



Operating Instructions, 110-400 kW D-Frame

VLT[®] HVAC Drive FC 100

Safety

Safety

⚠ WARNING

HIGH VOLTAGE!

Frequency converters contain high voltage when connected to AC mains input power. Installation, start up, and maintenance should be performed by qualified personnel only. Failure to perform installation, start up, and maintenance by qualified personnel could result in death or serious injury.

High Voltage

Frequency converters are connected to hazardous mains voltages. Extreme care should be taken to protect against shock. Only trained personnel familiar with electronic equipment should install, start, or maintain this equipment.

⚠ WARNING

UNINTENDED START!

When the frequency converter is connected to AC mains, the motor may start at any time. The frequency converter, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the frequency converter is connected to AC mains could result in death, serious injury, equipment, or property damage.

Unintended Start

When the frequency converter is connected to the AC mains, the motor may be started by means of an external switch, a serial bus command, an input reference signal, or a cleared fault condition. Use appropriate cautions to guard against an unintended start.

⚠ WARNING

DISCHARGE TIME!

Frequency converters contain DC-link capacitors that can remain charged even when the frequency converter is not powered. To avoid electrical hazards, disconnect AC mains, any permanent magnet type motors, and any remote DC-link power supplies, including battery backups, UPS and DC-link connections to other frequency converters. Wait for the capacitors to fully discharge before performing any service or repair work. The amount of wait time is listed in the *Discharge Time* table. Failure to wait the specified time after power has been removed before doing service or repair could result in death or serious injury.

| Voltage [V] | Power range [kW] | Minimum waiting time [min] |
|-------------|------------------|----------------------------|
| 3x400 | 90-250 | 20 |
| 3x400 | 110-315 | 20 |
| 3x500 | 110-315 | 20 |
| 3x500 | 132-355 | 20 |
| 3x525 | 75-250 | 20 |
| 3x525 | 90-315 | 20 |
| 3x690 | 90-250 | 20 |
| 3x690 | 110-315 | 20 |

Discharge Time

Approvals

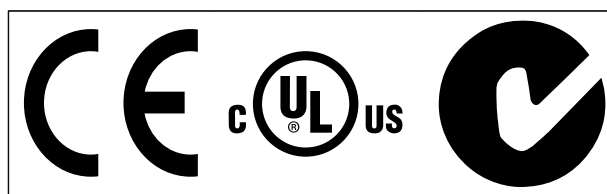


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1 Introduction

1

1.1 Product Overview

1.1.1 Interior Views

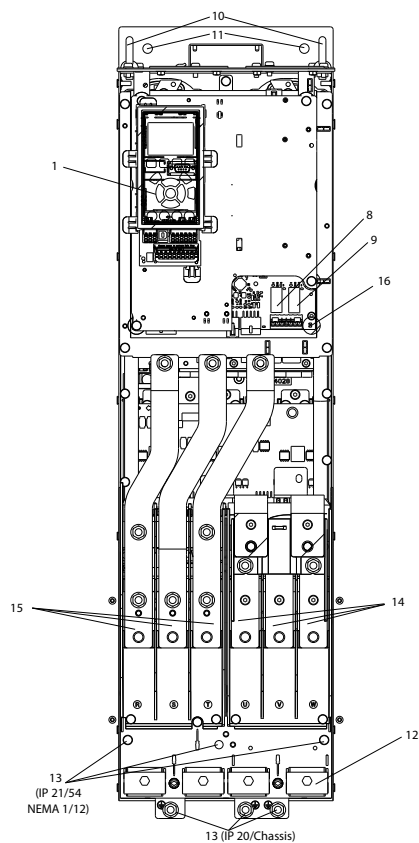


Illustration 1.1 D1 Interior Components

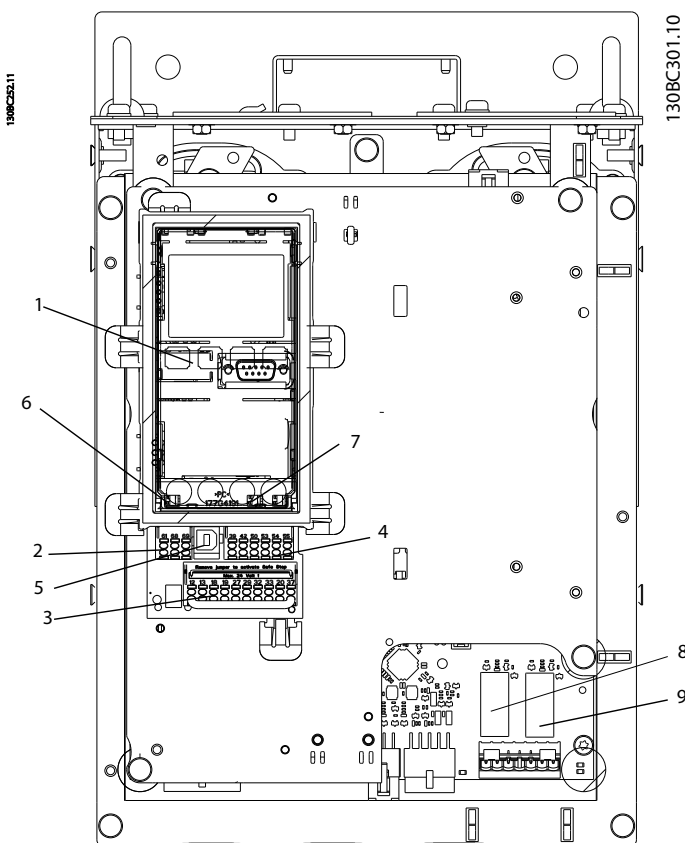


Illustration 1.2 Close-up View: LCP and Control Functions

| | | | |
|---|-----------------------------------|----|---|
| 1 | LCP (Local Control Panel) | 9 | Relay 2 (04, 05, 06) |
| 2 | RS-485 serial bus connector | 10 | Lifting ring |
| 3 | Digital I/O and 24 V power supply | 11 | Mounting slot |
| 4 | Analog I/O connector | 12 | Cable clamp (PE) |
| 5 | USB connector | 13 | Earth (ground) |
| 6 | Serial bus terminal switch | 14 | Motor output terminals 96 (U), 97 (V), 98 (W) |
| 7 | Analog switches (A53), (A54) | 15 | Mains input terminals 91 (L1), 92 (L2), 93 (L3) |
| 8 | Relay 1 (01, 02, 03) | 16 | TB5 (IP21/54 only). Terminal block for anti-condensation heater |

Table 1.1

NOTE

For location of TB6 (terminal block for contactor), see 2.4.3.2 Terminal Locations: D5h-D8h.

1.1.2 Extended Options Cabinets

If a frequency converter is ordered with one of the following options, it is supplied with an options cabinet that makes it taller.

- Brake chopper
- Mains disconnect

- Contactor
- Mains disconnect with contactor
- Circuit breaker

Illustration 1.3 shows an example of a frequency converter with an options cabinet. Table 1.2 lists the variants for the frequency converters that include input options.

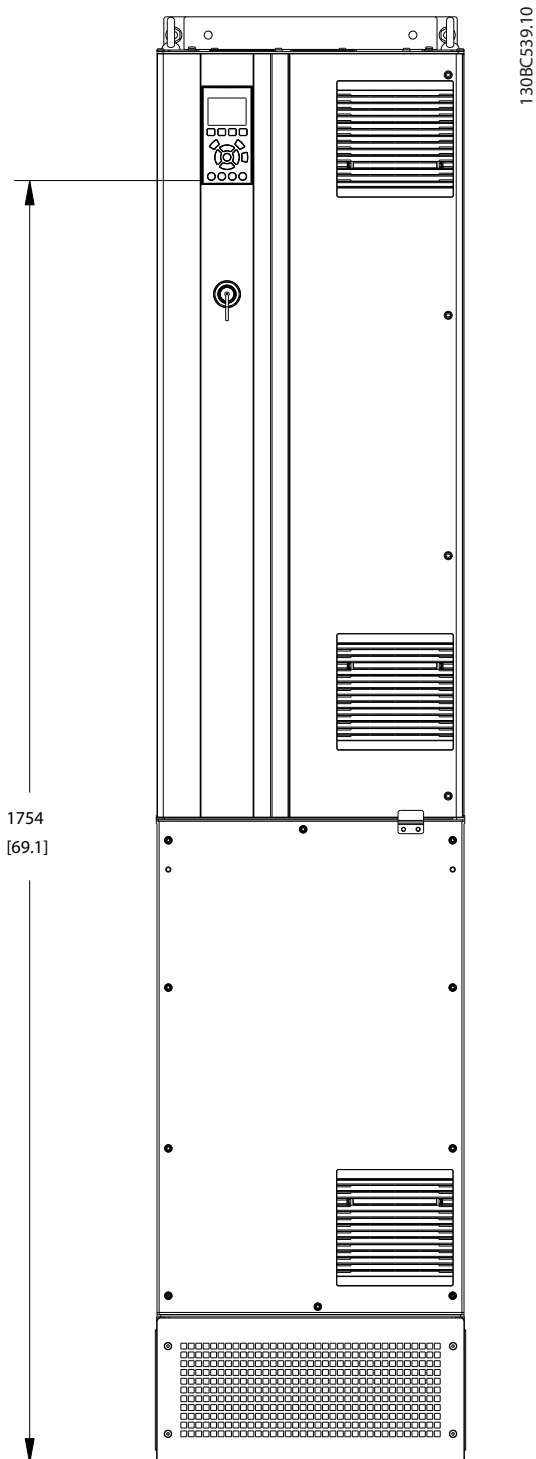


Illustration 1.3 D7h Enclosure

| Options unit designations | Extension cabinets | Possible options |
|---------------------------|------------------------------------|---|
| D5h | D1h enclosure with short extension | Brake, Disconnect |
| D6h | D1h enclosure with tall extension | Contactor, Contactor with Disconnect, Circuit Breaker |
| D7h | D2h enclosure with short extension | Brake, Disconnect |
| D8h | D2h enclosure with tall extension | Contactor, Contactor with Disconnect, Circuit Breaker |

Table 1.2

The D7h and D8h frequency converters (D2h plus options cabinet), include a 200 mm pedestal for floor mounting.

There is a safety latch on the front cover of the options cabinet. If the frequency converter is supplied with a mains disconnect or circuit breaker, the safety latch prevents the cabinet door from being opened while the frequency converter is energized. Before opening the door of the frequency converter, the disconnect or circuit breaker must be opened (to de-energize the frequency converter) and the cover of the options cabinet must be removed.

For frequency converters purchased with a disconnect, contactor or circuit breaker, the name plate label includes a type code for a replacement that does not include the option. If there is a problem with the frequency converter, it is replaced independent of the options.

Refer to 2.7 *Optional Equipment* for more detailed descriptions of the input options and other options that may be added to the frequency converter.

1.2 Purpose of the Manual

This manual is intended to provide detailed information for the installation and start up of the frequency converter. 2 *Installation* provides requirements for mechanical and electrical installation, including input, motor, control and serial communications wiring and control terminal functions. 3 *Start Up and Commissioning* provides detailed procedures for start up, basic operational programming, and functional testing. The remaining chapters provide supplementary details. These details include user interface, detailed programming, application examples, start-up troubleshooting, and specifications.

1.3 Additional Resources

Other resources are available to understand advanced frequency converter functions and programming.

- The *VLT® Programming Guide* provides greater detail on working with parameters and many application examples.
- The *VLT® Design Guide* is intended to provide detailed capabilities and functionality to design motor control systems.
- Supplemental publications and manuals are available from Danfoss. See <http://www.danfoss.com/BusinessAreas/Drives-Solutions/Documentations/Technical+Documentation.htm> for listings.
- Optional equipment is available that may change some of the procedures described. Reference the instructions supplied with those options for specific requirements. Contact the local Danfoss supplier or visit the Danfoss website: <http://www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm>, for downloads or additional information.

1.4 Product Overview

A frequency converter 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 frequency converter can vary the speed of the motor in response to system feedback, such as position sensors on a conveyor belt. The frequency converter can also regulate the motor by responding to remote commands from external controllers.

In addition, the frequency converter monitors the system and motor status, issues warnings or alarms for fault conditions, starts and stops the motor, optimizes energy efficiency, and offers many more control, monitoring, and efficiency functions. Operation and monitoring functions are available as status indications to an outside control system or serial communication network.

1.5 Internal Controller Functions

Illustration 1.4 is a block diagram of the frequency converter's internal components. See *Table 1.3* for their functions.

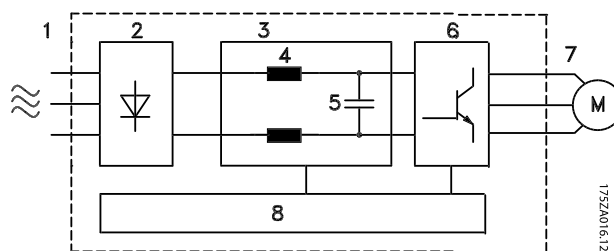


Illustration 1.4 Frequency Converter Block Diagram

| Area | Title | Functions |
|------|-------------------|---|
| 1 | Mains input | <ul style="list-style-type: none"> • Three-phase AC mains power supply to the frequency converter |
| 2 | Rectifier | <ul style="list-style-type: none"> • The rectifier bridge converts the AC input to DC current to supply inverter power |
| 3 | DC bus | <ul style="list-style-type: none"> • Intermediate DC-bus circuit handles the DC current |
| 4 | DC reactors | <ul style="list-style-type: none"> • Filter the intermediate DC circuit voltage • Provide line transient protection • Reduce RMS current • Raise the power factor reflected back to the line • Reduce harmonics on the AC input |
| 5 | Capacitor bank | <ul style="list-style-type: none"> • Stores the DC power • Provides ride-through protection for short power losses |
| 6 | Inverter | <ul style="list-style-type: none"> • Converts the DC into a controlled PWM AC waveform for a controlled variable output to the motor |
| 7 | Output to motor | <ul style="list-style-type: none"> • Regulated three-phase output power to the motor |
| 8 | Control circuitry | <ul style="list-style-type: none"> • Input power, internal processing, output, and motor current are monitored to provide efficient operation and control • User interface and external commands are monitored and performed • Status output and control can be provided |

Table 1.3 Frequency Converter Internal Components

1.6 Frame Sizes and Power Ratings

| | | | | | | | | | |
|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| kW High Overload | 75 | 90 | 110 | 132 | 160 | 200 | 250 | 315 | 315 |
| kW Normal Overload | 90 | 110 | 132 | 160 | 200 | 250 | 315 | 355 | 400 |
| 400 V | | D3h | D3h | D3h | D4h | D4h | D4h | | |
| 500 V | | | D3h | D3h | D3h | D4h | D4h | D4h | |
| 525 V | D3h | D3h | D3h | D4h | D4h | D4h | D4h | | |
| 690 V | | D3h | D3h | D3h | D4h | D4h | D4h | | D4h |

Table 1.4 kW Rated Frequency Converters

| | | | | | | | | |
|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| HP High Overload | 100 | 125 | 150 | 200 | 250 | 300 | 350 | 350 |
| HP Normal Overload | 125 | 150 | 200 | 250 | 300 | 350 | 400 | 450 |
| 460 V | | D3h | D3h | D3h | D4h | D4h | | D4h |
| 575 V | D3h | D3h | D3h | D4h | D4h | D4h | D4h | |

Table 1.5 HP Rated Frequency Converters

1

2 Installation

2.1 Planning the Installation Site

2

NOTE

Before performing the installation it is important to plan the installation of the frequency converter. Neglecting this may result in extra work during and after installation.

Select the best possible operation site by considering the following (see details on the following pages and the respective Design Guides):

- Ambient operating temperature
- Installation method
- How to cool the unit
- Position of the frequency converter
- Cable routing
- Ensure the power source supplies the correct voltage and necessary current
- Ensure that the motor current rating is within the maximum current from the frequency converter
- If the frequency converter is without built-in fuses, ensure that the external fuses are rated correctly

| Voltage [V] | Altitude restrictions |
|-------------|---|
| 380-500 | At altitudes above 3 km, contact Danfoss regarding PELV |
| 525-690 | At altitudes above 2 km, contact Danfoss regarding PELV |

Table 2.1 Installation in High Altitudes

2.2 Pre-Installation Check List

- Before unpacking the frequency converter, ensure the packaging is intact. If any damage has occurred, immediately contact the shipping company to claim the damage.
- Before unpacking the frequency converter, locate it as close as possible to the final installation site
- Compare the model number on the nameplate to what was ordered to verify the proper equipment
- Ensure each of the following are rated for the same voltage:
 - Mains (power)
 - Frequency converter
 - Motor
- Ensure that frequency converter output current rating is equal to or greater than motor full load current for peak motor performance

- Motor size and frequency converter power must match for proper overload protection
- If frequency converter rating is less than motor, full motor output cannot be achieved

2.3 Mechanical Installation

2.3.1 Cooling

- Top and bottom clearance for air cooling must be provided. Generally, 225 mm (9 in) is required.
- Improper mounting can result in over heating and reduced performance
- Derating for temperatures starting between 45 °C (113 °F) and 50 °C (122 °F) and elevation 1000 m (3300 ft) above sea level must be considered. See *VLT® Design Guide* for detailed information.

The high power frequency converters utilise a back-channel cooling concept that removes heatsink cooling air, which carries approximately 90% of the heat out of the back channel of the frequency converters. The back-channel air can be redirected from the panel or room using one of the kits below.

Duct cooling

A back-channel cooling kit is available to direct the heatsink cooling air out of the panel when an IP20/chassis frequency converters is installed in a Rittal enclosure. Use of this kit reduces the heat in the panel and smaller door fans can be specified on the enclosure.

Cooling out the back (top and bottom 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.

A door fan(s) is required on the enclosure to remove the heat not contained in the backchannel of the frequency converters and any additional losses generated by other components inside the enclosure. The total required air flow must be calculated so that the appropriate fans can be selected.

Airflow

The necessary airflow over the heat sink must be secured.
The flow rate is shown in *Table 2.2*.

The fan runs for the following reasons:

- AMA
- DC Hold
- Pre-Mag
- DC Brake
- 60% of nominal current is exceeded
- Specific heatsink temperature exceeded (power size dependent)
- Specific Power Card ambient temperature exceeded (power size dependent)
- Specific Control Card ambient temperature exceeded

| Frame | Door fan/top fan | Heatsink fan |
|---------|----------------------------------|----------------------------------|
| D1h/D3h | 102 m ³ /hr (60 CFM) | 420 m ³ /hr (250 CFM) |
| D2h/D4h | 204 m ³ /hr (120 CFM) | 840 m ³ /hr (500 CFM) |

Table 2.2 Airflow

2.3.2 Lifting

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

CAUTION

The angle from the top of the frequency converter to the lifting cables should be 60° or greater.

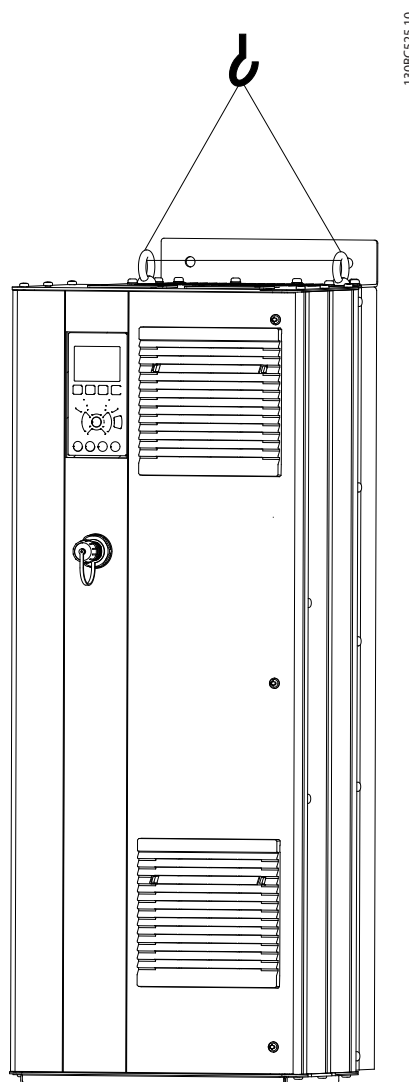


Illustration 2.1 Recommended Lifting Method

2.3.3 Wall Mounting - IP21 (NEMA 1) and IP54 (NEMA 12) Units

Consider the following before selecting the final installation site:

- Free space for cooling
- Access to open the door
- Cable entry from the bottom

2.4 Electrical Installation

2.4.1 General Requirements

This section contains detailed instructions for wiring the frequency converter. The following tasks are described:

- Wiring the motor to the frequency converter output terminals
- Wiring the AC mains to the frequency converter input terminals
- Connecting control and serial communication wiring
- After power has been applied, checking input and motor power; programming control terminals for their intended functions

⚠ WARNING

EQUIPMENT HAZARD!

Rotating shafts and electrical equipment can be hazardous. All electrical work must conform to national and local electrical codes. It is strongly recommended that installation, start up, and maintenance be performed only by trained and qualified personnel. Failure to follow these guidelines could result in death or serious injury.

CAUTION

WIRING ISOLATION!

Run input power, motor wiring and control wiring in three separate metallic conduits or use separated shielded cable for high frequency noise isolation. Failure to isolate power, motor and control wiring could result in less than optimum frequency converter and associated equipment performance.

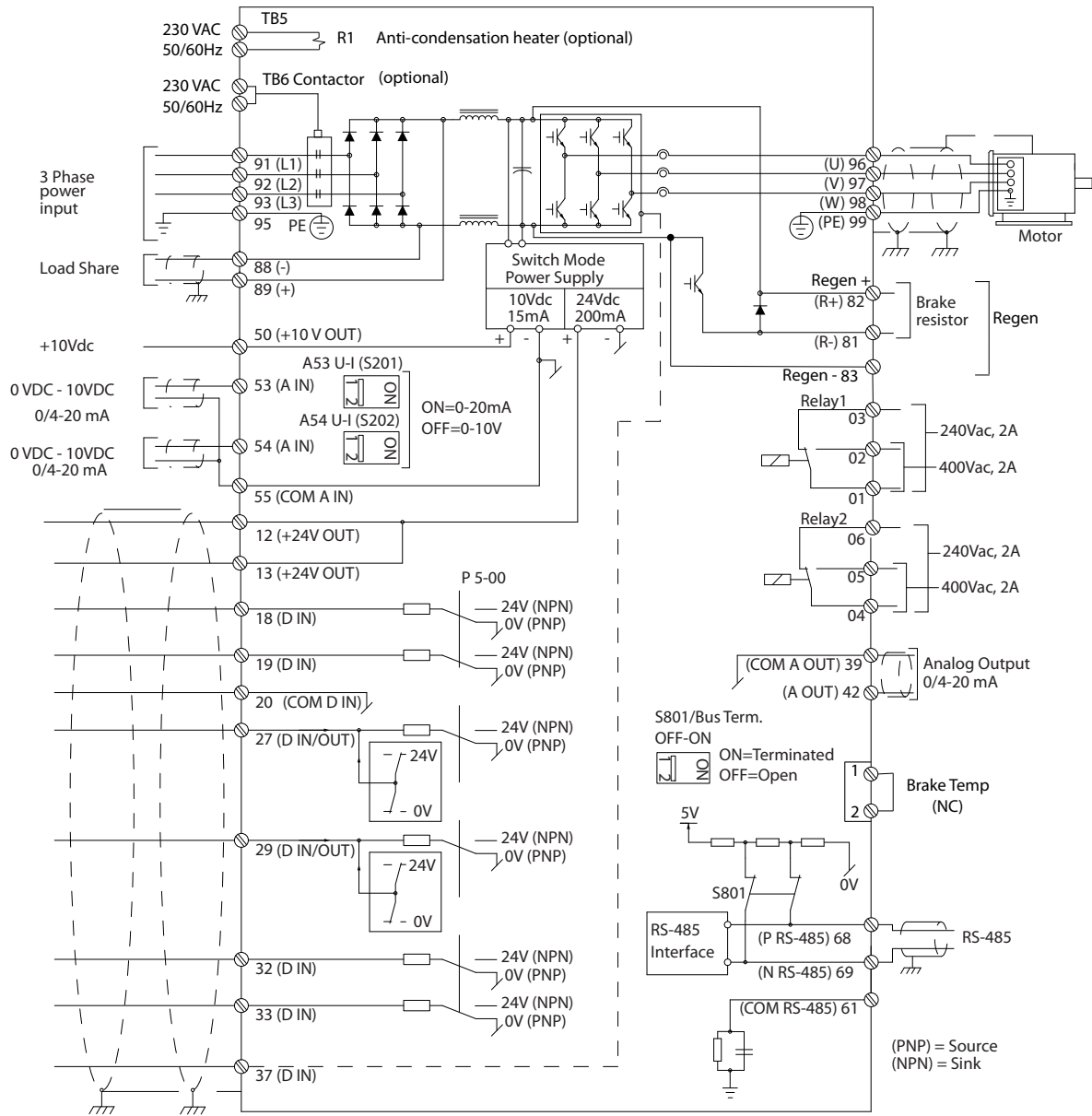


Illustration 2.2 Interconnect Diagram

For your safety, comply with the following requirements

- Electronic controls equipment is connected to hazardous mains voltage. Extreme care should be taken to protect against electrical hazards when applying power to the unit.
- Run motor cables from multiple frequency converters multiple frequency converters separately. Induced voltage from output motor cables run together can charge equipment capacitors even with the equipment turned off and locked out.
- Field wiring terminals are not intended to receive a conductor one size larger.

Overload and Equipment Protection

- An electronically activated function within the frequency converter provides overload protection for the motor. The overload calculates the level of increase to activate timing for the trip (controller output stop) function. The higher the current draw, the quicker the trip response. The overload provides Class 20 motor protection. See *8 Warnings and Alarms* for details on the trip function.
- Because the motor wiring carries high frequency current, it is important that wiring for mains, motor power, and control are run separately. Use metallic conduit or separated shielded wire. See *Illustration 2.3*. Failure to isolate power, motor, and control wiring could result in less than optimum equipment performance.
- All frequency converters must be provided with short-circuit and over-current protection. Input fusing is required to provide this protection, see *Illustration 2.4*. If not factory supplied, fuses must be provided by the installer as part of installation. See maximum fuse ratings in *10.3.1 Protection*.

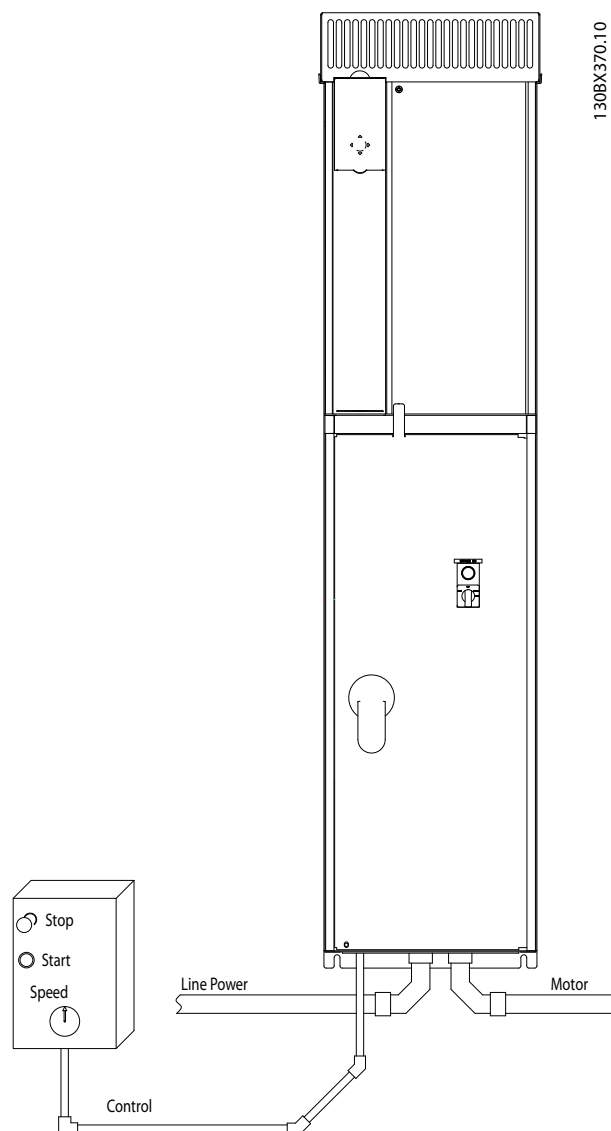


Illustration 2.3 Example of Proper Electrical Installation Using Conduit

- All frequency converters must be provided with short-circuit and over-current protection. Input fusing is required to provide this protection, see *Illustration 2.4*. If not factory supplied, fuses must be provided by the installer as part of installation. See maximum fuse ratings in *10.3.1 Protection*.

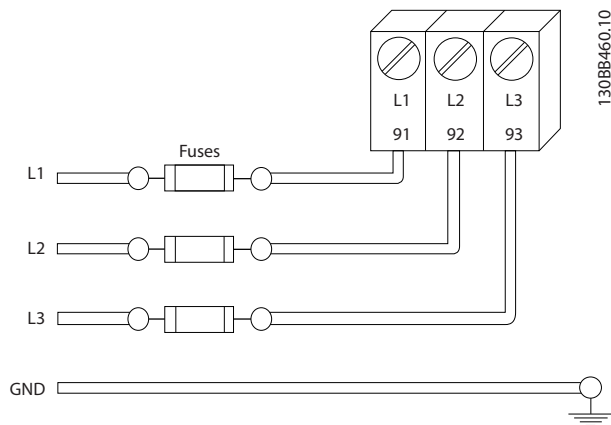


Illustration 2.4 Frequency Converter Fuses

Wire Type and Ratings

- All wiring must comply with local and national regulations regarding cross-section and ambient temperature requirements.
- Danfoss recommends that all power connections be made with a minimum 75 °C rated copper wire.

2.4.2 Earth (Grounding) Requirements

⚠ WARNING

EARTHING (GROUNDING) HAZARD!

For operator safety, it is important to earth (ground) the frequency converter properly in accordance with national and local electrical codes as well as instructions contained within this document. Do not use conduit connected to the frequency converter as a replacement for proper grounding. Earth (ground) currents are higher than 3.5 mA. Failure to earth (ground) the frequency converter properly could result in death or serious injury.

NOTE

It is the responsibility of the user or certified electrical installer to ensure correct earthing (grounding) of the equipment in accordance with national and local electrical codes and standards.

- Follow all local and national electrical codes to earth (ground) electrical equipment properly
- Proper protective earthing (grounding) for equipment with earth (ground) currents higher

than 3.5 mA must be established, see *2.4.2.1 Leakage Current (>3.5 mA)*

- A dedicated earth wire (ground wire) is required for input power, motor power and control wiring
- Use the clamps provided with the equipment for proper earth connections (ground connections)
- Do not earth (ground) one frequency converter to another in a “daisy chain” fashion
- Keep the earth (ground) wire connections as short as possible
- Using high-strand wire to reduce electrical noise is recommended
- Follow motor manufacturer wiring requirements

2.4.2.1 Leakage Current (>3.5 mA)

Follow national and local codes regarding protective earthing of equipment with a leakage current >3.5 mA. Frequency converter technology implies high frequency switching at high power. This will generate a leakage current in the earth connection. A fault current in the frequency converter at the output power terminals might contain a DC component, which can charge the filter capacitors and cause a transient earth current. The earth leakage current depends on various system configurations including RFI filtering, screened motor cables, and frequency converter power.

EN/IEC61800-5-1 (Power Drive System Product Standard) requires special care if the leakage current exceeds 3.5 mA. Earthing (grounding) must be reinforced in one of the following ways:

- Earth (ground) wire of at least 10 mm²
- Two separate earth (ground) wires both complying with the dimensioning rules

See EN 60364-5-54 § 543.7 for further information.

Using RCDs

Where residual current devices (RCDs)—also known as earth leakage circuit breakers (ELCBs)—are used, comply with the following: residual current devices (RCDs)

- Use RCDs of type B only, which are capable of detecting AC and DC currents
- Use RCDs with an inrush delay to prevent faults due to transient earth currents
- Dimension RCDs according to the system configuration and environmental considerations

2

2.4.2.2 Earthing (Grounding) IP20 Enclosures

The frequency converter can be earthed (grounded) using conduit or shielded cable. For earthing (grounding) of the power connections, use the dedicated earthing (grounding) points as shown in *Illustration 2.6*.

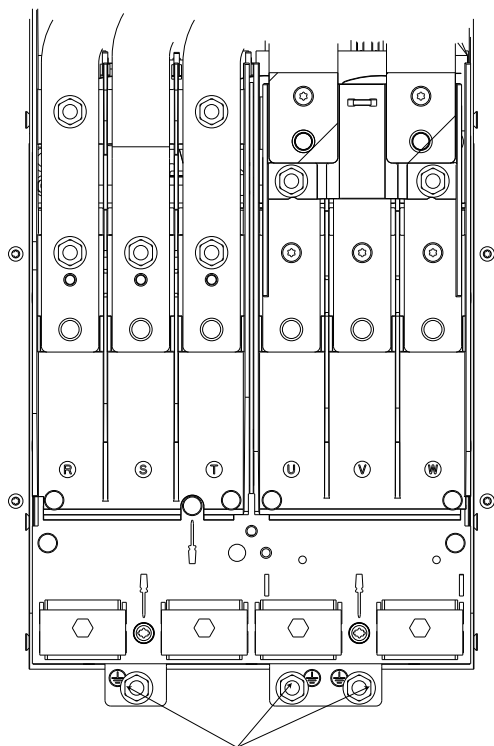


Illustration 2.5 Earthing (Grounding) Points for IP20 (Chassis) Enclosures

2.4.2.3 Earthing (Grounding) IP21/54 Enclosures

The frequency converter can be earthed (grounded) using conduit or shielded cable. For earthing (grounding) of the power connections, use the dedicated earthing (grounding) points as shown in *Illustration 2.6*.

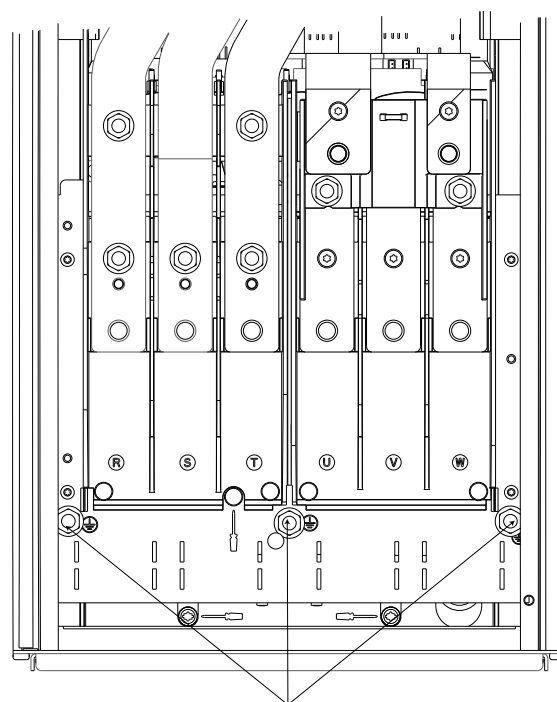


Illustration 2.6 Earthing (Grounding) for IP21/54 Enclosures.

2.4.3 Motor Connection

⚠ WARNING

INDUCED VOLTAGE!

Run output motor cables from multiple frequency converters separately. Induced voltage from output motor cables run together can charge equipment capacitors even with the equipment turned off and locked out. Failure to run output motor cables separately could result in death or serious injury.

- For maximum cable sizes, see 10.1 *Power-dependent Specifications*
- Comply with local and national electrical codes for cable sizes
- Gland plates are provided at the base of IP21/54 and higher (NEMA1/12) units
- Do not install power factor correction capacitors between the frequency converter and the motor
- Do not wire a starting or pole-changing device between the frequency converter and the motor
- Connect the 3-phase motor wiring to terminals 96 (U), 97 (V), and 98 (W)
- Earth (ground) the cable in accordance with the instructions provided

- Torque terminals in accordance with the information provided in 10.3.4 Connection Tightening Torques
- Follow motor manufacturer wiring requirements

2.4.3.1 Terminal Locations: D1h-D4h

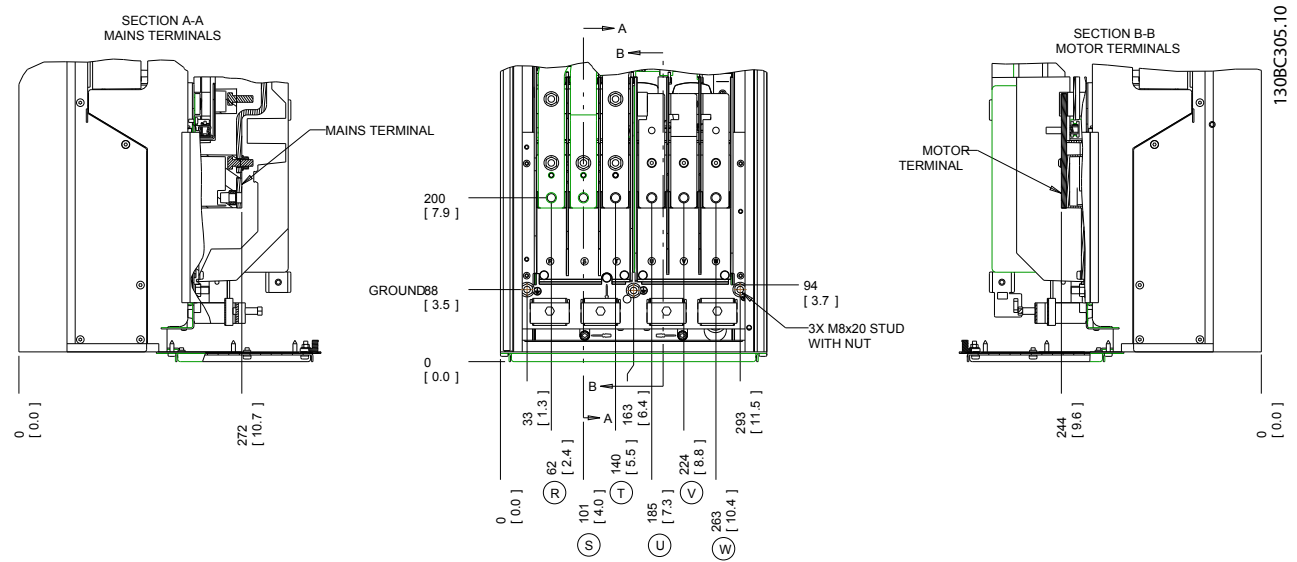


Illustration 2.7 Terminal Locations D1h

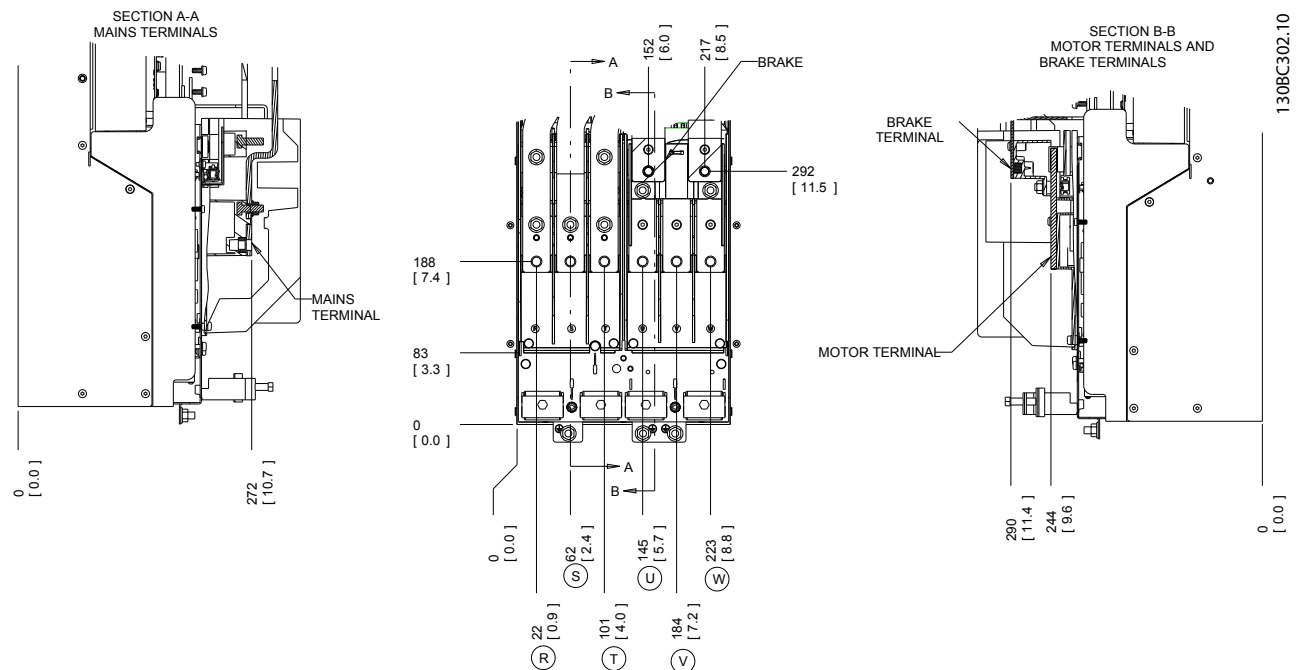


Illustration 2.8 Terminal Locations D3h

2

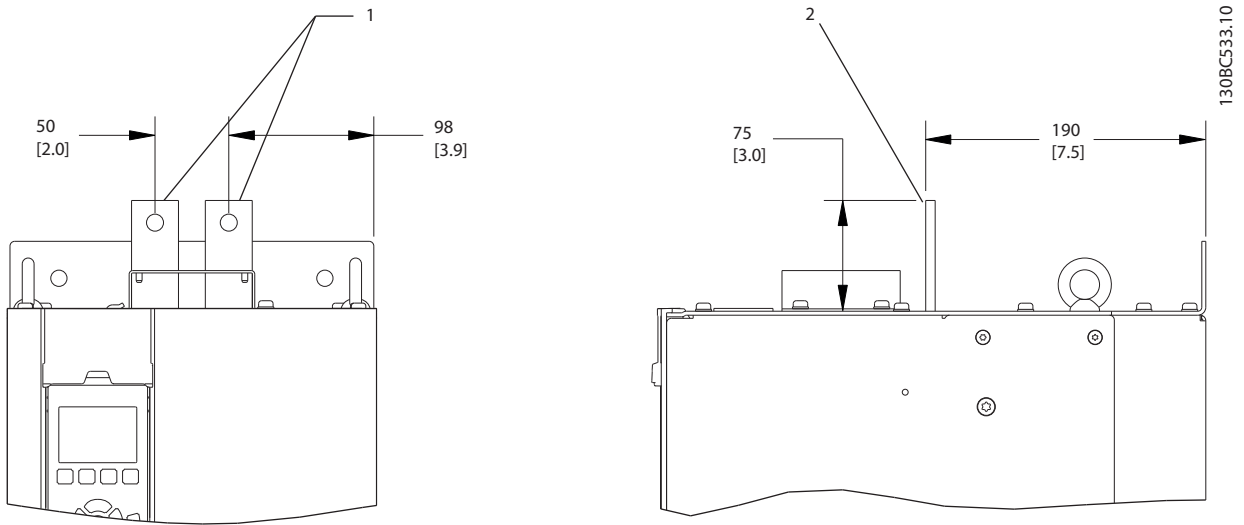


Illustration 2.9 Loadshare and Regeneration Terminals, D3h

| | |
|---|------------|
| 1 | Front view |
| 2 | Side view |

Table 2.3

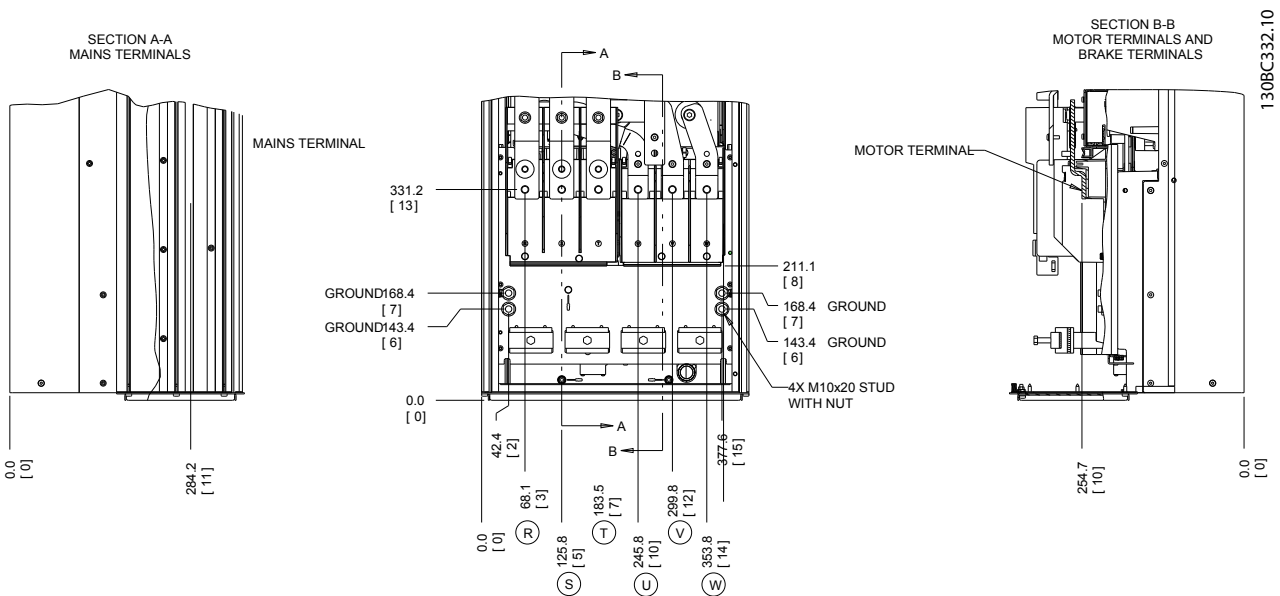
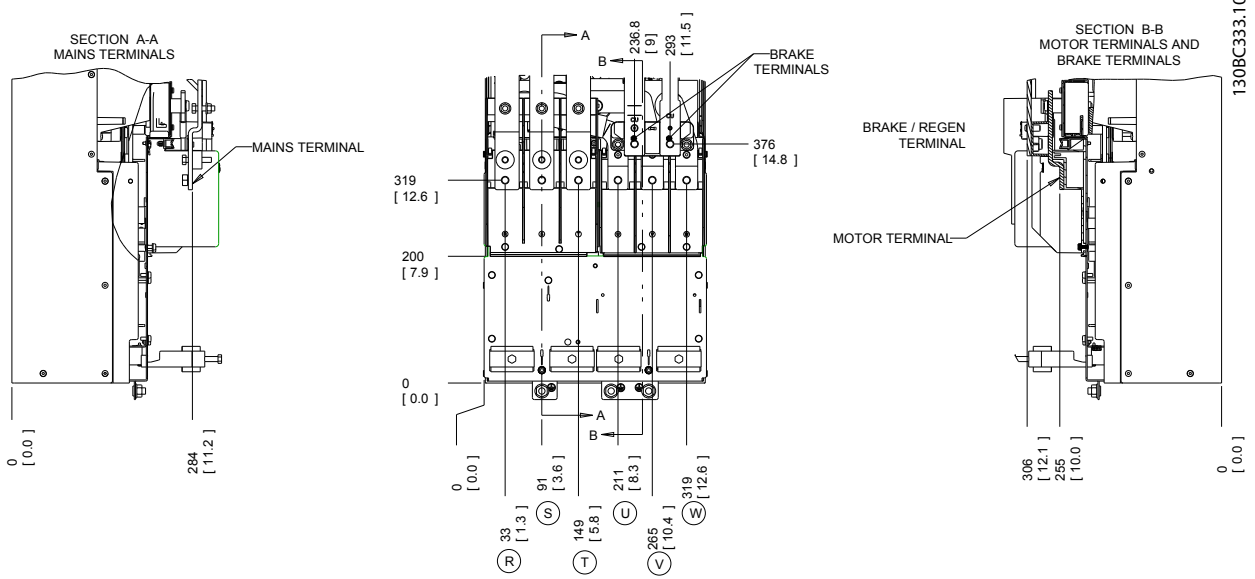


Illustration 2.10 Terminal Locations D2h



2

Illustration 2.11 Terminal Locations D4h

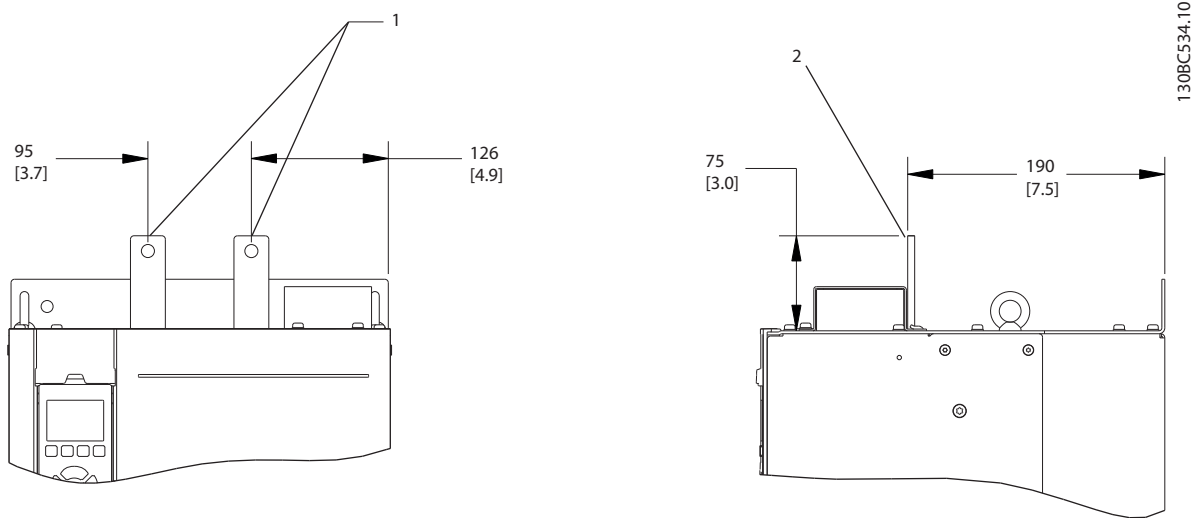


Illustration 2.12 Load share and Regeneration Terminals, D4h

| | |
|---|------------|
| 1 | Front view |
| 2 | Side view |

Table 2.4

2.4.3.2 Terminal Locations: D5h-D8h

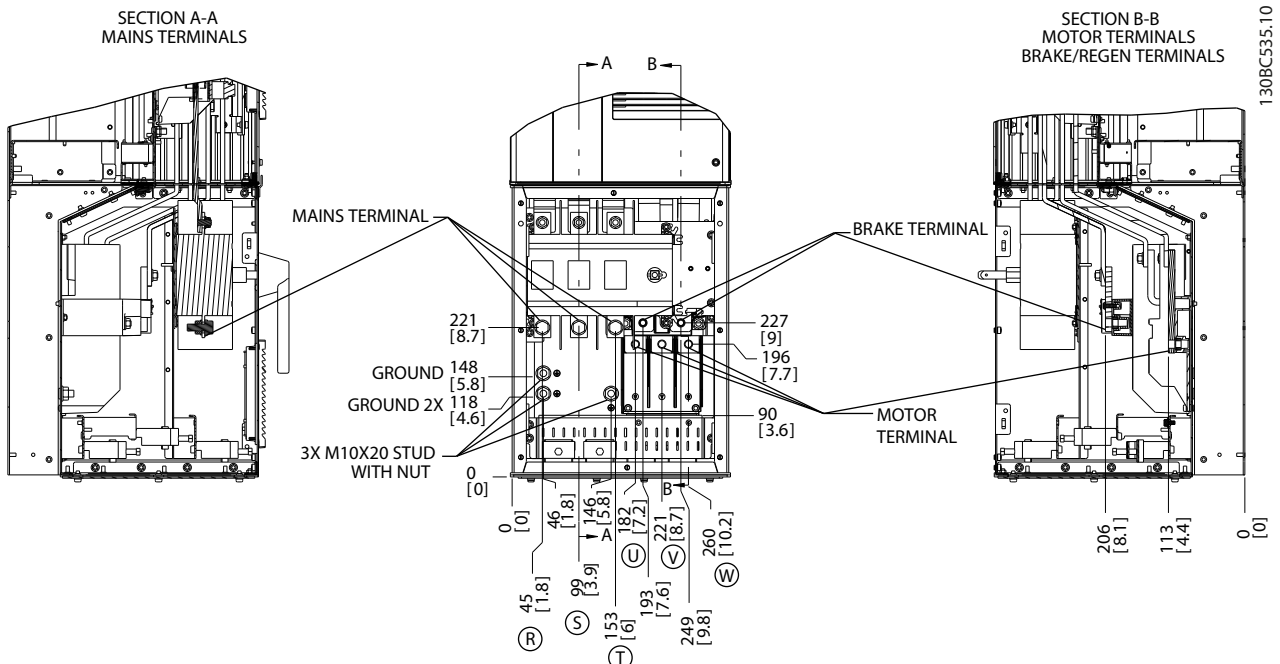


Illustration 2.13 Terminal Locations, D5h with Disconnect Option

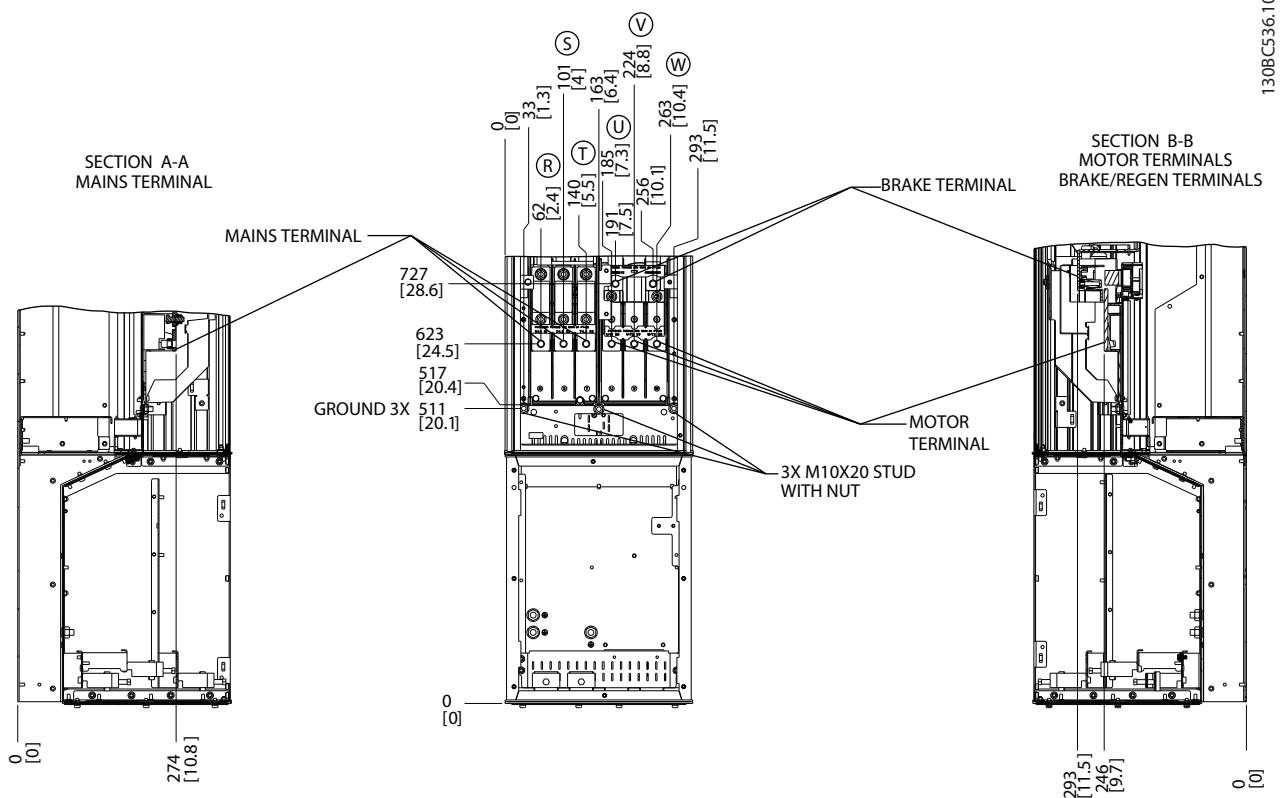


Illustration 2.14 Terminal Locations, D5h with Brake Option

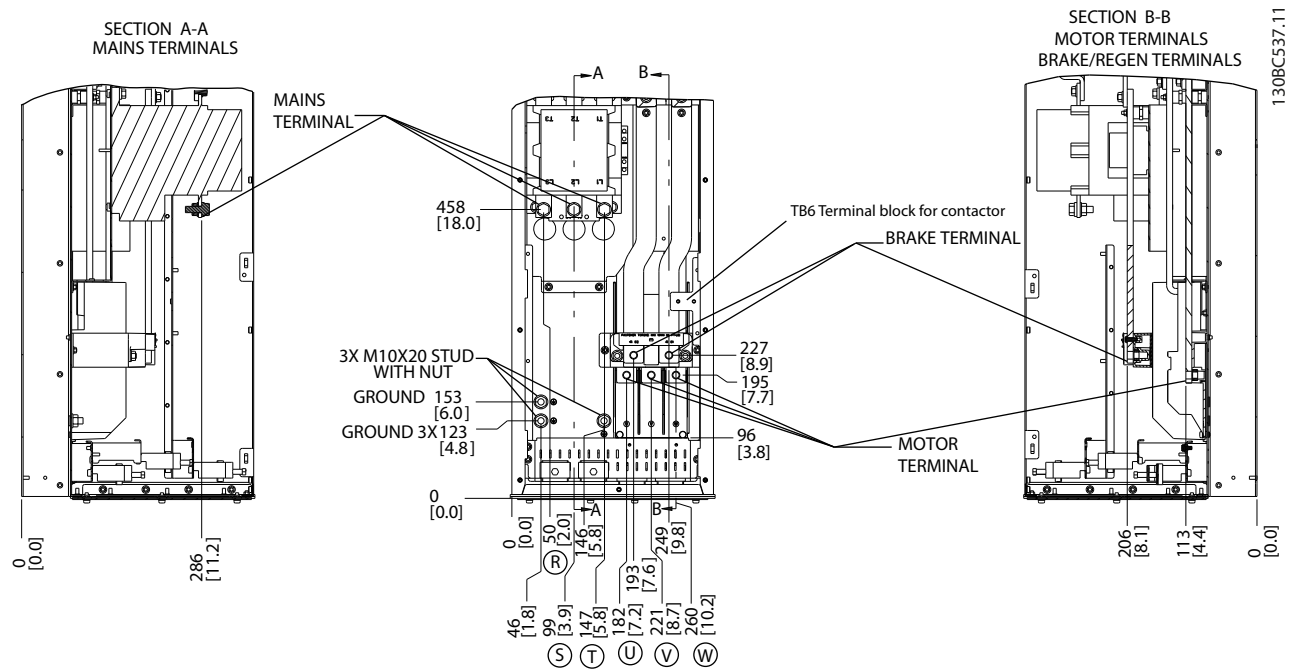


Illustration 2.15 Terminal Locations, D6h with Contactor Option

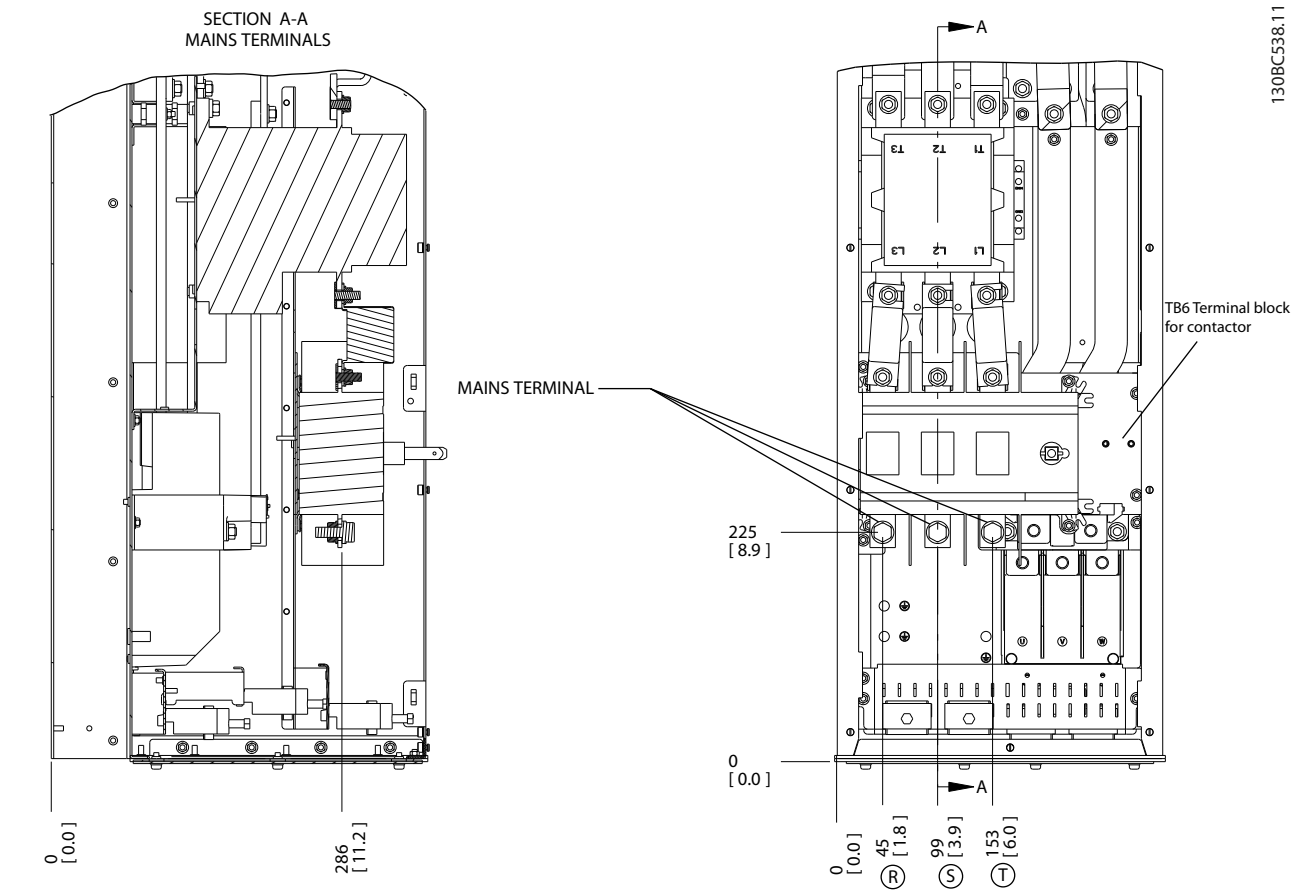


Illustration 2.16 Terminal Locations, D6h with Contactor and Disconnect Options

2

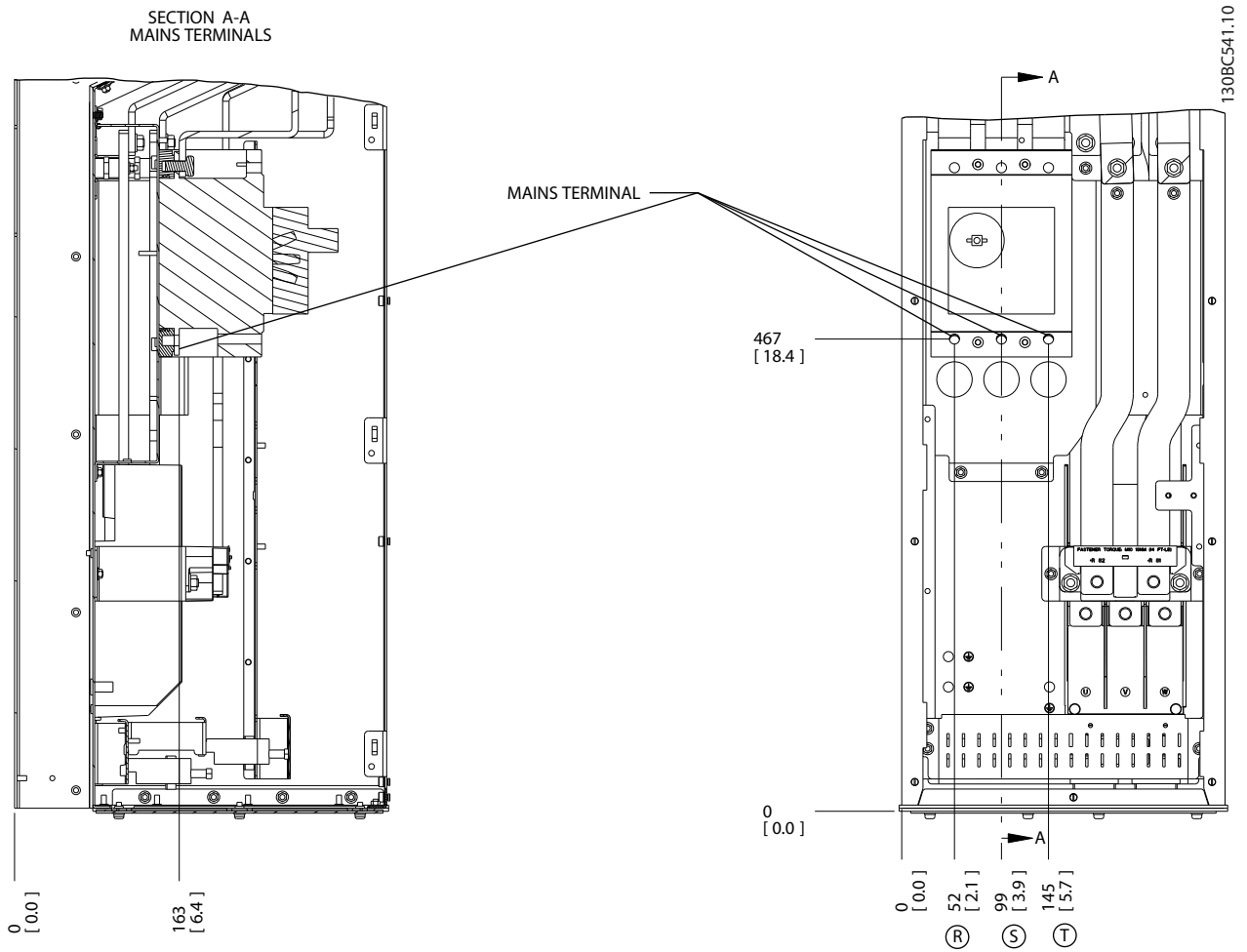
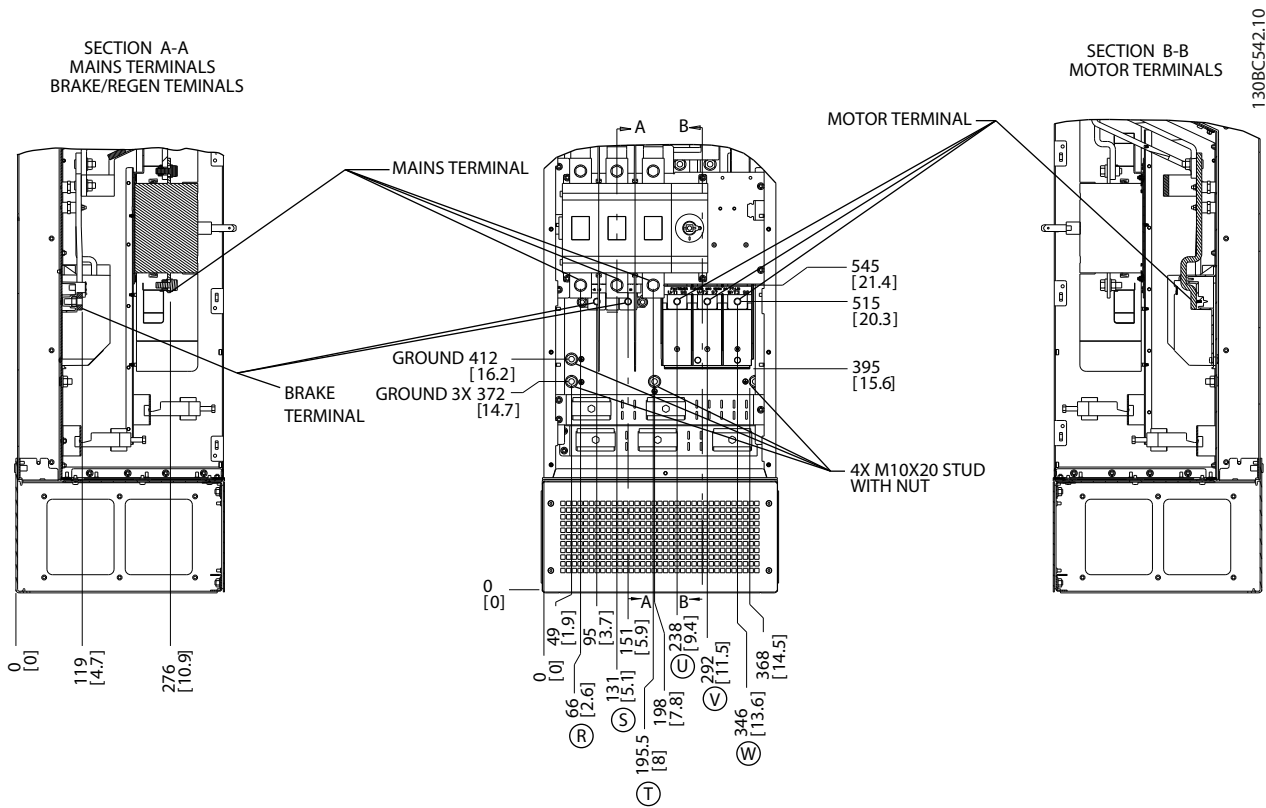


Illustration 2.17 Terminal Locations, D6h with Circuit Breaker Option



2

Illustration 2.18 Terminal Locations, D7h with Disconnect Option

2

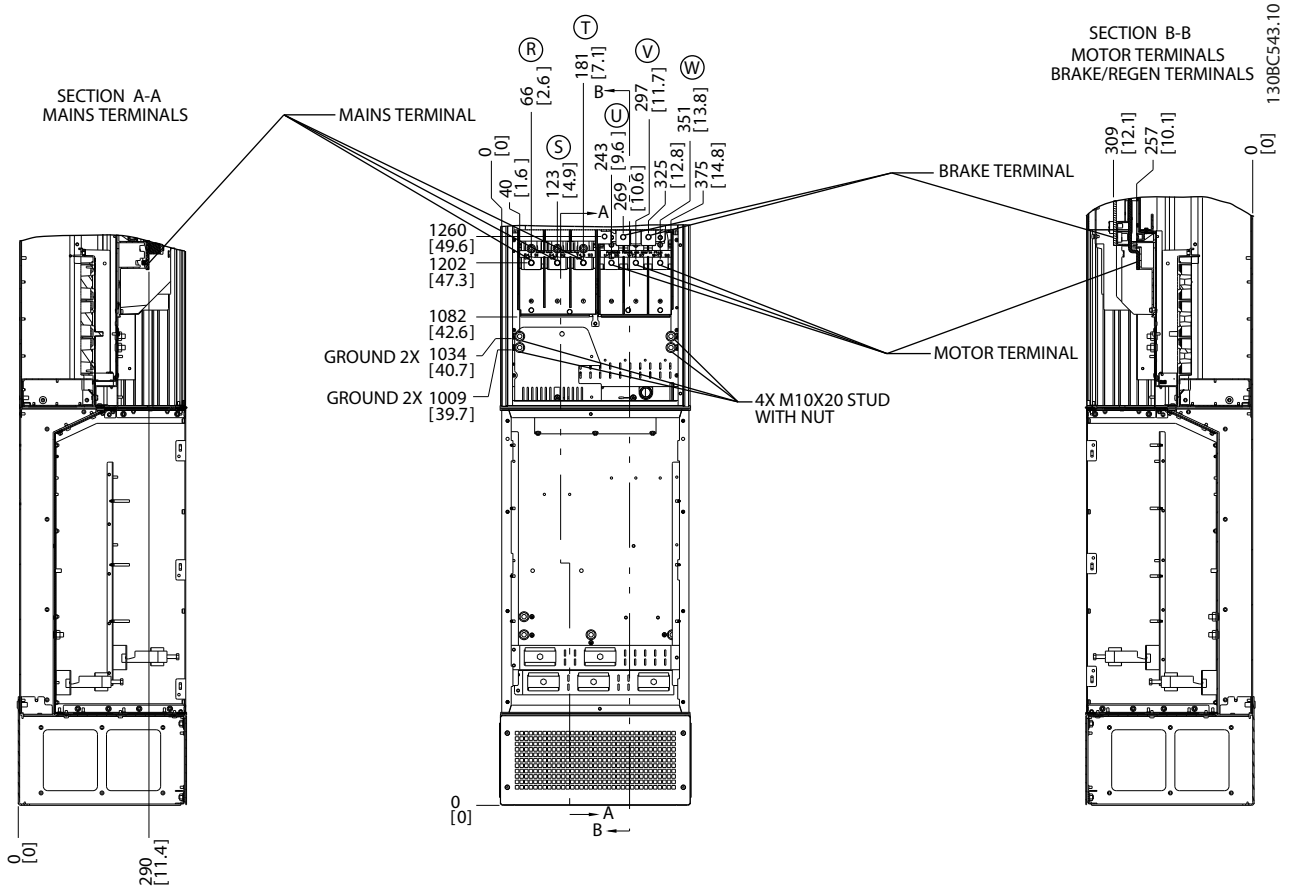
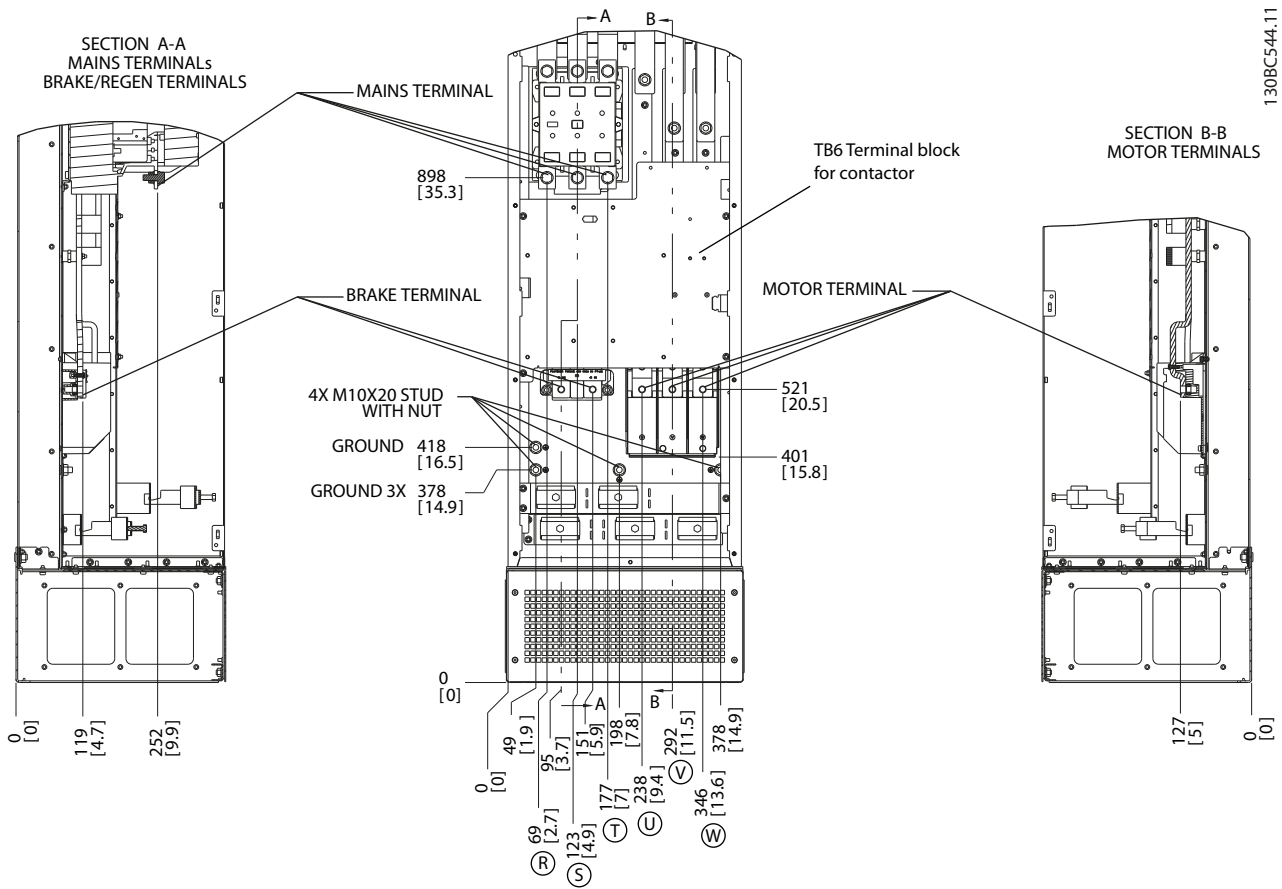


Illustration 2.19 Terminal Locations, D7h with Brake Option



2

Illustration 2.20 Terminal Locations, D8h with Contactor Option

2

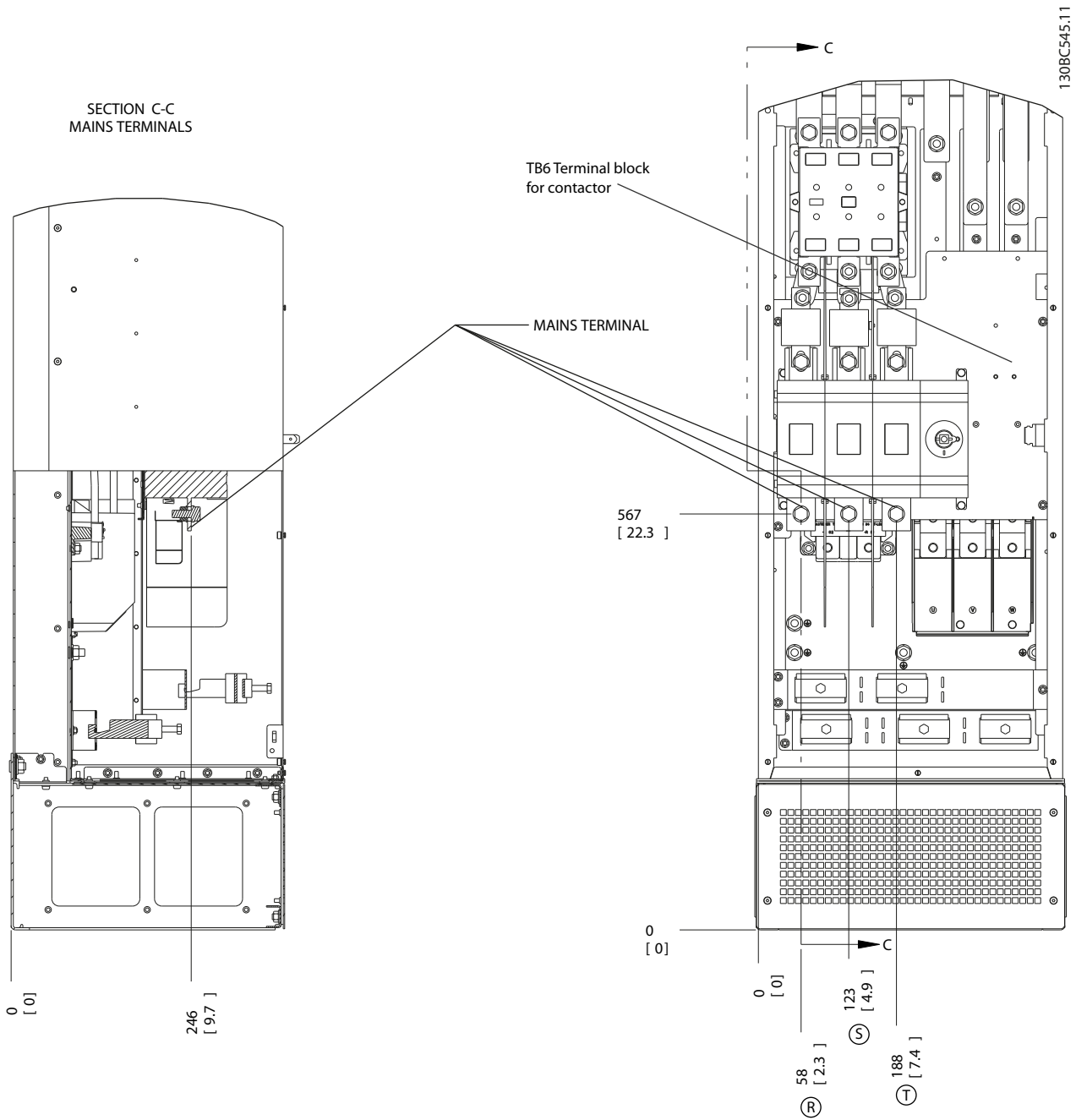
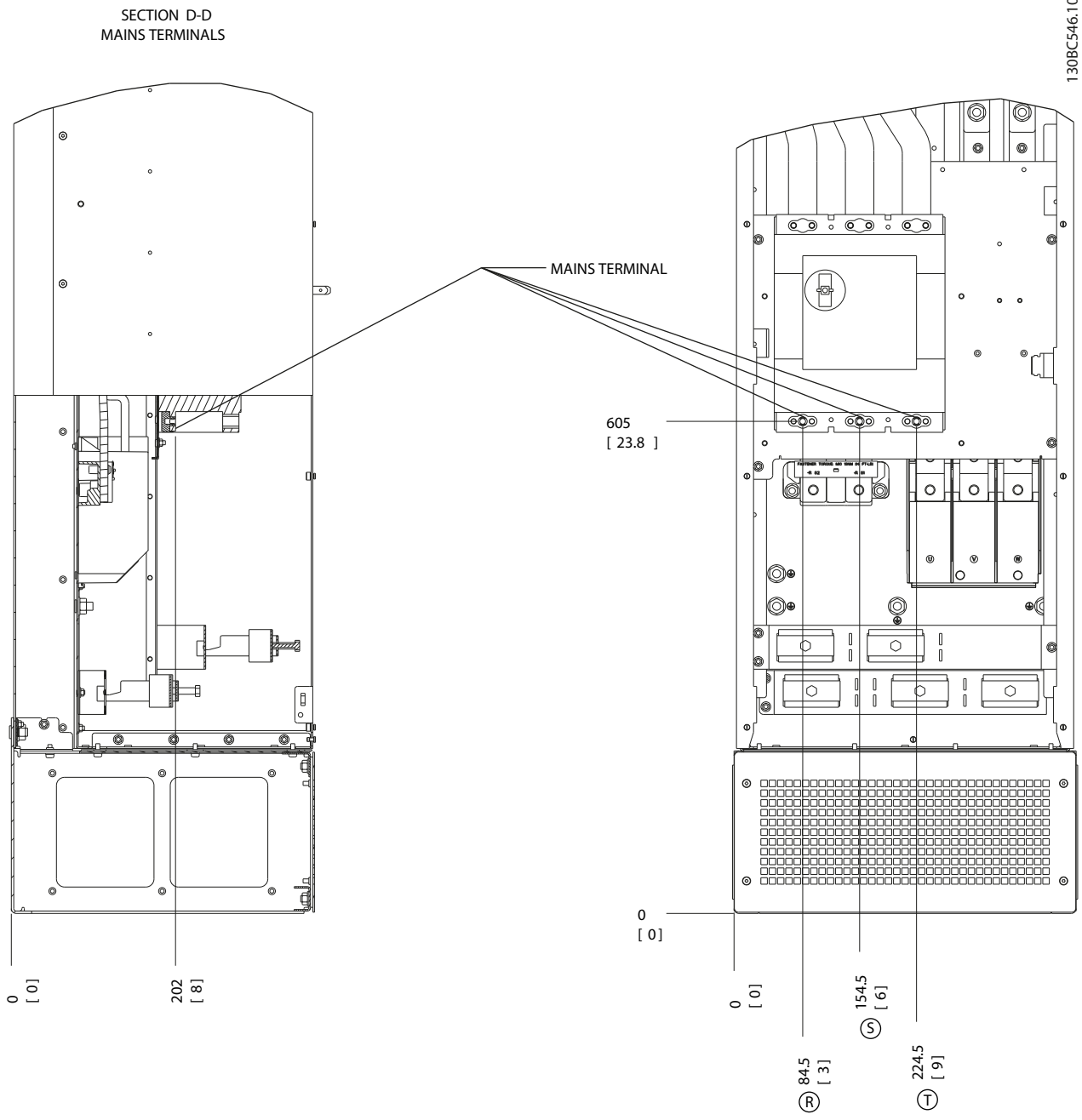


Illustration 2.21 Terminal Locations, D8h with Contactor and Disconnect Options



130BC546.10

2

Illustration 2.22 Terminal Locations, D8h with Circuit Breaker Option

2.4.4 Motor Cable

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

| Terminal no. | Function |
|----------------|--|
| 96, 97, 98, 99 | Mains U/T1, V/T2, W/T3 Earth (ground) |

Table 2.5

2.4.5 Motor Rotation Check

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

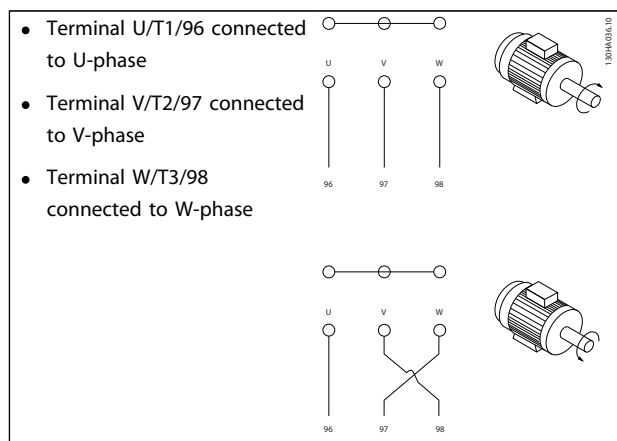


Table 2.6

A motor rotation check can be performed using 1-28 Motor Rotation Check and following the steps shown in the display.

2.4.6 AC Mains Connection

- Size wiring is based upon the input current of the frequency converter
- Comply with local and national electrical codes for cable sizes
- Connect 3-phase AC input power wiring to terminals L1, L2, and L3 (see Illustration 2.23)

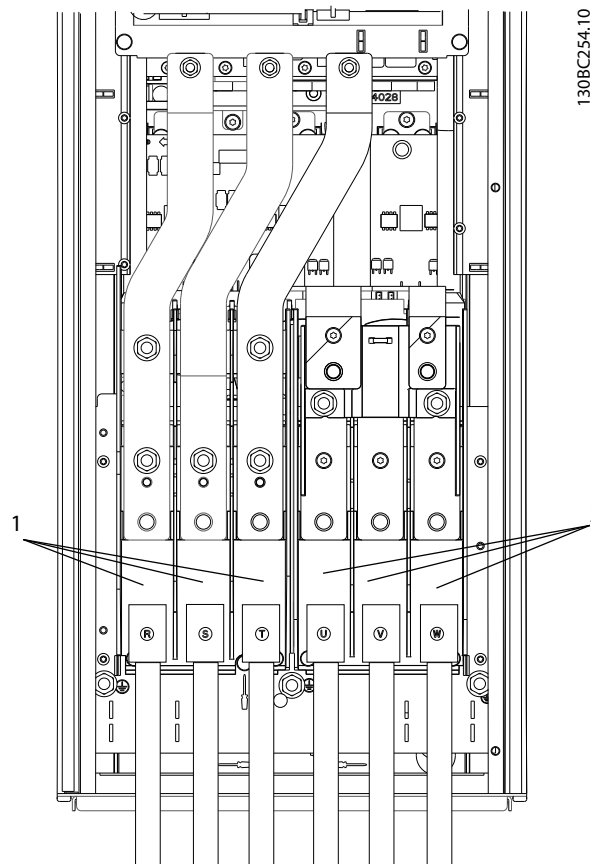


Illustration 2.23 Connecting to AC Mains

| | |
|---|------------------|
| 1 | Mains connection |
| 2 | Motor connection |

Table 2.7

- Earth (ground) the cable in accordance with the instructions provided
- All frequency converters may be used with an isolated input source as well as with earth (ground) reference power lines. When supplied from an isolated mains source (IT mains or floating delta) or TT/TN-S mains with a grounded leg (grounded delta), set 14-50 RFI Filter to OFF. When off, the internal RFI filter capacitors between the chassis and the intermediate circuit are isolated to avoid damage to the intermediate circuit and to reduce earth (ground) capacity currents in accordance with IEC 61800-3.

2.5 Control Wiring Connection

- Isolate control wiring from high power components in the frequency converter
- If the frequency converter is connected to a thermistor, for PELV isolation, optional thermistor control wiring must be reinforced/double insulated. A 24 V DC supply voltage is recommended.

2.5.1 Access

All terminals to the control cables are located underneath the LCP on the inside of the frequency converter. To access, open the door (IP21/54) or remove the front panel (IP20).

2.5.2 Using Screened Control Cables

Danfoss recommends braided screened/armoured cables to optimise EMC immunity of the control cables and the EMC emission from the motor cables.

The ability of a cable to reduce the incoming and outgoing radiation of electric noise depends on the transfer impedance (Z_T). The screen of a cable is normally designed to reduce the transfer of electric noise; however, a screen with a lower transfer impedance (Z_T) value is more effective than a screen with a higher transfer impedance (Z_T).

Transfer impedance (Z_T) is rarely stated by cable manufacturers but it is often possible to estimate transfer impedance (Z_T) by assessing the physical design of the cable.

Transfer impedance (Z_T) can be assessed on the basis of the following factors:

- The conductivity of the screen material
 - The contact resistance between the individual screen conductors
 - The screen coverage, i.e. the physical area of the cable covered by the screen - often stated as a percentage value
 - Screen type, i.e. braided or twisted pattern
- a. Aluminium-clad with copper wire
 - b. Twisted copper wire or armoured steel wire cable
 - c. Single-layer braided copper wire with varying percentage screen coverage. This is the typical Danfoss reference cable.
 - d. Double-layer braided copper wire

- e. Twin layer of braided copper wire with a magnetic, screened/armoured intermediate layer
- f. Cable that runs in copper tube or steel tube
- g. Lead cable with 1.1 mm wall thickness

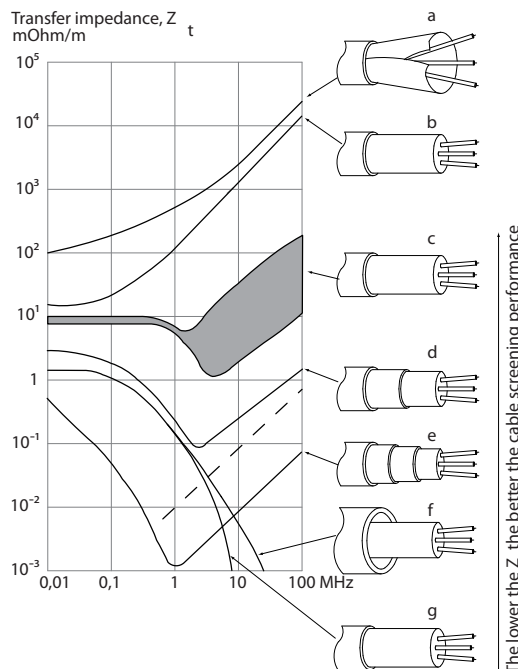


Illustration 2.24

2.5.3 Earthing (Grounding) of Screened Control Cables

Correct screening

The preferred method in most cases is to secure control and serial communication cables with screening clamps provided at both ends to ensure best possible high frequency cable contact. If the earth (ground) potential between the frequency converter and the PLC is different, electric noise may occur that will disturb the entire system. Solve this problem by fitting an equalizing cable next to the control cable. Minimum cable cross section: 16 mm².

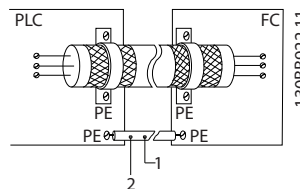


Illustration 2.25

| | |
|---|-------------------------|
| 1 | Min. 16 mm ² |
| 2 | Equalizing cable |

Table 2.8

2

50/60 Hz earth (ground) loops

With very long control cables, earth loops (ground loops) may occur. To eliminate earth (ground) loops, connect one end of the screen-to-earth (ground) with a 100 nF capacitor (keeping leads short).

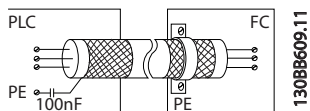


Illustration 2.26

Avoid EMC noise on serial communication

This terminal is connected to earth (ground) via an internal RC link. Use twisted-pair cables to reduce interference between conductors. The recommended method is shown below:

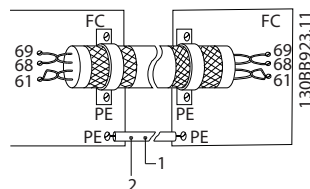


Illustration 2.27

| | |
|---|-------------------------|
| 1 | Min. 16 mm ² |
| 2 | Equalizing cable |

Table 2.9

Alternatively, the connection to terminal 61 can be omitted:

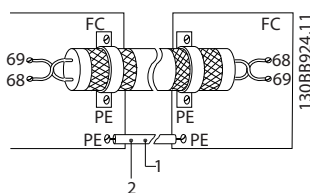


Illustration 2.28

| | |
|---|-------------------------|
| 1 | Min. 16 mm ² |
| 2 | Equalizing cable |

Table 2.10

2.5.4 Control Terminal Types

Terminal functions and default settings are summarized in 2.5.6 *Control Terminal Functions*.

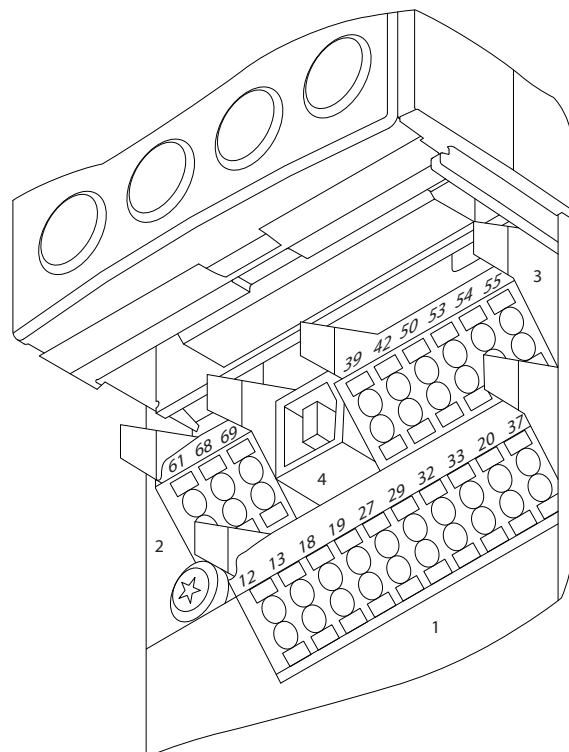


Illustration 2.29 Control Terminal Locations

- **Connector 1** provides four programmable digital input terminals, two additional digital terminals programmable as either input or output, a 24 V DC terminal supply voltage, and a common for optional customer supplied 24 V DC voltage
- **Connector 2** terminals (+)68 and (-)69 are for an RS-485 serial communications connection
- **Connector 3** provides two analog inputs, one analog output, 10 V DC supply voltage, and commons for the inputs and output
- **Connector 4** is a USB port available for use with the MCT 10 Set-up Software
- Also provided are two Form C relay outputs that are in various locations depending upon the frequency converter configuration and size
- Some options available for ordering with the unit may provide additional terminals. See the manual provided with the equipment option

2.5.5 Wiring to Control Terminals

Terminal plugs can be removed for easy access.

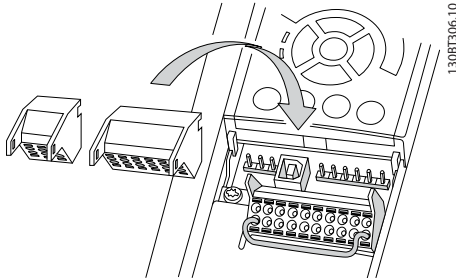


Illustration 2.30 Removal of Control Terminals

2.5.6 Control Terminal Functions

Frequency converter functions are commanded by receiving control input signals.

- Each terminal must be programmed for the function it will be supporting in the parameters associated with that terminal. See *5 Programming* and *6 Application Examples* for terminals and associated parameters.
- It is important to confirm that the control terminal is programmed for the correct function. See *5 Programming* for details on accessing parameters and programming.
- The default terminal programming is intended to initiate frequency converter functioning in a typical operational mode

2.5.6.1 Terminal 53 and 54 Switches

- Analog input terminals 53 and 54 can select either voltage (-10 to 10 V) or current (0/4-20 mA) input signals
- Remove power to the frequency converter before changing switch positions
- Set switches A53 and A54 to select the signal type. U selects voltage, I selects current
- The switches are accessible when the LCP has been removed (see *Illustration 2.31*).

NOTE

Some option cards available for the unit may cover these switches and must be removed to change switch settings. Always remove power to the unit before removing option cards.

- Terminal 53 default is for a speed reference signal in open loop set in *16-61 Terminal 53 Switch Setting*
- Terminal 54 default is for a feedback signal in closed loop set in *16-63 Terminal 54 Switch Setting*

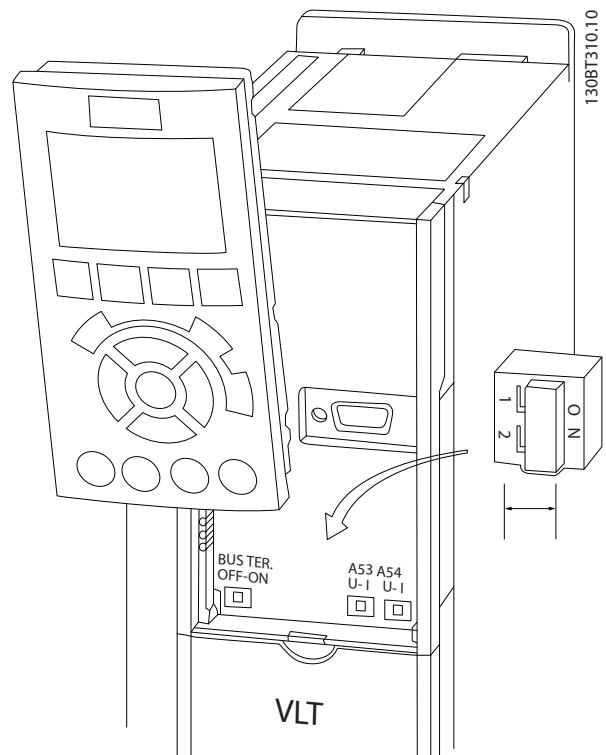


Illustration 2.31 Location of Terminals 53 and 54 Switches and Bus Termination Switch

2.6 Serial Communication

RS-485 is a two-wire bus interface compatible with multi-drop network topology, i.e. nodes can be connected as a bus, or via drop cables from a common trunk line. A total of 32 nodes can be connected to one network segment. Repeaters divide network segments. Each repeater functions as a node within the segment in which it is installed. Each node connected within a given network must have a unique node address across all segments. Terminate each segment at both ends, using either the termination switch (S801) of the frequency converter or a biased termination resistor network. Always use screened twisted pair (STP) cable for bus cabling, and always follow good common installation practice.

Low-impedance earth (ground) connection of the screen at every node is important, including at high frequencies. Thus, connect a large surface of the screen to earth (ground), for example with a cable clamp or a conductive cable gland. It may be necessary to apply potential-equalizing cables to maintain the same earth (ground) potential throughout the network. Particularly in installations with long cables.

To prevent impedance mismatch, always use the same type of cable throughout the entire network. When connecting a motor to the frequency converter, always use screened motor cable.

| | |
|-------------------|---|
| Cable | Screened twisted pair (STP) |
| Impedance | 120 Ω |
| Max. cable length | 1200 m (including drop lines) 500 m station-to-station |

Table 2.11

2.7 Optional Equipment

2.7.1 Load Share Terminals

Load share terminals enable the connection of the DC circuits of several frequency converters. Load share terminals are available in IP20 frequency converters and extend out the top of the frequency converter. A terminal cover, supplied with the frequency converter, must be installed to maintain the IP20 rating of the enclosure. *Illustration 2.32* shows both the covered and uncovered terminals.

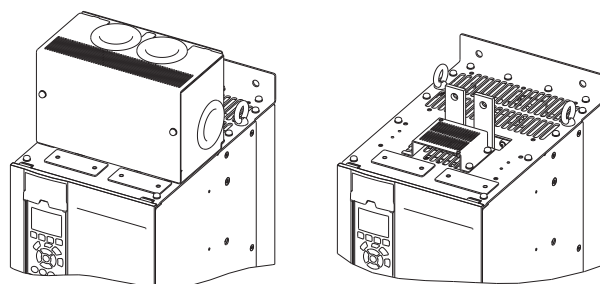


Illustration 2.32 Load Share or Regeneration Terminal with Cover (L) and without Cover (R)

2.7.2 Regeneration Terminals

Regen (regeneration) terminals can be supplied for applications that have a regenerative load. A regenerative unit, supplied by a third party, connects to the regen terminals so that power can be regenerated back into the mains, resulting in energy savings. Regen terminals are available in IP20 frequency converters and extend out the top of the frequency converter. A terminal cover, supplied with the frequency converter, must be installed to maintain the IP20 rating of the enclosure. *Illustration 2.32* shows both the covered and uncovered terminals.

2.7.3 Anti-condensation Heater

An anti-condensation heater can be installed inside the frequency converter to prevent condensation from forming inside the enclosure when the unit is turned off. The heater is controlled by customer-supplied 230 V AC. For best results, operate the heater only when the unit is not running and turn the heater off when the unit is running.

2.7.4 Brake Chopper

A brake chopper can be supplied for applications that have a regenerative load. The brake chopper connects to a brake resistor, which consumes the braking energy, preventing an overvoltage fault on the DC bus. The braking chopper is automatically activated when the DC bus voltage exceeds a specified level, depending on the nominal voltage of the frequency converter.

2.7.5 Mains Shield

The mains shield is a Lexan cover installed inside the enclosure to provide protection according to VBG-4 accident-prevention requirements.

2.7.6 Mains Disconnect

The disconnect option is available in both varieties of option cabinets. The position of the disconnect changes based on the size of the options cabinet and whether or not other options are present. *Table 2.12* provides more detail about which disconnects are used.

| Voltage | Frequency converter model | Disconnect manufacturer and type |
|-----------|---------------------------|----------------------------------|
| 380–500 V | N110T5–N160T4 | ABB OT400U03 |
| | N200T5–N315T4 | ABB OT600U03 |
| 525–690 V | N75KT7–N160T7 | ABB OT400U03 |
| | N200T7–N400T7 | ABB OT600U03 |

Table 2.12

2.7.7 Contactor

The contactor is powered by a customer-supplied 230 V AC 50/60 Hz signal.

| Voltage | Frequency converter model | Contactor manufacturer and type | IEC utilization category |
|-----------|---------------------------|---------------------------------|--------------------------|
| 380–500 V | N110T5–N160T4 | GE CK95BE311N | AC-3 |
| | N200T5–N250T4 | GE CK11CE311N | AC-3 |
| | N315T4 | GE CK11CE311N | AC-1 |
| 525–690 V | N75KT7–N160T7 | GE CK95BE311N | AC-3 |
| | N200T7–N400T7 | GE CK11CE311N | AC-3 |

Table 2.13

NOTE

In applications requiring UL listing, when the frequency converter is supplied with a contactor, the customer must provide external fusing to maintain the UL rating of the frequency converter and a short circuit current rating of 100,000 A. See *10.1.1 Power-dependent Specifications* for fuse recommendations.

2.7.8 Circuit Breaker

Table 2.14 provides details on the type of circuit breaker provided as an option with the various units and power ranges.

| Voltage | Frequency converter model | Circuit breaker manufacturer and type |
|-----------|---------------------------|---------------------------------------|
| 380–500 V | N110T5–N132T5 | ABB T5L400TW |
| | N160T5 | ABB T5LQ400TW |
| | N200T5 | ABB T6L600TW |
| | N250T5 | ABB T6LQ600TW |
| | N315T5 | ABB T6LQ800TW |
| 525–690 V | N75KT7–N160T7 | ABB T5L400TW |
| | N200T7–N315T7 | ABB T6L600TW |
| | N400T7 | ABB T6LQ600TW |

Table 2.14

3 Start Up and Commissioning

3.1 Pre-start

CAUTION

Before applying power to the unit, inspect the entire installation as detailed in *Table 3.1*. Check mark those items when completed.

3

| Inspect for | Description | <input checked="" type="checkbox"/> |
|-------------------------------|---|-------------------------------------|
| Auxiliary equipment | <ul style="list-style-type: none"> Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers that may reside on the input power side of the frequency converter or output side to the motor. Ensure that they are ready for full speed operation. Check function and installation of any sensors used for feedback to the frequency converter Remove power factor correction caps on motor(s), if present | <input type="checkbox"/> |
| Cable routing | <ul style="list-style-type: none"> Ensure that input power, motor wiring, and control wiring are separated or in three separate metallic conduits for high frequency noise isolation | <input type="checkbox"/> |
| Control wiring | <ul style="list-style-type: none"> Check for broken or damaged wires and loose connections Check that control wiring is isolated from power and motor wiring for noise immunity Check the voltage source of the signals, if necessary The use of shielded cable or twisted pair is recommended. Ensure that the shield is terminated correctly | <input type="checkbox"/> |
| Cooling clearance | <ul style="list-style-type: none"> Measure that top and bottom clearance is adequate to ensure proper air flow for cooling | <input type="checkbox"/> |
| EMC considerations | <ul style="list-style-type: none"> Check for proper installation regarding electromagnetic compatibility | <input type="checkbox"/> |
| Environmental considerations | <ul style="list-style-type: none"> See equipment label for the maximum ambient operating temperature limits Humidity levels must be 5-95% non-condensing | <input type="checkbox"/> |
| Fusing and circuit breakers | <ul style="list-style-type: none"> Check for proper fusing or circuit breakers Check that all fuses are inserted firmly and in operational condition and that all circuit breakers are in the open position | <input type="checkbox"/> |
| Earthing (Grounding) | <ul style="list-style-type: none"> The unit requires an earth wire (ground wire) from its chassis to the building earth (ground) Check for good earth connections (ground connections) that are tight and free of oxidation Earthing (grounding) to conduit or mounting the back panel to a metal surface is not a suitable earth (ground) | <input type="checkbox"/> |
| Input and output power wiring | <ul style="list-style-type: none"> Check for loose connections Check that motor and mains are in separate conduit or separated screened cables | <input type="checkbox"/> |
| Panel interior | <ul style="list-style-type: none"> Inspect that the unit interior is free of dirt, metal chips, moisture, and corrosion | <input type="checkbox"/> |
| Switches | <ul style="list-style-type: none"> Ensure that all switch and disconnect settings are in the proper positions | <input type="checkbox"/> |
| Vibration | <ul style="list-style-type: none"> Check that the unit is mounted solidly or that shock mounts are used, as necessary Check for an unusual amount of vibration | <input type="checkbox"/> |

Table 3.1 Start Up Check List

3.2 Applying Power

⚠ WARNING

HIGH VOLTAGE!

Frequency converters contain high voltage when connected to AC mains. Installation, start-up and maintenance should be performed by qualified personnel only. Failure to perform installation, start-up and maintenance by qualified personnel could result in death or serious injury.

⚠ WARNING

UNINTENDED START!

When the frequency converter is connected to AC mains, the motor may start at any time. The frequency converter, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the frequency converter is connected to AC mains could result in death, serious injury, equipment, or property damage.

1. Confirm input voltage is balanced within 3%. If not, correct input voltage imbalance before proceeding. Repeat procedure after voltage correction.
2. Ensure optional equipment wiring, if present, matches installation application.
3. Ensure that all operator devices are in the OFF position. Panel doors closed or cover mounted.
4. Apply power to the unit. DO NOT start the frequency converter at this time. For units with a disconnect switch, turn to the ON position to apply power to the frequency converter.

NOTE

If the status line at the bottom of the LCP reads **AUTO REMOTE COAST**, this indicates that the unit is ready to operate but is missing an input signal on terminal 27.

3.3 Basic Operational Programming

Frequency converters require basic operational programming before running for best performance. Basic operational programming requires entering motor-nameplate data for the motor being operated and the minimum and maximum motor speeds. Parameter settings recommended are intended for start up and checkout purposes. Application settings may vary. See 4.1 *Local Control Panel* for detailed instructions on entering data through the LCP.

Enter data with power ON, but before operating the frequency converter. There are two ways of programming the frequency converter: either by using the Smart Application Set-up (SAS) or by using the procedure described further down. The SAS is a quick wizard for setting up the most commonly used applications. At first power-up and after a reset the SAS appears on the LCP. Follow the instructions that appear on the successive screens for setting-up the applications listed. SAS can also be found under the Quick Menu. [Info] can be used throughout the Smart Set-up to see help information for various selections, settings, and messages.

NOTE

The start conditions will be ignored while in the wizard.

NOTE

If no action is taken after first power-up or reset, the SAS screen will automatically disappear after 10 minutes.

When not using the SAS, enter data in accordance with the following procedure.

1. Press [Main Menu] twice on the LCP.
2. Press the navigation keys to scroll to parameter group 0-** *Operation/Display* and press [OK].

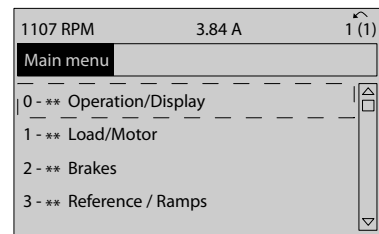


Illustration 3.1

3. Press the navigation keys to scroll to parameter group 0-0* *Basic Settings* and press [OK].

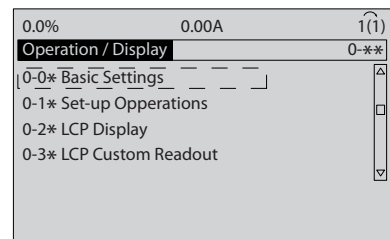


Illustration 3.2

- Press the navigation keys to scroll to *0-03 Regional Settings* and press [OK].

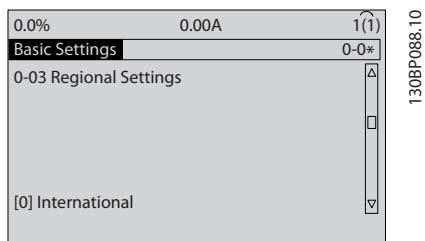


Illustration 3.3

- Press the navigation keys to select *International* or *North America* as appropriate and press [OK]. (This changes the default settings for a number of basic parameters. See 5.5 *Parameter Menu Structure* for a complete list.)
- Press [Quick Menu] on the LCP.
- Press the navigation keys to scroll to parameter group *Q2 Quick Setup* and press [OK].

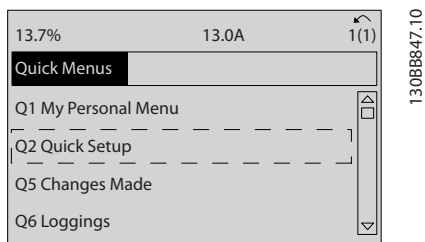


Illustration 3.4

- Select language and press [OK]. Then enter the motor data in *1-20 Motor Power [kW]* / *1-21 Motor Power [HP]* to *1-25 Motor Nominal Speed*. The information can be found on the motor nameplate.
 - 1-20 Motor Power [kW]* or *1-21 Motor Power [HP]*
 - 1-22 Motor Voltage*
 - 1-23 Motor Frequency*
 - 1-24 Motor Current*
 - 1-25 Motor Nominal Speed*

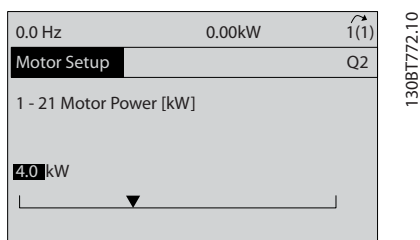


Illustration 3.5

- A jumper wire should be in place between control terminals 12 and 27. If this is the case, leave *5-12 Terminal 27 Digital Input* at factory default. Otherwise select *No Operation*. For frequency converters with an optional bypass, no jumper wire is required.
- 3-02 Minimum Reference*
- 3-03 Maximum Reference*
- 3-41 Ramp 1 Ramp Up Time*
- 3-42 Ramp 1 Ramp Down Time*
- 3-13 Reference Site*. Linked to *Hand/Auto** Local Remote.

This concludes the quick set-up procedure. Press [Status] to return to the operational display.

3.4 Local-control Test

CAUTION

MOTOR START!

Ensure that the motor, system and any attached equipment are ready for start. It is the responsibility of the user to ensure safe operation under any condition. Failure to ensure that the motor, system, and any attached equipment is ready for start could result in personal injury or equipment damage.

NOTE

The [Hand On] key provides a local start command to the frequency converter. The [Off] key provides the stop function.

When operating in local mode, [▲] and [▼] increase and decrease the speed output of the frequency converter. [←] and [→] move the display cursor in the numeric display.

- Press [Hand On].
- Accelerate the frequency converter by pressing [▲] to full speed. Moving the cursor left of the decimal point provides quicker input changes.
- Note any acceleration problems.
- Press [Off].
- Note any deceleration problems.

If acceleration problems were encountered

- If warnings or alarms occur, see 8 *Warnings and Alarms*
- Check that motor data is entered correctly
- Increase the ramp-up time accel time in *3-41 Ramp 1 Ramp Up Time*
- Increase current limit in *4-18 Current Limit*
- Increase torque limit in *4-16 Torque Limit Motor Mode*

If deceleration problems were encountered

- If warnings or alarms occur, see *8 Warnings and Alarms*.
- Check that motor data is entered correctly.
- Increase the ramp-down time decel time in *3-42 Ramp 1 Ramp Down Time*.
- Enable overvoltage control in *2-17 Over-voltage Control*.

NOTE

The OVC algorithm does not work when using PM motors.

See *4.1.1 Local Control Panel* for resetting the frequency converter after a trip.

NOTE

3.2 Applying Power to 3.3 Basic Operational Programming conclude the procedures for applying power to the frequency converter, basic programming, set-up and functional testing.

3.5 System Start Up

The procedure in this section requires user-wiring and application programming to be completed. See *6 Application Examples* for application set-up information. The following procedure is recommended after application set-up by the user is completed.

CAUTION

MOTOR START!

Ensure that the motor, system, and any attached equipment is ready for start. It is the responsibility of the user to ensure safe operation under any condition. Failure to do so could result in personal injury or equipment damage.

1. Press [Auto On].
2. Ensure that external control functions are properly wired to the frequency converter and all programming is completed.
3. Apply an external run command.
4. Adjust the speed reference throughout the speed range.
5. Remove the external run command.
6. Note any problem.

If warnings or alarms occur, see *8 Warnings and Alarms*.

4 User Interface

4.1 Local Control Panel

The local control panel (LCP) is the combined display and keypad on the front of the unit. The LCP is the user interface to the frequency converter.

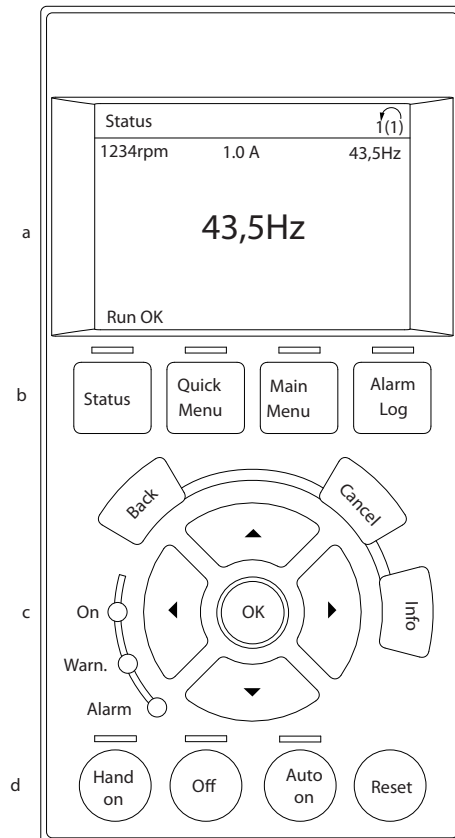
The LCP has several user functions.

- Start, stop, and control speed when in local control
- Display operational data, status, warnings and cautions
- Programming frequency converter functions
- Manually reset the frequency converter after a fault when auto-reset is inactive

An optional numeric LCP (NLCP) is also available. The NLCP operates in a manner similar to the LCP. See the *Programming Guide*, for details on use of the NLCP.

4.1.1 LCP Layout

The LCP is divided into four functional groups (see *Illustration 4.1*).



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Illustration 4.1 LCP

- Display area.
- Display menu keys for changing the display to show status options, programming, or error message history.
- Navigation keys for programming functions, moving the display cursor, and speed control in local operation. Also included are the status indicator lights.
- Operational mode keys and reset.

4.1.2 Setting LCP Display Values

The display area is activated when the frequency converter receives power from mains voltage, a DC bus terminal, or an external 24 V DC supply.

The information displayed on the LCP can be customized for user application.

- Each display readout has a parameter associated with it
- Options are selected in the quick menu Q3-13 *Display Settings*
- Display 2 has an alternate larger display option
- The frequency converter status at the bottom line of the display is generated automatically and is not selectable

| Display | Parameter number | Default setting |
|---------|------------------|----------------------|
| 1.1 | 0-20 | Motor RPMs |
| 1.2 | 0-21 | Motor current |
| 1.3 | 0-22 | Motor power (kW) |
| 2 | 0-23 | Motor frequency |
| 3 | 0-24 | Reference in percent |

Table 4.1

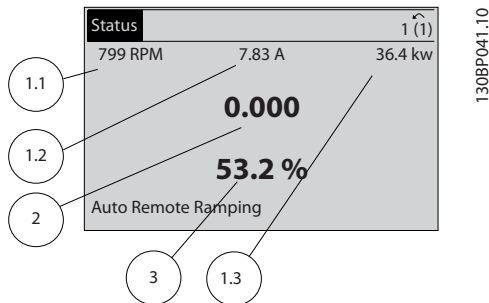


Illustration 4.2

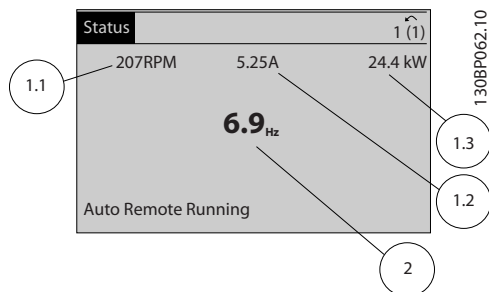


Illustration 4.3

4.1.3 Display

Menu keys are used for menu access for parameter set-up, toggling through status display modes during normal operation, and viewing fault log data.



Illustration 4.4

| Key | Function |
|-------------------|---|
| Status | Shows operational information. <ul style="list-style-type: none"> • In Auto mode, press to toggle between status read-out displays • Press repeatedly to scroll through each status display • Press [Status] plus [▲] or [▼] to adjust the display brightness • The symbol in the upper right corner of the display shows the direction of motor rotation and which set-up is active. This is not programmable. |
| Quick Menu | Allows access to programming parameters for initial set up instructions and many detailed application instructions. <ul style="list-style-type: none"> • Press to access Q2 <i>Quick Setup</i> for sequenced instructions to program the basic frequency controller set up • Follow the sequence of parameters as presented for the function set up |
| Main Menu | Allows access to all programming parameters. <ul style="list-style-type: none"> • Press twice to access top-level index • Press once to return to the last location accessed • Press to enter a parameter number for direct access to that parameter |
| Alarm Log | Displays a list of current warnings, the last 10 alarms, and the maintenance log. <ul style="list-style-type: none"> • For details about the frequency converter before it entered the alarm mode, select the alarm number using the navigation keys and press [OK]. |

Table 4.2

4.1.4 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. Three frequency converter status indicator lights are also located in this area.

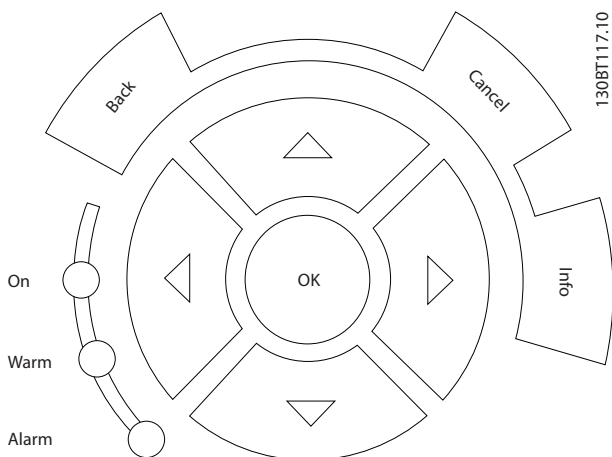


Illustration 4.5

| Key | Function |
|------------------------|---|
| Back | Reverts to the previous step or list in the menu structure. |
| Cancel | Cancels the last change or command as long as the display mode has not changed. |
| Info | Press for a definition of the function being displayed. |
| Navigation Keys | Use the four navigation keys to move between items in the menu. |
| OK | Use to access parameter groups or to enable a choice. |

Table 4.3

| Light | Indicator | Function |
|--------|-----------|---|
| Green | ON | The ON light activates when the frequency converter receives power from mains voltage, a DC bus terminal, or an external 24 V supply. |
| Yellow | WARN | When warning conditions are met, the yellow WARN light comes on and text appears in the display area identifying the problem. |
| Red | ALARM | A fault condition causes the red alarm light to flash and an alarm text is displayed. |

Table 4.4

4.1.5 Operation Keys

Operation keys are found at the bottom of the LCP.

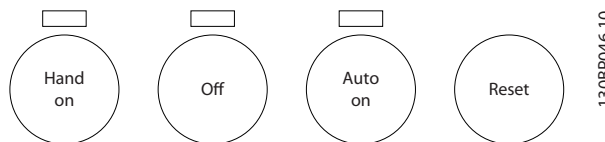


Illustration 4.6

| Key | Function |
|----------------|---|
| Hand On | Starts the frequency converter in local control. <ul style="list-style-type: none"> Use the navigation keys to control frequency converter speed An external stop signal by control input or serial communication overrides the local hand on |
| Off | Stops the motor but does not remove power to the frequency converter. |
| Auto On | Puts the system in remote operational mode. <ul style="list-style-type: none"> Responds to an external start command by control terminals or serial communication Speed reference is from an external source |
| Reset | Resets the frequency converter manually after a fault has been cleared. |

Table 4.5

4.2 Back Up and Copying Parameter Settings

Programming data is stored internally in the frequency converter.

- The data can be uploaded into the LCP memory as a storage back up
- Once stored in the LCP, the data can be downloaded back into the frequency converter
- Data can also be downloaded into other frequency converters by connecting the LCP into those units and downloading the stored settings. (This is a quick way to program multiple units with the same settings).
- Initialisation of the frequency converter to restore factory default settings does not change data stored in the LCP memory

⚠ WARNING**UNINTENDED START!**

When the frequency converter is connected to AC mains, the motor may start at any time. The frequency converter, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the frequency converter is connected to AC mains could result in death, serious injury, or equipment or property damage.

4.2.1 Uploading Data to the LCP

1. Press [Off] to stop the motor before uploading or downloading data.
2. Go to *0-50 LCP Copy*.
3. Press [OK].
4. Select *All to LCP*.
5. Press [OK]. A progress bar shows the uploading process.
6. Press [Hand On] or [Auto On] to return to normal operation.

4.2.2 Downloading Data from the LCP

1. Press [Off] to stop the motor before uploading or downloading data.
2. Go to *0-50 LCP Copy*.
3. Press [OK].
4. Select *All from LCP*.
5. Press [OK]. A progress bar shows the downloading process.
6. Press [Hand On] or [Auto On] to return to normal operation.

4.3 Restoring Default Settings

CAUTION

Initialisation restores the unit to factory default settings. Any programming, motor data, localization, and monitoring records will be lost. Uploading data to the LCP provides a backup before initialisation.

Restoring the frequency converter parameter settings back to default values is done by initialisation of the frequency converter. Initialisation can be through *14-22 Operation Mode* or manually.

- Initialisation using *14-22 Operation Mode* does not change frequency converter data such as operating hours, serial communication selections,

personal menu settings, fault log, alarm log, and other monitoring functions

- Using *14-22 Operation Mode* is generally recommended
- Manual initialisation erases all motor, programming, localization, and monitoring data and restores factory default settings

4.3.1 Recommended Initialisation

1. Press [Main Menu] twice to access parameters.
2. Scroll to *14-22 Operation Mode*.
3. Press [OK].
4. Scroll to *Initialisation*.
5. Press [OK].
6. Remove power to the unit and wait for the display to turn off.
7. Apply power to the unit.

Default parameter settings are restored during start up. This may take slightly longer than normal.

8. Alarm 80 is displayed.
9. Press [Reset] to return to operation mode.

4.3.2 Manual Initialisation

1. Remove power to the unit and wait for the display to turn off.
2. Press and hold [Status], [Main Menu], and [OK] at the same time and apply power to the unit.

Factory default parameter settings are restored during start up. This may take slightly longer than normal.

Manual initialisation does not the following frequency converter information

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

5 Programming

5.1 Introduction

The frequency converter is programmed for its application functions using parameters. Parameters are accessed by pressing either [Quick Menu] or [Main Menu] on the LCP. (See 4.1 *Local Control Panel* for details on using the LCP function keys). Parameters may also be accessed through a PC using the MCT 10 Set-up Software (see 5.6.1 *Remote Programming with MCT 10 Set-up Software*).

The quick menu is intended for initial start up (Q2-** *Quick Set Up*) and detailed instructions for common frequency converter applications (Q3-** *Function Set Up*). Step-by-step instructions are provided. These instructions enable the user to walk through the parameters used for programming applications in their proper sequence. Data entered in a parameter can change the options available in the parameters following that entry. The quick menu presents easy guidelines for getting most systems up and running.

The main menu accesses all parameters and allows for advanced frequency converter applications.

5.2 Programming Example

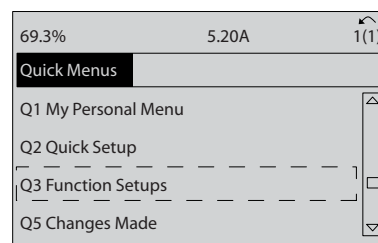
Here is an example for programming the frequency converter for a common application in open loop using the quick menu.

- This procedure programs the frequency converter to receive a 0-10 V DC analog control signal on input terminal 53
- The frequency converter will respond by providing 20-50 Hz output to the motor proportional to the input signal (0-10 V DC=20-50 Hz)

This is a common pump or fan application.

Press [Quick Menu] and select the following parameters using the navigation keys to scroll to the titles and press [OK] after each action.

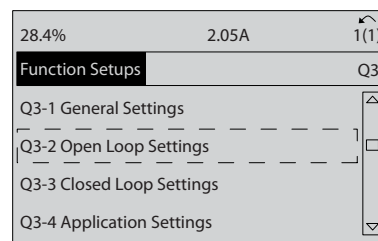
1. Q3 Function Setups
2. Parameter Data Set



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Illustration 5.1

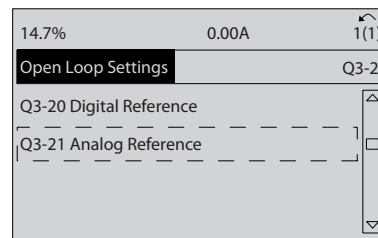
3. Q3-2 Open Loop Settings



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Illustration 5.2

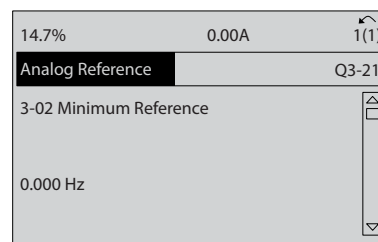
4. Q3-21 Analog Reference



130BT761.10

Illustration 5.3

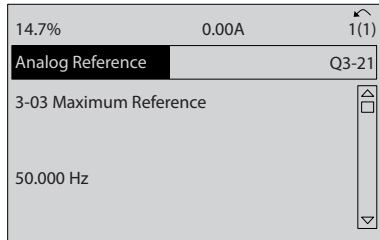
5. 3-02 Minimum Reference. Set minimum internal frequency converter reference to 0 Hz. (This sets the minimum frequency converter speed at 0 Hz).



130BT762.10

Illustration 5.4

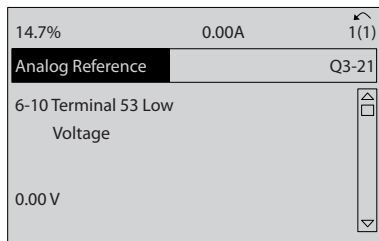
6. **3-03 Maximum Reference.** Set maximum internal frequency converter reference to 60 Hz. (This sets the maximum frequency converter speed at 60 Hz. Note that 50/60 Hz is a regional variation).



130BT763.11

Illustration 5.5

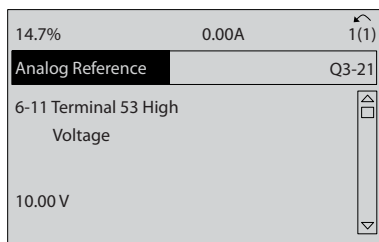
7. **6-10 Terminal 53 Low Voltage.** Set minimum external voltage reference on terminal 53 at 0 V. (This sets the minimum input signal at 0 V).



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Illustration 5.6

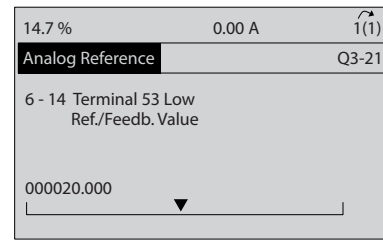
8. **6-11 Terminal 53 High Voltage.** Set maximum external voltage reference on terminal 53 at 10 V. (This sets the maximum input signal at 10 V).



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Illustration 5.7

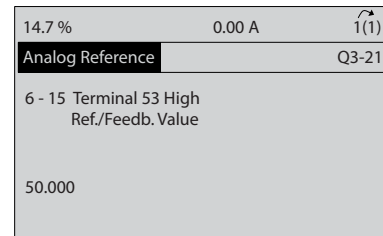
9. **6-14 Terminal 53 Low Ref./Feedb. Value.** Set minimum speed reference on terminal 53 at 20 Hz. (This tells the frequency converter that the minimum voltage received on terminal 53 (0 V) equals 20 Hz output).



130BT773.11

Illustration 5.8

10. **6-15 Terminal 53 High Ref./Feedb. Value.** Set maximum speed reference on terminal 53 at 50 Hz. (This tells the frequency converter that the maximum voltage received on terminal 53 (10 V) equals 50 Hz output).



130BT774.11

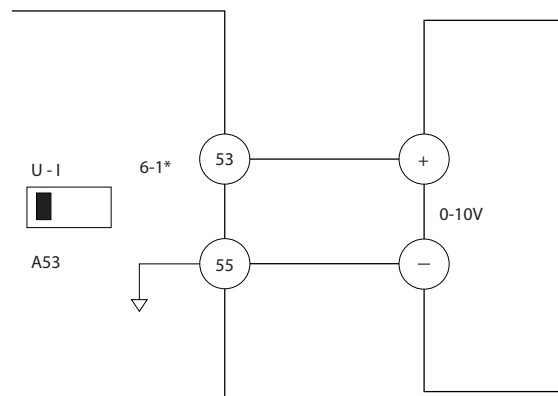
Illustration 5.9

With an external device providing a 0-10 V control signal connected to frequency converter terminal 53, the system is now ready for operation.

NOTE

The scroll bar on the right in the last illustration of the display is at the bottom, indicating the procedure is complete.

Illustration 5.10 shows the wiring connections used to enable this set up.



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Illustration 5.10 Wiring Example for External Device Providing 0-10 V Control Signal

5.3 Control Terminal Programming Examples

Control terminals can be programmed.

- Each terminal has specified functions it is capable of performing
- Parameters associated with the terminal enable the function
- For proper frequency converter functioning, the control terminals must be
 - wired properly
 - programmed for the intended function
 - receiving a signal

See *Table 5.1* for control terminal parameter number and default setting. (Default setting can change based on the selection in *0-03 Regional Settings*).

The following example shows accessing Terminal 18 to see the default setting.

1. Press [Main Menu] twice, scroll to parameter group 5-** *Digital In/Out Parameter Data Set* and press [OK].

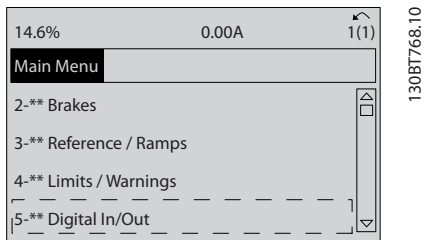


Illustration 5.11

2. Scroll to parameter group 5-1* *Digital Inputs* and press [OK].

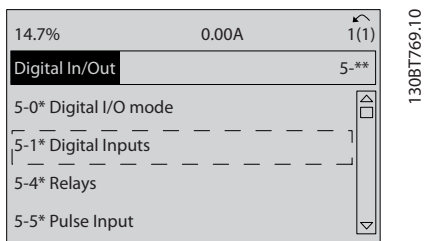


Illustration 5.12

3. Scroll to 5-10 *Terminal 18 Digital Input*. Press [OK] to access function choices. The default setting *Start* is shown.

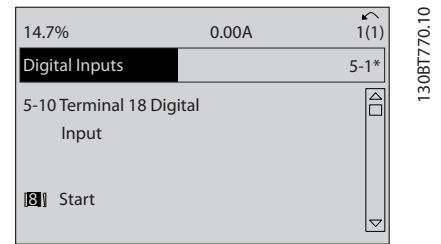


Illustration 5.13

5.4 International/North American Default Parameter Settings

Setting *0-03 Regional Settings* [0] *International* or [1] *North America* changes the default settings for some parameters. *Table 5.1* lists those parameters that are affected.

| Parameter | International default parameter value | North American default parameter value |
|---|---------------------------------------|--|
| 0-03 Regional Settings | International | North America |
| 0-71 Date Format | DD-MM-YYYY | MM/DD/YYYY |
| 0-72 Time Format | 24 h | 12 h |
| 1-20 Motor Power [kW] | See Note 1 | See Note 1 |
| 1-21 Motor Power [HP] | See Note 2 | See Note 2 |
| 1-22 Motor Voltage | 230 V/400 V/575 V | 208 V/460 V/575 V |
| 1-23 Motor Frequency | 50 Hz | 60 Hz |
| 3-03 Maximum Reference | 50 Hz | 60 Hz |
| 3-04 Reference Function | Sum | External/Preset |
| 4-13 Motor Speed High Limit [RPM] | 1500 RPM | 1800 RPM |
| 4-14 Motor Speed High Limit [Hz] | 50 Hz | 60 Hz |
| 4-19 Max Output Frequency | 100 Hz | 120 Hz |
| 4-53 Warning Speed High | 1500 RPM | 1800 RPM |
| 5-12 Terminal 27 Digital Input | Coast inverse | External interlock |
| 5-40 Function Relay | Alarm | No alarm |
| 6-15 Terminal 53 High Ref./Feedb. Value | 50 | 60 |
| 6-50 Terminal 42 Output | Speed 0-HighLim | Speed 4-20 mA |
| 14-20 Reset Mode | Manual reset | Infinite auto reset |

| Parameter | International default parameter value | North American default parameter value |
|---|---------------------------------------|--|
| 22-85 Speed at Design Point [RPM] See Note 3 | 1500 RPM | 1800 RPM |
| 22-86 Speed at Design Point [Hz] | 50 Hz | 60 Hz |
| 24-04 Fire Mode Max Reference | 50 Hz | 60 Hz |

Table 5.1 International/North American Default Parameter Settings

5.5 Parameter Menu Structure

Establishing the correct programming for applications often requires setting functions in several related parameters. These parameter settings provide the frequency converter with system details it needs to operate properly. System details may include such things as input and output signal types, programming terminals, minimum and maximum signal ranges, custom displays, automatic restart, and other features.

- See the LCP display to view detailed parameter programming and setting options
- Press [Info] in any menu location to view additional details for that function
- Press and hold [Main Menu] to enter a parameter number for direct access to that parameter
- Details for common application set ups are provided in *6 Application Examples*

5.5.1 Main Menu Structure

| Code | Operation / Display | Code | Function | Code | Function | Code | Function |
|------|--------------------------------------|------|-------------------------------|------|------------------------------|------|-------------------------------------|
| 0-0* | Basic Settings | 1-00 | Motor Thermal Protection | 1-90 | Motor Thermal Protection | 4-17 | Torque Limit Generator Mode |
| 0-01 | Language | 1-01 | Motor External Fan | 1-91 | Motor External Fan | 4-18 | Current Limit |
| 0-02 | Motor Speed Unit | 1-03 | Thermistor Source | 1-93 | Thermistor Source | 4-19 | Max Output Frequency |
| 0-03 | Regional Settings | 2-0* | DC-Brake | 2-00 | DC Hold/Preheat Current | 4-5* | Adj. Warnings |
| 0-04 | Operating State at Power-up | 2-01 | DC Brake Current | 2-01 | DC Brake Current | 4-50 | Warning Current Low |
| 0-05 | Local Mode Unit | 2-02 | DC Braking Time | 2-02 | DC Braking Time | 4-51 | Warning Current High |
| 0-1* | Set-up Operations | 2-03 | DC Brake Cut In Speed [RPM] | 2-03 | DC Brake Cut In Speed [RPM] | 4-52 | Warning Speed High |
| 0-10 | Active Set-up | 2-04 | Low Speed Filter Time Const. | 2-04 | DC Brake Cut In Speed [Hz] | 4-54 | Warning Reference Low |
| 0-11 | Programming Set-up | 2-06 | High Speed Filter Time Const. | 2-06 | Parking Current | 4-55 | Warning Reference High |
| 0-12 | This Set-up Linked to | 2-07 | Voltage filter time const. | 2-07 | Parking Time | 4-56 | Warning Feedback Low |
| 0-13 | Readout: Linked Set-ups | 2-1* | Motor Data | 2-1* | Brake Energy Funct. | 4-57 | Warning Feedback High |
| 0-14 | Readout: Prog. Set-ups / Channel | 2-10 | Motor Power [kW] | 2-10 | Brake Function | 4-58 | Missing Motor Phase Function |
| 0-2* | LCP Display | 2-11 | Motor Power [HP] | 2-11 | Brake Resistor (ohm) | 4-6* | Speed Bypass |
| 0-20 | Display Line 1.1 Small | 2-12 | Motor Voltage | 2-12 | Brake Power Limit (kW) | 4-60 | Bypass Speed From [RPM] |
| 0-21 | Display Line 1.2 Small | 2-13 | Motor Frequency | 2-13 | Brake Power Monitoring | 4-61 | Bypass Speed From [Hz] |
| 0-22 | Display Line 1.3 Small | 2-15 | Motor Current | 2-15 | Brake Check | 4-62 | Bypass Speed To [RPM] |
| 0-23 | Display Line 2 Large | 2-16 | Motor Nominal Speed | 2-16 | AC brake Max. Current | 4-63 | Bypass Speed To [Hz] |
| 0-24 | Display Line 3 Large | 2-17 | Motor Cont. Rated Torque | 2-17 | Over-voltage Control | 5-5* | Semi-Auto Bypass Set-up |
| 0-25 | My Personal Menu | 3-0* | Reference / Ramps | 3-0* | Reference Limits | 5-0* | Digital In/O mode |
| 0-30 | LCP Custom Readout | 3-01 | Minimum Reference | 3-01 | Minimum Reference | 5-00 | Digital I/O Mode |
| 0-31 | Custom Readout Min Value | 3-02 | Maximum Reference | 3-02 | Maximum Reference | 5-01 | Digital I/O Mode |
| 0-32 | Custom Readout Max Value | 3-03 | Reference Function | 3-03 | Reference Function | 5-02 | Digital I/O Mode |
| 0-37 | Display Text 1 | 3-1* | References | 3-1* | References | 5-1* | Digital Inputs |
| 0-38 | Display Text 2 | 3-10 | Preset Reference | 3-10 | Preset Reference | 5-10 | Terminal 18 Digital Input |
| 0-39 | Display Text 3 | 3-11 | Jog Speed [Hz] | 3-11 | Jog Speed [Hz] | 5-11 | Terminal 19 Digital Input |
| 0-40 | [Hand on] Key on LCP | 3-12 | Reference Site | 3-12 | Reference Site | 5-12 | Terminal 27 Digital Input |
| 0-41 | [Off] Key on LCP | 3-13 | Reference Relative | 3-13 | Reference Relative | 5-13 | Terminal 29 Digital Input |
| 0-42 | [Auto on] Key on LCP | 3-14 | Reference 1 Source | 3-14 | Reference 1 Source | 5-14 | Terminal 32 Digital Input |
| 0-43 | [Reset] Key on LCP | 3-15 | Reference 2 Source | 3-15 | Reference 2 Source | 5-15 | Terminal 33 Digital Input |
| 0-44 | [Drive Bypass] Key on LCP | 3-16 | Reference 3 Source | 3-16 | Reference 3 Source | 5-16 | Terminal X30/2 Digital Input |
| 0-45 | [Copy/Save] Key on LCP | 3-17 | Reference 1 Source | 3-17 | Reference 1 Source | 5-17 | Terminal X30/3 Digital Input |
| 0-50 | LCP Copy | 3-18 | Reference 2 Source | 3-18 | Reference 2 Source | 5-18 | Terminal X30/4 Digital Input |
| 0-51 | Set-up Copy | 3-19 | Reference 3 Source | 3-19 | Reference 3 Source | 5-19 | Terminal 37 Safe Stop |
| 0-6* | Password | 3-4* | Ramp 1 | 3-4* | Ramp 1 | 5-3* | Digital Outputs |
| 0-60 | Main Menu Password | 3-41 | Ramp 1 Ramp Up Time | 3-41 | Ramp 1 Ramp Up Time | 5-30 | Terminal 27 Digital Output |
| 0-61 | Access to Main Menu w/o Password | 3-42 | Ramp 1 Ramp Down Time | 3-42 | Ramp 1 Ramp Down Time | 5-31 | Terminal 29 Digital Output |
| 0-65 | Personal Menu Password | 3-5* | Ramp 2 | 3-5* | Ramp 2 | 5-32 | Terminal 29 Digital Output |
| 0-66 | Access to Personal Menu w/o Password | 3-51 | Ramp 2 Ramp Up Time | 3-51 | Ramp 2 Ramp Up Time | 5-33 | Terminal X30/6 Digi Out (MCB 101) |
| 0-7* | Clock Settings | 3-52 | Ramp 2 Ramp Down Time | 3-52 | Ramp 2 Ramp Down Time | 5-34 | Terminal X30/7 Digi Out (MCB 101) |
| 0-70 | Date and Time | 3-8* | Other Ramps | 3-8* | Other Ramps | 5-4* | Relays |
| 0-71 | Date Format | 3-80 | Jog Ramp Time | 3-80 | Jog Ramp Time | 5-40 | Function Relay |
| 0-72 | Time Format | 3-81 | Quick Stop Ramp Time | 3-81 | Quick Stop Ramp Time | 5-41 | On Delay, Relay |
| 0-74 | DST/Summertime | 3-82 | Starting Ramp Up Time | 3-82 | Starting Ramp Up Time | 5-42 | Off Delay, Relay |
| 0-76 | DST/Summertime Start | 3-9* | Digital Pot/Meter | 3-9* | Digital Pot/Meter | 5-5* | Pulse Input |
| 0-77 | DST/Summertime End | 3-90 | Step Size | 3-90 | Step Size | 5-50 | Term. 29 Low Frequency |
| 0-79 | Clock Fault | 3-91 | Ramp Time | 3-91 | Ramp Time | 5-51 | Term. 29 High Frequency |
| 0-81 | Working Days | 3-92 | Power Restore | 3-92 | Power Restore | 5-52 | Term. 29 Low Ref./Feedb. Value |
| 0-82 | Additional Working Days | 3-93 | Maximum Limit | 3-93 | Maximum Limit | 5-53 | Term. 29 High Ref./Feedb. Value |
| 0-83 | Additional Non-Working Days | 3-94 | Minimum Limit | 3-94 | Minimum Limit | 5-54 | Term. 29 High Ref./Feedb. Value |
| 0-89 | Date and Time Readout | 3-95 | Ramp Delay | 3-95 | Ramp Delay | 5-55 | Pulse Filter Time Constant #29 |
| | | 4-1* | Motor Limits | 4-1* | Motor Limits | 5-56 | Term. 33 Low Frequency |
| | | 4-10 | Motor Speed Direction | 4-10 | Motor Speed Direction | 5-57 | Term. 33 High Frequency |
| | | 4-11 | Motor Speed Low Limit [RPM] | 4-11 | Motor Speed Low Limit [RPM] | 5-58 | Term. 33 High Ref./Feedb. Value |
| | | 4-12 | Motor Speed Low Limit [Hz] | 4-12 | Motor Speed Low Limit [Hz] | 5-59 | Term. 33 High Ref./Feedb. Value |
| | | 4-13 | Motor Speed High Limit [RPM] | 4-13 | Motor Speed High Limit [RPM] | 5-6* | Pulse Output |
| | | 4-14 | Motor Speed High Limit [Hz] | 4-14 | Motor Speed High Limit [Hz] | 5-60 | Terminal 27 Pulse Output Variable |
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| 24-03 | Fire Mode Min Reference | 25-80 | Cascade Status | 31-10 | Bypass Status Word | 99-27 | HS Temp. (PC8) |
| 24-04 | Fire Mode Max Reference | 25-81 | Pump Status | 31-11 | Bypass Running Hours | 99-29 | Platform Version |
| 24-05 | Fire Mode Preset Reference | 25-82 | Lead Pump | 31-19 | Remote Bypass Activation | 99-40 | StartupWizardState |
| 24-06 | Fire Mode Reference Source | 25-83 | Relay Status | 35-5** | Sensor Input Option | 99-90 | Options present |
| 24-07 | Fire Mode Feedback Source | 25-84 | Pump ON Time | 35-0* | Temp. Input Mode | 99-91 | Motor Power Internal |
| 24-09 | Fire Mode Alarm Handling | 25-85 | Relay ON Time | 35-01 | Term. X48/4 Temp. Unit | 99-92 | Motor Voltage Internal |
| 24-1* | Drive Bypass | 25-86 | Reset Relay Counters | 35-02 | Term. X48/4 Input Type | 99-93 | Motor Frequency Internal |
| 24-10 | Drive Bypass Function | 25-9* | Service | 35-03 | Term. X48/7 Input Type | 99-94 | Imbalance derate [%] |
| 24-11 | Drive Bypass Delay Time | 25-91 | Pump Interlock | 35-04 | Term. X48/10 Temp. Unit | 99-95 | Temperature derate [%] |
| 24-5* | Multi-Motor Funct. | 25-92 | Manual Alternation | 35-05 | Term. X48/10 Input Type | 99-96 | Overload derate [%] |
| 24-90 | Missing Motor Function | 26-0* | Analog I/O Option | 35-06 | Temperature Sensor Alarm Function | | |
| 24-91 | Missing Motor Coefficient 1 | 26-00 | Terminal X42/1 Mode | 35-1* | Temp. Input X48/4 | | |
| 24-92 | Missing Motor Coefficient 2 | 26-01 | Terminal X42/3 Mode | 35-14 | Term. X48/4 Filter Time Constant | | |
| 24-93 | Missing Motor Coefficient 3 | 26-02 | Terminal X42/5 Mode | 35-15 | Term. X48/4 Temp. Monitor | | |
| 24-94 | Missing Motor Coefficient 4 | 26-1* | Analog Input X42/1 | 35-16 | Term. X48/4 Low Temp. Limit | | |
| 24-95 | Locked Rotor Function | 26-10 | Terminal X42/1 Low Voltage | 35-17 | Term. X48/4 High Temp. Limit | | |
| 24-96 | Locked Rotor Coefficient 1 | 26-11 | Terminal X42/1 High Voltage | 35-2* | Temp. Input X48/7 | | |
| 24-97 | Locked Rotor Coefficient 2 | 26-12 | Term. X42/1 Low Ref./Feedb. Value | 35-24 | Term. X48/7 Filter Time Constant | | |
| 24-98 | Locked Rotor Coefficient 3 | 26-13 | Term. X42/1 High Ref./Feedb. Value | 35-25 | Term. X48/7 Temp. Monitor | | |
| 24-99 | Locked Rotor Coefficient 4 | 26-14 | Term. X42/1 Filter Time Constant | 35-26 | Term. X48/7 Low Temp. Limit | | |
| 25-0* | Cascade Controller | 26-15 | Term. X42/1 Live Zero | 35-27 | Term. X48/7 High Temp. Limit | | |
| 25-00 | Cascade Controller | 26-2* | Analog Input X42/3 | 35-3* | Temp. Input X48/10 | | |
| 25-02 | Motor Start | 26-20 | Terminal X42/3 Low Voltage | 35-34 | Term. X48/10 Filter Time Constant | | |
| 25-04 | Pump Cycling | 26-21 | Terminal X42/3 High Voltage | 35-35 | Term. X48/10 Temp. Monitor | | |
| 25-05 | Fixed Lead Pump | 26-22 | Term. X42/3 Low Ref./Feedb. Value | 35-36 | Term. X48/10 Low Temp. Limit | | |
| 25-06 | Number of Pumps | 26-23 | Term. X42/3 High Ref./Feedb. Value | 35-37 | Term. X48/10 High Temp. Limit | | |
| 25-2* | Bandwidth Settings | 26-24 | Term. X42/3 Filter Time Constant | 35-4* | Analog Input X48/2 | | |
| 25-20 | Staging Bandwidth | 26-25 | Term. X42/3 Live Zero | 35-42 | Term. X48/2 Low Current | | |
| 25-21 | Override Bandwidth | 26-3* | Analog Input X42/5 | 35-43 | Term. X48/2 High Current | | |
| 25-22 | Fixed Speed Bandwidth | 26-30 | Terminal X42/5 Low Voltage | 35-44 | Term. X48/2 Low Ref./Feedb. Value | | |
| 25-23 | SBW Staging Delay | 26-31 | Terminal X42/5 High Voltage | 35-45 | Term. X48/2 High Ref./Feedb. Value | | |
| 25-24 | SBW Destaging Delay | 26-32 | Term. X42/5 Low Ref./Feedb. Value | 35-46 | Term. X48/2 Filter Time Constant | | |
| 25-25 | OBW Time | 26-33 | Term. X42/5 High Ref./Feedb. Value | 35-47 | Term. X48/2 Live Zero | | |
| 25-26 | Destage At No-Flow | 26-34 | Term. X42/5 Filter Time Constant | 99-* | Level support | | |
| 25-27 | Stage Function | 26-35 | Term. X42/5 Live Zero | 99-00 | DAC 1 selection | | |
| 25-28 | Stage Function Time | 26-4* | Analog Out X42/7 | 99-01 | DAC 2 selection | | |
| 25-29 | Destage Function | 26-40 | Terminal X42/7 Output | 99-02 | DAC 3 selection | | |

5.6 Remote Programming with MCT 10 Set-up Software

Danfoss has a software program available for developing, storing, and transferring frequency converter programming. The MCT 10 Set-up Software allows the user to connect a PC to the frequency converter and perform live programming rather than using the LCP. Additionally, all frequency converter programming can be done off-line and simply downloaded to the frequency converter. Or the entire frequency converter profile can be loaded onto the PC for back up storage or analysis.

5

The USB connector or RS-485 terminal are available for connecting to the frequency converter.

MCT 10 Set-up Software is available for free download at www.VLT-software.com. A CD is also available by requesting part number 130B1000. *The Operating Instructions*, provide detailed information on how to programme using the MCT 10 Set-up Software.

6 Application Examples

6.1 Introduction

NOTE

A jumper wire may be required between terminal 12 (or 13) and terminal 37 for the frequency converter to operate when using factory default programming values.

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 0-03 Regional Settings)
- Parameters associated with the terminals and their settings are shown next to the drawings
- Where switch settings for analog terminals A53 or A54 are required, these are also shown

6.2 Application Examples

CAUTION

Thermistors must use reinforced or double insulation to meet PELV insulation requirements.

| FC | | Parameters | |
|------------------|----|---|-------------------------|
| | | Function | Setting |
| +24 V | 12 | | |
| +24 V | 13 | | |
| D IN | 18 | 1-29 Automatic Motor | [1] Enable complete AMA |
| D IN | 19 | Adaptation (AMA) | AMA |
| COM | 20 | | |
| D IN | 27 | 5-12 Terminal 27 Digital Input | [2]* Coast inverse |
| D IN | 29 | | |
| D IN | 32 | | |
| D IN | 33 | | |
| D IN | 37 | | |
| * =Default Value | | Notes/comments: Parameter group 1-2* Motor Data must be set according to motor | |
| +10 V | 50 | | |
| A IN | 53 | | |
| A IN | 54 | | |
| COM | 55 | | |
| A OUT | 42 | | |
| COM | 39 | | |

Table 6.1 AMA with T27 Connected

| FC | | Parameters | |
|------------------|----|---|-------------------------|
| | | Function | Setting |
| +24 V | 12 | | |
| +24 V | 13 | | |
| D IN | 18 | 1-29 Automatic Motor | [1] Enable complete AMA |
| D IN | 19 | Adaptation (AMA) | AMA |
| COM | 20 | | |
| D IN | 27 | 5-12 Terminal 27 Digital Input | [0] No operation |
| D IN | 29 | | |
| D IN | 32 | | |
| D IN | 33 | | |
| D IN | 37 | | |
| * =Default Value | | Notes/comments: Parameter group 1-2* Motor Data must be set according to motor | |
| +10 V | 50 | | |
| A IN | 53 | | |
| A IN | 54 | | |
| COM | 55 | | |
| A OUT | 42 | | |
| COM | 39 | | |

Table 6.2 AMA without T27 Connected

| FC | | Parameters | |
|------------------|----|---|----------|
| | | Function | Setting |
| +24 V | 12 | | |
| +24 V | 13 | | |
| D IN | 18 | 6-10 Terminal 53 Low Voltage | 0.07 V* |
| D IN | 19 | 6-11 Terminal 53 High Voltage | 10 V* |
| COM | 20 | | |
| D IN | 27 | 6-14 Terminal 53 Low Ref./Feedb. Value | 0 RPM |
| D IN | 29 | 6-15 Terminal 53 High Ref./Feedb. Value | 1500 RPM |
| D IN | 32 | | |
| D IN | 33 | | |
| D IN | 37 | | |
| * =Default Value | | Notes/comments: | |
| +10 V | 50 | | |
| A IN | 53 | | |
| A IN | 54 | | |
| COM | 55 | | |
| A OUT | 42 | | |
| COM | 39 | | |

Table 6.3 Analog Speed Reference (Voltage)

| | | Parameters | |
|------------------------|----|------------------|----------|
| FC | | Function | Setting |
| +24 V | 12 | | |
| +24 V | 13 | 6-12 Terminal 53 | 4 mA* |
| D IN | 18 | Low Current | |
| D IN | 19 | 6-13 Terminal 53 | 20 mA* |
| COM | 20 | High Current | |
| D IN | 27 | 6-14 Terminal 53 | 0 RPM |
| D IN | 29 | Low Ref./Feedb. | |
| D IN | 32 | Value | |
| D IN | 33 | 6-15 Terminal 53 | 1500 RPM |
| D IN | 37 | High Ref./Feedb. | |
| | | Value | |
| * = Default Value | | | |
| Notes/comments: | | | |
| | | | |

Table 6.4 Analog Speed Reference (Current)

| | | Parameters | |
|---|----|------------------|------------------|
| FC | | Function | Setting |
| +24 V | 12 | | |
| +24 V | 13 | 5-10 Terminal 18 | [8] Start* |
| D IN | 18 | Digital Input | |
| D IN | 19 | 5-12 Terminal 27 | [0] No operation |
| COM | 20 | Digital Input | |
| D IN | 27 | 5-19 Terminal 37 | [1] Safe Stop |
| D IN | 29 | Safe Stop | Alarm |
| D IN | 32 | | |
| D IN | 33 | | |
| D IN | 37 | | |
| * = Default Value | | | |
| Notes/comments: | | | |
| If 5-12 Terminal 27 Digital Input is set to [0] No operation, a jumper wire to terminal 27 is not needed. | | | |
| +10 | 50 | | |
| A IN | 53 | | |
| A IN | 54 | | |
| COM | 55 | | |
| A OUT | 42 | | |
| COM | 39 | | |

Table 6.5 Start/Stop Command with Safe Stop

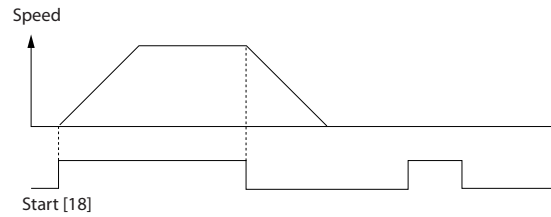


Illustration 6.1

| | | Parameters | |
|---|----|------------------|-------------|
| FC | | Function | Setting |
| +24 V | 12 | | |
| +24 V | 13 | 5-10 Terminal 18 | [9] Latched |
| D IN | 18 | Digital Input | Start |
| D IN | 19 | 5-12 Terminal 27 | [6] Stop |
| COM | 20 | Digital Input | Inverse |
| D IN | 27 | | |
| D IN | 29 | | |
| D IN | 32 | | |
| D IN | 33 | | |
| D IN | 37 | | |
| * = Default Value | | | |
| Notes/comments: | | | |
| If 5-12 Terminal 27 Digital Input is set to [0] No operation, a jumper wire to terminal 27 is not needed. | | | |
| +10 V | 50 | | |
| A IN | 53 | | |
| A IN | 54 | | |
| COM | 55 | | |
| A OUT | 42 | | |
| COM | 39 | | |

Table 6.6 Pulse Start/Stop

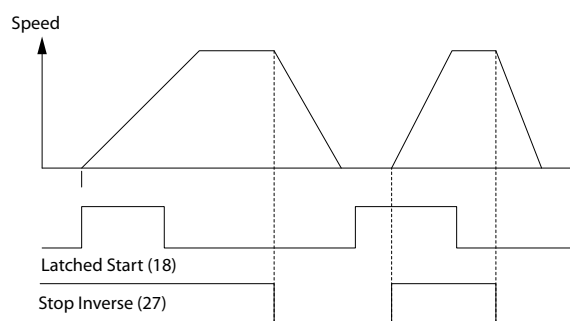


Illustration 6.2

| | | Parameters | |
|--|--|-----------------------------------|-----------------------|
| | | Function | Setting |
| | | 5-10 Terminal 18 Digital Input | [8] Start |
| | | 5-11 Terminal 19 Digital Input | [10] Reversing* |
| | | 5-12 Terminal 27 Digital Input | [0] No operation |
| | | 5-14 Terminal 32 Digital Input | [16] Preset ref bit 0 |
| | | 5-15 Terminal 33 Digital Input | [17] Preset ref bit 1 |
| | | 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 6.7 Start/Stop with Reversing and 4 Preset Speeds

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

Table 6.8 External Alarm Reset

| | | Parameters | |
|--|--|--|----------|
| | | Function | Setting |
| | | 6-10 Terminal 53 Low Voltage | 0.07 V* |
| | | 6-11 Terminal 53 High Voltage | 10 V* |
| | | 6-14 Terminal 53 Low Ref./Feedb. Value | 0 RPM |
| | | 6-15 Terminal 53 High Ref./Feedb. Value | 1500 RPM |
| | | *=-Default Value | |
| | | Notes/comments: | |

Table 6.9 Speed Reference (using a Manual Potentiometer)

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

Table 6.10 Speed Up/Down

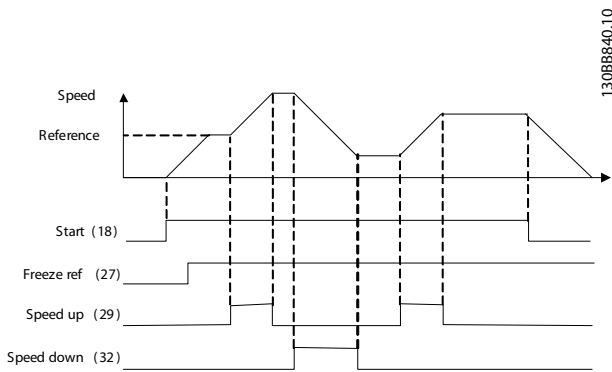


Illustration 6.3

| | | Parameters | |
|-------|-------|------------------------------|---------|
| | | Function | Setting |
| FC | | | |
| +24 V | 12 | | |
| +24 V | 13 | | |
| D IN | 18 | 8-30 Protocol | FC* |
| D IN | 19 | 8-31 Address | 1* |
| COM | 20 | 8-32 Baud Rate | 9600* |
| D IN | 27 | *=Default Value | |
| D IN | 29 | Notes/comments: | |
| D IN | 32 | Select protocol, address and | |
| D IN | 33 | baud rate in the above | |
| D IN | 37 | mentioned parameters. | |
| +10 V | 50 | | |
| A IN | 53 | | |
| A IN | 54 | | |
| COM | 55 | | |
| A OUT | 42 | | |
| COM | 39 | | |
| R1 | 01-03 | | |
| R2 | 04-06 | | |
| | 61-69 | RS-485 | |

Table 6.11 RS-485 Network Connection

| | | Parameters | |
|-------|----|---------------------------------|------------|
| | | Function | Setting |
| FC | | | |
| +24 V | 12 | | |
| +24 V | 13 | | |
| D IN | 18 | 1-90 Motor | [2] |
| D IN | 19 | Thermal | Thermistor |
| COM | 20 | Protection | trip |
| D IN | 27 | 1-93 Thermistor | [1] Analog |
| D IN | 29 | Source | input 53 |
| D IN | 32 | *=Default Value | |
| D IN | 33 | Notes/comments: | |
| D IN | 37 | If only a warning is desired, | |
| | | 1-90 Motor Thermal Protection | |
| | | should be set to [1] Thermistor | |
| | | warning. | |
| +10 V | 50 | | |
| A IN | 53 | | |
| A IN | 54 | | |
| COM | 55 | | |
| A OUT | 42 | | |
| COM | 39 | | |
| U - I | | | |
| A53 | | | |

Table 6.12 Motor Thermistor

| | | Parameters | |
|-------|----|--|----------------------------|
| | | Function | Setting |
| FC | | | |
| +24 V | 12 | 4-30 Motor Feedback Loss Function | [1] Warning |
| +24 V | 13 | 4-31 Motor Feedback Speed Error | 100 RPM |
| D IN | 18 | 4-32 Motor Feedback Loss Timeout | 5 s |
| D IN | 19 | 7-00 Speed PID Feedback Source | [2] MCB 102 |
| COM | 20 | 17-11 Resolution (PPR) | 1024* |
| D IN | 27 | 13-00 SL Controller Mode | [1] On |
| D IN | 29 | 13-01 Start Event | [19] Warning |
| D IN | 32 | 13-02 Stop Event | [44] Reset key |
| D IN | 33 | 13-10 Comparat or Operand | [21] Warning no. |
| D IN | 37 | 13-11 Comparat or Operator | [1] ≈* |
| +10 V | 50 | 13-12 Comparat or Value | 90 |
| A IN | 53 | 13-51 SL Controller Event | [22] |
| A IN | 54 | 13-52 SL Controller Action | [32] Set digital out A low |
| COM | 55 | 5-40 Function Relay | [80] SL digital output A |
| A OUT | 42 | *=Default Value | |
| COM | 39 | Notes/comments: If the limit in the feedback monitor is exceeded, Warning 90 will be issued. The SLC monitors Warning 90 and in the case that Warning 90 becomes TRUE then Relay 1 is triggered. External equipment may then indicate that service may be required. If the feedback error goes below the limit again within 5 s then the frequency converter continues and the warning disappears. But Relay 1 will still be triggered until [Reset] on the LCP. | |

| | | Parameters | |
|-------|----|---------------------------------|---|
| | | Function | Setting |
| FC | | | |
| +24 V | 12 | 5-40 Function Relay | [32] Mech. brake ctrl. |
| +24 V | 13 | 5-10 Terminal 18 Digital Input | [8] Start* |
| D IN | 18 | 5-11 Terminal 19 Digital Input | [11] Start reversing |
| D IN | 19 | 1-71 Start Delay | 0.2 |
| COM | 20 | 1-72 Start Function | [5] VVC ^{plus} /FLUX Clockwise |
| D IN | 27 | 1-76 Start Current | I _{m,n} |
| D IN | 29 | 2-20 Release Brake Current | App. dependent |
| D IN | 32 | 2-21 Activate Brake Speed [RPM] | Half of nominal slip of the motor |
| D IN | 33 | *=Default Value | |
| D IN | 37 | Notes/comments: | |

Table 6.14 Mechanical Brake Control

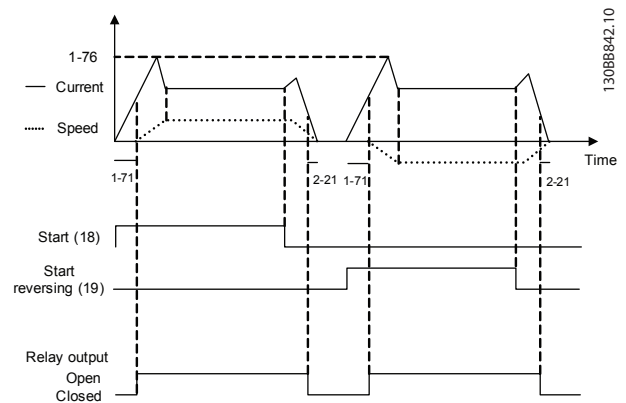


Illustration 6.4

Table 6.13 Using SLC to Set a Relay

7 Status Messages

7.1 Status Display

When the frequency converter is in status mode, status messages are generated automatically from within the frequency converter and appear in the bottom line of the display (see *Illustration 7.1*.)

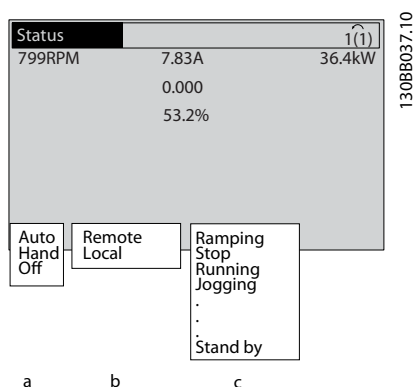


Illustration 7.1 Status Display

- The first part of the status line indicates where the stop/start command originates.
- The second part of the status line indicates where the speed control originates.
- The last part of the status line gives the present frequency converter status. These show the operational mode the frequency converter is in.

NOTE

In auto/remote mode, the frequency converter requires external commands to execute functions.

7.2 Status Message Definitions Table

The next three tables define the meaning of the status message display words.

| | |
|---------|--|
| Off | The frequency converter does not react to any control signal until [Auto On] or [Hand On] is pressed. |
| Auto on | The frequency converter is controlled from the control terminals and/or the serial communication. |
| Hand on | The frequency converter can be controlled by the navigation keys on the LCP. Stop commands, reset, reversing, DC brake, and other signals applied to the control terminals can override local control. |

Table 7.1 Operation Mode

| | |
|--------|--|
| Remote | The speed reference is given from external signals, serial communication, or internal preset references. |
| Local | The frequency converter uses [Hand On] control or reference values from the LCP. |

Table 7.2 Reference Site

| | |
|---------------|---|
| AC Brake | AC Brake was selected in 2-10 Brake Function. The AC brake over-magnetizes 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. Press [Hand On] to start. |
| AMA running | AMA process is in progress. |
| Braking | The brake chopper is in operation. Generative energy is absorbed by the brake resistor. |
| Braking max. | The brake chopper is in operation. The power limit for the brake resistor defined in 2-12 Brake Power Limit (kW) is reached. |
| Coast | <ul style="list-style-type: none"> Coast inverse was selected as a function for a digital input (parameter group 5-1* Digital Inputs). The corresponding terminal is not connected. Coast activated by serial communication |

| | |
|-----------------------|--|
| Ctrl. Ramp-down | Control Ramp-down was selected in <i>14-10 Mains Failure</i> . <ul style="list-style-type: none"> The mains voltage is below the value set in <i>14-11 Mains Voltage at Mains Fault</i> at mains fault The frequency converter ramps down the motor using a controlled ramp down |
| Current High | The frequency converter output current is above the limit set in <i>4-51 Warning Current High</i> . |
| Current Low | The frequency converter output current is below the limit set in <i>4-52 Warning Speed Low</i> |
| DC Hold | DC hold is selected in <i>1-80 Function at Stop</i> and a stop command is active. The motor is held by a DC current set in <i>2-00 DC Hold/ Preheat Current</i> . |
| DC Stop | The motor is held with a DC current (<i>2-01 DC Brake Current</i>) for a specified time (<i>2-02 DC Braking Time</i>). <ul style="list-style-type: none"> DC Brake is activated in <i>2-03 DC Brake Cut In Speed [RPM]</i> and a Stop command is active DC Brake (inverse) is selected as a function for a digital input (parameter group <i>5-1* Digital Inputs</i>). The corresponding terminal is not active. The DC Brake is activated via serial communication |
| Feedback high | The sum of all active feedbacks is above the feedback limit set in <i>4-57 Warning Feedback High</i> . |
| Feedback low | The sum of all active feedbacks is below the feedback limit set in <i>4-56 Warning Feedback Low</i> . |
| Freeze output | The remote reference is active, which holds the present speed. <ul style="list-style-type: none"> Freeze output was selected as a function for a digital input (parameter group <i>5-1* Digital Inputs</i>). The corresponding terminal is active. Speed control is only possible via the terminal functions speed up and speed down. Hold ramp is activated via serial communication |
| Freeze output request | A freeze output command has been given, but the motor will remain stopped until a run permissive signal is received. |
| Freeze ref. | <i>Freeze Reference</i> was chosen as a function for a digital input (parameter group <i>5-1* Digital Inputs</i>). The corresponding terminal is active. The frequency converter 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 will be stopped until a run permissive signal is received via a digital input. |
| Jogging | The motor is running as programmed in <i>3-19 Jog Speed [RPM]</i> . <ul style="list-style-type: none"> <i>Jog</i> was selected as function for a digital input (parameter group <i>5-1* Digital Inputs</i>). The corresponding terminal (e.g. Terminal 29) is active. The Jog function is activated via the serial communication The Jog function was selected as a reaction for a monitoring function (e.g. No signal). The monitoring function is active |
| Motor check | In <i>1-80 Function at Stop, Motor Check</i> was selected. A stop command is active. To ensure that a motor is connected to the frequency converter, a permanent test current is applied to the motor. |
| OVC control | <i>Overvoltage</i> control was activated in <i>2-17 Overvoltage Control</i> . The connected motor is supplying the frequency converter with generative energy. The overvoltage control adjusts the V/Hz ratio to run the motor in controlled mode and to prevent the frequency converter from tripping. |
| PowerUnit Off | (For frequency converters with an external 24 V power supply installed only). Mains supply to the frequency converter is removed, but the control card is supplied by the external 24 V. |
| Protection md | Protection mode is active. The unit has detected a critical status (an overcurrent or overvoltage). <ul style="list-style-type: none"> To avoid tripping, switching frequency is reduced to 4 kHz If possible, protection mode ends after approximately 10 s Protection mode can be restricted in <i>14-26 Trip Delay at Inverter Fault</i> |
| QStop | The motor is decelerating using <i>3-81 Quick Stop Ramp Time</i> . <ul style="list-style-type: none"> <i>Quick stop inverse</i> was chosen as a function for a digital input (parameter group <i>5-1* Digital Inputs</i>). The corresponding terminal is not active. 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 <i>4-55 Warning Reference High</i> . |

| | |
|---------------|---|
| Ref. low | The sum of all active references is below the reference limit set in <i>4-54 Warning Reference Low</i> . |
| Run on ref. | The frequency converter 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 motor is driven by the frequency converter. |
| Speed high | Motor speed is above the value set in <i>4-53 Warning Speed High</i> . |
| Speed low | Motor speed is below the value set in <i>4-52 Warning Speed Low</i> . |
| Standby | In Auto On Auto mode, the frequency converter will start the motor with a start signal from a digital input or serial communication. |
| Start delay | In <i>1-71 Start Delay</i> , a delay starting time was set. A start command is activated and the motor will start after the start delay time expires. |
| Start fwd/rev | Start forward and start reverse were selected as functions for two different digital inputs (parameter group <i>5-1* Digital Inputs</i>). The motor will start in forward or reverse depending on which corresponding terminal is activated. |
| Stop | The frequency converter has received a stop command from the LCP, digital input or serial communication. |
| Trip | An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, the frequency converter can be reset manually by pressing [Reset] or remotely by control terminals or serial communication. |
| Trip lock | An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, power must be cycled to the frequency converter. The frequency converter can then be reset manually by pressing [Reset] or remotely by control terminals or serial communication. |

Table 7.3 Operation Status

8 Warnings and Alarms

8.1 System Monitoring

The frequency converter monitors the condition of its input power, output, and motor factors as well as other system performance indicators. A warning or alarm may not necessarily indicate a problem internal to the frequency converter itself. In many cases, it indicates failure conditions from input voltage, motor load or temperature, external signals, or other areas monitored by the frequency converter's internal logic. Be sure to investigate those areas exterior to the frequency converter as indicated in the alarm or warning.

8.2 Warning and Alarm Types

8.2.1 Warnings

A warning is issued when an alarm condition is impending or when an abnormal operating condition is present and may result in the frequency converter issuing an alarm. A warning clears by itself when the abnormal condition is removed.

8.2.2 Alarm Trip

An alarm is issued when the frequency converter is tripped, that is, the frequency converter suspends operation to prevent frequency converter or system damage. The motor will coast to a stop. The frequency converter logic will continue to operate and monitor the frequency converter status. After the fault condition is remedied, the frequency converter can be reset. It will then be ready to start operation again.

A trip can be reset in any of 4 ways:

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

8.2.3 Alarm Trip-lock

An alarm that causes the frequency converter to trip-lock requires that input power be cycled. The motor will coast to a stop. The frequency converter logic will continue to operate and monitor the frequency converter status. Remove input power to the frequency converter and correct the cause of the fault, then restore power. This action puts the frequency converter into a trip condition as described above and may be reset in any of those 4 ways.

8.3 Warning and Alarm Displays

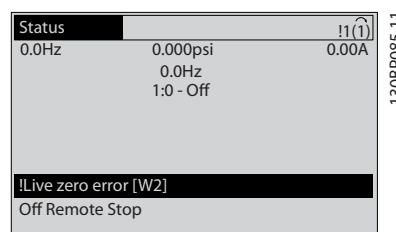


Illustration 8.1

An alarm or trip-lock alarm will flash on the display along with the alarm number.

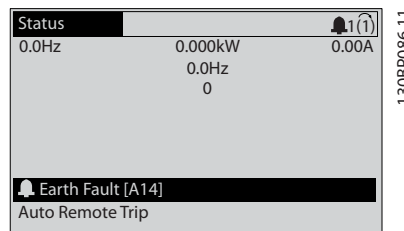


Illustration 8.2

In addition to the text and alarm code on the frequency converter display, there are three status indicator lights.

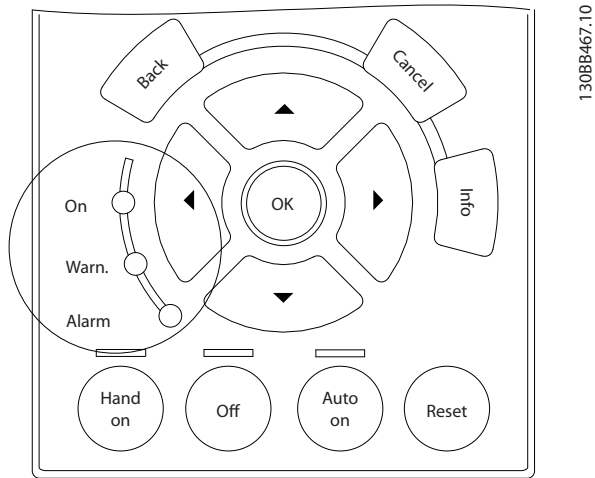


Illustration 8.3

| | Warn. LED | Alarm LED |
|-----------|-----------|---------------|
| Warning | ON | OFF |
| Alarm | OFF | ON (Flashing) |
| Trip-Lock | ON | ON (Flashing) |

Table 8.1

8.4 Warning and Alarm Definitions

Table 8.2 defines whether a warning is issued before an alarm, and whether the alarm trips the unit or trip locks the unit.

| No. | Description | Warning | Alarm/Trip | Alarm/Trip lock | Parameter reference |
|-----|--|---------|------------|-----------------|---|
| 1 | 10 Volts low | X | | | |
| 2 | Live zero error | (X) | (X) | | 6-01 Live Zero Timeout Function |
| 4 | Mains phase loss | (X) | (X) | (X) | 14-12 Function at Mains Imbalance |
| 5 | DC link voltage high | X | | | |
| 6 | DC link voltage low | X | | | |
| 7 | DC over voltage | X | X | | |
| 8 | DC under voltage | X | X | | |
| 9 | Inverter overloaded | X | X | | |
| 10 | Motor ETR over temperature | (X) | (X) | | 1-90 Motor Thermal Protection |
| 11 | Motor thermistor over temperature | (X) | (X) | | 1-90 Motor Thermal Protection |
| 12 | Torque limit | X | X | | |
| 13 | Over Current | X | X | X | |
| 14 | Earth (ground) fault | X | X | X | |
| 15 | Hardware mismatch | | X | X | |
| 16 | Short Circuit | | X | X | |
| 17 | Control word timeout | (X) | (X) | | 8-04 Control Timeout Function |
| 18 | Start Failed | | | | |
| 23 | Internal Fan Fault | X | | | |
| 24 | External Fan Fault | X | | | 14-53 Fan Monitor |
| 25 | Brake resistor short-circuited | X | | | |
| 26 | Brake resistor power limit | (X) | (X) | | 2-13 Brake Power Monitoring |
| 27 | Brake chopper short-circuited | X | X | | |
| 28 | Brake check | (X) | (X) | | 2-15 Brake Check |
| 29 | Drive over temperature | X | X | X | |
| 30 | Motor phase U missing | (X) | (X) | (X) | 4-58 Missing Motor Phase Function |
| 31 | Motor phase V missing | (X) | (X) | (X) | 4-58 Missing Motor Phase Function |
| 32 | Motor phase W missing | (X) | (X) | (X) | 4-58 Missing Motor Phase Function |
| 33 | Inrush fault | | X | X | |
| 34 | Fieldbus communication fault | X | X | | |
| 35 | Out of frequency range | X | X | | |
| 36 | Mains failure | X | X | | |
| 37 | Phase Imbalance | X | X | | |
| 38 | Internal fault | | X | X | |
| 39 | Heatsink sensor | | X | X | |
| 40 | Overload of Digital Output Terminal 27 | (X) | | | 5-00 Digital I/O Mode, 5-01 Terminal 27 Mode |
| 41 | Overload of Digital Output Terminal 29 | (X) | | | 5-00 Digital I/O Mode, 5-02 Terminal 29 Mode |
| 42 | Overload of Digital Output On X30/6 | (X) | | | 5-32 Term X30/6 Digi Out (MCB 101) |
| 42 | Overload of Digital Output On X30/7 | (X) | | | 5-33 Term X30/7 Digi Out (MCB 101) |
| 46 | Pwr. card supply | | X | X | |
| 47 | 24 V supply low | X | X | X | |

| No. | Description | Warning | Alarm/Trip | Alarm/Trip lock | Parameter reference |
|-----|---|---------|-----------------|-----------------|------------------------------|
| 48 | 1.8 V supply low | | X | X | |
| 49 | Speed limit | X | (X) | | 1-86 Trip Speed Low [RPM] |
| 50 | AMA calibration failed | | X | | |
| 51 | AMA check U _{nom} and I _{nom} | | X | | |
| 52 | AMA low I _{nom} | | X | | |
| 53 | AMA motor too big | | X | | |
| 54 | AMA motor too small | | X | | |
| 55 | AMA Parameter out of range | | X | | |
| 56 | AMA interrupted by user | | X | | |
| 57 | AMA timeout | | X | | |
| 58 | AMA internal fault | X | X | | |
| 59 | Current limit | X | | | |
| 60 | External Interlock | X | | | |
| 62 | Output Frequency at Maximum Limit | X | | | |
| 64 | Voltage Limit | X | | | |
| 65 | Control board overtemperature | X | X | X | |
| 66 | Heat sink Temperature Low | X | | | |
| 67 | Option Configuration has Changed | | X | | |
| 70 | Illegal FC configuration | | | X | |
| 71 | PTC 1 Safe Stop | X | X ¹⁾ | | |
| 72 | Dangerous Failure | | | X ¹⁾ | |
| 73 | Safe Stop Auto Restart | | | | |
| 76 | Power Unit Setup | X | | | |
| 77 | Reduced Power Mode | | | | |
| 79 | Illegal PS config | | X | X | |
| 80 | Drive Initialized to Default Value | | X | | |
| 91 | Analog input 54 wrong settings | | | X | |
| 92 | NoFlow | X | X | | 22-2* No-Flow Detection |
| 93 | Dry Pump | X | X | | 22-2* No-Flow Detection |
| 94 | End of Curve | X | X | | 22-5* End of Curve |
| 95 | Broken Belt | X | X | | 22-6* Broken Belt Detection |
| 96 | Start Delayed | X | | | 22-7* Short Cycle Protection |
| 97 | Stop Delayed | X | | | 22-7* Short Cycle Protection |
| 98 | Clock Fault | X | | | 0-7* Clock Settings |
| 104 | Mixing Fan Fault | X | X | | 14-53 Fan Monitor |
| 203 | Missing Motor | | | | |
| 204 | Locked Rotor | | | | |
| 243 | Brake IGBT | X | X | | |
| 244 | Heatsink temp | X | X | X | |
| 245 | Heatsink sensor | | X | X | |
| 246 | Pwr.card supply | | X | X | |
| 247 | Pwr.card temp | | X | X | |
| 248 | Illegal PS config | | X | X | |
| 250 | New spare parts | | | X | |
| 251 | New Type Code | | X | X | |

Table 8.2 Alarm/Warning Code List
(X) Dependent on parameter
¹⁾ Cannot be Auto reset via 14-20 Reset Mode

8.5 Fault Messages

The warning/alarm information below defines each warning/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 below 10 V from terminal 50. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Max. 15 mA or minimum 590 Ω.

This condition can be caused by a short in a connected potentiometer or improper wiring of the potentiometer.

Troubleshooting

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

WARNING/ALARM 2, Live zero error

This warning or alarm only appears if programmed by the user in *6-01 Live Zero Timeout Function*. The signal on one of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or faulty device sending the signal can cause this condition.

Troubleshooting

- Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. MCB 101 terminals 11 and 12 for signals, terminal 10 common. MCB 109 terminals 1, 3, 5 for signals, terminals 2, 4, 6 common).
- Check that the frequency converter programming and switch settings match the analog signal type
- Perform Input Terminal Signal Test

WARNING/ALARM 3, No motor

No motor has been connected to the output of the frequency converter.

WARNING/ALARM 4, Mains phase loss

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

Troubleshooting

Check the supply voltage and supply currents to the frequency converter.

WARNING 5, DC link voltage high

The intermediate circuit voltage (DC) is higher than the high voltage warning limit. The limit is dependent on the frequency converter voltage rating. The unit is still active.

WARNING 6, DC link voltage low

The intermediate circuit voltage (DC) is lower than the low voltage warning limit. The limit is dependent on the frequency converter voltage rating. The unit is still active.

WARNING/ALARM 7, DC overvoltage

If the intermediate circuit voltage exceeds the limit, the frequency converter trips after a time.

Troubleshooting

- Connect a brake resistor
- Extend the ramp time
- Change the ramp type
- Activate the functions in *2-10 Brake Function*
- Increase *14-26 Trip Delay at Inverter Fault*

WARNING/ALARM 8, DC under voltage

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

Troubleshooting

- Check that the supply voltage matches the frequency converter voltage
- Perform input voltage test
- Perform soft charge circuit test

WARNING/ALARM 9, Inverter overload

The frequency converter is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection gives a warning at 98% and trips at 100%, while giving an alarm. The frequency converter *cannot* be reset until the counter is below 90%.

The fault is that the frequency converter is overloaded by more than 100% for too long.

Troubleshooting

- Compare the output current shown on the LCP with the frequency converter rated current
- Compare the output current shown on the LCP with measured motor current
- Display the Thermal Drive Load on the LCP and monitor the value. When running above the frequency converter continuous current rating, the counter should increase. When running below the frequency converter continuous current rating, the counter should decrease.

WARNING/ALARM 10, Motor overload temperature

According to the electronic thermal protection (ETR), the motor is too hot. Select whether the frequency converter gives a warning or an alarm when the counter reaches 100% in *1-90 Motor Thermal Protection*. The fault occurs when the motor is overloaded by more than 100% for too long.

Troubleshooting

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

WARNING/ALARM 11, Motor thermistor over temp

The thermistor might be disconnected. Select whether the frequency converter gives a warning or an alarm in *1-90 Motor Thermal Protection*.

Troubleshooting

- Check for motor overheating
- Check if the motor is mechanically overloaded
- Check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply) and that the terminal switch for 53 or 54 is set for voltage. Check *1-93 Thermistor Source* selects terminal 53 or 54.
- When using digital inputs 18 or 19, check that the thermistor is connected correctly between either terminal 18 or 19 (digital input PNP only) and terminal 50
- If a KTY sensor is used, check for correct connection between terminals 54 and 55
- If using a thermal switch or thermistor, check that the programming in *1-93 Thermistor Resource* matches sensor wiring
- If using a KTY sensor, check the programming of *1-95 KTY Sensor Type*, *1-96 KTY Thermistor Resource*, and *1-97 KTY Threshold level* match sensor wiring

WARNING/ALARM 12, Torque limit

The torque has exceeded the value in *4-16 Torque Limit Motor Mode* or the value in *4-17 Torque Limit Generator Mode*. *14-25 Trip Delay at Torque Limit* can change this 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, possibly increase the torque limit. Be sure 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 about 1.5 secs., then the frequency converter trips and issues an alarm. This fault may be caused by shock loading or fast acceleration with high inertia loads. If extended mechanical brake control is selected, trip can be reset externally.

Troubleshooting

- Remove power and check if the motor shaft can be turned
- Check that the motor size matches the frequency converter
- Check parameters 1-20 to 1-25 for correct motor data

ALARM 14, Earth (ground) fault

There is current from the output phases to earth, either in the cable between the frequency converter and the motor or in the motor itself.

Troubleshooting:

- Remove power to the frequency converter and repair the earth fault
- Check for earth faults in the motor by measuring the resistance to ground of the motor leads and the motor with a megohmmeter
- Perform current sensor test

ALARM 15, Hardware mismatch

A fitted option is not operational with the present control board hardware or software.

Record the value of the following parameters and contact the Danfoss supplier:

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

ALARM 16, Short circuit

There is short-circuiting in the motor or motor wiring.

Remove power to the frequency converter and repair the short circuit.

WARNING/ALARM 17, Control word timeout

There is no communication to the frequency converter. The warning will only be active when *8-04 Control Word Timeout Function* is NOT set to OFF.

If *8-04 Control Word Timeout Function* is set to *Stop* and *Trip*, a warning appears and the frequency converter ramps down until it trips then displays an alarm.

Troubleshooting:

- Check connections on the serial communication cable
- Increase *8-03 Control Word Timeout Time*
- Check the operation of the communication equipment
- Verify a proper installation based on EMC requirements

WARNING/ALARM 22, Hoist mechanical brake

Report value shows what kind it is.

0=The torque ref. was not reached before timeout.

1=There was no brake feedback before timeout.

WARNING 23, Internal fan fault

The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in *14-53 Fan Monitor ([0] Disabled)*.

Troubleshooting

- Check fan resistance
- Check soft charge fuses

WARNING 24, External fan fault

The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in *14-53 Fan Monitor ([0] Disabled)*.

Troubleshooting

- Check fan resistance.
- Check soft charge fuses.

WARNING 25, Brake resistor short circuit

The brake resistor is monitored during operation. If a short circuit occurs, the brake function is disabled and the warning appears. The frequency converter is still operational but without the brake function. Remove power to the frequency converter and replace the brake resistor (see *2-15 Brake Check*).

WARNING/ALARM 26, Brake resistor power limit

The power transmitted to the brake resistor is calculated as a mean value over the last 120 s of run time. The calculation is based on the intermediate circuit voltage and the brake resistance value set in *2-16 AC brake Max. Current*. The warning is active when the dissipated braking is higher than 90% of the brake resistance power. If *[2] Trip* is selected in *2-13 Brake Power Monitoring*, the frequency converter will trip when the dissipated braking power reaches 100%.

WARNING

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

WARNING/ALARM 27, Brake chopper fault

The brake transistor is monitored during operation and if a short circuit occurs, the brake function is disabled and a warning is issued. The frequency converter is still operational but, since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.

Remove power to the frequency converter and remove the brake resistor.

This alarm/warning could also occur should the brake resistor overheat. Terminals 104 and 106 are available as brake resistors Klixon inputs.

WARNING/ALARM 28, Brake check failed

The brake resistor is not connected or not working.

Check *2-15 Brake Check*.

ALARM 29, Heatsink temp

The maximum temperature of the heatsink has been exceeded. The temperature fault will not reset until the temperature falls below a defined heatsink temperature. The trip and reset points are different based on the frequency converter power size.

Troubleshooting

Check for the following conditions

- Ambient temperature too high
- Motor cable too long
- Incorrect airflow clearance above and below the frequency converter
- Blocked airflow around the frequency converter
- Damaged heatsink fan
- Dirty heatsink

This alarm is based on the temperature measured by the heatsink sensor mounted inside the IGBT modules.

Troubleshooting

- Check fan resistance
- Check soft charge fuses
- IGBT thermal sensor

ALARM 30, Motor phase U missing

Motor phase U between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase U.

ALARM 31, Motor phase V missing

Motor phase V between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase V.

ALARM 32, Motor phase W missing

Motor phase W between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase W.

ALARM 33, Inrush fault

Too many power-ups have occurred within a short time period. Let the unit cool to operating temperature.

WARNING/ALARM 34, Fieldbus communication fault

The fieldbus on the communication option card is not working.

WARNING/ALARM 36, Mains failure

This warning/alarm is only active if the supply voltage to the frequency converter is lost and *14-10 Mains Failure* is NOT set to [0] *No Function*. Check the fuses to the frequency converter and mains power supply to the unit.

ALARM 38, Internal fault

When an internal fault occurs, a code number defined in the table below is displayed.

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.

| No. | Text |
|-----------|--|
| 0 | Serial port cannot be initialised. Contact the Danfoss supplier or Danfoss Service Department. |
| 256-258 | Power EEPROM data is defective or too old. |
| 512 | Control board EEPROM data is defective or too old. |
| 513 | Communication time out reading EEPROM data |
| 514 | Communication time out reading EEPROM data |
| 515 | Application oriented control cannot recognize the EEPROM data. |
| 516 | Cannot write to the EEPROM because a write command is on progress. |
| 517 | Write command is under time out |
| 518 | Failure in the EEPROM |
| 519 | Missing or invalid barcode data in EEPROM |
| 783 | Parameter value outside of min/max limits |
| 1024-1279 | A centelegram that has to be sent can not be sent. |
| 1281 | Digital signal processor flash timeout |
| 1282 | Power micro software version mismatch |
| 1283 | Power EEPROM data version mismatch |
| 1284 | Cannot read digital signal processor software version |
| 1299 | Option SW in slot A is too old |
| 1300 | Option SW in slot B is too old |
| 1301 | Option SW in slot C0 is too old |
| 1302 | Option SW in slot C1 is too old |

| No. | Text |
|-----------|--|
| 1315 | Option SW in slot A is not supported (not allowed) |
| 1316 | Option SW in slot B is not supported (not allowed) |
| 1317 | Option SW in slot C0 is not supported (not allowed) |
| 1318 | Option SW in slot C1 is not supported (not allowed) |
| 1379 | Option A did not respond when calculating platform version |
| 1380 | Option B did not respond when calculating platform version |
| 1381 | Option C0 did not respond when calculating platform version. |
| 1382 | Option C1 did not respond when calculating platform version. |
| 1536 | An exception in the application oriented control is registered. Debug information written in LCP |
| 1792 | DSP watchdog is active. Debugging of power part data, motor oriented control data not transferred correctly. |
| 2049 | Power data restarted |
| 2064-2072 | H081x: option in slot x has restarted |
| 2080-2088 | H082x: option in slot x has issued a powerup-wait |
| 2096-2104 | H983x: option in slot x has issued a legal powerup-wait |
| 2304 | Could not read any data from power EEPROM |
| 2305 | Missing SW version from power unit |
| 2314 | Missing power unit data from power unit |
| 2315 | Missing SW version from power unit |
| 2316 | Missint lo_statepage from power unit |
| 2324 | Power card configuration is determined to be incorrect at power up |
| 2325 | A power card has stopped communicating while main power is applied |
| 2326 | Power card configuration is determined to be incorrect after the delay for power cards to register. |
| 2327 | Too many power card locations have been registered as present. |
| 2330 | Power size information between the power cards does not match. |
| 2561 | No communication from DSP to ATACD |
| 2562 | No communication from ATACD to DSP (state running) |
| 2816 | Stack overflow control board module |
| 2817 | Scheduler slow tasks |
| 2818 | Fast tasks |
| 2819 | Parameter thread |
| 2820 | LCP stack overflow |
| 2821 | Serial port overflow |
| 2822 | USB port overflow |
| 2836 | cfListMempool too small |
| 3072-5122 | Parameter value is outside its limits |
| 5123 | Option in slot A: Hardware incompatible with control board hardware |

| No. | Text |
|-----------|---|
| 5124 | Option in slot B: Hardware incompatible with Control board hardware. |
| 5125 | Option in slot C0: Hardware incompatible with control board hardware. |
| 5126 | Option in slot C1: Hardware incompatible with control board hardware. |
| 5376-6231 | Out of memory |

Table 8.3
ALARM 39, Heatsink sensor

No feedback from the heatsink temperature sensor.

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

WARNING 40, Overload of digital output terminal 27

Check the load connected to terminal 27 or remove short-circuit connection. Check *5-00 Digital I/O Mode* and *5-01 Terminal 27 Mode*.

WARNING 41, Overload of digital output terminal 29

Check the load connected to terminal 29 or remove short-circuit connection. Check *5-00 Digital I/O Mode* and *5-02 Terminal 29 Mode*.

WARNING 42, Overload of digital output on X30/6 or overload of digital output on X30/7

For X30/6, check the load connected to X30/6 or remove the short-circuit connection. Check *5-32 Term X30/6 Digi Out (MCB 101)*.

For X30/7, check the load connected to X30/7 or remove the short-circuit connection. Check *5-33 Term X30/7 Digi Out (MCB 101)*.

ALARM 46, Power card supply

The supply on the power card is out of range.

There are three power supplies generated by the switch mode power supply (SMPS) on the power card: 24 V, 5 V, ±18 V. When powered with 24 V DC with the MCB 107 option, only the 24 V and 5 V supplies are monitored. When powered with three phase mains voltage, all three supplies are monitored.

WARNING 47, 24 V supply low

The 24 V DC is measured on the control card. The external 24 V DC backup power supply may be overloaded, otherwise contact the Danfoss supplier.

WARNING 48, 1.8 V supply low

The 1.8 V DC supply used on the control card is outside of allowable limits. The power supply is measured on the control card. Check for a defective control card. If an option card is present, check for an overvoltage condition.

WARNING 49, Speed limit

When the speed is not within the specified range in *4-11 Motor Speed Low Limit [RPM]* and *4-13 Motor Speed High Limit [RPM]*, the frequency converter shows a warning.

When the speed is below the specified limit in *1-86 Trip Speed Low [RPM]* (except when starting or stopping) the frequency converter will trip.

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

ALARM 52, AMA low I_{nom}

The motor current is too low. Check the settings.

ALARM 53, AMA motor too big

The motor is too big 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 parameter values of the motor are outside of the acceptable range. AMA will not run.

ALARM 56, AMA interrupted by user

The user has interrupted the AMA.

ALARM 57, AMA internal fault

Try to restart AMA again a number of times, until the AMA is carried out. Note that repeated runs may heat the motor to a level where the resistance R_s and R_r are increased. In most cases, however, this is not critical.

ALARM 58, AMA internal fault

Contact the Danfoss supplier.

WARNING 59, Current limit

The current is higher than the value in *4-18 Current Limit*. Ensure that Motor data in parameters 1-20 to 1-25 are set correctly. Possibly increase the current limit. Be sure that the system can operate safely at a higher limit.

WARNING 60, External interlock

External interlock has been activated. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock and reset the frequency converter (via serial communication, digital I/O, or by pressing [Reset]).

WARNING/ALARM 61, Tracking error

An error between calculated motor speed and speed measurement from feedback device. The function Warning/Alarm/Disable is set in *4-30 Motor Feedback Loss Function*. Accepted error setting in *4-31 Motor Feedback Speed Error* and the allowed time the error occur setting in *4-32 Motor Feedback Loss Timeout*. During a commissioning procedure the function may be effective.

WARNING 62, Output frequency at maximum limit

The output frequency is higher than the value set in *4-19 Max Output Frequency*.

ALARM 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 control card has reached its trip temperature of 75 °C.

WARNING 66, Heatsink temperature low

The frequency converter 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 frequency converter whenever the motor is stopped by setting *2-00 DC Hold/Preheat Current* at 5% and *1-80 Function at Stop*

Troubleshooting

The heatsink temperature measured as 0 °C could indicate that the temperature sensor is defective, causing the fan speed to increase to the maximum. If the sensor wire between the IGBT and the gate drive card is disconnected, this warning would result. Also, check the IGBT thermal sensor.

ALARM 67, Option module configuration has changed

One or more options have either been added or removed since the last power-down. Check that the configuration change is intentional and reset the unit.

ALARM 68, Safe Stop activated

Safe stop has been activated. To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal (via Bus, Digital I/O, or by pressing [Reset]).

ALARM 69, Power card temperature

The temperature sensor on the power card is either too hot or too cold.

Troubleshooting

- Check the operation of the door fans
- Check that the filters for the door fans are not blocked
- Check that the gland plate is properly installed on IP21/IP54 (NEMA 1/12) frequency converters

ALARM 70, Illegal FC configuration

The control card and power card are incompatible. Contact the supplier with the type code of the unit from the nameplate and the part numbers of the cards to check compatibility.

ALARM 71, PTC 1 safe stop

Safe Stop has been activated from the MCB 112 PTC Thermistor Card (motor too warm). Normal operation can be resumed when the MCB 112 applies 24 V DC to T37 again (when the motor temperature reaches an acceptable level) and when the Digital Input from the MCB 112 is deactivated. When that happens, a reset signal must be sent (via Bus, Digital I/O, or by pressing [Reset]).

NOTE

If automatic restart is enabled, the motor may start when the fault is cleared.

ALARM 72, Dangerous failure

Safe Stop with Trip Lock. Unexpected signal levels on safe stop and digital input from the MCB 112 PTC thermistor card.

WARNING 73, Safe stop auto restart

Safe stopped. With automatic restart enabled, the motor may start when the fault is cleared.

WARNING 76, Power unit setup

The required number of power units does not match the detected number of active power units.

Troubleshooting:

When replacing an F-frame module, this will occur if the power specific data in the module power card does not match the rest of the frequency converter. Confirm the spare part and its power card are the correct part number.

WARNING 77, Reduced power mode

This warning indicates that the frequency converter is operating in reduced power mode (i.e. less than the allowed number of inverter sections). This warning will be generated on power cycle when the frequency converter is set to run with fewer inverters and will remain on.

ALARM 79, Illegal power section configuration

The scaling card is the incorrect part number or not installed. Also MK102 connector on the power card could not be installed.

ALARM 80, Drive initialised to default value

Parameter settings are initialised to default settings after a manual reset. Reset the unit to clear the alarm.

ALARM 81, CSIV corrupt

CSIV file has syntax errors.

ALARM 82, CSIV parameter error

CSIV failed to init a parameter.

ALARM 85, Dang fail PB

Profibus/Profisafe Error.

WARNING/ALARM 104, Mixing fan fault

The fan monitor checks that the fan is spinning at drive power-up or whenever the mixing fan is turned on. If the fan is not operating, then the fault is annunciated. The mixing-fan fault can be configured as a warning or an alarm trip by *14-53 Fan Monitor*.

Troubleshooting

Cycle power to the frequency converter to determine if the warning/alarm returns.

WARNING 250, New spare part

A component in the frequency converter has been replaced. Reset the frequency converter for normal operation.

WARNING 251, New typecode

The power card or other components have been replaced and the typecode changed. Reset to remove the warning and resume normal operation.

9 Basic Troubleshooting

9.1 Start Up and Operation

| Symptom | Possible cause | Test | Solution |
|--------------------------|--|---|--|
| Display dark/No function | Missing input power. | See <i>Table 3.1</i> . | Check the input power source. |
| | Missing or open fuses or circuit breaker tripped. | See open fuses and tripped circuit breaker 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 terminals 12/13 to 20-39 or 10 V supply for terminals 50 to 55. | Wire the terminals properly. |
| | Wrong LCP (LCP from VLT® 2800 or 5000/6000/8000/ FCD or FCM). | | 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 power supply (SMPS) due to improper control wiring or a fault within the frequency converter. | To rule out a problem in the control wiring, disconnect all control wiring by removing the terminal blocks. | If the display stays lit, then 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. |
| 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 no output, check that mains power is applied to the frequency converter. | Apply mains power to run the unit. |
| | LCP Stop. | Check if [Off] has been pressed. | Press [Auto On] or [Hand On] (depending on operation mode) to run the motor. |
| | Missing start signal (Standby). | Check <i>5-10 Terminal 18 Digital Input</i> for correct setting for terminal 18 (use default setting). | Apply a valid start signal to start the motor. |
| | Motor coast signal active (Coasting). | Check <i>5-12 Coast inv.</i> for correct setting for terminal 27 (use default setting).. | Apply 24 V on terminal 27 or program this terminal to <i>No operation</i> . |
| | Wrong reference signal source. | Check reference signal: Local, remote or bus reference? Preset reference active? Terminal connection correct? Scaling of terminals correct? Reference signal available? | Program correct settings. Check <i>3-13 Reference Site</i> . Set preset reference active in parameter group <i>3-1* References</i> . 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 <i>4-10 Motor Speed Direction</i> is programmed correctly. | Program correct settings. |
| | Active reversing signal. | Check if a reversing command is programmed for the terminal in parameter group <i>5-1* Digital inputs..</i> | Deactivate reversing signal. |
| | Wrong motor phase connection. | | See <i>2.4.5 Motor Rotation Check</i> in this manual. |
| Motor is not reaching maximum speed | Frequency limits set wrong. | Check output limits in <i>4-13 Motor Speed High Limit [RPM]</i> , <i>4-14 Motor Speed High Limit [Hz]</i> and <i>4-19 Max Output Frequency</i> . | Program correct limits. |
| | Reference input signal not scaled correctly. | Check reference input signal scaling in <i>6-0* Analog I/O Mode</i> and parameter group <i>3-1* References</i> . Reference limits in parameter group <i>3-0* Reference Limit</i> . | 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 <i>1-6* Analog I/O mode</i> . For closed loop operation, check settings in parameter group <i>20-0* Feedback..</i> |
| Motor runs rough | Possible over-magnetization. | Check for incorrect motor settings in all motor parameters. | Check motor settings in parameter groups <i>1-2* Motor Data</i> , <i>1-3* Adv Motor Data</i> , and <i>1-5* Load Indep. Setting</i> . |
| Motor will not brake | Possible incorrect settings in the brake parameters. Possible too short ramp down times. | Check brake parameters. Check ramp time settings. | Check parameter group <i>2-0* DC Brake</i> and <i>3-0* Reference Limits</i> . |
| Open power fuses or circuit breaker trip | Phase to phase short. | Motor or panel has a short phase to phase. Check motor and panel phase for shorts. | Eliminate any shorts detected. |
| | Motor overload. | Motor is overloaded for the application. | Perform startup test and verify motor current is within specifications. If motor current is exceeding nameplate full load current, motor may run only with reduced load. Review the specifications for the application. |
| | Loose connections. | Perform pre-startup check for loose connections. | Tighten loose connections. |
| Mains current imbalance greater than 3% | Problem with mains power (See <i>Alarm 4 Mains phase loss</i> description). | Rotate input power leads into the frequency converter one position: A to B, B to C, C to A. | If imbalanced leg follows the wire, it is a power problem. Check mains power supply. |
| | Problem with the frequency converter. | Rotate input power leads into the frequency converter one position: A to B, B to C, C to A. | If imbalance leg stays on same input terminal, it is a problem with the unit. Contact the supplier. |
| Motor current imbalance greater than 3% | Problem with motor or motor wiring. | Rotate output motor leads one position: U to V, V to W, W to U. | If imbalanced leg follows the wire, the problem is in the motor or motor wiring. Check motor and motor wiring. |
| | Problem with the frequency converters. | Rotate output motor leads one position: U to V, V to W, W to U. | If imbalance leg stays on same output terminal, it is a problem with the unit. Contact the supplier. |

| Symptom | Possible cause | Test | Solution |
|---|---|---|---|
| Acoustic noise or vibration (e.g. a fan blade is making noise or vibrations at certain frequencies) | Resonances, e.g. in the motor/fan system. | Bypass critical frequencies by using parameters in parameter group 4-6* <i>Speed Bypass</i> . | Check if noise and/or vibration have been reduced to an acceptable limit. |
| | | Turn off over-modulation in 14-03 <i>Overmodulation</i> . | |
| | | Change switching pattern and frequency in parameter group 14-0* <i>Inverter Switching</i> . | |
| | | Increase Resonance Dampening in 1-64 <i>Resonance Dampening</i> . | |

Table 9.1

10 Specifications

10.1 Power-dependent Specifications

| | N110 | N132 | N160 | N200 | N250 | N315 | | | |
|--|----------------|-----------|-----------|---------------|-----------|-----------|-----|-----|-----|
| Normal Load* | NO | NO | NO | NO | NO | NO | | | |
| Typical Shaft output at 400 V [kW] | 110 | 132 | 160 | 200 | 250 | 315 | | | |
| Typical Shaft output at 460 V [hp] | 150 | 200 | 250 | 300 | 350 | 450 | | | |
| Typical Shaft output at 480 V [kW] | 132 | 160 | 200 | 250 | 315 | 355 | | | |
| Enclosure IP21 | D1h | D1h | D1h | D2h | D2h | D2h | | | |
| Enclosure IP54 | D1h | D1h | D1h | D2h | D2h | D2h | | | |
| Enclosure IP20 | D3h | D3h | D3h | D4h | D4h | D4h | | | |
| Output current | | | | | | | | | |
| Continuous (at 400 V) [A] | 212 | 260 | 315 | 395 | 480 | 588 | | | |
| Intermittent (60 s overload) (at 400 V)[A] | 233 | 286 | 347 | 435 | 528 | 647 | | | |
| Continuous (at 460/500 V) [A] | 190 | 240 | 302 | 361 | 443 | 535 | | | |
| Intermittent (60 s overload) (at 460/500 V) [kVA] | 209 | 264 | 332 | 397 | 487 | 588 | | | |
| Continuous kVA (at 400 V) [kVA] | 147 | 180 | 218 | 274 | 333 | 407 | | | |
| Continuous kVA (at 460 V) [kVA] | 151 | 191 | 241 | 288 | 353 | 426 | | | |
| Max. Input current | | | | | | | | | |
| Continuous (at 400 V) [A] | 204 | 251 | 304 | | 381 | 381 | 463 | 463 | 567 |
| Continuous (at 460/500 V) [A] | 183 | 231 | 291 | | 348 | 348 | 427 | 427 | 516 |
| Max. cable size: mains, motor, brake and load share mm (AWG) | 2 x 95 (2x3/0) | | | 2x185 (2x350) | | | | | |
| Max. external mains fuses [A] | 315 | 350 | 400 | 550 | 630 | 800 | | | |
| Estimated power loss at 400 V [W] | 2555 | 2949 | 3764 | 4109 | 5129 | 6663 | | | |
| Estimated power loss at 460 V [W] | 2257 | 2719 | 3622 | 3561 | 4558 | 5703 | | | |
| Weight, enclosure IP21, IP54 kg (lbs.) | 62 (135) | | | 125 (275) | | | | | |
| Weight, enclosure IP20 kg (lbs.) | 62 (135) | | | 125 (275) | | | | | |
| Efficiency | 0.98 | | | | | | | | |
| Output frequency | 0-590 Hz | | | | | | | | |
| *Normal overload=110% current for 60 s | | | | | | | | | |

Table 10.1 Mains Supply 3x380-480 V AC

| | N75K | N90K | N110 | N132 | N160 | N200 |
|--|--------------|-----------|-----------|-----------|-----------|-------------------|
| Normal Load* | NO | NO | NO | NO | NO | NO |
| Typical Shaft output at 550 V [kW] | 55 | 75 | 90 | 110 | 132 | 160 |
| Typical Shaft output at 575 V [hp] | 75 | 100 | 125 | 150 | 200 | 250 |
| Typical Shaft output at 690 V [kW] | 75 | 90 | 110 | 132 | 160 | 200 |
| Enclosure IP21 | D1h | D1h | D1h | D1h | D1h | D2h |
| Enclosure IP54 | D1h | D1h | D1h | D1h | D1h | D2h |
| Enclosure IP20 | D3h | D3h | D3h | D3h | D3h | D4h |
| Output current | | | | | | |
| Continuous (at 550 V) [A] | 90 | 113 | 137 | 162 | 201 | 253 |
| Intermittent (60 s overload) (at 550 V)[A] | 99 | 124 | 151 | 178 | 221 | 278 |
| Continuous (at 575/690 V) [A] | 86 | 108 | 131 | 155 | 192 | 242 |
| Intermittent (60 s overload) (at 575/690 V) [kVA] | 95 | 119 | 144 | 171 | 211 | 266 |
| Continuous kVA (at 550 V) [kVA] | 86 | 108 | 131 | 154 | 191 | 241 |
| Continuous kVA (at 575 V) [kVA] | 86 | 108 | 130 | 154 | 191 | 241 |
| Continuous kVA (at 690 V) [kVA] | 103 | 129 | 157 | 185 | 229 | 289 |
| Max. Input current | | | | | | |
| Continuous (at 550 V) [A] | 89 | 110 | 130 | 158 | 198 | 245 |
| Continuous (at 575 V) [A] | 85 | 106 | 124 | 151 | 189 | 234 |
| Continuous (at 690 V) [A] | 87 | 109 | 128 | 155 | 197 | 240 |
| Max. cable size: mains, motor, brake and load share [mm (AWG)] | 2x95 (2x3/0) | | | | | 2x185 (2x350 mcm) |
| Max. external mains fuses [A] | 160 | 315 | 315 | 315 | 350 | 350 |
| Estimated power loss at 575 V [W] | 1161 | 1426 | 1739 | 2099 | 2646 | 3071 |
| Estimated power loss at 690 V [W] | 1203 | 1476 | 1796 | 2165 | 2738 | 3172 |
| Weight, enclosure IP21, IP54 kg (lbs.) | 62 (135) | | | | | 125 (275) |
| Weight, enclosure IP20 kg (lbs.) | 62 (135) | | | | | 125 (275) |
| Efficiency | 0.98 | | | | | |
| Output frequency | 0-590 Hz | | | | | |
| Heatsink overtemp. trip | 110 °C | | | | | |
| Power card ambient trip | 75 °C | | | | | |
| *Normal overload=110% current for 60 s | | | | | | |

Table 10.2 Mains Supply 3x525-690 V AC

| | N250 | N315 | N400 |
|---|-------------------|-----------|-----------|
| Normal Load* | NO | NO | NO |
| Typical Shaft output at 550 V [kW] | 200 | 250 | 315 |
| Typical Shaft output at 575 V [hp] | 300 | 350 | 400 |
| Typical Shaft output at 690 V [kW] | 250 | 315 | 400 |
| Enclosure IP21 | D2h | D2h | D2h |
| Enclosure IP54 | D2h | D2h | D2h |
| Enclosure IP20 | D4h | D4h | D4h |
| Output current | | | |
| Continuous (at 550 V) [A] | 303 | 360 | 418 |
| Intermittent (60 s overload) (at 550 V)[A] | 333 | 396 | 460 |
| Continuous (at 575/690 V) [A] | 290 | 344 | 400 |
| Intermittent (60 s overload) (at 575/690 V) [kVA] | 319 | 378 | 440 |
| Continuous kVA (at 550 V) [kVA] | 289 | 343 | 398 |
| Continuous kVA (at 575 V) [kVA] | 289 | 343 | 398 |
| Continuous kVA (at 690 V) [kVA] | 347 | 411 | 478 |
| Max. Input current | | | |
| Continuous (at 550 V) [A] | 299 | 355 | 408 |
| Continuous (at 575 V) [A] | 286 | 339 | 390 |
| Continuous (at 690 V) [A] | 296 | 352 | 400 |
| Max. cable size: mains, motor, brake and load share, mm (AWG) | 2x185 (2x350 mcm) | | |
| Max. external mains fuses [A] | 400 | 500 | 550 |
| Estimated power loss at 575 V [W] | 3719 | 4460 | 5023 |
| Estimated power loss at 690 V [W] | 3848 | 4610 | 5150 |
| Weight, enclosure IP21, IP54 kg (lbs.) | 125 (275) | | |
| Weight, enclosure IP20 kg (lbs.) | 125 (275) | | |
| Efficiency | 0.98 | | |
| Output frequency | 0-590 Hz | | |
| Heatsink overtemp. trip | 110 °C | | |
| Power card ambient trip | 75 °C | | |
| *Normal overload=110% current for 60 s | | | |

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Table 10.3 Mains Supply 3x525-690 V AC

The typical power loss is at nominal load conditions and expected to be within $\pm 15\%$ (tolerance relates to variety in voltage and cable conditions).

The losses are based on the default switching frequency. The losses increase significantly at higher switching frequencies.

The options cabinet adds weight to the frequency converter. The maximum weights of the D5h–D8h frames is shown in *Table 10.4*

| Frame size | Description | Maximum weight [kg] ([lbs.]) |
|------------|--|------------------------------|
| D5h | D1h ratings+disconnect and/or brake chopper | 166 (255) |
| D6h | D1h ratings+contactor and/or circuit breaker | 129 (285) |
| D7h | D2h ratings+disconnect and/or brake chopper | 200 (440) |
| D8h | D2h ratings+contactor and/or circuit breaker | 225 (496) |

Table 10.4 D5h–D8h Weights

10.2 General Technical Data

Mains supply (L1, L2, L3)

| | |
|----------------|-------------------------------|
| Supply voltage | 380–480 V ±10%, 525–690 V±10% |
|----------------|-------------------------------|

Mains voltage low/mains voltage drop-out:

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

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

The unit is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes, 480/600 V

Motor Output (U, V, W)

| | |
|---------------------|--------------------------|
| Output voltage | 0-100% of supply voltage |
| Output frequency | 0-590 Hz* |
| Switching on output | Unlimited |
| Ramp times | 0.01-3600 s |

* *Dependent on voltage and power*

Torque Characteristics

| | |
|-----------------------------------|---------------------------|
| Starting torque (Constant torque) | maximum 110% for 60 s* |
| Starting torque | maximum 135% up to 0.5 s* |
| Overload torque (Constant torque) | maximum 110% for 60 s* |

* *Percentage relates to the frequency converter's nominal torque*

Cable lengths and cross sections

| | |
|--|---|
| Max. motor cable length, screened/armoured | 150 m |
| Max. motor cable length, unscreened/unarmoured | 300 m |
| Max. cross section to motor, mains, load sharing and brake * | |
| 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 |

* *Depending on voltage and power.*

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 | <14V DC |
| Maximum voltage on input | 28 V DC |
| Input resistance, R _i | approx. 4 k Ω |

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

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

| | |
|------------------------------|-------------------------------|
| Analog inputs | |
| Number of analog inputs | 2 |
| Terminal number | 53, 54 |
| Modes | Voltage or current |
| Mode select | Switches A53 and A54 |
| Voltage mode | Switch A53/A54=(U) |
| Voltage level | 0 V to 10 V (scaleable) |
| Input resistance, R_i | approx. 10 k Ω |
| Max. voltage | ± 20 V |
| Current mode | Switch A53/A54=(I) |
| Current level | 0/4 to 20 mA (scaleable) |
| Input resistance, R_i | approx. 200 Ω |
| Max. current | 30 mA |
| Resolution for analog inputs | 10 bit (+sign) |
| Accuracy of analog inputs | Max. error 0.5% of full scale |
| Bandwidth | 100 Hz |

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

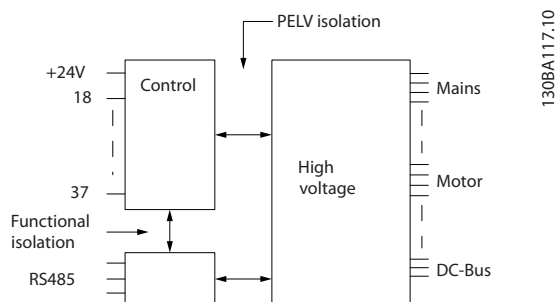


Illustration 10.1

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| | |
|---|---------------------------------|
| Pulse inputs | |
| Programmable pulse inputs | 2 |
| Terminal number pulse | 29, 33 |
| Max. frequency at terminal, 29, 33 | 110 kHz (Push-pull driven) |
| Max. frequency at terminal, 29, 33 | 5 kHz (open collector) |
| Min. frequency at terminal 29, 33 | 4 Hz |
| Voltage level | see 10.2.1 Digital Inputs: |
| Maximum voltage on input | 28 V DC |
| Input resistance, R_i | approx. 4 k Ω |
| Pulse input accuracy (0.1-1 kHz) | Max. error: 0.1% of full scale |
| Analog output | |
| Number of programmable analog outputs | 1 |
| Terminal number | 42 |
| Current range at analog output | 0/4-20 mA |
| Max. resistor load to common at analog output | 500 Ω |
| Accuracy on analog output | Max. error: 0.8 % of full scale |
| Resolution on analog output | 8 bit |

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

| | |
|--|----------------------------------|
| Control card, RS-485 serial communication | |
| Terminal number | 68 (P,TX+, RX+), 69 (N,TX-, RX-) |
| Terminal number 61 | Common for terminals 68 and 69 |

The RS-485 serial communication circuit is functionally seated from other central circuits and galvanically isolated from the supply voltage (PELV).

Specifications
**VLT® HVAC Drive D-Frame
Operating Instructions**
Digital output

| | |
|--|---------------------------------|
| Programmable digital/pulse outputs | 2 |
| Terminal number | 27, 29 ¹⁾ |
| Voltage level at digital/frequency output | 0-24 V |
| Max. output current (sink or source) | 40 mA |
| Max. load at frequency output | 1 kΩ |
| Max. capacitive load at frequency output | 10 nF |
| Minimum output frequency at frequency output | 0 Hz |
| Maximum output frequency at frequency output | 32 kHz |
| Accuracy of frequency output | Max. error: 0.1 % of full scale |
| Resolution of frequency outputs | 12 bit |

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

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

Control card, 24 V DC output

| | |
|-----------------|--------|
| Terminal number | 12, 13 |
| Max. load | 200 mA |

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

Relay outputs

| | |
|----------------------------|---|
| Programmable relay outputs | 2 |
|----------------------------|---|

Relay 01 Terminal number 1-3 (break), 1-2 (make)

| | |
|--|---|
| Max. terminal load (AC-1) ¹⁾ on 1-2 (NO) (Resistive load) ²⁾³⁾ | 400 V AC, 2 A |
| Max. terminal load (AC-15) ¹⁾ on 1-2 (NO) (Inductive load @ cosφ 0.4) | 240 V AC, 0.2 A |
| Max. terminal load (DC-1) ¹⁾ on 1-2 (NO) (Resistive load) | 80 V DC, 2 A |
| Max. terminal load (DC-13) ¹⁾ on 1-2 (NO) (Inductive load) | 24 V DC, 0.1 A |
| Max. terminal load (AC-1) ¹⁾ on 1-3 (NC) (Resistive load) | 240 V AC, 2 A |
| Max. terminal load (AC-15) ¹⁾ on 1-3 (NC) (Inductive load @ cosφ 0.4) | 240 V AC, 0.2 A |
| Max. terminal load (DC-1) ¹⁾ on 1-3 (NC) (Resistive load) | 50 V DC, 2 A |
| Max. terminal load (DC-13) ¹⁾ on 1-3 (NC) (Inductive load) | 24 V DC, 0.1 A |
| Min. terminal load on 1-3 (NC), 1-2 (NO) | 24 V DC 10 mA, 24V 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)

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

¹⁾ IEC 60947 t 4 and 5

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

²⁾ Overvoltage Category II

³⁾ UL applications 300 V AC 2 A

Control card, 10 V DC output

| | |
|-----------------|---------------|
| Terminal number | 50 |
| Output voltage | 10.5 V ±0.5 V |
| Max. load | 25 mA |

The 10 V DC supply is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control characteristics

| | |
|---|--------------------------------------|
| Resolution of output frequency at 0-1000 Hz | ± 0.003 Hz |
| System response time (terminals 18, 19, 27, 29, 32, 33) | ≤2 ms |
| Speed control range (open loop) | 1:100 of synchronous speed |
| Speed accuracy (open loop) | 30-4000 rpm: Maximum error of ±8 rpm |

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

Surroundings

| | |
|--|--|
| Enclosure type D1h/D2h/D5h/D6h/D7h/D8h | IP21/Type 1, IP54/Type12 |
| Enclosure type D3h/D4h | IP20/Chassis |
| Vibration test all enclosure types | 1.0 g |
| Relative humidity | 5%-95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation |
| Aggressive environment (IEC 60068-2-43) H ₂ S test | class Kd |
| Test method according to IEC 60068-2-43 H ₂ S (10 days) | |
| Ambient temperature (at 60 AVM switching mode) | |
| - with derating | max. 55 °C ¹⁾ |
| - with full output power of typical EFF2 motors (up to 90% output current) | max. 50 °C ¹⁾ |
| - at full continuous FC output current | max. 45 °C ¹⁾ |

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

| | |
|---|------------------|
| Minimum ambient temperature during full-scale operation | 0 °C |
| Minimum ambient temperature at reduced performance | -10 °C |
| Temperature during storage/transport | -25 to +65/70 °C |
| Maximum altitude above sea level without derating | 1000 m |
| Maximum altitude above sea level with derating | 3000 m |

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

| | |
|-------------------------|--|
| EMC standards, Emission | EN 61800-3, EN 61000-6-3/4, EN 55011, IEC 61800-3 EN 61800-3, EN 61000-6-1/2, |
| EMC standards, Immunity | EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6 |

See the Design Guide, section on Special Conditions.

Control card performance

| | |
|---------------|------|
| Scan interval | 5 ms |
|---------------|------|

Control card, USB Serial Communication

| | |
|--------------|--------------------------|
| USB standard | 1.1 (Full speed) |
| USB plug | USB type B "device" plug |

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

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

The USB connection is not galvanically isolated from protection earth (ground). Use only isolated laptop/PC as connection to the USB connector on frequency converter or an isolated USB cable/converter.

Protection and Features

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the frequency converter trips if the temperature reaches $95\text{ }^{\circ}\text{C}\pm 5\text{ }^{\circ}\text{C}$. An overload temperature cannot be reset until the temperature of the heatsink is below $70\text{ }^{\circ}\text{C}\pm 5\text{ }^{\circ}\text{C}$ (Guideline - these temperatures may vary for different power sizes, enclosures etc.). The frequency converter has an auto derating function to avoid its heatsink reaching $95\text{ }^{\circ}\text{C}$.
- The frequency converter is protected against short-circuits on motor terminals U, V, W.
- If a mains phase is missing, the frequency converter trips or issues a warning (depending on the load).
- Monitoring of the intermediate circuit voltage ensures that the frequency converter trips if the intermediate circuit voltage is too low or too high.
- The frequency converter is protected against earth (ground) faults on motor terminals U, V, W.

10.3 Fuse Tables

10.3.1 Protection

Branch Circuit Protection

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

Short-circuit Protection

The frequency converter must be protected against short-circuit to avoid electrical or fire hazard. Danfoss recommends using the fuses mentioned below to protect service personnel and equipment in case of an internal failure in the frequency converter. The frequency converter provides full short-circuit protection in case of a short-circuit on the motor output.

Over-current Protection

Provide overload protection to avoid fire hazard due to overheating of the cables in the installation. The frequency converter is equipped with an internal over-current protection that can be used for upstream overload

protection (UL-applications excluded). See 4-18 *Current Limit*. Moreover, fuses or circuit breakers can be used to provide the over-current protection in the installation. Over-current protection must always be carried out according to national regulations.

10.3.2 Fuse Selection

Danfoss recommends using the following fuses which will ensure compliance with EN50178. In case of malfunction, not following the recommendation may result in unnecessary damage to the frequency converter.

The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical).

| | | |
|-----------|-----------|---------|
| N110-N315 | 380–500 V | type aR |
| N75K-N400 | 525–690 V | type aR |

Table 10.5

| Power Size | Fuse options | | | | | | | |
|------------|--------------|---------------|---------------|-------------|---------------|-------------------|----------------------------|-----------------------------------|
| | Bussman PN | Littelfuse PN | Littelfuse PN | Bussmann PN | Siba PN | Ferraz-Shawmut PN | Ferraz-Shawmut PN (Europe) | Ferraz-Shawmut PN (North America) |
| N110 | 170M2619 | LA50QS300-4 | L50S-300 | FWH-300A | 20 610 31.315 | A50QS300-4 | 6,9URD31D08A0315 | A070URD31KI0315 |
| N132 | 170M2620 | LA50QS350-4 | L50S-350 | FWH-350A | 20 610 31.350 | A50QS350-4 | 6,9URD31D08A0350 | A070URD31KI0350 |
| N160 | 170M2621 | LA50QS400-4 | L50S-400 | FWH-400A | 20 610 31.400 | A50QS400-4 | 6,9URD31D08A0400 | A070URD31KI0400 |
| N200 | 170M4015 | LA50QS500-4 | L50S-500 | FWH-500A | 20 610 31.550 | A50QS500-4 | 6,9URD31D08A0550 | A070URD31KI0550 |
| N250 | 170M4016 | LA50QS600-4 | L50S-600 | FWH-600A | 20 610 31.630 | A50QS600-4 | 6,9URD31D08A0630 | A070URD31KI0630 |
| N315 | 170M4017 | LA50QS800-4 | L50S-800 | FWH-800A | 20 610 31.800 | A50QS800-4 | 6,9URD32D08A0800 | A070URD31KI0800 |

Table 10.6 Fuse Options for 380-480 V Frequency Converters

| OEM | | Fuse options | | |
|-----------|-------------|---------------|----------------------------|----------------------------------|
| VLT Model | Bussmann PN | Siba PN | Ferraz-Shawmut European PN | Ferraz-Shawmut North American PN |
| N75k T7 | 170M2616 | 20 610 31.160 | 6,9URD30D08A0160 | A070URD30KI0160 |
| N90k T7 | 170M2619 | 20 610 31.315 | 6,9URD31D08A0315 | A070URD31KI0315 |
| N110 T7 | 170M2619 | 20 610 31.315 | 6,9URD31D08A0315 | A070URD31KI0315 |
| N132 T7 | 170M2619 | 20 610 31.315 | 6,9URD31D08A0315 | A070URD31KI0315 |
| N160 T7 | 170M2619 | 20 610 31.315 | 6,9URD31D08A0315 | A070URD31KI0315 |
| N200 T7 | 170M4015 | 20 620 31.550 | 6,9URD32D08A0550 | A070URD32KI0550 |
| N250 T7 | 170M4015 | 20 620 31.550 | 6,9URD32D08A0550 | A070URD32KI0550 |
| N315 T7 | 170M4015 | 20 620 31.550 | 6,9URD32D08A0550 | A070URD32KI0550 |
| N400 T7 | 170M4015 | 20 620 31.550 | 6,9URD32D08A0550 | A070URD32KI0550 |

Table 10.7 Fuse Options for 525-690 V Frequency Converters

For UL compliance, for units supplied without a contactor-only option, the Bussmann 170M series fuses must be used. See *Table 10.9* for SCCR ratings and UL fuse criteria if a contactor-only option is supplied with the frequency converter.

10.3.3 Short Circuit Current Rating (SCCR)

If the frequency converter is not supplied with a mains disconnect, contactor or circuit breaker, the Short Circuit Current Rating (SCCR) of the frequency converters is 100,000 amps at all voltages (380–690 V).

If the frequency converter is supplied with a mains disconnect, the SCCR of the frequency converter is 100,000 amps at all voltages (380–690 V).

If the frequency converter is supplied with a circuit breaker, the SCCR depends on the voltage, see *Table 10.8*:

| | 415 V | 480 V | 600 V | 690 V |
|-----------|-----------|-----------|----------|----------|
| D6h frame | 100,000 A | 100,000 A | 65,000 A | 70,000 A |
| D8h frame | 100,000 A | 100,000 A | 42,000 A | 30,000 A |

Table 10.8

If the frequency converter is supplied with a contactor-only option and is externally fused according to *Table 10.9*, the SCCR of the frequency converter is as follows:

| | 415 V IEC ¹⁾ | 480 V UL ²⁾ | 600 V UL ²⁾ | 690 V IEC ¹⁾ |
|--------------------------------------|----------------------------|---------------------------|---------------------------|----------------------------|
| D6h frame | 100,000 A | 100,000 A | 100,000 A | 100,000 A |
| D8h frame (not including the N315T4) | 100,000 A | 100,000 A | 100,000 A | 100,000 A |
| D8h frame (N315T4 only) | 100,000 A | Consult factory | Not applicable | |

Table 10.9

¹⁾ With a Bussmann type LPJ-SP or Gould Shawmut type AJT fuse. 450 A max fuse size for D6h and 900 A max fuse size for D8h.

²⁾ Must use Class J or L branch fuses for UL approval. 450 A max fuse size for D6h and 600 A max fuse size for D8h.

10.3.4 Connection Tightening Torques

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

| Frame Size | Terminal | Torque | Bolt size |
|---------------------|---|--------------------------------|-----------|
| D1h/D3h/D5h/ D6h | Mains Motor Load sharing Regen | 19-40 Nm (168-354 in-lbs) | M10 |
| | Earth (Ground) Brake | 8.5-20.5 Nm (75-181 in-lbs) | M8 |
| D2h/D4h/D7h/ D8h | Mains Motor Regen Load sharing Earth (ground) | 19-40 Nm (168-354 in-lbs) | M10 |
| | Brake | 8.5-20.5 Nm (75-181 in-lbs) | M8 |

Table 10.10 Torque for Terminals

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