannot operate without a signal on terminal 27, unless terminal 27 is reprogrammed using *parameter 5-12 Terminal 27 Digital Input*.**

### 5.8.5 Configuring RS485 Serial Communication

RS485 is a 2-wire bus interface compatible with multi-drop network topology, and it contains the following features:

- Either Danfoss FC or Modbus RTU communication protocol, which are internal to the drive, can be used.
- Functions can be programmed remotely using the protocol software and RS485 connection or in *parameter group 8-** Communications and Options*.
- Selecting a specific communication protocol changes various default parameter settings to match the specifications of the protocol, making more protocol-specific parameters available.
- Option cards for the drive are available to provide more communication protocols. See the option card documentation for installation and operation instructions.
- A switch (BUS TER) is provided on the control card for bus termination resistance. See *Figure 5.16*.

For basic serial communication set-up, perform the following steps:

1. Connect RS485 serial communication wiring to terminals (+)68 and (-)69.
   - 1a Use shielded serial communication cable (recommended).
   - 1b See *chapter 5.4 Connecting to Ground* for proper grounding.
2. Select the following parameter settings:
   - 2a Protocol type in *parameter 8-30 Protocol*.
   - 2b Drive address in *parameter 8-31 Address*.
   - 2c Baud rate in *parameter 8-32 Baud Rate*.

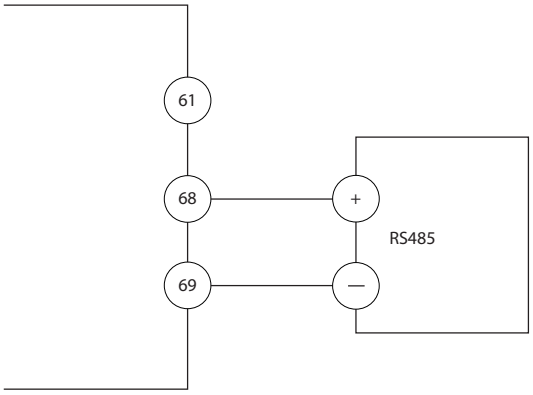



**Figure 5.15 Serial Communication Wiring Diagram**

### 5.8.6 Selecting Voltage/Current Input Signal

The analog input terminals 53 and 54 allow setting of input signal to voltage (0–10 V) or current (0/4–20 mA).

**Default parameter setting:**

- Terminal 53: Speed reference signal in open loop (see *parameter 16-61 Terminal 53 Switch Setting*).
- Terminal 54: Feedback signal in closed loop (see *parameter 16-63 Terminal 54 Switch Setting*).

***NOTICE!***

**Disconnect power to the drive before changing switch positions.**

1. Remove the LCP (local control panel). See *chapter 3.7 LCP Menus*.
2. Remove any optional equipment covering the switches.
3. Set switches A53 and A54 to select the signal type (U = voltage, I = current).

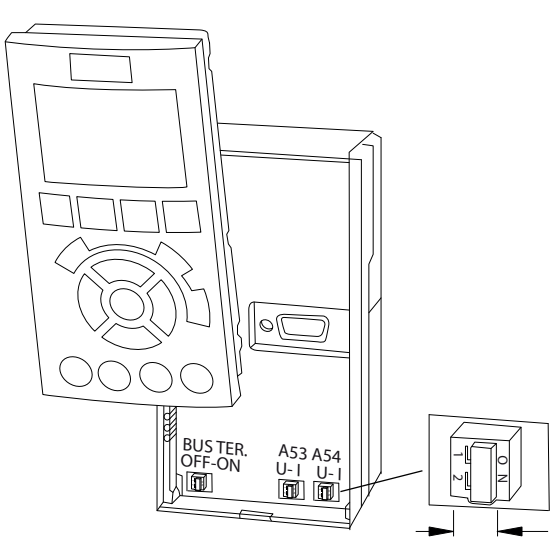



**Figure 5.16 Location of Terminal 53 and 54 Switches**

# 6 Pre-start Check List

Before completing installation of the unit, inspect the entire installation as detailed in *Table 6.1*. Check and mark the items when completed.

| Inspect for | Description | ☑ |
|---|---|---|
| Motor | • Confirm continuity of the motor by measuring ohm values on U–V (96–97), V–W (97–98), and W– U (98–96).<br>• Confirm that the supply voltage matches the voltage of the drive and the motor. | |
| Switches | • Ensure that all switch and disconnect settings are in the proper positions. | |
| Auxiliary equipment | • Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers that reside on the input power side of the drive or output side to the motor. Ensure that they are ready for full-speed operation.<br>• Check function and installation of any sensors used for feedback to the drive.<br>• Remove any power factor correction caps on motor.<br>• Adjust any power factor correction caps on the mains side and ensure that they are dampened. | |
| Cable routing | • Ensure that motor wiring, brake wiring (if equipped), and control wiring are separated or shielded, or in 3 separate metallic conduits for high-frequency interference isolation. | |
| Control wiring | • Check for broken or damaged wires and loose connections.<br>• Check that control wiring is isolated from high-power wiring for noise immunity.<br>• Check the voltage source of the signals, if necessary.<br>• Use shielded cable or twisted pair and ensure that the shield is terminated correctly. | |
| Input and output power wiring | • Check for loose connections.<br>• Check that motor and mains are in separate conduit or separated shielded cables. | |
| Grounding | • Check for good ground connections that are tight and free of oxidation.<br>• Grounding to conduit, or mounting the back panel to a metal surface, is not a suitable grounding. | |
| Fuses and circuit breakers | • Check for proper fusing or circuit breakers.<br>• Check that all fuses are inserted firmly and are in operational condition and that all circuit breakers (if used) are in the open position. | |
| Cooling clearance | • Look for any obstructions in the airflow path.<br>• Measure top and bottom clearance of the drive to verify adequate airflow for cooling, see *chapter 4.5 Installation and Cooling Requirements*. | |
| Ambient conditions | • Check that requirements for ambient conditions are met. See *chapter 10.4 Ambient Conditions*. | |
| Interior of Drive | • Inspect that the unit interior is free of dirt, metal chips, moisture, and corrosion.<br>• Verify that all installation tools have been removed from unit interior.<br>• Ensure that the unit is mounted on an unpainted, metal surface. | |
| Vibration | • Check that the unit is mounted solidly, or that shock mounts are used, if necessary.<br>• Check for an unusual amount of vibration. | |

**Table 6.1 Pre-start Check List**

# 7 Commissioning

## 7.1 Applying Power

**⚠WARNING**

**UNINTENDED START**

**When the drive is connected to AC mains, DC supply, or load sharing, the motor can start at any time, causing risk of death, serious injury, and equipment, or property damage. The motor can start by activation of an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up software, or after a cleared fault.**

**To prevent unintended motor start:**

- **Press [Off] on the LCP before programming parameters.**
- **Disconnect the drive from mains whenever personal safety considerations make it necessary to avoid unintended motor start.**
- **Check that the drive, motor, and any driven equipment are in operational readiness.**

***NOTICE!***

**MISSING SIGNAL**

**If the status at the bottom of the LCP reads AUTO REMOTE COASTING, or *alarm 60, External interlock* is shown, it indicates that the unit is ready to operate but is missing an input signal on, for example, terminal 27. See *chapter 5.8.4 Enabling Motor Operation (Terminal 27)*.**

Apply power to the drive using the following steps:

1. Confirm that the input voltage is balanced within 3%. If not, correct the input voltage imbalance before proceeding. Repeat this procedure after the voltage correction.
2. Ensure that any optional equipment wiring matches the installation requirements.
3. Ensure that all operator devices are in the OFF position.
4. Close and securely fasten all covers and doors on the drive.
5. Apply power to the unit, but do not start the drive. For units with a disconnect switch, turn the switch to the ON position to apply power to the drive.

## 7.2 Programming the Drive

### 7.2.1 Parameter Overview

Parameters contain various settings that are used to configure and operate the drive and motor. These parameter settings are programmed into the local control panel (LCP) through the different LCP menus. For more detail on parameters, see the product-specific *programming guide*.

Parameter settings are assigned a default value at the factory, but can be configured for their unique application. Each parameter has a name and number that remain the same regardless of the programming mode.

In the Main Menu mode, the parameters are divided into groups. The first digit of the parameter number (from the left) indicates the parameter group number. The parameter group is then broken down into sub groups, if necessary. For example:

| | |
|---|---|
| *0-** Operation/Display* | Parameter group |
| *0-0* Basic Settings* | Parameter sub group |
| *Parameter 0-01 Language* | Parameter |
| *Parameter 0-02 Motor Speed Unit* | Parameter |
| *Parameter 0-04 Operating State at Power-up (Hand)* | Parameter |

**Table 7.1 Example of Parameter Group Hierarchy**

### 7.2.2 Parameter Navigation

Use the following LCP keys to navigate through the parameters:

- Press [▲] [▼] to scroll up or down.
- Press [◄] [►] to shift a space to the left or right of a decimal point while editing a decimal parameter value.
- Press [OK] to accept the change.
- Press [Cancel] to disregard the change and exit edit mode.
- Press [Back] twice to show the status view.
- Press [Main Menu] once to go back to the main menu.



### 7.2.3 Entering System Information

***NOTICE!***

**SOFTWARE DOWNLOAD**

**For commissioning via PC, install MCT 10 Set-up Software. The software is available for download (basic version) or for ordering (advanced version, code number 130B1000). For more information and downloads, see *www.danfoss.com/en/service-and-support/downloads/dds/vlt-motion-control-tool-mct-10/*.**

The following steps are used to enter basic system information into the drive. Recommended parameter settings are intended for start-up and checkout purposes. Application settings vary.

7

***NOTICE!***

**Although these steps assume that an asynchronous motor is used, a permanent magnet motor can be used. For more information on specific motor types, see the product-specific *programming guide*.**

1. Press [Main Menu] on the LCP.
2. Select *0-** Operation/Display* and press [OK].
3. Select *0-0* Basic Settings* and press [OK].
4. Press [Quick Menus] on the LCP and then select *02 Quick Setup*.
5. Change the following parameters settings listed in *Table 7.2* if necessary. The motor data is found on the motor nameplate.

| Parameter | Default setting |
|---|---|
| *Parameter 0-01 Language* | English |
| *Parameter 1-20 Motor Power [kW]* | 4.00 kW |
| *Parameter 1-22 Motor Voltage* | 400 V |
| *Parameter 1-23 Motor Frequency* | 50 Hz |
| *Parameter 1-24 Motor Current* | 9.00 A |
| *Parameter 1-25 Motor Nominal Speed* | 1420 RPM |
| *Parameter 5-12 Terminal 27 Digital Input* | Coast inverse |
| *Parameter 3-02 Minimum Reference* | 0.000 RPM |
| *Parameter 3-03 Maximum Reference* | 1500.000 RPM |
| *Parameter 3-41 Ramp 1 Ramp-up Time* | 3.00 s |
| *Parameter 3-42 Ramp 1 Ramp-down Time* | 3.00 s |
| *Parameter 3-13 Reference Site* | Linked to Hand/ Auto |
| *Parameter 1-29 Automatic Motor Adaptation (AMA)* | Off |

**Table 7.2 Quick Set-up Settings**

***NOTICE!***

**MISSING INPUT SIGNAL**

**When the LCP shows AUTO REMOTE COASTING or *alarm 60, External Interlock*, the unit is ready to operate but is missing an input signal. See *chapter 5.8.4 Enabling Motor Operation (Terminal 27)* for details.**

### 7.2.4 Configuring Automatic Energy Optimization

Automatic energy optimization (AEO) is a procedure that minimizes voltage to the motor, reducing energy consumption, heat, and noise.

1. Press [Main Menu].
2. Select *1-** Load and Motor* and press [OK].
3. Select *1-0* General Settings* and press [OK].
4. Select *parameter 1-03 Torque Characteristics* and press [OK].
5. Select either *[2] Auto Energy Optim CT* or *[3] Auto Energy Optim VT* and press [OK].

### 7.2.5 Configuring Automatic Motor Adaptation

Automatic motor adaptation is a procedure that optimizes compatibility between the drive and the motor.

The drive builds a mathematical model of the motor for regulating output motor current. The procedure also tests the input phase balance of electrical power. It compares the motor characteristics with the data entered in *parameters 1-20* to *1-25*.

***NOTICE!***

**If warnings or alarms occur, see *chapter 9.5 List of Warnings and Alarms*. Some motors are unable to run the complete version of the test. In that case, or if an output filter is connected to the motor, select *[2] Enable reduced AMA*.**

Run this procedure on a cold motor for best results.

1. Press [Main Menu].
2. Select *1-** Load and Motor* and press [OK].
3. Select *1-2* Motor Data* and press [OK].
4. Select *parameter 1-29 Automatic Motor Adaptation (AMA)* and press [OK].
5. Select *[1] Enable complete AMA* and press [OK].

6. Press [Hand On] and then [OK].
   The test runs automatically and indicates when it is complete.

## 7.3 Testing Before System Start-up

**⚠WARNING**

**MOTOR START**

**Failure to ensure that the motor, system, and any attached equipment are ready for start can result in personal injury or equipment damage. Before start,**

- **Ensure that equipment is safe to operate under any condition.**
- **Ensure that the motor, system, and any attached equipment are ready for start.**

### 7.3.1 Motor Rotation

***NOTICE!***

**If the motor runs in the wrong direction, it can damage equipment. Before running the unit, check the motor rotation by briefly running the motor. The motor runs briefly at either 5 Hz or the minimum frequency set in *parameter 4-12 Motor Speed Low Limit [Hz]*.**

1. Press [Hand On].
2. Move the left cursor to the left of the decimal point by using the left arrow key, and enter an RPM that slowly rotates the motor.
3. Press [OK].
4. If the motor rotation is wrong, set *parameter 1-06 Clockwise Direction* to *[1] Inverse*.

### 7.3.2 Encoder Rotation

If encoder feedback is used, perform the following steps:

1. Select *[0] Open Loop* in *parameter 1-00 Configuration Mode*.
2. Select *[1] 24 V encoder* in *parameter 7-00 Speed PID Feedback Source*.
3. Press [Hand On].
4. Press [►] for positive speed reference (*parameter 1-06 Clockwise Direction* at *[0] Normal*).
5. In *parameter 16-57 Feedback [RPM]*, check that the feedback is positive.

For more information on the encoder option, refer to the option manual.

***NOTICE!***

**NEGATIVE FEEDBACK**

**If the feedback is negative, the encoder connection is wrong. Use either *parameter 5-71 Term 32/33 Encoder Direction* or *parameter 17-60 Feedback Direction* to inverse the direction, or reverse the encoder cables. *Parameter 17-60 Feedback Direction* is only available with the VLT® Encoder Input MCB 102 option.**

## 7.4 System Start-up

**⚠WARNING**

**MOTOR START**

**Failure to ensure that the motor, system, and any attached equipment are ready for start can result in personal injury or equipment damage. Before start,**

- **Ensure that equipment is safe to operate under any condition.**
- **Ensure that the motor, system, and any attached equipment are ready for start.**

The procedure in this section requires user-wiring and application programming to be completed. The following procedure is recommended after application set-up is completed.

1. Press [Auto On].
2. Apply an external run command.
   Examples of external run commands are a switch, key, or programmable logic controller (PLC).
3. Adjust the speed reference throughout the speed range.
4. Ensure that the system is working as intended by checking sound and vibration level of the motor.
5. Remove the external run command.

If warnings or alarms occur, see *chapter 9.5 List of Warnings and Alarms*.

7

## 7.5 Parameter Setting

Establishing the correct programming for applications requires setting several parameter functions. Details for parameters are provided in the *programming guide*.

Parameter settings are stored internally in the drive, allowing the following advantages:

- Parameter settings can be uploaded into the LCP memory and stored as a back-up.
- Multiple units can be programmed quickly by connecting the LCP to the unit and downloading the stored parameter settings.
- Settings that are stored in the LCP are not changed when restoring factory default settings.
- Changes made to default settings as well as any programming entered into parameters are stored and available for viewing in the quick menu. See *chapter 3.7 LCP Menus*.



### 7.5.1 Uploading and Downloading Parameter Settings

The drive operates using parameters stored on the control card, which is located within the drive. The upload and download functions move the parameters between the control card and the LCP.

1. Press [Off].
2. Go to *parameter 0-50 LCP Copy* and press [OK].
3. Select 1 of the following:
   - 3a To upload data from the control card to the LCP, select *[1] All to LCP*.
   - 3b To download data from the LCP to the control card, select *[2] All from LCP*.
4. Press [OK]. A progress bar shows the uploading or downloading process.
5. Press [Hand On] or [Auto On].

### 7.5.2 Restoring Factory Default Settings

***NOTICE!***

**LOSS OF DATA**

**Loss of programming, motor data, localization, and monitoring records occurs when restoring default settings. To create a back-up, upload data to the LCP before initialization. Refer to *chapter 7.5.1 Uploading and Downloading Parameter Settings*.**

Restore the default parameter settings by initializing the unit. Initialization is carried out through *parameter 14-22 Operation Mode* or manually.

*Parameter 14-22 Operation Mode* does not reset settings such as the following:

- Running hours.
- Serial communication options.
- Personal menu settings.
- Fault log, alarm log, and other monitoring functions.

**Recommended initialization**

1. Press [Main Menu] twice to access parameters.
2. Go to *parameter 14-22 Operation Mode* and press [OK].
3. Scroll to *Initialization* and press [OK].
4. Remove power to the unit and wait for the display to turn off.
5. Apply power to the unit. Default parameter settings are restored during start-up. Start-up takes slightly longer than normal.
6. After *alarm 80, Drive initialized to default value* appears, press [Reset].

**Manual initialization**

Manual initialization resets all factory settings except for the following:

- *Parameter 15-00 Operating Hours*.
- *Parameter 15-03 Power-ups*.
- *Parameter 15-04 Over Temps*.
- *Parameter 15-05 Over Volts*.

To perform manual initialization:

1. Remove power to the unit and wait for the display to turn off.
2. Press and hold [Status], [Main Menu], and [OK] simultaneously while applying power to the unit (approximately 5 s or until an audible click sounds and the fan starts). Start-up takes slightly longer than normal.

# 8 Wiring Configuration Examples

## 8.1 Introduction

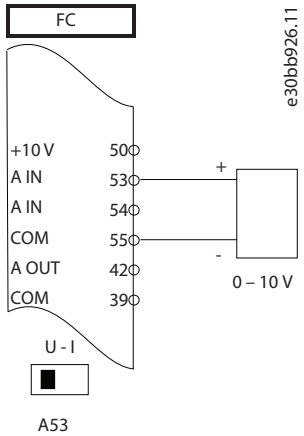
The examples in this section are intended as a quick reference for common applications.

- Parameter settings are the regional default values unless otherwise indicated (selected in *parameter 0-03 Regional Settings*).
- Parameters associated with the terminals and their settings are shown next to the drawings.
- Required switch settings for analog terminals A53 or A54 are also shown.

***NOTICE!***

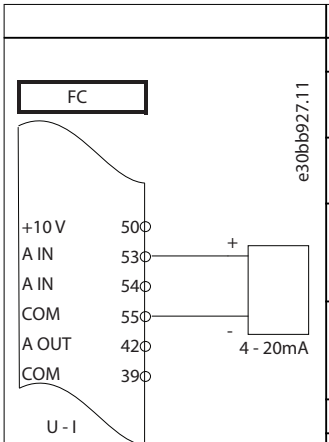
**When not using the optional STO feature, a jumper wire is required between terminal 12 (or 13) and terminal 37 for the drive to operate with factory default programming values.**

## 8.2 Wiring for Open-loop Speed Control



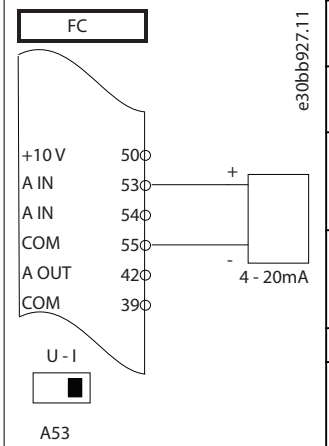

| | Parameters | |
|---|---|---|
| | **Function** | **Setting** |
| | *Parameter 6-10 Terminal 53 Low Voltage* | 0.07 V* |
| | *Parameter 6-11 Terminal 53 High Voltage* | 10 V* |
| | *Parameter 6-14 Terminal 53 Low Ref./Feedb. Value* | 0 RPM |
| | *Parameter 6-15 Terminal 53 High Ref./Feedb. Value* | 1500 RPM |
| | * = Default value | |
| | **Notes/comments:** Assumptions are 0 V DC input = 0 Hz speed and 10 V DC input = 50 Hz speed. | |

**Table 8.1 Analog Speed Reference (Voltage)**




| | Parameters | |
|---|---|---|
| | **Function** | **Setting** |
| | *Parameter 6-12 Terminal 53 Low Current* | 4 mA* |
| | *Parameter 6-13 Terminal 53 High Current* | 20 mA* |
| | *Parameter 6-14 Terminal 53 Low Ref./Feedb. Value* | 0 RPM |
| | *Parameter 6-15 Terminal 53 High Ref./Feedb. Value* | 1500 RPM |
| | * = Default value | |
| | **Notes/comments:** Assumptions are 4 mA input = 0 Hz speed and 20 mA input = 50 Hz speed. | |

**Table 8.2 Analog Speed Reference (Current)**

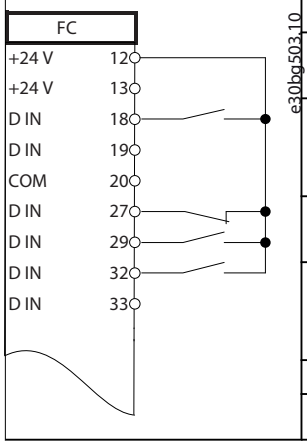



| | Parameters | |
|---|---|---|
| | **Function** | **Setting** |
| | *Parameter 6-12 Terminal 53 Low Current* | 4 mA* |
| | *Parameter 6-13 Terminal 53 High Current* | 20 mA* |
| | *Parameter 6-14 Terminal 53 Low Ref./Feedb. Value* | 0 RPM |
| | *Parameter 6-15 Terminal 53 High Ref./Feedb. Value* | 1500 RPM |
| | * = Default value | |
| | **Notes/comments:** Assumptions are 0 V DC input = 0 RPM speed and 10 V DC input = 1500 RPM speed. | |

**Table 8.3 Speed Reference (Using a Manual Potentiometer)**

8




| Parameters | |
|---|---|
| **Function** | **Setting** |
| *Parameter 5-10 Terminal 18 Digital Input* | *[8] Start** |
| *Parameter 5-12 Terminal 27 Digital Input* | *[19] Freeze Reference* |
| *Parameter 5-13 Terminal 29 Digital Input* | *[21] Speed Up* |
| *Parameter 5-14 Terminal 32 Digital Input* | *[22] Speed Down* |
| * = Default value | |
| **Notes/comments:** | |

**Table 8.4 Speed Up/Speed Down**

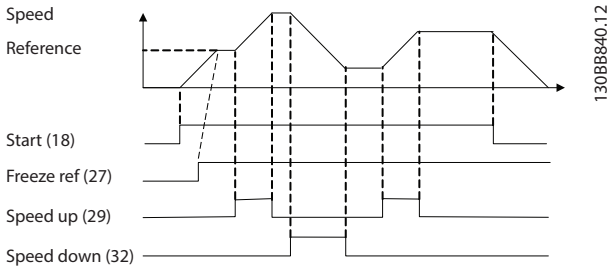
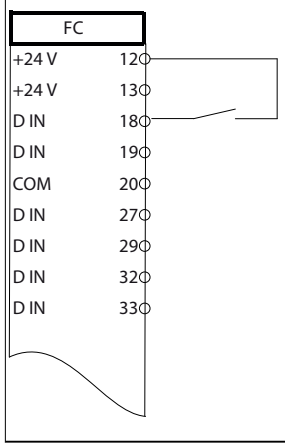



**Figure 8.1 Speed Up/Speed Down**

## 8.3 Wiring for Start/Stop




| Parameters | |
|---|---|
| **Function** | **Setting** |
| *Parameter 5-10 Terminal 18 Digital Input* | [8] Start* |
| *Parameter 5-12 Terminal 27 Digital Input* | [0] No operation |
| * = Default value | |
| **Notes/comments:** If *parameter 5-12 Terminal 27 Digital Input* is set to *[0] No operation*, a jumper wire to terminal 27 is not needed. | |

**Table 8.5 Start/Stop Command**

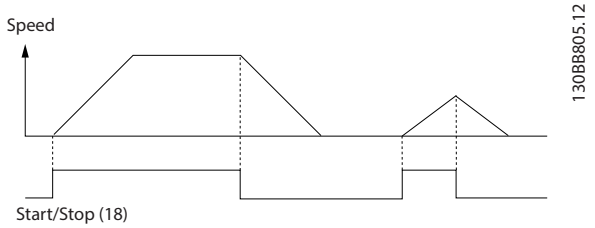
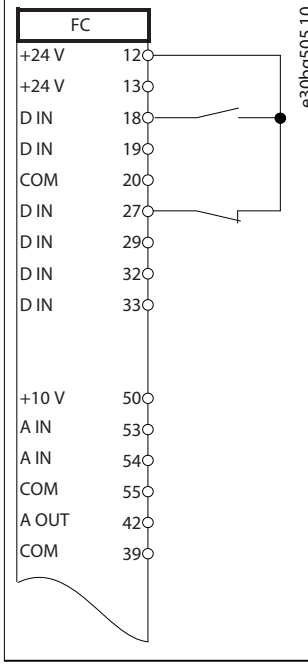



**Figure 8.2 Start/Stop Command**




| Parameters | |
|---|---|
| **Function** | **Setting** |
| *Parameter 5-10 Terminal 18 Digital Input* | [9] Latched Start |
| *Parameter 5-12 Terminal 27 Digital Input* | [6] Stop Inverse |
| * = Default value | |
| **Notes/comments:** | |

**Table 8.6 Pulse Start/Stop**

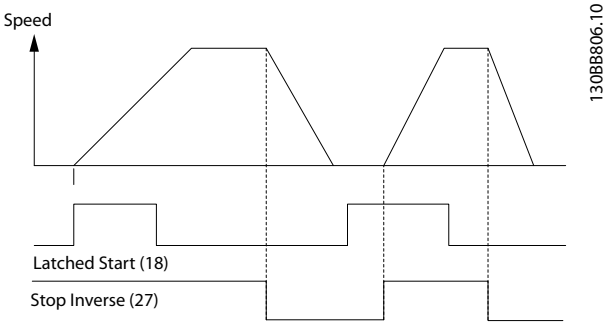
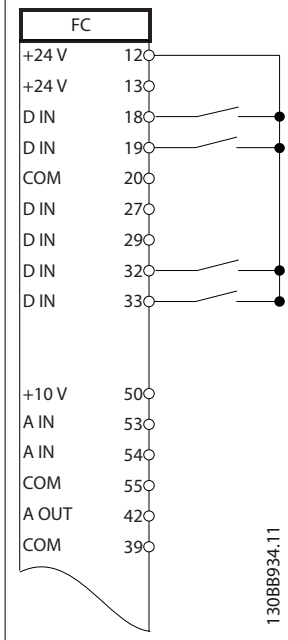


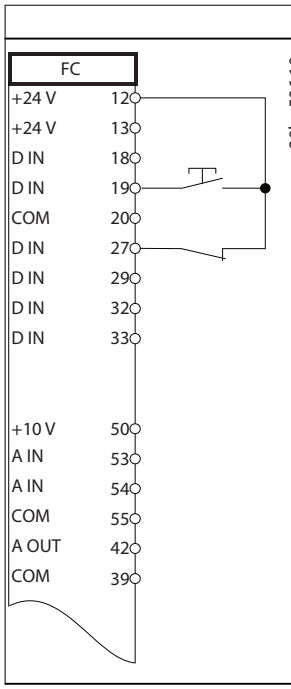

**Figure 8.3 Latched Start/Stop Inverse**




| Parameters | |
|---|---|
| **Function** | **Setting** |
| *Parameter 5-10 Terminal 18 Digital Input* | [8] Start |
| *Parameter 5-11 Terminal 19 Digital Input* | [10] Reversing* |
| *Parameter 5-12 Terminal 27 Digital Input* | [0] No operation |
| *Parameter 5-14 Terminal 32 Digital Input* | [16] Preset ref bit 0 |
| *Parameter 5-15 Terminal 33 Digital Input* | [17] Preset ref bit 1 |
| *Parameter 3-10 Preset Reference* | |
| Preset ref. 0 | 25% |
| Preset ref. 1 | 50% |
| Preset ref. 2 | 75% |
| Preset ref. 3 | 100% |
| * = Default value | |
| **Notes/comments:** | |

**Table 8.7 Start/Stop with Reversing and 4 Preset Speeds**

## 8.4 Wiring for External Alarm Reset




| Parameters | |
|---|---|
| **Function** | **Setting** |
| *Parameter 5-11 Terminal 19 Digital Input* | *[1] Reset* |
| * = Default value | |
| **Notes/comments:** | |

**Table 8.8 External Alarm Reset**

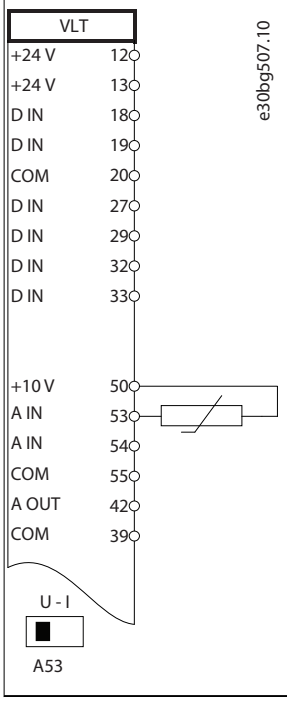
## 8.5 Wiring for a Motor Thermistor

**WARNING**

**THERMISTOR INSULATION**

**Risk of personal injury or equipment damage.**

- **To meet PELV insulation requirements, use only thermistors with reinforced or double insulation.**




| Parameters | |
|---|---|
| **Function** | **Setting** |
| *Parameter 1-90 Motor Thermal Protection* | *[2] Thermistor trip* |
| *Parameter 1-93 Thermistor Resource* | *[1] Analog input 53* |
| * = Default value | |
| **Notes/comments:** If only a warning is desired, set *parameter 1-90 Motor Thermal Protection* to *[1] Thermistor warning*. | |

**Table 8.9 Motor Thermistor**

8

# 9 Maintenance, Diagnostics, and Troubleshooting

This chapter includes:

- Maintenance and service guidelines.
- Status messages.
- Warnings and alarms.
- Basic troubleshooting.

## 9.1 Maintenance and Service

Under normal operating conditions and load profiles, the drive is maintenance-free throughout its designed lifetime. To prevent breakdown, danger, and damage, examine the drive at regular intervals depending on the operating conditions. Replace worn or damaged parts with original spare parts or standard parts. For service and support, refer to *www.danfoss.com/en/contact-us/contacts-list/?filter=type%3Adanfoss-sales-service-center%2Csegments%3ADDS*.

**⚠WARNING**

**UNINTENDED START**

**When the drive is connected to AC mains, DC supply, or load sharing, the motor can start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. The motor can start with an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up Software, or after a cleared fault condition.**

**To prevent unintended motor start:**

- **Press [Off/Reset] on the LCP before programming parameters.**
- **Disconnect the drive from the mains.**
- **Completely wire and assemble the drive, motor, and any driven equipment before connecting the drive to AC mains, DC supply, or load sharing.**

## 9.2 Heat Sink Access Panel

### 9.2.1 Removing the Heat Sink Access Panel

The drive can be ordered with an optional access panel in the back of the unit. This panel provides access to the heat sink and allows the heat sink to be cleaned of any dust buildup.

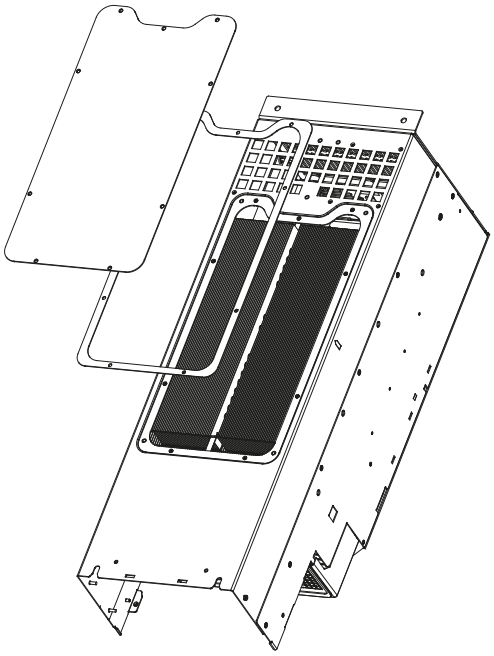



**Figure 9.1 Heat Sink Access Panel**

***NOTICE!***

**DAMAGE TO HEAT SINK**

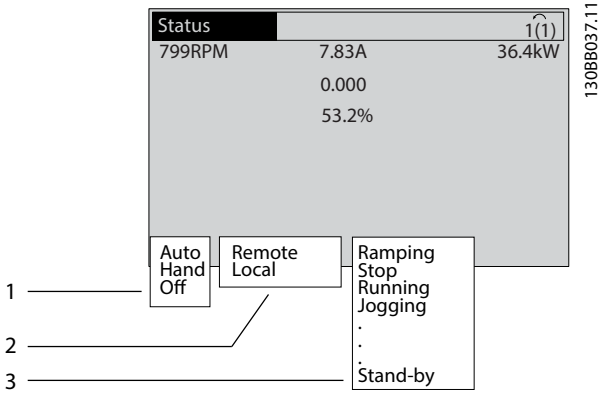
**Using fasteners that are longer than those originally supplied with the heat sink panel can damage the heat sink cooling fins.**

1. Remove power from the drive and wait 20 minutes for the capacitors to discharge completely. Refer to *chapter 2 Safety*.
2. Position the drive so that the back of the drive is accessible.
3. Remove the screws (3 mm [0.12 in] internal hex) connecting the access panel to the back of the enclosure. There are 5 or 9 screws depending on the size of the drive.
4. Inspect the heat sink for damage or dust buildup.
5. Remove dust and debris with a vacuum.
6. Replace the panel and secure it to the back of the enclosure with the screws previously removed. Tighten the fasteners according to *chapter 10.8 Fastener Tightening Torques*.

## 9.3 Status Messages

When the drive is in status mode, status messages automatically appear in the lowest line of the LCP display. Refer to *Figure 9.2*. Status messages are defined in *Table 9.1 – Table 9.3*.




| | |
|---|---|
| 1 | Where the stop/start command originates. Refer to *Table 9.1*. |
| 2 | Where the speed control originates. Refer to *Table 9.2*. |
| 3 | Provides the drive status. Refer to *Table 9.3*. |

**Figure 9.2 Status Display**

***NOTICE!***

**In auto/remote mode, the drive requires external commands to execute functions.**

*Table 9.1* to *Table 9.3* define the meaning of the shown status messages.

| | |
|---|---|
| Off | The drive does not react to any control signal until [Auto On] or [Hand On] is pressed. |
| Auto | The start/stop commands are sent via the control terminals and/or the serial communication. |
| Hand | The navigation keys on the LCP can be used to control the drive. Stop commands, reset, reversing, DC brake, and other signals applied to the control terminals override local control. |

**Table 9.1 Operating Mode**

| | |
|---|---|
| Remote | The speed reference is given from<br>• External signals.<br>• Serial communication.<br>• Internal preset references. |
| Local | The drive uses reference values from the LCP. |

**Table 9.2 Reference Site**

| | |
|---|---|
| AC brake | AC brake was selected in *parameter 2-10 Brake Function*. The AC brake overmagnetizes the motor to achieve a controlled slow down. |
| AMA finish OK | Automatic motor adaptation (AMA) was carried out successfully. |
| AMA ready | AMA is ready to start. To start, press [Hand On]. |
| AMA running | AMA process is in progress. |
| Coast | • *[2] Coast inverse* was selected as a function for a digital input (*parameter group 5-1* Digital Inputs*). The corresponding terminal is not connected.<br>• Coast activated by serial communication. |
| Ctrl. ramp-down | *[1] Ctrl. ramp-down* was selected in *parameter 14-10 Line Failure*.<br>• The mains voltage is below the value set in *parameter 14-11 Line Voltage at Line Fault* at mains fault.<br>• The drive ramps down the motor using a controlled ramp down. |
| Current high | The drive output current is above the limit set in *parameter 4-51 Warning Current High*. |
| Current low | The drive output current is below the limit set in *parameter 4-52 Warning Speed Low*. |
| DC hold | DC hold is selected in *parameter 1-80 Function at Stop* and a stop command is active. The motor is held by a DC current set in *parameter 2-00 DC Hold Current*. |
| DC stop | The motor is held with a DC current (*parameter 2-01 DC Brake Current*) for a specified time (*parameter 2-02 DC Braking Time*).<br>• DC brake is activated in *parameter 2-03 DC Brake Cut-in Speed [RPM]* and a stop command is active.<br>• DC brake (inverse) is selected as a function for a digital input (*parameter group 5-1* Digital Inputs*). The corresponding terminal is not active.<br>• The DC brake is activated via serial communication. |
| Feedback high | The sum of all active feedbacks is above the feedback limit set in *parameter 4-57 Warning Feedback High*. |
| Feedback low | The sum of all active feedbacks is below the feedback limit set in *parameter 4-56 Warning Feedback Low*. |

9

| | |
|---|---|
| Freeze output | The remote reference is active, which holds the present speed.<br>• *[20] Freeze Output* was selected as a function for a digital input (*parameter group 5-1* Digital Inputs*). The corresponding terminal is active. Speed control is only possible via the terminal functions speed up and speed down.<br>• Hold ramp is activated via serial communication. |
| Freeze output request | A freeze output command has been given, but the motor remains stopped until a run permissive signal is received. |
| Freeze ref. | *[19] Freeze Reference* was selected as a function for a digital input (*parameter group 5-1* Digital Inputs*). The corresponding terminal is active. The drive saves the actual reference. Changing the reference is now only possible via terminal functions speed up and speed down. |
| Jog request | A jog command has been given, but the motor is stopped until a run permissive signal is received via a digital input. |
| Jogging | The motor is running as programmed in *parameter 3-19 Jog Speed [RPM]*.<br>• *[14] Jog* was selected as function for a digital input (*parameter group 5-1* Digital Inputs*). The corresponding terminal (for example, terminal 29) is active.<br>• The jog function is activated via the serial communication.<br>• The jog function was selected as a reaction for a monitoring function (for example, No signal). The monitoring function is active. |
| OVC control | Overvoltage control was activated in *parameter 2-17 Over-voltage Control*, *[2] Enabled*. The connected motor is supplying the drive with generative energy. The overvoltage control adjusts the V/Hz ratio to run the motor in controlled mode and to prevent the drive from tripping. |
| Power unit off | (For drives with a 24 V DC external supply installed only.) Mains supply to the drive is removed, but the control card is supplied by the 24 V DC external supply. |
| Protection md | Protection mode is active. The unit has detected a critical status (an overcurrent or overvoltage).<br>• To avoid tripping, the switching frequency is reduced to 1500 kHz if *parameter 14-55 Output Filter* is set to *[2] Sine-Wave Filter Fixed*. Otherwise, the switching frequency is reduced to 1000 Hz.<br>• If possible, protection mode ends after approximately 10 s.<br>• Protection mode can be restricted in *parameter 14-26 Trip Delay at Inverter Fault*. |
| QStop | The motor is decelerating using *parameter 3-81 Quick Stop Ramp Time*.<br>• *[4] Quick stop inverse* was selected as a function for a digital input (*parameter group 5-1* Digital Inputs*). The corresponding terminal is not active.<br>• The quick stop function was activated via serial communication. |
| Ramping | The motor is accelerating/decelerating using the active ramp up/down. The reference, a limit value, or a standstill is not yet reached. |
| Ref. high | The sum of all active references is above the reference limit set in *parameter 4-55 Warning Reference High*. |
| Ref. low | The sum of all active references is below the reference limit set in *parameter 4-54 Warning Reference Low*. |
| Run on ref. | The drive is running in the reference range. The feedback value matches the setpoint value. |
| Run request | A start command has been given, but the motor is stopped until a run permissive signal is received via digital input. |
| Running | The drive is driving the motor. |
| Sleep mode | The energy saving function is enabled. This function being enabled means that now the motor has stopped, but that it restarts automatically when required. |
| Speed high | The motor speed is above the value set in *parameter 4-53 Warning Speed High*. |
| Speed low | The motor speed is below the value set in *parameter 4-52 Warning Speed Low*. |
| Standby | In auto-on mode, the drive starts the motor with a start signal from a digital input or serial communication. |
| Start delay | In *parameter 1-71 Start Delay*, a delay starting time was set. A start command is activated and the motor starts after the start delay time expires. |

| | |
|---|---|
| Start fwd/rev | *[12] Enable Start Forward* and *[13] Enable Start Reverse* were selected as functions for 2 different digital inputs (*parameter group 5-1* Digital Inputs*). The motor starts in forward or reverse depending on which corresponding terminal is activated. |
| Stop | The drive has received a stop command from 1 of the following:<br>• LCP.<br>• Digital input.<br>• Serial communication. |
| Trip | An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, reset the drive using 1 of the following:<br>• Pressing [Reset].<br>• Remotely by control terminals.<br>• Via serial communication.<br>Pressing [Reset] or remotely by control terminals or via serial communication. |
| Trip lock | An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, cycle power to the drive. Reset the drive manually by 1 of the following:<br>• Pressing [Reset].<br>• Remotely by control terminals.<br>• Via serial communication. |

**Table 9.3 Operation Status**

## 9.4 Warning and Alarm Types

The drive software issues warnings and alarms to help in diagnosing issues. The warning or alarm number appears in the LCP.

**Warning**
A warning indicates that the drive has encountered an abnormal operating condition that leads to an alarm. A warning stops when the abnormal condition is removed or resolved.

**Alarm**
An alarm indicates a fault that requires immediate attention. The fault always triggers a trip or trip lock. Reset the drive after an alarm.
Reset the drive in any of 4 ways:

- Press [Reset]/[Off/Reset].
- Digital reset input command.
- Serial communication reset input command.
- Auto reset.

**Trip**
When tripping, the drive suspends operation to prevent damage to the drive and other equipment. When a trip occurs, the motor coasts to a stop. The drive logic continues to operate and monitor the drive status. After the fault condition is remedied, the drive is ready for a reset.

**Trip lock**
When trip locking, the drive suspends operation to prevent damage to the drive and other equipment. When a trip lock occurs, the motor coasts to a stop. The drive logic continues to operate and monitor the drive status. The drive starts a trip lock only when serious faults occur that can damage the drive or other equipment. After the faults are fixed, cycle the input power before resetting the drive.

**Warning and alarm displays**

- A warning is shown in the LCP along with the warning number.
- An alarm flashes along with the alarm number.

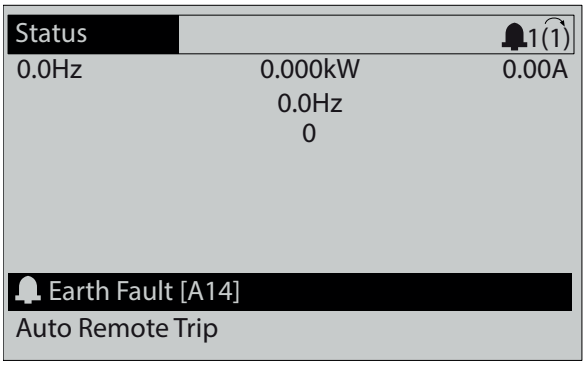
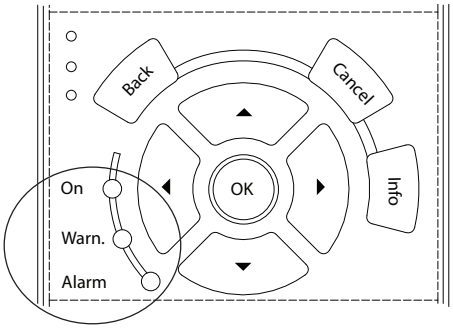



**Figure 9.3 Alarm Example**

In addition to the text and alarm code in the LCP, there are 3 status indicator lights.

9




| | Warning indicator light | Alarm indicator light |
|---|---|---|
| Warning | On | Off |
| Alarm | Off | On (flashing) |
| Trip lock | On | On (flashing) |

**Figure 9.4 Status Indicator Lights**

## 9.5 List of Warnings and Alarms



The following warning and alarm information defines each warning or alarm condition, provides the probable cause for the condition, and details a remedy or troubleshooting procedure.

**WARNING 1, 10 Volts low**
The control card voltage is less than 10 V from terminal 50. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Maximum 15 mA or minimum 590 Ω.

A short circuit in a connected potentiometer or incorrect wiring of the potentiometer can cause this condition.

**Troubleshooting**

- Remove the wiring from terminal 50. If the warning clears, the problem is with the wiring. If the warning does not clear, replace the control card.

**WARNING/ALARM 2, Live zero error**
This warning or alarm only appears if programmed in *parameter 6-01 Live Zero Timeout Function*. The signal on 1 of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or a faulty device sending the signal can cause this condition.

**Troubleshooting**

- Check connections on all analog mains terminals.
  - Control card terminals 53 and 54 for signals, terminal 55 common.
  - VLT® General Purpose I/O MCB 101 terminals 11 and 12 for signals, terminal 10 common.
- Check that the drive programming and switch settings match the analog signal type.
- Perform an input terminal signal test.

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

**WARNING/ALARM 4, Mains phase loss**
A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier. Options are programmed in *parameter 14-12 Function at Mains Imbalance*.

**Troubleshooting**

- Check the supply voltage and supply currents to the drive.

**WARNING 5, DC link voltage high**
The DC-link voltage (DC) is higher than the high-voltage warning limit. The limit depends on the drive voltage rating. The unit is still active.

**WARNING 6, DC link voltage low**
The DC-link voltage (DC) is lower than the low-voltage warning limit. The limit depends on the drive voltage rating. The unit is still active.

**WARNING/ALARM 7, DC overvoltage**
If the DC-link voltage exceeds the limit, the drive trips after a certain time.

**Troubleshooting**

- Connect a brake resistor.
- Extend the ramp time.
- Change the ramp type.
- Activate the functions in *parameter 2-10 Brake Function*.
- Increase *parameter 14-26 Trip Delay at Inverter Fault*.
- If the alarm/warning occurs during a power sag, use kinetic back-up (*parameter 14-10 Line Failure*).

**WARNING/ALARM 8, DC under voltage**
If the DC-link voltage drops below the undervoltage limit, the drive checks for 24 V DC back-up supply. If no 24 V DC back-up supply is connected, the drive trips after a fixed time delay. The time delay varies with unit size.

**Troubleshooting**

- Check that the supply voltage matches the drive voltage.
- Perform an input voltage test.
- Perform a soft-charge circuit test.

**WARNING/ALARM 9, Inverter overload**
The drive has run with more than 100% overload for too long and is about to cut out. The counter for electronic thermal inverter protection issues a warning at 98% and trips at 100% with an alarm. The drive cannot be reset until the counter is below 90%.

**Troubleshooting**

- Compare the output current shown on the LCP with the drive rated current.
- Compare the output current shown on the LCP with the measured motor current.
- Show the thermal drive load on the LCP and monitor the value. When running above the drive continuous current rating, the counter increases. When running below the drive continuous current rating, the counter decreases.

**WARNING/ALARM 10, Motor overload temperature**
According to the electronic thermal protection (ETR), the motor is too hot.

Select 1 of these options:

- The drive issues a warning or an alarm when the counter is >90% if *parameter 1-90 Motor Thermal Protection* is set to warning options.
- The drive trips when the counter reaches 100% if *parameter 1-90 Motor Thermal Protection* is set to trip options.

The fault occurs when the motor runs with more than 100% overload for too long.

**Troubleshooting**

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the motor current set in *parameter 1-24 Motor Current* is correct.
- Ensure that the motor data in *parameters 1-20 to 1-25* is set correctly.
- If an external fan is in use, check that it is selected in *parameter 1-91 Motor External Fan*.
- Running AMA in *parameter 1-29 Automatic Motor Adaptation (AMA)* tunes the drive to the motor more accurately and reduces thermal loading.

**WARNING/ALARM 11, Motor thermistor overtemp**
Check whether the thermistor is disconnected. Select whether the drive issues a warning or an alarm in *parameter 1-90 Motor Thermal Protection*.

**Troubleshooting**

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 or 54 is set for voltage. Check that *parameter 1-93 Thermistor Resource* selects terminal 53 or 54.
- When using terminal 18, 19, 31, 32, or 33 (digital inputs), check that the thermistor is connected correctly between the digital input terminal used (digital input PNP only) and terminal 50. Select the terminal to use in *parameter 1-93 Thermistor Resource*.

**WARNING/ALARM 12, Torque limit**
The torque has exceeded the value in *parameter 4-16 Torque Limit Motor Mode* or the value in *parameter 4-17 Torque Limit Generator Mode*.
*Parameter 14-25 Trip Delay at Torque Limit* can change this warning from a warning-only condition to a warning followed by an alarm.

**Troubleshooting**

- If the motor torque limit is exceeded during ramp-up, extend the ramp-up time.
- If the generator torque limit is exceeded during ramp-down, extend the ramp-down time.
- If torque limit occurs while running, increase the torque limit. Make sure that the system can operate safely at a higher torque.
- Check the application for excessive current draw on the motor.

**WARNING/ALARM 13, Over current**
The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts approximately 1.5 s, then the drive trips and issues an alarm. Shock loading or quick acceleration with high-inertia loads can cause this fault. If the acceleration during ramp-up is quick, the fault can also appear after kinetic back-up.
If extended mechanical brake control is selected, a trip can be reset externally.

**Troubleshooting**

- Remove the power and check if the motor shaft can be turned.
- Check that the motor size matches the drive.
- Check that the motor data is correct in *parameters 1-20* to *1-25*.

**ALARM 14, Earth (ground) fault**
There is current from the output phase to ground, either in the cable between the drive and the motor, or in the motor itself. The current transducers detect the ground fault by measuring current going out from the drive and current going into the drive from the motor. Ground fault is issued if the deviation of the 2 currents is too large. The current going out of the drive must be the same as the current going into the drive.



**Troubleshooting**

- Remove power to the drive and repair the ground fault.
- Check for ground faults in the motor by measuring the resistance to ground of the motor cables and the motor with a megohmmeter.
- Reset any potential individual offset in the 3 current transducers in the drive. Perform the manual initialization or perform a complete AMA. This method is most relevant after changing the power card.

**ALARM 15, Hardware mismatch**
A fitted option is not operational with the present control card hardware or software.

Record the value of the following parameters and contact Danfoss.

- *Parameter 15-40 FC Type*.
- *Parameter 15-41 Power Section*.
- *Parameter 15-42 Voltage*.
- *Parameter 15-43 Software Version*.
- *Parameter 15-45 Actual Typecode String*.
- *Parameter 15-49 SW ID Control Card*.
- *Parameter 15-50 SW ID Power Card*.
- *Parameter 15-60 Option Mounted*.
- *Parameter 15-61 Option SW Version* (for each option slot).

**ALARM 16, Short circuit**
There is short-circuiting in the motor or motor wiring.

**Troubleshooting**

- Remove the power to the drive and repair the short circuit.

**⚠WARNING**

**HIGH VOLTAGE**

**Drives contain high voltage when connected to AC mains input, DC supply, or load sharing. Failure to use qualified personnel to install, start up, and maintain the drive can result in death or serious injury.**

- **Disconnect power before proceeding.**

**WARNING/ALARM 17, Control word timeout**
There is no communication to the drive.
The warning is only active when *parameter 8-04 Control Word Timeout Function* is NOT set to *[0] Off*.
If *parameter 8-04 Control Word Timeout Function* is set to *[5] Stop and trip*, a warning appears, and the drive ramps down to a stop and shows an alarm.

**Troubleshooting**

- Check the connections on the serial communication cable.
- Increase *parameter 8-03 Control Word Timeout Time*.
- Check the operation of the communication equipment.
- Verify that proper EMC installation was performed.

**ALARM 18, Start failed**
The speed cannot exceed the value set in *parameter 1-78 Compressor Start Max Speed [Hz]* during start within the allowed time which is set in *parameter 1-79 Compressor Start Max Time to Trip*. The alarm may be caused by a blocked motor.

**WARNING/ALARM 21, Parameter error**
The parameter is out of range. The parameter number is shown in the display.

**Troubleshooting**

- Set the affected parameter to a valid value.

**WARNING 23, Internal fan fault**
The fan warning function is a protective function that checks if the fan is running/mounted. The fan warning can be disabled in *parameter 14-53 Fan Monitor* (*[0] Disabled*).

For drives with DC fans, a feedback sensor is mounted in the fan. If the fan is commanded to run and there is no feedback from the sensor, this alarm appears. For drives with AC fans, the voltage to the fan is monitored.

**Troubleshooting**

- Check for proper fan operation.
- Cycle power to the drive and check that the fan operates briefly at start-up.
- Check the sensors on the control card.

**WARNING 24, External fan fault**
The fan warning function is a protective function that checks if the fan is running/mounted. The fan warning can be disabled in *parameter 14-53 Fan Monitor* (*[0] Disabled*).

For drives with DC fans, a feedback sensor is mounted in the fan. If the fan is commanded to run and there is no feedback from the sensor, this alarm appears. For drives with AC fans, the voltage to the fan is monitored.

**Troubleshooting**

- Check for proper fan operation.
- Cycle power to the drive and check that the fan operates briefly at start-up.
- Check the sensors on the heat sink.

**ALARM 29, Power module temp**
The power module is over temperature. If the enclosure is IP00 or IP20/NEMA 1, the cutout temperature of the heat-sink is 90 °C (194 °F). If the enclosure is IP54, the cutout temperature is 80 °C (176 °F).

**ALARM 30, Motor phase U missing**
Motor phase U between the drive and the motor is missing.

**WARNING**

**HIGH VOLTAGE**

**Drives contain high voltage when connected to AC mains input, DC supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.**

- **Only qualified personnel must perform installation, start-up, and maintenance.**
- **Before performing any service or repair work, use an appropriate voltage measuring device to make sure that there is no remaining voltage on the drive.**

**Troubleshooting**

- Remove the power from the drive and check motor phase U.

**ALARM 31, Motor phase V missing**
Motor phase V between the drive and the motor is missing.

**WARNING**

**HIGH VOLTAGE**

**Drives contain high voltage when connected to AC mains input, DC supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.**

- **Only qualified personnel must perform installation, start-up, and maintenance.**
- **Before performing any service or repair work, use an appropriate voltage measuring device to make sure that there is no remaining voltage on the drive.**

**Troubleshooting**

- Remove the power from the drive and check motor phase V.

**ALARM 32, Motor phase W missing**
Motor phase W between the drive and the motor is missing.

**WARNING**

**HIGH VOLTAGE**

**Drives contain high voltage when connected to AC mains input, DC supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.**

- **Only qualified personnel must perform installation, start-up, and maintenance.**
- **Before performing any service or repair work, use an appropriate voltage measuring device to make sure that there is no remaining voltage on the drive.**

**Troubleshooting**

- Remove the power from the drive and check motor phase W.

**ALARM 33, Inrush fault**
Too many power-ups have occurred within a short time period.

**Troubleshooting**

- Let the unit cool to operating temperature.
- Check potential DC-link fault to ground.

**WARNING/ALARM 34, Fieldbus communication fault**
The fieldbus on the communication option card is not working.

**WARNING/ALARM 35, Option fault**
An option alarm is received. The alarm is option-specific. The most likely cause is a power-up or a communication fault.

**WARNING/ALARM 36, Mains failure**
This warning/alarm is only active if the supply voltage to the drive is lost and *parameter 14-10 Mains Failure* is not set to *[0] No function*.

**Troubleshooting**

- Check the fuses to the drive and mains supply to the unit.

**ALARM 37, Phase imbalance**
There is a current imbalance between the power units.

**ALARM 38, Internal fault**
When an internal fault occurs, a code number defined in *Table 9.4* is shown.

**Troubleshooting**

- Cycle power.
- Check that the option is properly installed.
- Check for loose or missing wiring.

It may be necessary to contact the Danfoss supplier or service department. Note the code number for further troubleshooting directions.

| Number | Text |
|---|---|
| 0 | The serial port cannot be initialized. Contact the Danfoss supplier or Danfoss service department. |
| 256–258 | The power EEPROM data is defective or too old. Replace the power card. |
| 512–519 | Internal fault. Contact the Danfoss supplier or Danfoss service department. |
| 783 | Parameter value outside of minimum/maximum limits. |
| 1024–1284 | Internal fault. Contact the Danfoss supplier or Danfoss service department. |
| 1299 | The option software in slot A is too old. |
| 1300 | The option software in slot B is too old. |
| 1302 | The option software in slot C1 is too old. |
| 1315 | The option software in slot A is not supported/ allowed. |
| 1316 | The option software in slot B is not supported/ allowed. |
| 1318 | The option software in slot C1 is not supported/ allowed. |
| 1379–2819 | Internal fault. Contact the Danfoss supplier or Danfoss service department. |
| 1792 | Hardware reset of digital signal processor. |
| 1793 | Motor-derived parameters not transferred correctly to the digital signal processor. |
| 1794 | Power data not transferred correctly at power-up to the digital signal processor. |
| 1795 | The digital signal processor has received too many unknown SPI telegrams. The AC drive also uses this fault code if the MCO does not power up correctly. This situation can occur due to poor EMC protection or improper grounding. |
| 1796 | RAM copy error. |
| 2561 | Replace the control card. |
| 2820 | LCP stack overflow. |
| 2821 | Serial port overflow. |
| 2822 | USB port overflow. |
| 3072–5122 | Parameter value is outside its limits. |
| 5123 | Option in slot A: Hardware incompatible with the control board hardware. |
| 5124 | Option in slot B: Hardware incompatible with the control board hardware. |
| 5125 | Option in slot C0: Hardware incompatible with the control board hardware. |
| 5126 | Option in slot C1: Hardware incompatible with the control board hardware. |
| 5376–6231 | Internal fault. Contact the Danfoss supplier or Danfoss service department. |

**Table 9.4 Internal Fault Codes**

**ALARM 39, Heat sink sensor**
No feedback from the heat sink temperature sensor.

The signal from the IGBT thermal sensor is not available on the power card. The problem could be on the power card, on the gatedrive card, or the ribbon cable between the power card and gatedrive card.

**WARNING 40, Overload of digital output terminal 27**
Check the load connected to terminal 27 or remove the short-circuit connection. Check *parameter 5-00 Digital I/O Mode* and *parameter 5-01 Terminal 27 Mode*.

**WARNING 41, Overload of digital output terminal 29**
Check the load connected to terminal 29 or remove the short-circuit connection. Also check *parameter 5-00 Digital I/O Mode* and *parameter 5-02 Terminal 29 Mode*.

**WARNING 42, Overload of digital output on X30/6 or overload of digital output on X30/7**
For terminal X30/6, check the load connected to terminal X30/6 or remove the short-circuit connection. Also check *parameter 5-32 Term X30/6 Digi Out (MCB 101)* (VLT® General Purpose I/O MCB 101).

For terminal X30/7, check the load connected to terminal X30/7 or remove the short-circuit connection. Check *parameter 5-33 Term X30/7 Digi Out (MCB 101)* (VLT® General Purpose I/O MCB 101).

**ALARM 45, Earth fault 2**
Ground fault.

**Troubleshooting**

- Check for proper grounding and loose connections.
- Check for proper wire size.
- Check the motor cables for short circuits or leakage currents.

**ALARM 46, Power card supply**
The supply for the gate drive on the power card is out of range.

**Troubleshooting**

- Check for a defective power card.

**WARNING 47, 24 V supply low**
The 24 V DC is measured on the control card.

**Troubleshooting**

- Contact the Danfoss supplier or Danfoss Service Department.

**WARNING 48, 1.8 V supply low**
The 1.2 V DC supply used on the control card is outside of the allowable limits. The supply is measured on the control card.

**Troubleshooting**

- Check for a defective control card.
- If an option card is present, check for overvoltage.

**WARNING 49, Speed limit**
The warning is shown when the speed is outside of the specified range in *parameter 4-11 Motor Speed Low Limit [RPM]* and *parameter 4-13 Motor Speed High Limit [RPM]*. When the speed is below the specified limit in *parameter 1-86 Trip Speed Low [RPM]* (except when starting or stopping), the drive trips.

**ALARM 50, AMA calibration failed**
Contact the Danfoss supplier or Danfoss Service Department.

**ALARM 51, AMA check $U_{nom}$ and $I_{nom}$**
The settings for motor voltage, motor current, and motor power are wrong.

**Troubleshooting**

- Check the settings in *parameters 1-20 to 1-25*.

**ALARM 52, AMA low $I_{nom}$**
The motor current is too low.

**Troubleshooting**

- Check the settings in *parameter 1-24 Motor Current*.

**ALARM 53, AMA motor too big**
The motor is too large for the AMA to operate.

**ALARM 54, AMA motor too small**
The motor is too small for the AMA to operate.

**ALARM 55, AMA parameter out of range**
The AMA cannot run because the parameter values of the motor are outside of the acceptable range.

**ALARM 56, AMA interrupted by user**
The AMA is manually interrupted.

**ALARM 57, AMA internal fault**
Try to restart the AMA. Repeated restarts can overheat the motor.

**ALARM 58, AMA Internal fault**
Contact the Danfoss supplier.

**WARNING 59, Current limit**
The current is higher than the value in *parameter 4-18 Current Limit*. Ensure that the motor data in *parameters 1-20 to 1-25* is set correctly. Increase the current limit if necessary. Ensure that the system can operate safely at a higher limit.

**WARNING 60, External interlock**
A digital input signal indicates a fault condition external to the drive. An external interlock has commanded the drive to trip. Clear the external fault condition. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock, and reset the drive.

**WARNING/ALARM 61, Feedback error**
An error between calculated speed and speed measurement from feedback device.

**Troubleshooting**

- Check the settings for warning/alarm/disabling in *parameter 4-30 Motor Feedback Loss Function*.
- Set the tolerable error in *parameter 4-31 Motor Feedback Speed Error*.
- Set the tolerable feedback loss time in *parameter 4-32 Motor Feedback Loss Timeout*.

**WARNING 62, Output frequency at maximum limit**
If the output frequency reaches the value set in *parameter 4-19 Max Output Frequency*, the drive issues a warning. The warning ceases when the output drops below the maximum limit. If the drive is unable to limit the frequency, it trips and issues an alarm. The latter may happen in the flux mode if the drive loses control of the motor.

**Troubleshooting**

- Check the application for possible causes.
- Increase the output frequency limit. Ensure that the system can operate safely at a higher output frequency.

**ALARM 63, Mechanical brake low**
The actual motor current has not exceeded the release brake current within the start delay time window.

**WARNING 64, Voltage Limit**
The load and speed combination demands a motor voltage higher than the actual DC-link voltage.

**WARNING/ALARM 65, Control card over temperature**
The cutout temperature of the control card is 85 °C (185 °F).

**Troubleshooting**

- Check that the ambient operating temperature is within the limits.
- Check for clogged filters.
- Check the fan operation.
- Check the control card.

**WARNING 66, Heat sink temperature low**
The drive is too cold to operate. This warning is based on the temperature sensor in the IGBT module. Increase the ambient temperature of the unit. Also, a trickle amount of current can be supplied to the drive whenever the motor is stopped by setting *parameter 2-00 DC Hold/Preheat Current* to 5% and *parameter 1-80 Function at Stop*.



**ALARM 67, Option module configuration has changed**
One or more options have either been added or removed since the last power-down. Check that the configuration change is intentional and reset the unit.

**ALARM 69, Power card temperature**
The temperature sensor on the power card is either too hot or too cold.

**Troubleshooting**

- Check that the ambient operating temperature is within limits.
- Check for clogged filters.
- Check fan operation.
- Check the power card.

**ALARM 70, Illegal FC configuration**
The control card and power card are incompatible. To check compatibility, contact the Danfoss supplier with the type code from the unit nameplate and the part numbers of the cards.

**WARNING 76, Power unit setup**
The required number of power units does not match the detected number of active power units. When replacing an enclosure size F module, this warning occurs if the power-specific data in the module power card does not match the rest of the drive. If the power card connection is lost, the unit also triggers this warning.

**Troubleshooting**

- Confirm that the spare part and its power card are the correct part number.
- Ensure that the 44-pin cables between the MDCIC and power cards are mounted properly.

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

**ALARM 78, Tracking error**
The difference between setpoint value and actual value exceeds the value in *parameter 4-35 Tracking Error*.

**Troubleshooting**

- Disable the function or select an alarm/warning in *parameter 4-34 Tracking Error Function*.
- Investigate the mechanics around the load and motor. Check feedback connections from motor encoder to drive.
- Select motor feedback function in *parameter 4-30 Motor Feedback Loss Function*.
- Adjust the tracking error band in *parameter 4-35 Tracking Error* and *parameter 4-37 Tracking Error Ramping*.

**ALARM 79, Illegal power section configuration**
The scaling card has an incorrect part number or is not installed. The MK102 connector on the power card could not be installed.

**ALARM 80, Drive initialised to default value**
Parameter settings are initialized to default settings after a manual reset. To clear the alarm, reset the unit.

**ALARM 81, CSIV corrupt**
CSIV file has syntax errors.

**ALARM 82, CSIV parameter error**
CSIV failed to initialize a parameter.

**ALARM 83, Illegal option combination**
The mounted options are incompatible.

**ALARM 88, Option detection**
A change in the option layout is detected.
*Parameter 14-89 Option Detection* is set to *[0] Frozen configuration* and the option layout has been changed.

- To apply the change, enable option layout changes in *parameter 14-89 Option Detection*.
- Alternatively, restore the correct option configuration.

**ALARM 90, Feedback monitor**
Check the connection to encoder/resolver option and, if necessary, replace VLT® Encoder Input MCB 102 or VLT® Resolver Input MCB 103.

**ALARM 91, Analog input 54 wrong settings**
Set switch S202 in position OFF (voltage input) when a KTY sensor is connected to analog input terminal 54.

**ALARM 95, Broken belt**
Torque is below the torque level set for no load, indicating a broken belt. *Parameter 22-60 Broken Belt Function* is set for alarm.

**Troubleshooting**

- Troubleshoot the system and reset the frequency converter after clearing the fault.

**ALARM 99, Locked rotor**
The rotor is blocked.

**WARNING/ALARM 101, Speed monitor**
The speed monitor is out of range.

**WARNING/ALARM 104, Mixing fan fault**
The fan is not operating. The fan monitor checks that the fan is spinning at power-up or whenever the mixing fan is turned on. The mixing-fan fault can be configured as a warning or an alarm trip in *parameter 14-53 Fan Monitor*.

**Troubleshooting**

- Cycle power to the drive to determine if the warning/alarm returns.

**WARNING/ALARM 122, Mot. rotat. unexp.**
The drive performs a function that requires the motor to be at standstill, for example DC hold for PM motors.

**WARNING/ALARM 148, System temp**
One or more of the system temperature measurements is too high.

**WARNING/ALARM 154, D.out overload**
Digital output overloaded.

**ALARM 244, Heat sink temperature**
This alarm is equivalent to *ALARM 29, Power module temp*.

The report value in the alarm log indicates which power module generated the alarm:

1 = Leftmost inverter module.

2 = Middle inverter module.

2 = Right inverter module.

2 = Second drive from the left inverter module.

3 = Right inverter module.

3 = Third from the left inverter module.

4 = Far right inverter module.

5 = Rectifier module.

6 = Right rectifier module.

**ALARM 245, Heat sink sensor**
There is no feedback from the heat sink sensor.

The report value in the alarm log indicates which power module generated the alarm:

1 = Leftmost inverter module.

2 = Middle inverter module.

2 = Right inverter module.

2 = Second drive from the left inverter module.

3 = Right inverter module.

3 = Third from the left inverter module.

4 = Far right inverter module.

5 = Rectifier module.

6 = Right rectifier module.

**ALARM 246, Power card supply**
The supply on the power card is out of range.

The report value in the alarm log indicates which power module generated the alarm:

1 = Leftmost inverter module.

2 = Middle inverter module.

2 = Right inverter module.

2 = Second drive from the left inverter module.

3 = Right inverter module.

3 = Third from the left inverter module.

4 = Far right inverter module.

5 = Rectifier module.

6 = Right rectifier module.

**ALARM 247, Power card temperature**
The supply on the power card is out of range.

The report value in the alarm log indicates which power module generated the alarm:

1 = Leftmost inverter module.

2 = Middle inverter module.

2 = Right inverter module.

2 = Second drive from the left inverter module.

3 = Right inverter module.

3 = Third from the left inverter module.

4 = Far right inverter module.

5 = Rectifier module.

6 = Right rectifier module.

**ALARM 248, Illegal power section configuration**
Power size configuration fault on the power card.

The report value in the alarm log indicates which power module generated the alarm:

1 = Leftmost inverter module.

2 = Middle inverter module.

2 = Right inverter module.

2 = Second drive from the left inverter module.

3 = Right inverter module.

3 = Third from the left inverter module.

4 = Far right inverter module.

5 = Rectifier module.

6 = Right rectifier module.

**WARNING 249, Rect. low temperature**
The temperature of the rectifier heat sink is too low, which indicates that the temperature sensor may be defect.

**WARNING 250, New spare part**
The power or switch mode supply has been exchanged. Restore the drive type code in the EEPROM. Select the correct type code in *parameter 14-23 Typecode Setting* according to the label on the drive. Remember to select Save to EEPROM at the end.

**WARNING 251, New typecode**
The power card or other components are replaced, and the type code has changed.



## 9.6 Troubleshooting

| Symptom | Possible cause | Test | Solution |
|---|---|---|---|
| Display dark/No function | Missing input power. | See *Table 6.1*. | Check the input power source. |
| | Missing or open fuses. | See *Open power fuses* in this table for possible causes. | Follow the recommendations provided. |
| | No power to the LCP. | Check the LCP cable for proper connection or damage. | Replace the faulty LCP or connection cable. |
| | Shortcut on control voltage (terminal 12 or 50) or at control terminals. | Check the 24 V control voltage supply for terminal 12/13 to 20–39, or 10 V supply for terminals 50–55. | Wire the terminals properly. |
| | Incompatible LCP (Check if an incompatible LCP from VLT® 2800 or 5000/6000/8000/ FCD or FCM is used in this frequency converter). | – | Use only LCP 101 (P/N 130B1124) or LCP 102 (P/N 130B1107). |
| | Wrong contrast setting. | – | Press [Status] + [▲]/[▼] to adjust the contrast. |
| | Display (LCP) is defective. | Test using a different LCP. | Replace the faulty LCP or connection cable. |
| | Internal voltage supply fault or SMPS is defective. | – | Contact supplier. |
| Intermittent display | Overloaded supply (SMPS) due to improper control wiring or a fault within the AC drive. | To rule out a problem in the control wiring, disconnect all control wiring by removing the terminal blocks. | If the display stays lit, the problem is in the control wiring. Check the wiring for shorts or incorrect connections. If the display continues to cut out, follow the procedure for *Display dark/No function*. |
| Motor not running | Service switch open or missing motor connection. | Check if the motor is connected and the connection is not interrupted by a service switch or other device. | Connect the motor and check the service switch. |
| | No mains power with 24 V DC option card. | If the display is functioning, but there is no output, check that mains power is applied to the AC drive. | Apply mains power. |
| | LCP Stop. | Check if [Off] has been pressed. | Press [Auto On] or [Hand On] (depending on operating mode). |
| | Missing start signal (Standby). | Check *parameter 5-10 Terminal 18 Digital Input* for correct setting for terminal 18. Use default setting. | Apply a valid start signal. |
| | Motor coast signal active (Coasting). | Check *parameter 5-12 Terminal 27 Digital Input* for correct setting for terminal 27 (use default setting). | Apply 24 V on terminal 27 or program this terminal to *[0] No operation.* |
| | Wrong reference signal source. | Check reference signal:<br>• Local.<br>• Remote or bus reference?<br>• Preset reference active?<br>• Terminal connection correct?<br>• Scaling of terminals correct?<br>• Reference signal available? | Program correct settings. Check *parameter 3-13 Reference Site*. Set preset reference active in *parameter group 3-1* References*. Check for correct wiring. Check scaling of terminals. Check reference signal. |

| Symptom | Possible cause | Test | Solution |
|---|---|---|---|
| Motor running in wrong direction | Motor rotation limit. | Check that *parameter 4-10 Motor Speed Direction* is programmed correctly. | Program correct settings. |
| | Active reversing signal. | Check if a reversing command is programmed for the terminal in *parameter group 5-1* Digital inputs*. | Deactivate reversing signal. |
| | Wrong motor phase connection. | – | See *chapter 7.3.1 Warning - Motor Start*. |
| Motor is not reaching maximum speed | Frequency limits set wrong. | Check output limits in *parameter 4-13 Motor Speed High Limit [RPM]*, *parameter 4-14 Motor Speed High Limit [Hz]*, and *parameter 4-19 Max Output Frequency* | Program correct limits. |
| | Reference input signal not scaled correctly. | Check reference input signal scaling in *parameter group 6-0* Analog I/O mode* and *parameter group 3-1* References.* | Program correct settings. |
| Motor speed unstable | Possible incorrect parameter settings. | Check the settings of all motor parameters, including all motor compensation settings. For closed-loop operation, check PID settings. | Check settings in *parameter group 1-6* Load Depen. Setting*. For closed-loop operation, check settings in *parameter group 20-0* Feedback*. |
| Motor runs rough | Possible overmagnetization. | Check for incorrect motor settings in all motor parameters. | Check motor settings in *parameter groups 1-2* Motor data, 1-3* Adv Motor Data*, and *1-5* Load Indep. Setting.* |
| Motor does not brake | Possible incorrect settings in the brake parameters. Ramp-down times may be too short. | Check brake parameters. Check ramp time settings. | Check *parameter groups 2-0* DC Brake* and *3-0* Reference Limits*. |
| Open power fuses | Phase-to-phase short. | Motor or panel has a short phase-to-phase. Check motor and panel phases for shorts. | Eliminate any shorts detected. |
| | Motor overload. | Motor is overloaded for the application. | Perform start-up test and verify that motor current is within specifications. If motor current is exceeding the nameplate full load current, the motor can run only with reduced load. Review the specifications for the application. |
| | Loose connections. | Perform pre-start-up check for loose connections. | Tighten loose connections. |
| Mains current imbalance greater than 3% | Problem with mains power (see *alarm 4, Mains phase loss* description). | Rotate input power leads into the 1 position: A to B, B to C, C to A. | If imbalanced leg follows the wire, it is a power problem. Check the mains supply. |
| | Problem with the AC drive. | Rotate input power leads into the AC drive 1 position: A to B, B to C, C to A. | If the imbalanced leg stays on same input terminal, it is a problem with the AC drive. Contact supplier. |
| Motor current imbalance greater than 3% | Problem with motor or motor wiring. | Rotate output motor cables 1 position: U to V, V to W, W to U. | If the imbalanced leg follows the wire, the problem is in the motor or motor wiring. Check motor and motor wiring. |
| | Problem with AC drive. | Rotate output motor cables 1 position: U to V, V to W, W to U. | If the imbalanced leg stays on same output terminal, it is a problem with the unit. Contact supplier. |
| AC drive acceleration problems | Motor data are entered incorrectly. | If warnings or alarms occur, see *chapter 9.5 List of Warnings and Alarms*. Check that motor data are entered correctly. | Increase the ramp-up time in *parameter 3-41 Ramp 1 Ramp Up Time*. Increase current limit in *parameter 4-18 Current Limit*. Increase torque limit in *parameter 4-16 Torque Limit Motor Mode*. |



| Symptom | Possible cause | Test | Solution |
|---|---|---|---|
| AC drive deceleration problems | Motor data are entered incorrectly. | If warnings or alarms occur, see *chapter 9.5 List of Warnings and Alarms*. Check that motor data are entered correctly. | Increase the ramp-down time in *parameter 3-42 Ramp 1 Ramp Down Time*. Enable overvoltage control in *parameter 2-17 Over-voltage Control*. |

**Table 9.5 Troubleshooting**



# 10 Specifications

## 10.1 Electrical Data, 380-480 V

| VLT® AutomationDrive FC 361 | N90K | N110 | | N132 | | N160 | |
|---|---|---|---|---|---|---|---|
| **High/normal overload** (High overload=150% current during 60 s, normal overload=110% current during 60 s) | NO | HO | NO | HO | NO | HO | NO |
| Typical shaft output at 400 V [kW] | 90 | 90 | 110 | 110 | 132 | 132 | 160 |
| Typical shaft output at 460 V [hp] | 125 | 125 | 150 | 150 | 200 | 200 | 250 |
| **Enclosure size** | J8 | | | | | | |
| **Output current (3-phase)** | | | | | | | |
| Continuous (at 400 V) [A] | 177 | 177 | 212 | 212 | 260 | 260 | 315 |
| Intermittent (60 s overload) (at 400 V) [A] | 195 | 266 | 233 | 318 | 286 | 390 | 347 |
| Continuous (at 460 V) [A] | 160 | 160 | 190 | 190 | 240 | 240 | 302 |
| Intermittent (60 s overload) (at 460 V) [kVA] | 176 | 240 | 209 | 285 | 264 | 360 | 332 |
| Continuous kVA (at 400 V) [kVA] | 123 | 123 | 147 | 147 | 180 | 180 | 218 |
| Continuous kVA (at 460 V) [kVA] | 127 | 127 | 151 | 151 | 191 | 191 | 241 |
| **Maximum input current** | | | | | | | |
| Continuous (at 400 V) [A] | 171 | 171 | 204 | 204 | 251 | 251 | 304 |
| Continuous (at 460 V) [A] | 154 | 154 | 183 | 183 | 231 | 231 | 291 |
| **Maximum number and size of cables per phase** | | | | | | | |
| Mains, motor, brake, and load share [$mm^2$ (AWG)] | 2x95 (2x3/0) | | | | | | |
| Maximum external mains fuses [A][1)] | 315 | 315 | | 350 | | 400 | |
| Estimated power loss at 400 V [W][2), 3)] | 2031 | 2031 | 2559 | 2289 | 2954 | 2923 | 3770 |
| Estimated power loss at 460 V [W][2), 3)] | 1828 | 1828 | 2261 | 2051 | 2724 | 2089 | 3628 |
| Efficiency[3)] | 0.98 | | | | | | |
| Output frequency [Hz] | 0–590 | | | | | | |
| Heat sink overtemperature trip [°C (°F)] | 110 (230) | | | | | | |
| Weight, enclosure protection rating IP20 kg (lbs) | 101.2 (223.1) | | | | | | |
| Efficiency[3)] | 0.98 | | | | | | |
| Output frequency [Hz] | 0–590 | | | | | | |
| Heat sink overtemperature trip [°C (°F)] | 110 (230) | | | | | | |
| Control card overtemperature trip [°C (°F)] | 75 (167) | | | | | | |

**Table 10.1 Electrical Data for Enclosures J8, Mains Supply 3x380–480 V AC**

*1) For fuse ratings, see chapter 10.7 Fuses and Circuit Breakers.*

*2) Typical power loss is at normal conditions and expected to be within ±15% (tolerance relates to variety in voltage and cable conditions). These values are based on a typical motor efficiency (IE/IE3 border line). Lower efficiency motors add to the power loss in the drive. Applies for dimensioning of drive cooling. If the switching frequency is higher than the default setting, the power losses can increase. LCP and typical control card power consumptions are included. For power loss data according to EN 50598-2, refer to drives.danfoss.com/knowledge-center/energy-efficiency-directive/#/. Options and customer load can add up to 30 W to the losses, though usually a fully loaded control card and options for slots A and B each add only 4 W.*

*3) Measured using 5 m (16.4 ft) shielded motor cables at rated load and rated frequency. Efficiency measured at nominal current. For energy efficiency class, see chapter 10.4 Ambient Conditions. For part load losses, see drives.danfoss.com/knowledge-center/energy-efficiency-directive/#/.*



| VLT® AutomationDrive FC 361 | N200 | | N250 | | N315 | |
|---|---|---|---|---|---|---|
| **High/normal overload** (High overload=150% current during 60 s, normal overload=110% current during 60 s) | **HO** | **NO** | **HO** | **NO** | **HO** | **NO** |
| Typical shaft output at 400 V [kW] | 160 | 200 | 200 | 250 | 250 | 315 |
| Typical shaft output at 460 V [hp] | 250 | 300 | 300 | 350 | 350 | 450 |
| **Enclosure size** | **J9** | | | | | |
| **Output current (3-phase)** | | | | | | |
| Continuous (at 400 V) [A] | 315 | 395 | 395 | 480 | 480 | 588 |
| Intermittent (60 s overload) (at 400 V)[A] | 473 | 435 | 593 | 528 | 720 | 647 |
| Continuous (at 460 V) [A] | 302 | 361 | 361 | 443 | 443 | 535 |
| Intermittent (60 s overload) (at 460 V) [kVA] | 453 | 397 | 542 | 487 | 665 | 589 |
| Continuous kVA (at 400 V) [kVA] | 218 | 274 | 274 | 333 | 333 | 407 |
| Continuous kVA (at 460 V) [kVA] | 241 | 288 | 288 | 353 | 353 | 426 |
| **Maximum input current** | | | | | | |
| Continuous (at 400 V) [A] | 304 | 381 | 381 | 463 | 463 | 567 |
| Continuous (at 460 V) [A] | 291 | 348 | 348 | 427 | 427 | 516 |
| **Maximum number and size of cables per phase** | | | | | | |
| Mains, motor, brake, and load share [$mm^2$ (AWG)] | 2x185 (2x350 mcm) | | | | | |
| Maximum external mains fuses [A][1)] | 550 | | 630 | | 800 | |
| Estimated power loss at 400 V [W][2), 3)] | 3093 | 4116 | 4039 | 5137 | 5004 | 6674 |
| Estimated power loss at 460 V [W][2), 3)] | 2872 | 3569 | 3575 | 4566 | 4458 | 5714 |
| Efficiency[3)] | 0.98 | | | | | |
| Output frequency [Hz] | 0–590 | | | | | |
| Heat sink overtemperature trip [°C (°F)] | 110 (230) | | | | | |
| Weight, enclosure protection rating IP20 kg (lbs) | 168.6 (371.6) | | | | | |
| Efficiency[3)] | 0.98 | | | | | |
| Output frequency [Hz] | 0–590 | | | | | |
| Heat sink overtemperature trip [°C (°F)] | 110 (230) | | | | | |
| Control card overtemperature trip [°C (°F)] | 80 (176) | | | | | |

**Table 10.2 Electrical Data for Enclosures J9, Mains Supply 3x380–480 V AC**

*1) For fuse ratings, see chapter 10.7 Fuses and Circuit Breakers.*

*2) Typical power loss is at normal conditions and expected to be within ±15% (tolerance relates to variety in voltage and cable conditions). These values are based on a typical motor efficiency (IE/IE3 border line). Lower efficiency motors add to the power loss in the drive. Applies for dimensioning of drive cooling. If the switching frequency is higher than the default setting, the power losses can increase. LCP and typical control card power consumptions are included. For power loss data according to EN 50598-2, refer to drives.danfoss.com/knowledge-center/energy-efficiency-directive/#/. Options and customer load can add up to 30 W to the losses, though usually a fully loaded control card and options for slots A and B each add only 4 W.*

*3) Measured using 5 m (16.4 ft) shielded motor cables at rated load and rated frequency. Efficiency measured at nominal current. For energy efficiency class, see chapter 10.4 Ambient Conditions. For part load losses, see drives.danfoss.com/knowledge-center/energy-efficiency-directive/#/.*

## 10.2 Mains Supply

Mains supply (L1, L2, L3)

| | |
|---|---|
| Supply voltage | 380–480 V ±10% |

*Mains voltage low/mains voltage drop-out:*

*During low mains voltage or a mains drop-out, the drive continues until the DC-link voltage drops below the minimum stop level, which corresponds typically to 15% below the lowest rated supply voltage of the drive. Power-up and full torque cannot be expected at mains voltage lower than 10% below the lowest rated supply voltage of the drive.*

| | |
|---|---|
| Supply frequency | 50/60 Hz ±5% |
| Maximum imbalance temporary between mains phases | 3.0% of rated supply voltage[1)] |
| True power factor (λ) | ≥0.9 nominal at rated load |
| Displacement power factor (cos Φ) near unity | (>0.98) |
| Switching on input supply L1, L2, L3 (power ups) | Maximum 1 time/2 minute |
| Environment according to EN60664-1 | Overvoltage category III/pollution degree 2 |

*The drive is suitable for use on a circuit capable of delivering up to 100 kA short circuit current rating (SCCR) at 480/600 V.*

*1) Calculations based on IEC61800-3.*

## 10.3 Motor Output and Motor Data

| Motor output (U, V, W) | |
|---|---|
| Output voltage | 0–100% of supply voltage |
| Output frequency | 0–590 Hz[1)] |
| Output frequency in flux mode | 0–300 Hz |
| Switching on output | Unlimited |
| Ramp times | 0.01–3600 s |

*1) Dependent on voltage and power.*

| Torque characteristics | |
|---|---|
| Starting torque (constant torque) | Maximum 150% for 60 s[1), 2)] |
| Overload torque (constant torque) | Maximum 150% for 60 s[1), 2)] |

*1) Percentage relates to the nominal current of the drive.*

*2) Once every 10 minutes.*

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## 10.4 Ambient Conditions

| Environment | |
|---|---|
| J8/J9 enclosure | IP20/Chassis |
| Vibration test (standard/ruggedized) | 0.7 g/1.0 g |
| Relative humidity | 5%–95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation) |
| Aggressive environment (IEC 60068-2-43) $H_2S$ test | Class Kd |
| Aggressive gases (IEC 60721-3-3) | Class 3C3 |
| Test method according to IEC 60068-2-43 | H2S (10 days) |
| Ambient temperature (at SFAVM switching mode) | |
| - with derating | Maximum 55 °C (131 °F)[1)] |
| - with full output power of typical EFF2 motors (up to 90% output current) | Maximum 50 °C (122 °F)[1)] |
| - at full continuous FC output current | Maximum 45 °C (113 °F)[1)] |
| Minimum ambient temperature during full-scale operation | 0 °C (32 °F) |
| Minimum ambient temperature at reduced performance | -10 °C (14 °F) |
| Temperature during storage/transport | -25 to +65/70 °C (13 to 149/158 °F) |
| Maximum altitude above sea level without derating | 1000 m (3281 ft) |
| Maximum altitude above sea level with derating | 3000 m (9842 ft) |

*1) For more information on derating, see the design guide.*

| | |
|---|---|
| EMC standards, Emission | EN 61800-3 |
| EMC standards, Immunity | EN 61800-3 |

| | |
|---|---|
| Energy efficiency class[1)] | IE2 |

*1) Determined according to EN 50598-2 at:*

- *Rated load.*
- *90% rated frequency.*
- *Switching frequency factory setting.*
- *Switching pattern factory setting.*

## 10.5 Cable Specifications

| Cable lengths and cross-sections for control cables | |
|---|---|
| Maximum motor cable length, shielded | 150 m (492 ft) |
| Maximum motor cable length, unshielded | 300 m (984 ft) |
| Maximum cross-section to motor, mains, load sharing, and brake | See *chapter 10.1 Electrical Data, 380-480 V*[1)] |
| Maximum cross-section to control terminals, rigid wire | 1.5 $mm^2$/16 AWG (2x0.75 $mm^2$) |
| Maximum cross-section to control terminals, flexible cable | 1 $mm^2$/18 AWG |
| Maximum cross-section to control terminals, cable with enclosed core | 0.5 $mm^2$/20 AWG |
| Minimum cross-section to control terminals | 0.25 $mm^2$/23 AWG |

*1) For power cables, see electrical data in chapter 10.1 Electrical Data, 380-480 V.*

## 10.6 Control Input/Output and Control Data

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

| Analog inputs | |
|---|---|
| Number of analog inputs | 2 |
| Terminal number | 53, 54 |
| Modes | Voltage or current |
| Mode select | Switches A53 and A54 |
| Voltage mode | Switch A53/A54=(U) |
| Voltage level | 0 V to +10 V (scaleable) |
| Input resistance, $R_i$ | Approximately 10 kΩ |
| Maximum voltage | ±20 V |
| Current mode | Switch A53/A54=(I) |
| Current level | 0/4 to 20 mA (scaleable) |
| Input resistance, $R_i$ | Approximately 200 Ω |
| Maximum current | 30 mA |
| Resolution for analog inputs | 10 bit (+ sign) |
| Accuracy of analog inputs | Maximum error 0.5% of full scale |

  

| | |
|---|---|
| Bandwidth | 100 Hz |

*The analog inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.*

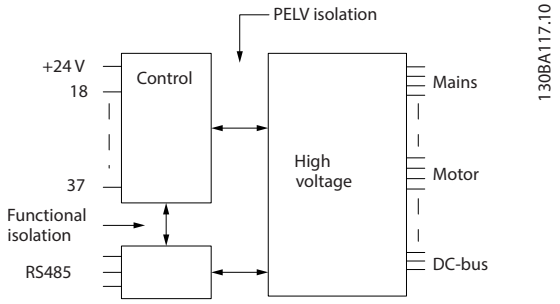


**Figure 10.1 PELV Isolation**

| Pulse inputs | |
|---|---|
| Programmable pulse inputs | 2 |
| Terminal number pulse | 29, 33 |
| Maximum frequency at terminal 29, 33 (push-pull driven) | 110 kHz |
| Maximum frequency at terminal 29, 33 (open collector) | 5 kHz |
| Minimum frequency at terminal 29, 33 | 4 Hz |
| Voltage level | See *Digital Inputs* in *chapter 10.6 Control Input/Output and Control Data* |
| Maximum voltage on input | 28 V DC |
| Input resistance, $R_i$ | Approximately 4 kΩ |
| Pulse input accuracy (0.1–1 kHz) | Maximum 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 |
| Maximum resistor load to common at analog output | 500 Ω |
| Accuracy on analog output | Maximum 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, RS485 serial communication | |
|---|---|
| Terminal number | 68 (P, TX+, RX+), 69 (N, TX-, RX-) |
| Terminal number 61 | Common for terminals 68 and 69 |

*The RS485 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 |
| Maximum output current (sink or source) | 40 mA |
| Maximum load at frequency output | 1 kΩ |
| Maximum 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 | Maximum error: 0.1% of full scale |
| Resolution of frequency outputs | 12 bit |

*1) Terminals 27 and 29 can also be programmed as inputs.*

*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 |
| Maximum load | 200 mA |

*The 24 V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analog and digital inputs and outputs.*

| Relay outputs | |
|---|---|
| Programmable relay outputs | 2 |
| Maximum cross-section to relay terminals | 2.5 $mm^2$ (12 AWG) |
| Minimum cross-section to relay terminals | 0.2 $mm^2$ (30 AWG) |
| Length of stripped wire | 8 mm (0.3 in) |
| **Relay 01 terminal number** | 1–3 (break), 1–2 (make) |
| Maximum terminal load (AC-1)[1] on 1–2 (NO) (Resistive load)[2, 3] | 400 V AC, 2 A |
| Maximum terminal load (AC-15)[1] on 1–2 (NO) (Inductive load @ cosφ 0.4) | 240 V AC, 0.2 A |
| Maximum terminal load (DC-1)[1] on 1–2 (NO) (Resistive load) | 80 V DC, 2 A |
| Maximum terminal load (DC-13)[1] on 1–2 (NO) (Inductive load) | 24 V DC, 0.1 A |
| Maximum terminal load (AC-1)[1] on 1–3 (NC) (Resistive load) | 240 V AC, 2 A |
| Maximum terminal load (AC-15)[1] on 1–3 (NC) (Inductive load @ cosφ 0.4) | 240 V AC, 0.2 A |
| Maximum terminal load (DC-1)[1] on 1–3 (NC) (Resistive load) | 50 V DC, 2 A |
| Maximum terminal load (DC-13)[1] on 1–3 (NC) (Inductive load) | 24 V DC, 0.1 A |
| Minimum terminal load on 1–3 (NC), 1–2 (NO) | 24 V DC 10 mA, 24 V AC 2 mA |
| Environment according to EN 60664-1 | Overvoltage category III/pollution degree 2 |
| **Relay 02 terminal number** | 4–6 (break), 4–5 (make) |
| Maximum terminal load (AC-1)[1] on 4–5 (NO) (Resistive load)[2, 3] | 400 V AC, 2 A |
| Maximum terminal load (AC-15)[1] on 4–5 (NO) (Inductive load @ cosφ 0.4) | 240 V AC, 0.2 A |
| Maximum terminal load (DC-1)[1] on 4–5 (NO) (Resistive load) | 80 V DC, 2 A |
| Maximum terminal load (DC-13)[1] on 4–5 (NO) (Inductive load) | 24 V DC, 0.1 A |
| Maximum terminal load (AC-1)[1] on 4–6 (NC) (Resistive load) | 240 V AC, 2 A |
| Maximum terminal load (AC-15)[1] on 4–6 (NC) (Inductive load @ cosφ 0.4) | 240 V AC, 0.2 A |
| Maximum terminal load (DC-1)[1] on 4–6 (NC) (Resistive load) | 50 V DC, 2 A |
| Maximum terminal load (DC-13)[1] on 4–6 (NC) (Inductive load) | 24 V DC, 0.1 A |
| Minimum terminal load on 4–6 (NC), 4–5 (NO) | 24 V DC 10 mA, 24 V AC 2 mA |
| Environment according to EN 60664-1 | Overvoltage category III/pollution degree 2 |

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

*1) IEC 60947 part 4 and 5.*

*2) Overvoltage Category II.*

| Control card, +10 V DC output | |
|---|---|
| Terminal number | 50 |
| Output voltage | 10.5 V ±0.5 V |
| Maximum 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 m/s |
| 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.*

| Control card performance | |
|---|---|
| Scan interval | 5 M/S |

| Control card, USB serial communication | |
|---|---|
| USB standard | 1.1 (full speed) |
| USB plug | USB type B device plug |

***NOTICE!***

**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 ground. Use only isolated laptop/PC as connection to the USB connector on the drive or an isolated USB cable/converter.**

## 10.7 Fuses and Circuit Breakers

Fuses ensure that possible damage to the drive is limited to damages inside the unit. To ensure compliance with EN 50178, use the recommended fuses as replacements. Use of fuses on the supply side is mandatory for IEC 60364 (CE) and NEC 2009 (UL) compliant installations.

**J8–J9 recommended fuses**
Type aR fuses are recommended for enclosures J8–J9. See *Table 10.3*.

| Model | 380–480 V |
|---|---|
| N90K | ar-315 |
| N110 | ar-315 |
| N132 | ar-350 |
| N160 | ar-400 |
| N200 | ar-500 |
| N250 | ar-630 |
| N315 | ar-800 |

**Table 10.3 J8–J9 Power/semiconductor Fuse Sizes**

| Model | Fuse Options | | | | | | |
|---|---|---|---|---|---|---|---|
| | Bussman | Littelfuse | Littelfuse | Bussmann | Siba | Ferraz-Shawmut | Ferraz-Shawmut (Europe) |
| N90K | 170M2619 | LA50QS300-4 | L50S-300 | FWH-300A | 20 189 20.315 | A50QS300-4 | 6,9URD31D08A0315 |
| N110 | 170M2619 | LA50QS300-4 | L50S-300 | FWH-300A | 20 189 20.315 | A50QS300-4 | 6,9URD31D08A0315 |
| N132 | 170M2620 | LA50QS350-4 | L50S-350 | FWH-350A | 20 189 20.350 | A50QS350-4 | 6,9URD31D08A0350 |
| N160 | 170M2621 | LA50QS400-4 | L50S-400 | FWH-400A | 20 189 20.400 | A50QS400-4 | 6,9URD31D08A0400 |
| N200 | 170M4015 | LA50QS500-4 | L50S-500 | FWH-500A | 20 610 31.550 | A50QS500-4 | 6,9URD31D08A0550 |
| N250 | 170M4016 | LA50QS600-4 | L50S-600 | FWH-600A | 20 610 31.630 | A50QS600-4 | 6,9URD31D08A0630 |
| N315 | 170M4017 | LA50QS800-4 | L50S-800 | FWH-800A | 20 610 31.800 | A50QS800-4 | 6,9URD32D08A0800 |

**Table 10.4 J8–J9 Power/semiconductor Fuse Options, 380–480 V**

| Bussmann | Rating |
|---|---|
| LPJ-21/2SP | 2.5 A, 600 V |

**Table 10.5 J8–J9 Space Heater Fuse Recommendation**



  

***NOTICE!***

**DISCONNECT SWITCH**

**All units ordered and supplied with a factory-installed disconnect switch require Class L branch circuit fusing to meet the 100 kA SCCR for the drive. If a circuit breaker is used, the SCCR rating is 42 kA. The input voltage and power rating of the drive determines the specific Class L fuse. The input voltage and power rating is found on the product nameplate. For more information regarding the nameplate, see *chapter 4 Mechanical Installation*.**

## 10.8 Fastener Tightening Torques

Apply the correct torque when tightening fasteners in the locations that are listed in *Table 10.6*. Too low or too high torque when fastening an electrical connection results in a bad electrical connection. To ensure correct torque, use a torque wrench.

| Location | Bolt size | Torque [Nm (in-lb)] |
|---|---|---|
| Mains terminals | M10/M12 | 19 (168)/37 (335) |
| Motor terminals | M10/M12 | 19 (168)/37 (335) |
| Ground terminals | M8/M10 | 9.6 (84)/19.1 (169) |
| Load sharing terminals | M10/M12 | 19 (168)/37 (335) |
| Relay terminals | – | 0.5 (4) |
| Door/panel cover | M5 | 2.3 (20) |
| Gland plate | M5 | 2.3 (20) |

**Table 10.6 Fastener Torque Ratings**



  

## 10.9 Enclosure Dimensions

### 10.9.1 J8 Exterior Dimensions

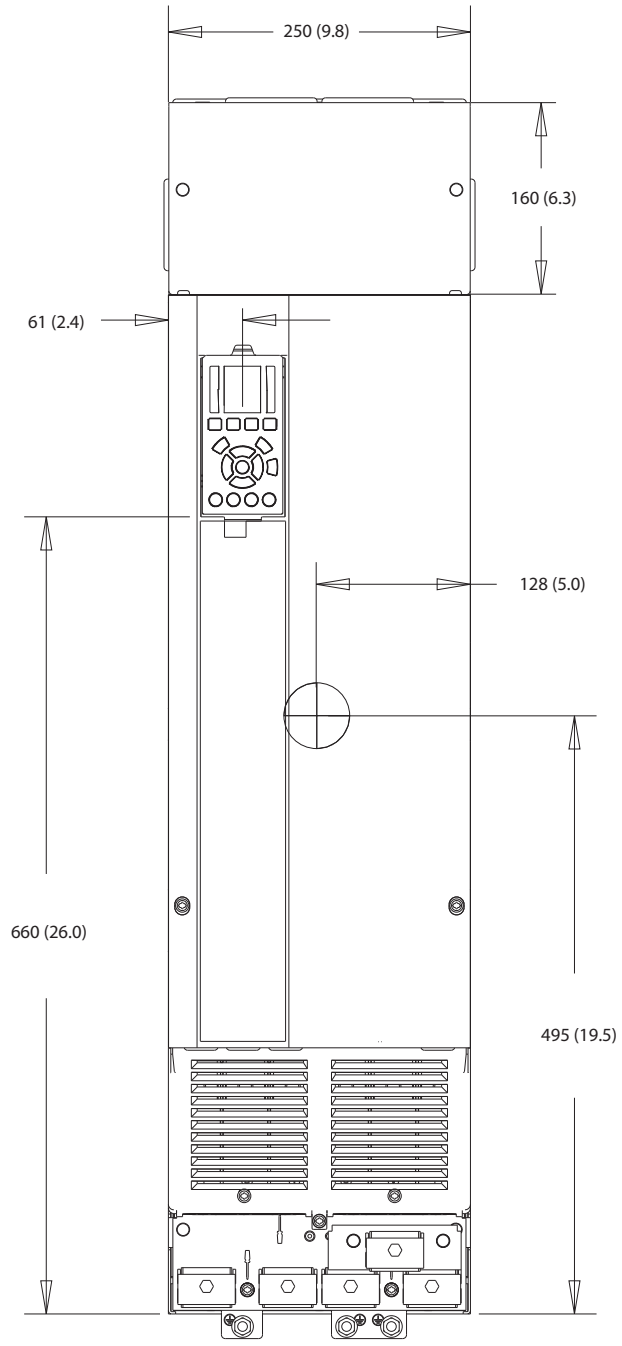


**Figure 10.2 Front View of J8**



  

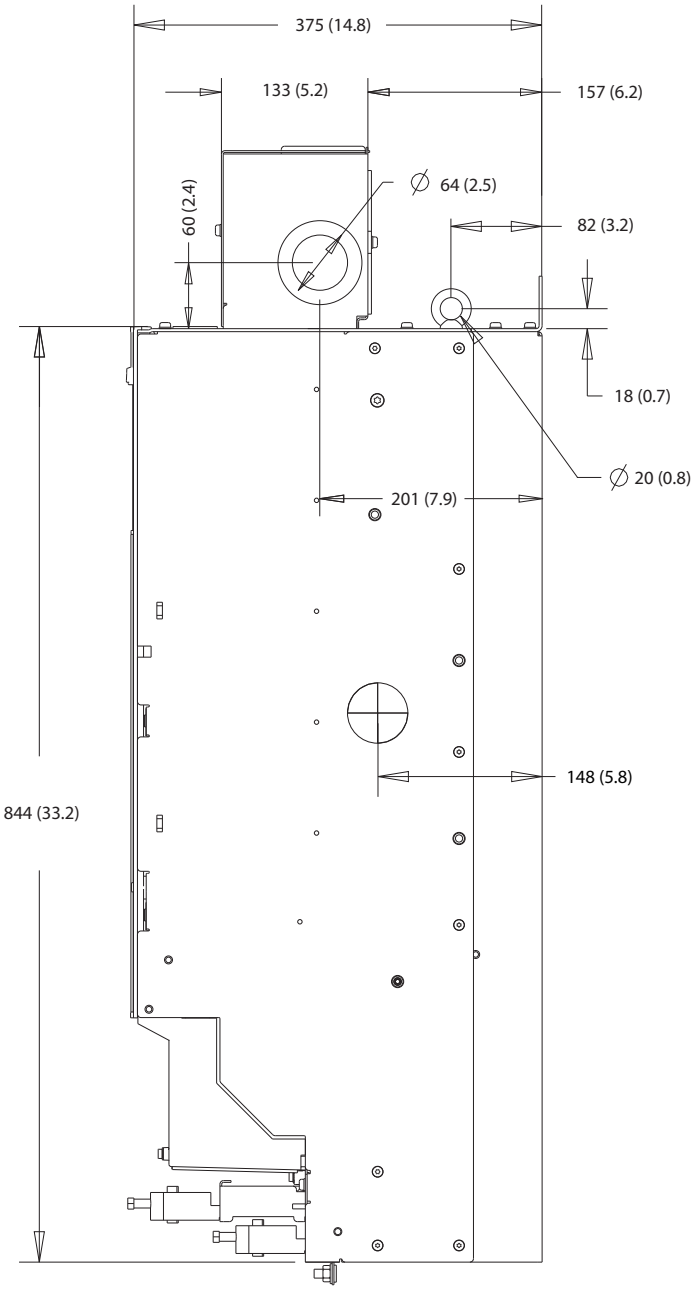


**Figure 10.3 Side View of J8**

10

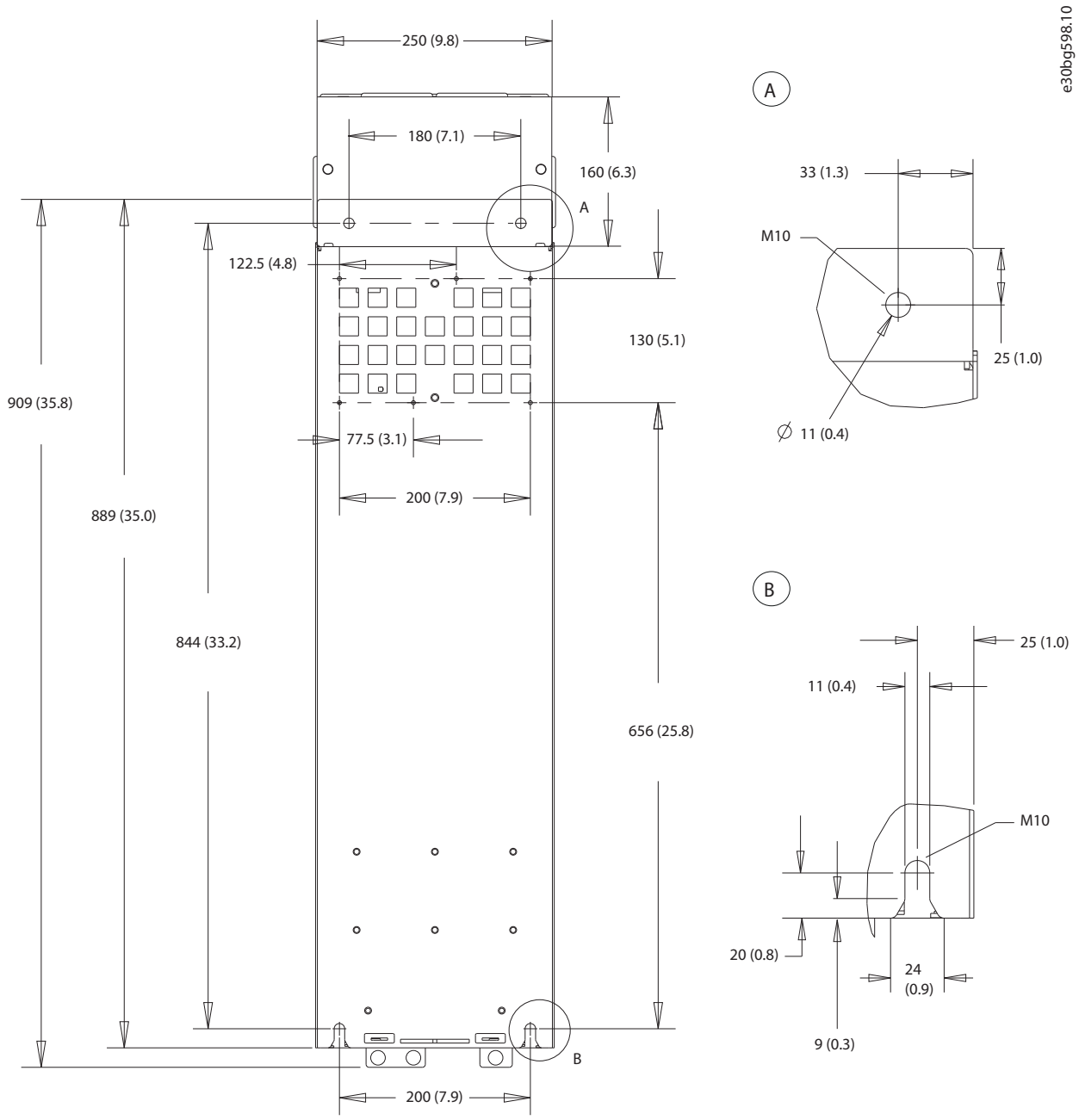


**Figure 10.4 Back View of J8**

10

## 10.9.2 J9 Enclosure Dimensions

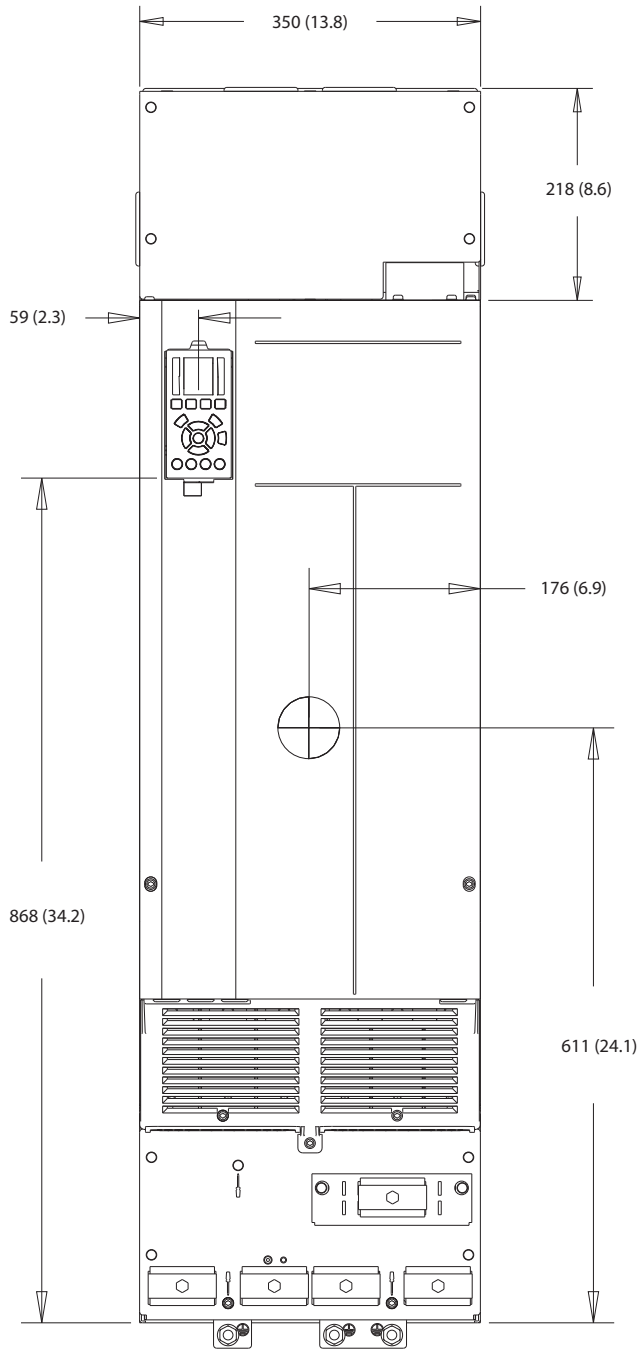


**Figure 10.5 Front View of J9**



  

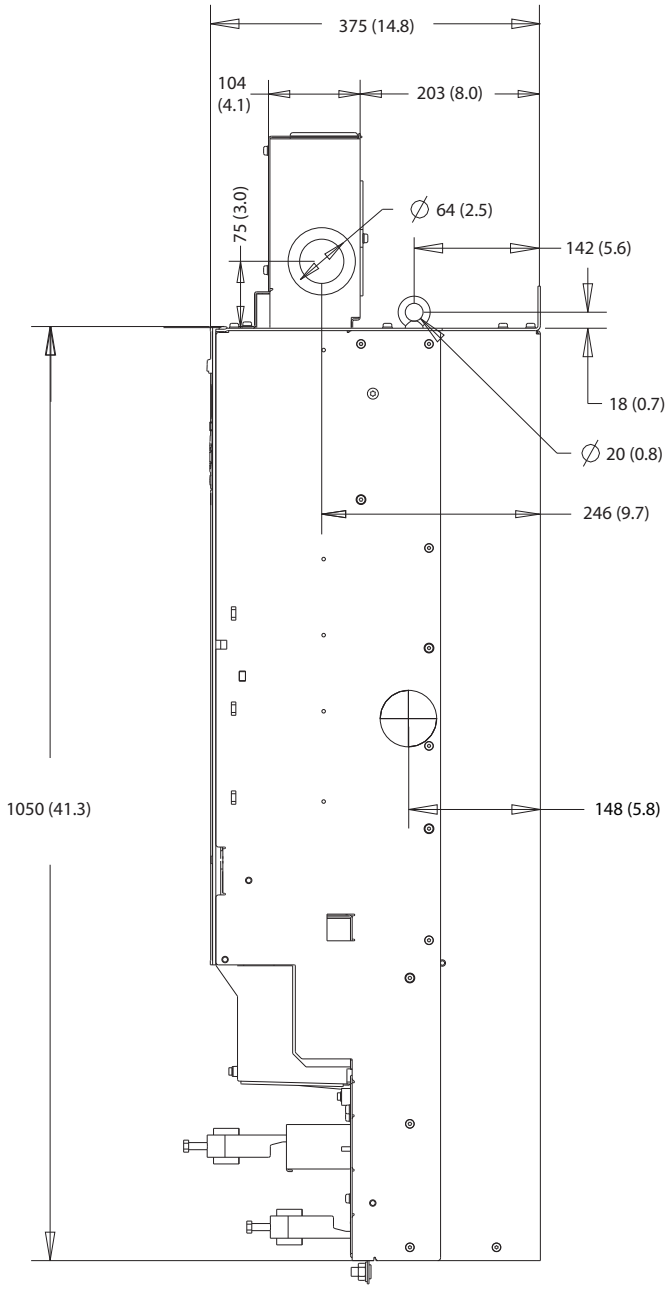


**Figure 10.6 Side View for J9**

10

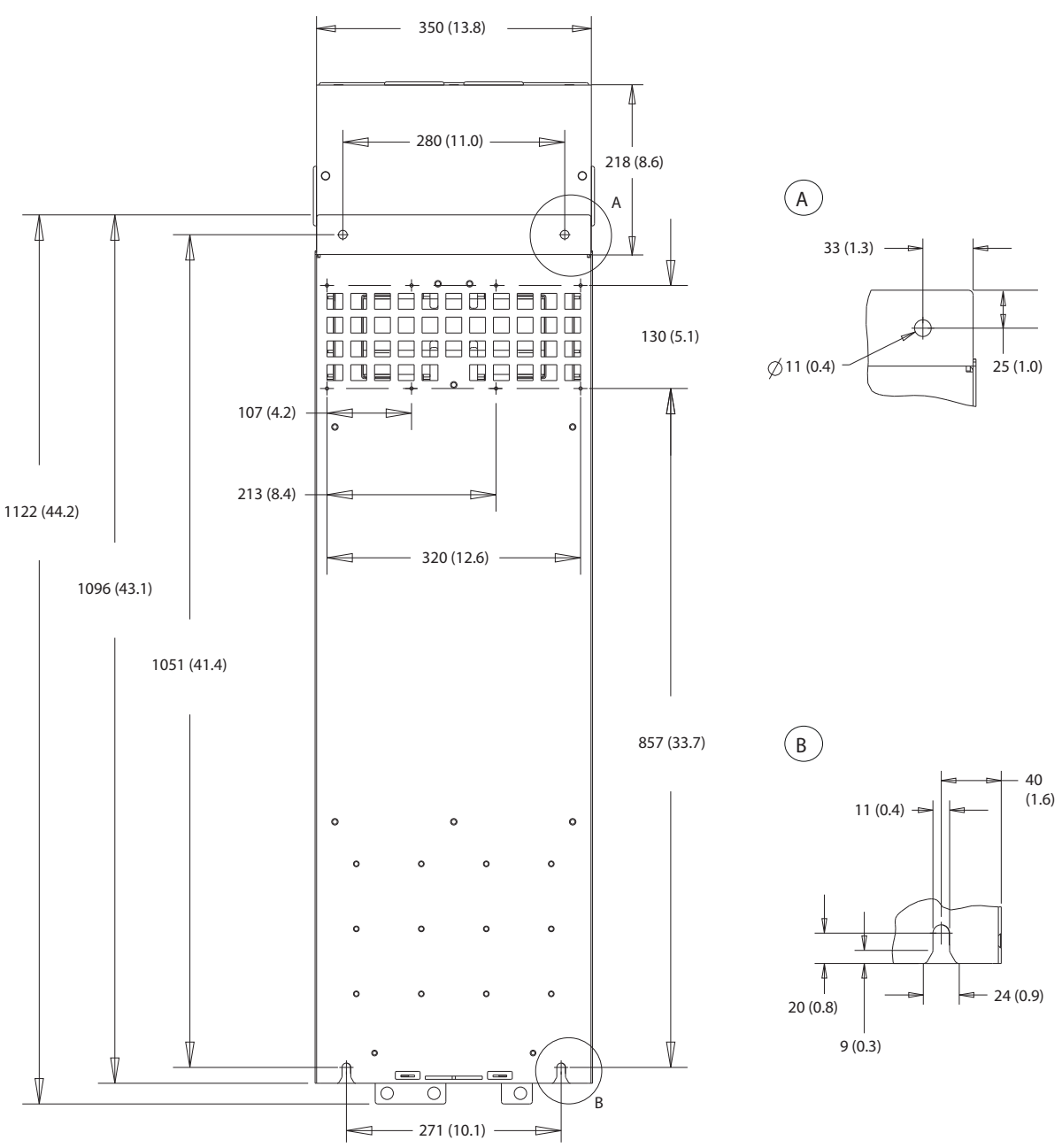


**Figure 10.7 Back View for J9**

  

# 11 Appendix

## 11.1 Abbreviations and Conventions

| | |
|---|---|
| °C | Degrees Celsius |
| °F | Degrees Fahrenheit |
| Ω | Ohm |
| AC | Alternating current |
| AEO | Automatic energy optimization |
| ACP | Application control processor |
| AMA | Automatic motor adaptation |
| AWG | American wire gauge |
| CPU | Central processing unit |
| CSIV | Customer-specific initialization values |
| CT | Current transformer |
| DC | Direct current |
| DVM | Digital voltmeter |
| EEPROM | Electrically erasable programmable read-only memory |
| EMC | Electromagnetic compatibility |
| EMI | Electromagnetic interference |
| ESD | Electrostatic discharge |
| ETR | Electronic thermal relay |
| $f_{M,N}$ | Nominal motor frequency |
| HF | High frequency |
| HVAC | Heating, ventilation, and air conditioning |
| Hz | Hertz |
| $I_{LIM}$ | Current limit |
| $I_{INV}$ | Rated inverter output current |
| $I_{M,N}$ | Nominal motor current |
| $I_{VLT,MAX}$ | Maximum output current |
| $I_{VLT,N}$ | Rated output current supplied by the drive |
| IEC | International electrotechnical commission |
| IGBT | Insulated-gate bipolar transistor |
| I/O | Input/output |
| IP | Ingress protection |
| kHz | Kilohertz |
| kW | Kilowatt |
| $L_d$ | Motor d-axis inductance |
| $L_q$ | Motor q-axis inductance |
| LC | Inductor-capacitor |
| LCP | Local control panel |
| LED | Light-emitting diode |
| LOP | Local operation pad |
| mA | Milliamp |
| MCB | Miniature circuit breakers |
| MCP | Motor control processor |
| mV | Millivolts |
| NEMA | National Electrical Manufacturers Association |
| NTC | Negative temperature coefficient |
| $P_{M,N}$ | Nominal motor power |
| PCB | Printed circuit board |
| PE | Protective earth |
| PELV | Protective extra low voltage |
| PID | Proportional integral derivative |
| PLC | Programmable logic controller |
| P/N | Part number |
| PROM | Programmable read-only memory |
| PS | Power section |
| PTC | Positive temperature coefficient |
| PWM | Pulse width modulation |
| $R_s$ | Stator resistance |
| RAM | Random-access memory |
| RCD | Residual current device |
| Regen | Regenerative terminals |
| RFI | Radio frequency interference |
| RMS | Root means square (cyclically alternating electric current) |
| RPM | Revolutions per minute |
| SCR | Silicon controlled rectifier |
| SMPS | Switch mode power supply |
| S/N | Serial number |
| $T_{LIM}$ | Torque limit |
| $U_{M,N}$ | Nominal motor voltage |
| V | Volt |
| VVC | Voltage vector control |
| $X_h$ | Motor main reactance |

**Table 11.1 Abbreviations, Acronyms, and Symbols**

**Conventions**

- Numbered lists indicate procedures.
- Bullet lists indicate other information and description of illustrations.
- Italicized text indicates:
  - Cross reference
  - Link
  - Footnote
  - Parameter name
  - Parameter group name
  - Parameter option
- All dimensions are in mm (inch).

## 11.2 Parameter Menu Structure



  

| | |
|---|---|
| **0-** ** | **Operation / Display** |
| **0-0*** | **Basic Settings** |
| 0-01 | Language |
| 0-02 | Motor Speed Unit |
| 0-04 | Operating State at Power-up (Hand) |
| **0-1*** | **Set-up Operations** |
| 0-10 | Active Set-up |
| 0-11 | Edit Set-up |
| 0-12 | This Set-up Linked to |
| 0-13 | Readout: Linked Set-ups |
| 0-14 | Readout: Edit Set-ups / Channel |
| **0-2*** | **LCP Display** |
| 0-20 | Display Line 1.1 Small |
| 0-21 | Display Line 1.2 Small |
| 0-22 | Display Line 1.3 Small |
| 0-23 | Display Line 2 Large |
| 0-24 | Display Line 3 Large |
| 0-25 | My Personal Menu |
| **0-3*** | **LCP Custom Readout** |
| 0-30 | Unit for User-defined Readout |
| 0-31 | Min Value of User-defined Readout |
| 0-32 | Max Value of User-defined Readout |
| 0-37 | Display Text 1 |
| 0-38 | Display Text 2 |
| 0-39 | Display Text 3 |
| **0-4*** | **LCP Keypad** |
| 0-40 | [Hand on] Key on LCP |
| 0-41 | [Off] Key on LCP |
| 0-42 | [Auto on] Key on LCP |
| 0-43 | [Reset] Key on LCP |
| **0-5*** | **Copy/Save** |
| 0-50 | LCP Copy |
| 0-51 | Set-up Copy |
| **0-6*** | **Password** |
| 0-60 | Main Menu Password |
| 0-61 | Access to Main Menu w/o Password |
| **1-** ** | **Load and Motor** |
| **1-0*** | **General Settings** |
| 1-00 | Configuration Mode |
| 1-01 | Motor Control Principle |
| 1-03 | Torque Characteristics |
| 1-04 | Overload Mode |
| 1-05 | Local Mode Configuration |
| 1-06 | Clockwise Direction |
| **1-1*** | **Special Settings** |
| 1-10 | Motor Construction |
| 1-14 | Damping Gain |
| 1-15 | Low Speed Filter Time Const. |
| 1-16 | High Speed Filter Time Const. |
| 1-17 | Voltage filter time const. |
| 1-18 | Min. Current at No Load |
| **1-2*** | **Motor Data** |
| 1-20 | Motor Power [kW] |
| 1-22 | Motor Voltage |
| 1-23 | Motor Frequency |
| 1-24 | Motor Current |
| 1-25 | Motor Nominal Speed |
| 1-26 | Motor Cont. Rated Torque |
| 1-29 | Automatic Motor Adaptation (AMA) |
| **1-3*** | **Adv. Motor Data** |
| 1-30 | Stator Resistance (Rs) |
| 1-31 | Rotor Resistance (Rr) |
| 1-33 | Stator Leakage Reactance (X1) |
| 1-34 | Rotor Leakage Reactance (X2) |
| 1-35 | Main Reactance (Xh) |
| 1-36 | Iron Loss Resistance (Rfe) |
| 1-37 | d-axis Inductance (Ld) |
| 1-38 | q-axis Inductance (Lq) |
| 1-39 | Motor Poles |
| 1-40 | Back EMF at 1000 RPM |
| 1-41 | Motor Angle Offset |
| 1-46 | Position Detection Gain |
| 1-47 | Torque Calibration |
| **1-5*** | **Load Indep. Setting** |
| 1-50 | Motor Magnetisation at Zero Speed |
| 1-51 | Min Speed Normal Magnetising [RPM] |
| 1-52 | Min Speed Normal Magnetising [Hz] |
| 1-55 | U/f Characteristic - U |
| 1-56 | U/f Characteristic - F |
| 1-58 | Flying Start Test Pulses Current |
| 1-59 | Flying Start Test Pulses Frequency |
| **1-6*** | **Load Depen. Setting** |
| 1-60 | Low Speed Load Compensation |
| 1-61 | High Speed Load Compensation |
| 1-62 | Slip Compensation |
| 1-63 | Slip Compensation Time Constant |
| 1-64 | Resonance Damping |
| 1-65 | Resonance Damping Time Constant |
| 1-66 | Min. Current at Low Speed |
| **1-7*** | **Start Adjustments** |
| 1-70 | Start Mode |
| 1-71 | Start Delay |
| 1-72 | Start Function |
| 1-73 | Flying Start |
| 1-74 | Start Speed [RPM] |
| 1-75 | Start Speed [Hz] |
| 1-76 | Start Current |
| 1-77 | Compressor Start Max Speed [RPM] |
| 1-78 | Compressor Start Max Speed [Hz] |
| 1-79 | Compressor Start Max Time to Trip |
| **1-8*** | **Stop Adjustments** |
| 1-80 | Function at Stop |
| 1-81 | Min Speed for Function at Stop [RPM] |
| 1-82 | Min Speed for Function at Stop [Hz] |
| **1-9*** | **Motor Temperature** |
| 1-90 | Motor Thermal Protection |
| 1-91 | Motor External Fan |
| 1-93 | Thermistor Resource |
| **2-** ** | **Brakes** |
| **2-0*** | **DC-Brake** |
| 2-00 | DC Hold Current |
| 2-01 | DC Brake Current |
| 2-02 | DC Braking Time |
| 2-03 | DC Brake Cut In Speed [RPM] |
| 2-04 | DC Brake Cut In Speed [Hz] |
| 2-06 | Parking Current |
| 2-07 | Parking Time |
| **2-1*** | **Brake Energy Funct.** |
| 2-10 | Brake Function |
| 2-16 | AC brake Max. Current |
| 2-17 | Over-voltage Control |
| 2-19 | Over-voltage Gain |
| **3-** ** | **Reference / Ramps** |
| **3-0*** | **Reference Limits** |
| 3-00 | Reference Range |
| 3-01 | Reference/Feedback Unit |
| 3-02 | Minimum Reference |
| 3-03 | Maximum Reference |
| 3-04 | Reference Function |
| **3-1*** | **References** |
| 3-10 | Preset Reference |
| 3-11 | Jog Speed [Hz] |
| 3-12 | Catch up/slow Down Value |
| 3-13 | Reference Site |
| 3-14 | Preset Relative Reference |
| 3-15 | Reference Resource 1 |
| 3-16 | Reference Resource 2 |
| 3-17 | Reference Resource 3 |
| 3-18 | Relative Scaling Reference Resource |
| 3-19 | Jog Speed [RPM] |
| **3-4*** | **Ramp 1** |
| 3-40 | Ramp 1 Type |
| 3-41 | Ramp 1 Ramp Up Time |
| 3-42 | Ramp 1 Ramp Down Time |
| 3-45 | Ramp 1 S-ramp Ratio at Accel. Start |
| 3-46 | Ramp 1 S-ramp Ratio at Accel. End |
| 3-47 | Ramp 1 S-ramp Ratio at Decel. Start |
| 3-48 | Ramp 1 S-ramp Ratio at Decel. End |
| **3-5*** | **Ramp 2** |
| 3-50 | Ramp 2 Type |
| 3-51 | Ramp 2 Ramp Up Time |
| 3-52 | Ramp 2 Ramp Down Time |
| 3-55 | Ramp 2 S-ramp Ratio at Accel. Start |
| 3-56 | Ramp 2 S-ramp Ratio at Accel. End |
| 3-57 | Ramp 2 S-ramp Ratio at Decel. Start |
| 3-58 | Ramp 2 S-ramp Ratio at Decel. End |
| **3-6*** | **Ramp 3** |
| 3-60 | Ramp 3 Type |
| 3-61 | Ramp 3 Ramp up Time |
| 3-62 | Ramp 3 Ramp down Time |
| 3-65 | Ramp 3 S-ramp Ratio at Accel. Start |
| 3-66 | Ramp 3 S-ramp Ratio at Accel. End |
| 3-67 | Ramp 3 S-ramp Ratio at Decel. Start |
| 3-68 | Ramp 3 S-ramp Ratio at Decel. End |
| **3-7*** | **Ramp 4** |
| 3-70 | Ramp 4 Type |
| 3-71 | Ramp 4 Ramp up Time |
| 3-72 | Ramp 4 Ramp Down Time |
| 3-75 | Ramp 4 S-ramp Ratio at Accel. Start |
| 3-76 | Ramp 4 S-ramp Ratio at Accel. End |
| 3-77 | Ramp 4 S-ramp Ratio at Decel. Start |
| 3-78 | Ramp 4 S-ramp Ratio at Decel. End |
| **3-8*** | **Other Ramps** |
| 3-80 | Jog Ramp Time |
| 3-81 | Quick Stop Ramp Time |
| 3-82 | Starting Ramp Up Time |
| **3-9*** | **Digital Pot.Meter** |
| 3-90 | Step Size |
| 3-91 | Ramp Time |
| 3-92 | Power Restore |
| 3-93 | Maximum Limit |
| 3-94 | Minimum Limit |
| 3-95 | Ramp Delay |
| **4-** ** | **Limits / Warnings** |
| **4-1*** | **Motor Limits** |
| 4-10 | Motor Speed Direction |
| 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] |
| 4-16 | Torque Limit Motor Mode |
| 4-17 | Torque Limit Generator Mode |
| 4-18 | Current Limit |
| 4-19 | Max Output Frequency |
| **4-2*** | **Limit Factors** |
| 4-20 | Torque Limit Factor Source |
| 4-21 | Speed Limit Factor Source |
| **4-3*** | **Motor Fb Monitor** |
| 4-30 | Motor Feedback Loss Function |
| 4-31 | Motor Feedback Speed Error |
| 4-32 | Motor Feedback Loss Timeout |
| **4-4*** | **Speed Monitor** |
| 4-40 | Warning Freq. Low |
| 4-41 | Warning Freq. High |
| 4-43 | Motor Speed Monitor Function |
| 4-44 | Motor Speed Monitor Max |
| 4-45 | Motor Speed Monitor Timeout |
| **4-5*** | **Adj. Warnings** |
| 4-50 | Warning Current Low |
| 4-51 | Warning Current High |
| 4-52 | Warning Speed Low |
| 4-53 | Warning Speed High |
| 4-54 | Warning Reference Low |
| 4-55 | Warning Reference High |
| 4-56 | Warning Feedback Low |
| 4-57 | Warning Feedback High |
| 4-58 | Missing Motor Phase Function |
| **4-6*** | **Speed Bypass** |
| 4-60 | Bypass Speed From [RPM] |
| 4-61 | Bypass Speed From [Hz] |
| 4-62 | Bypass Speed To [RPM] |
| 4-63 | Bypass Speed To [Hz] |
| **5-** ** | **Digital In/Out** |
| **5-0*** | **Digital I/O mode** |
| 5-00 | Digital I/O Mode |
| 5-01 | Terminal 27 Mode |
| 5-02 | Terminal 29 Mode |
| **5-1*** | **Digital Inputs** |
| 5-10 | Terminal 18 Digital Input |
| 5-11 | Terminal 19 Digital Input |
| 5-12 | Terminal 27 Digital Input |
| 5-13 | Terminal 29 Digital Input |
| 5-14 | Terminal 32 Digital Input |
| 5-15 | Terminal 33 Digital Input |
| 5-16 | Terminal X30/2 Digital Input |
| 5-17 | Terminal X30/3 Digital Input |
| 5-18 | Terminal X30/4 Digital Input |
| **5-3*** | **Digital Outputs** |
| 5-30 | Terminal 27 Digital Output |
| 5-31 | Terminal 29 Digital Output |
| 5-32 | Term X30/6 Digi Out (MCB 101) |
| 5-33 | Term X30/7 Digi Out (MCB 101) |
| **5-4*** | **Relays** |
| 5-40 | Function Relay |
| 5-41 | On Delay, Relay |
| 5-42 | Off Delay, Relay |
| **5-5*** | **Pulse Input** |
| 5-50 | Term. 29 Low Frequency |
| 5-51 | Term. 29 High Frequency |
| 5-52 | Term. 29 Low Ref./Feedb. Value |
| 5-53 | Term. 29 High Ref./Feedb. Value |
| 5-54 | Pulse Filter Time Constant #29 |
| 5-55 | Term. 33 Low Frequency |
| 5-56 | Term. 33 High Frequency |
| 5-57 | Term. 33 Low Ref./Feedb. Value |
| 5-58 | Term. 33 High Ref./Feedb. Value |
| 5-59 | Pulse Filter Time Constant #33 |
| **5-6*** | **Pulse Output** |
| 5-60 | Terminal 27 Pulse Output Variable |
| 5-62 | Pulse Output Max Freq #27 |
| 5-63 | Terminal 29 Pulse Output Variable |
| 5-65 | Pulse Output Max Freq #29 |
| 5-66 | Terminal X30/6 Pulse Output Variable |
| 5-68 | Pulse Output Max Freq #X30/6 |
| **5-7*** | **24V Encoder Input** |
| 5-70 | Term 32/33 Pulses Per Revolution |
| 5-71 | Term 32/33 Encoder Direction |
| **5-9*** | **Bus Controlled** |
| 5-90 | Digital & Relay Bus Control |
| 5-93 | Pulse Out #27 Bus Control |
| 5-94 | Pulse Out #27 Timeout Preset |
| 5-95 | Pulse Out #29 Bus Control |
| 5-96 | Pulse Out #29 Timeout Preset |
| 5-97 | Pulse Out #X30/6 Bus Control |
| 5-98 | Pulse Out #X30/6 Timeout Preset |
| **6-** ** | **Analog In/Out** |
| **6-0*** | **Analog I/O Mode** |
| 6-00 | Live Zero Timeout Time |
| 6-01 | Live Zero Timeout Function |
| **6-1*** | **Analog Input 1** |
| 6-10 | Terminal 53 Low Voltage |
| 6-11 | Terminal 53 High Voltage |
| 6-12 | Terminal 53 Low Current |
| 6-13 | Terminal 53 High Current |
| 6-14 | Terminal 53 Low Ref./Feedb. Value |
| 6-15 | Terminal 53 High Ref./Feedb. Value |
| 6-16 | Terminal 53 Filter Time Constant |
| **6-2*** | **Analog Input 2** |
| 6-20 | Terminal 54 Low Voltage |
| 6-21 | Terminal 54 High Voltage |
| 6-22 | Terminal 54 Low Current |
| 6-23 | Terminal 54 High Current |
| 6-24 | Terminal 54 Low Ref./Feedb. Value |

| | |
|---|---|
| 6-25 | Terminal 54 High Ref./Feedb. Value |
| 6-26 | Terminal 54 Filter Time Constant |
| **6-3*** | **Analog Input 3** |
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