

## 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**



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# 1 Introduction

## 1.1 Exploded Views

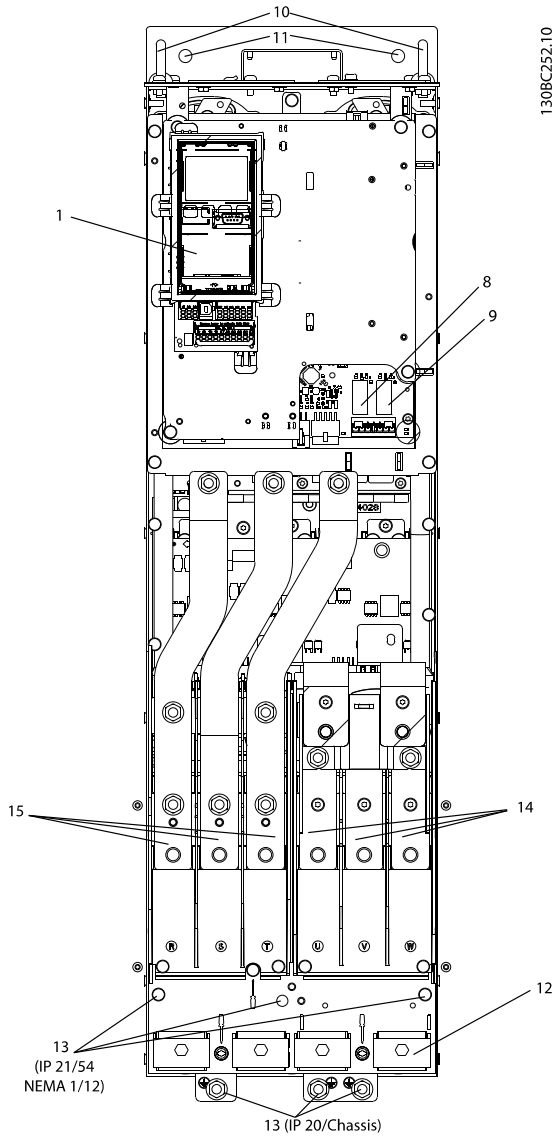


Figure 1.1 D1 Interior Components

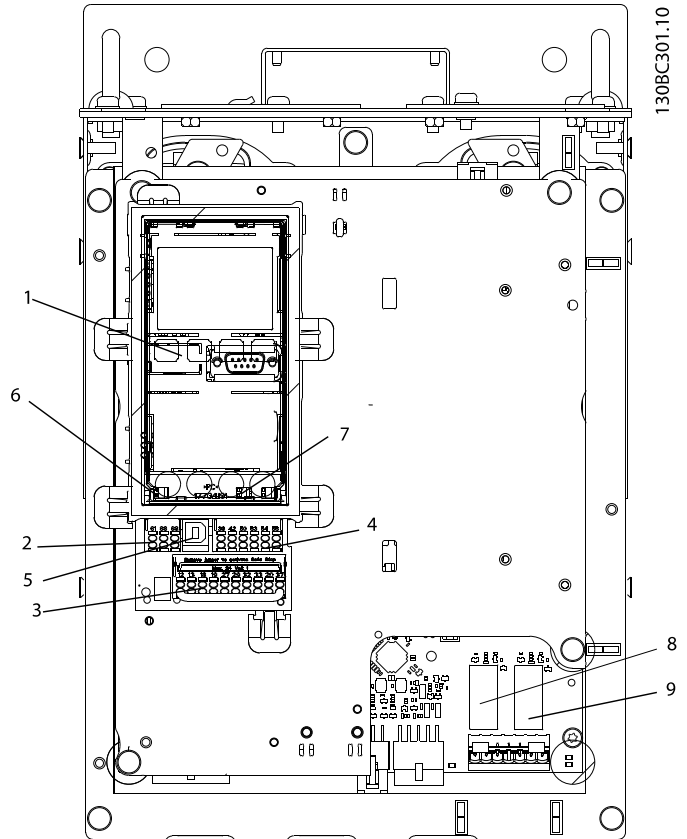


Figure 1.2 Close-up View: LCP and Control Functions

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)		

Table 1.1

## 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.
- 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 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

Figure 1.3 is a block diagram of the frequency converter's internal components. See Table 1.2 for their functions.

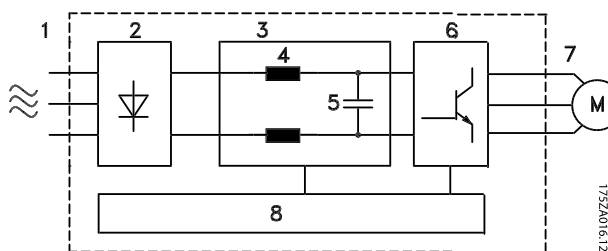


Figure 1.3 Frequency Converter Block Diagram

Area	Title	Functions
1	Mains input	<ul style="list-style-type: none"> <li>• Three-phase AC mains power supply to the frequency converter</li> </ul>
2	Rectifier	<ul style="list-style-type: none"> <li>• The rectifier bridge converts the AC input to DC current to supply inverter power</li> </ul>
3	DC bus	<ul style="list-style-type: none"> <li>• Intermediate DC-bus circuit handles the DC current</li> </ul>



Area	Title	Functions
4	DC reactors	<ul style="list-style-type: none"> <li>Filter the intermediate DC circuit voltage</li> <li>Provide line transient protection</li> <li>Reduce RMS current</li> <li>Raise the power factor reflected back to the line</li> <li>Reduce harmonics on the AC input</li> </ul>
5	Capacitor bank	<ul style="list-style-type: none"> <li>Stores the DC power</li> <li>Provides ride-through protection for short power losses</li> </ul>
6	Inverter	<ul style="list-style-type: none"> <li>Converts the DC into a controlled PWM AC waveform for a controlled variable output to the motor</li> </ul>

Area	Title	Functions
7	Output to motor	<ul style="list-style-type: none"> <li>Regulated three-phase output power to the motor</li> </ul>
8	Control circuitry	<ul style="list-style-type: none"> <li>Input power, internal processing, output, and motor current are monitored to provide efficient operation and control</li> <li>User interface and external commands are monitored and performed</li> <li>Status output and control can be provided</li> </ul>

Table 1.2 Frequency Converter Internal Components

### 1.6 Frame Sizes and Power Ratings

kW rated frequency converters									
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	D4h	D3h	D3h	D4h	D4h	D4h	D4h		
690 V		D3h	D3h	D3h	D4h	D4h	D4h		

Table 1.3

Horsepower 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 1.4



## 2 Installation

### 2.1 Planning the Installation Site

#### CAUTION

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.

Installation in High Altitudes	
Voltage	Altitude Restrictions
380-500 V	At altitudes above 3 km, contact Danfoss regarding PELV
525-690 V	At altitudes above 2 km, contact Danfoss regarding PELV.

Table 2.1

### 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 Danfoss VLT frequency converters utilize 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:

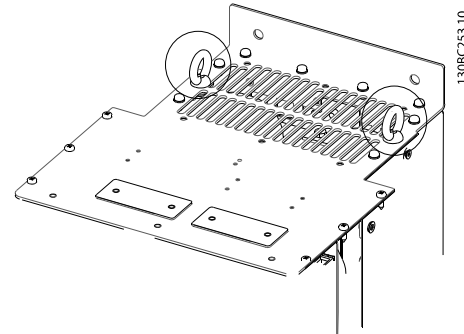
- AMA
- DC Hold
- Pre-Mag
- DC Brake
- 60% of nominal current is exceeded
- Specific heatsink temperature exceeded (power size dependent).
- Specific Power Card ambient temperature exceeded (power size dependent)
- Specific Control Card ambient temperature exceeded

Frame	Door fan/top fan	Heatsink fan
D1h/D3h	102 m <sup>3</sup> /hr (60 CFM)	420 m <sup>3</sup> /hr (250 CFM)
D2h/D4h	204 m <sup>3</sup> /hr (120 CFM)	840 m <sup>3</sup> /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.



**Figure 2.1 Position Lifting Straps where Indicated**

**CAUTION**

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

**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

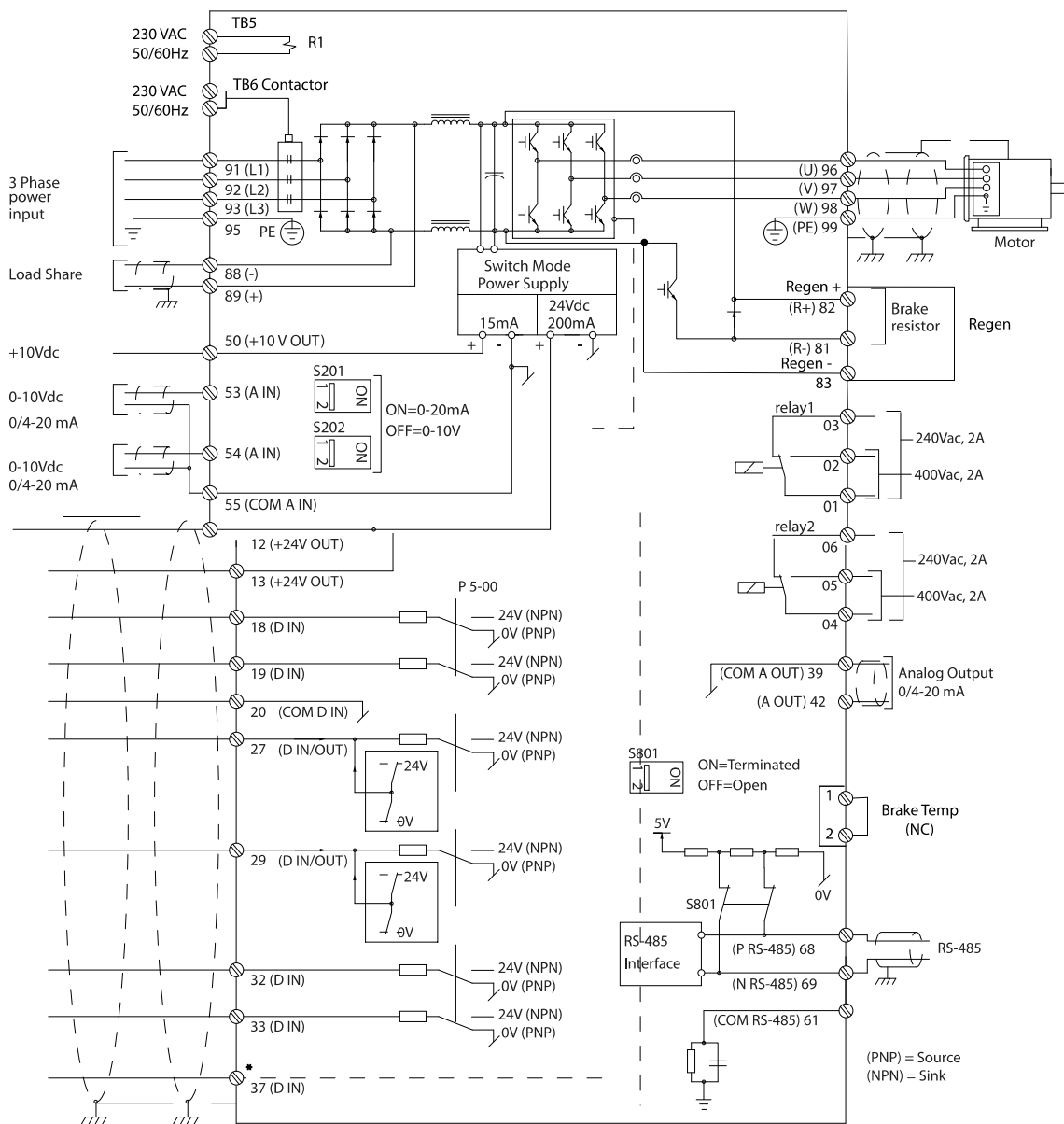
## 2.4 Electrical Installation

### 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



130BC300.10

Figure 2.2

**⚠ 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.

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 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 Figure 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 Figure 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.

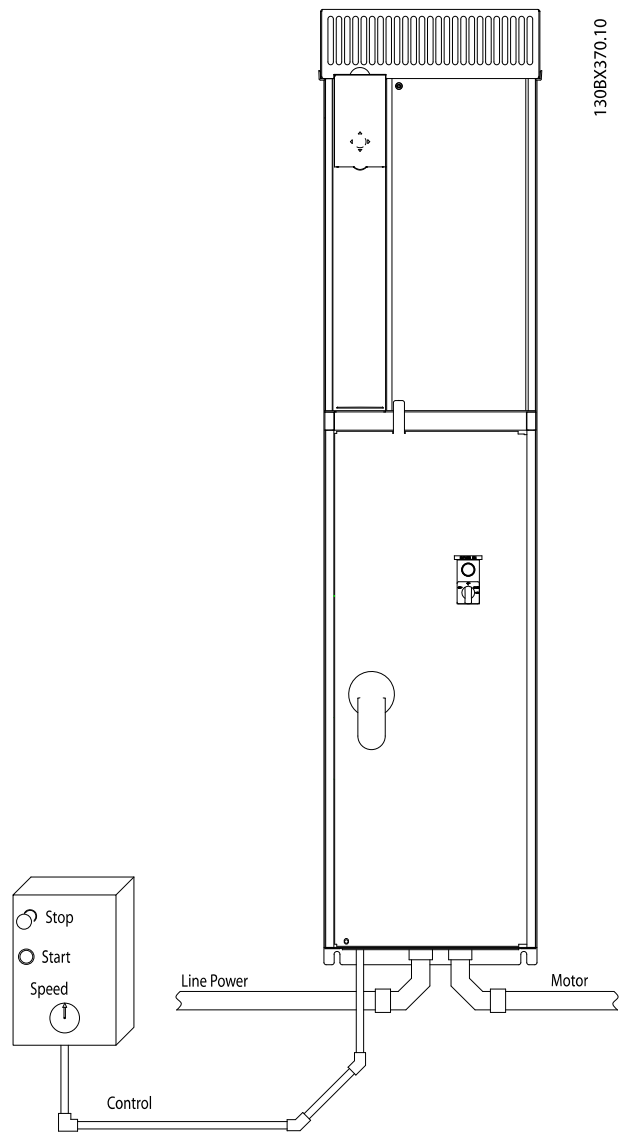


Figure 2.3 Example of Proper Electrical Installation Using Conduit

- All frequency converters must be provided with short-circuit and over-current protection. Input fusing is required to provide this protection, see *Figure 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*.

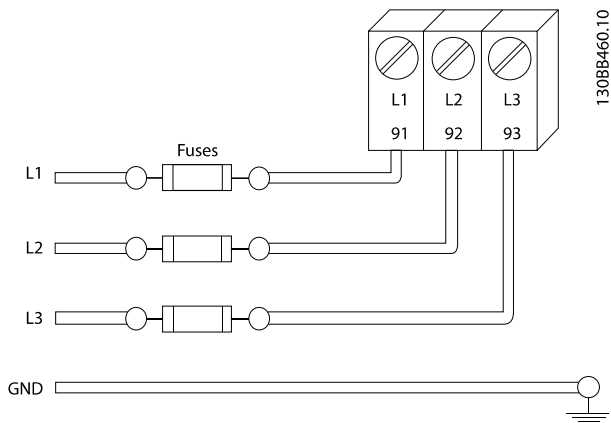


Figure 2.4 Frequency Converter Fuses

**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. Earthing (grounding) hazard

**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 mm<sup>2</sup>
- 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.

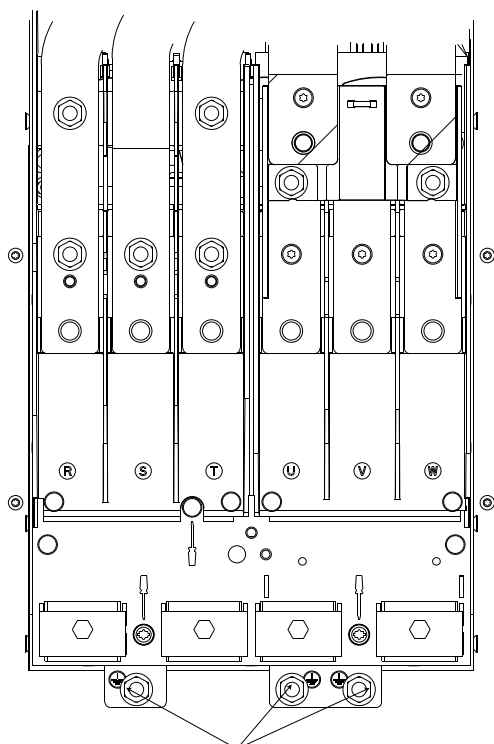
2.4.2.2 Earthing (Grounding) IP20 Enclosures

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 *Figure 2.6*.

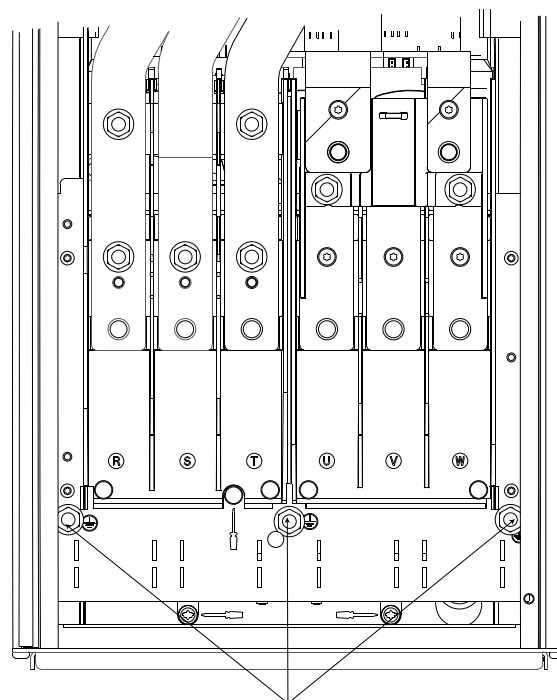
2.4.2.3 Earthing (Grounding) IP21/54 Enclosures

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 *Figure 2.6*.

2



1308C303.10



1308C304.10

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

Figure 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.

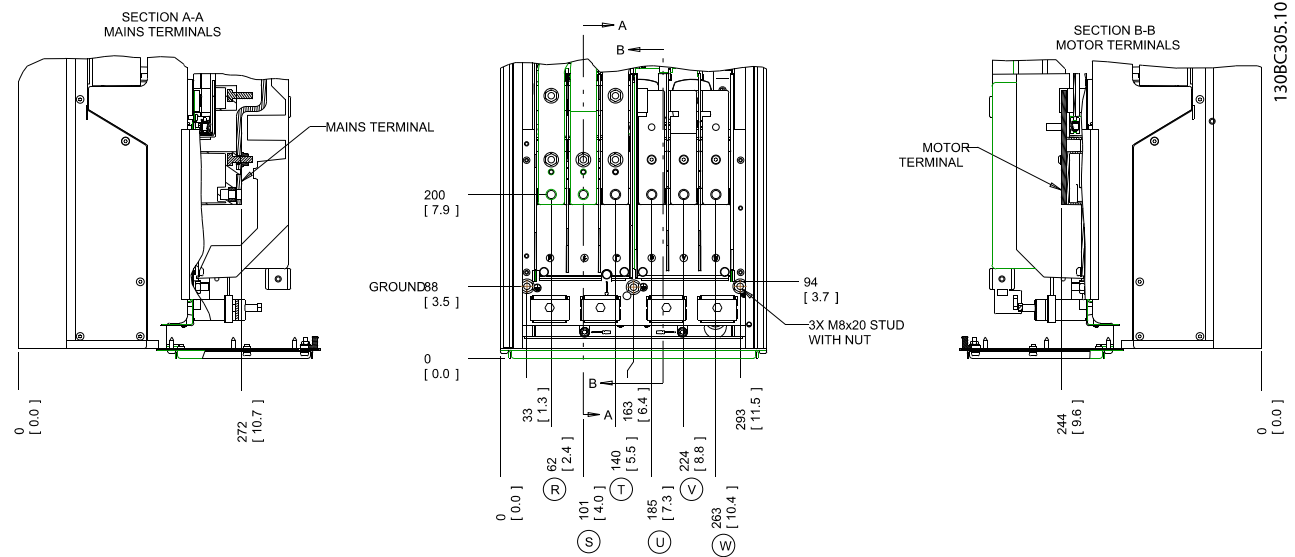


Figure 2.7 Terminal Locations D1h

2

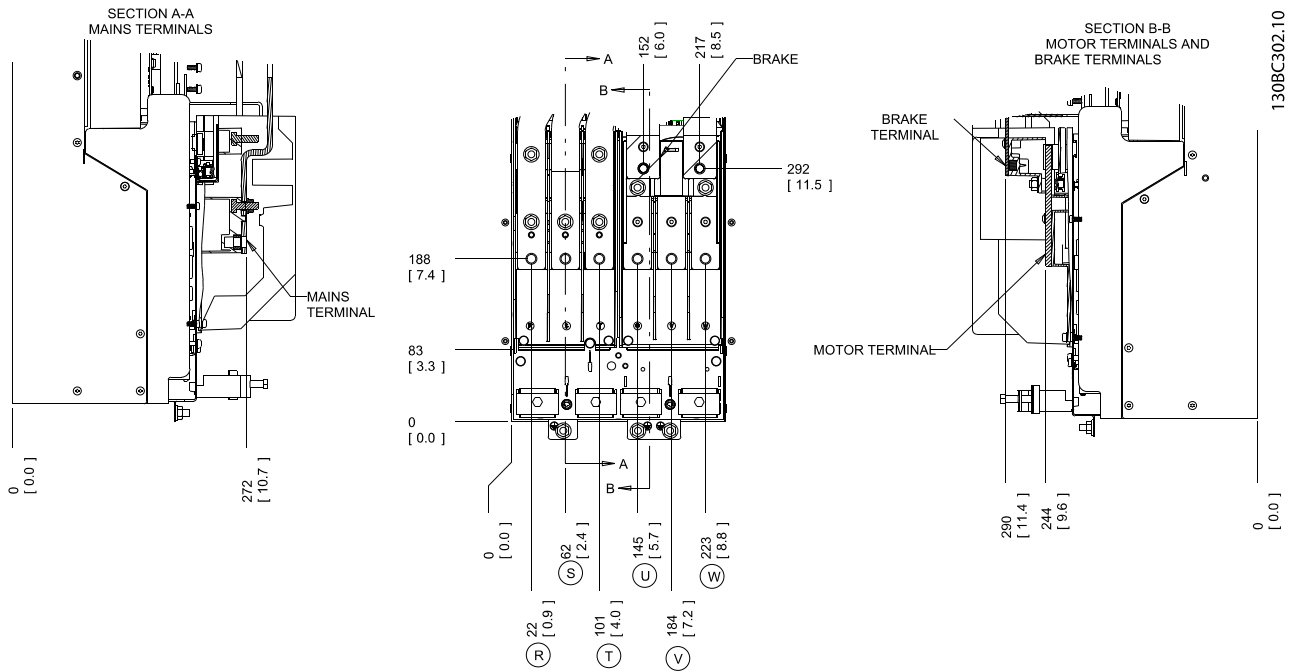


Figure 2.8 Terminal Locations D3h

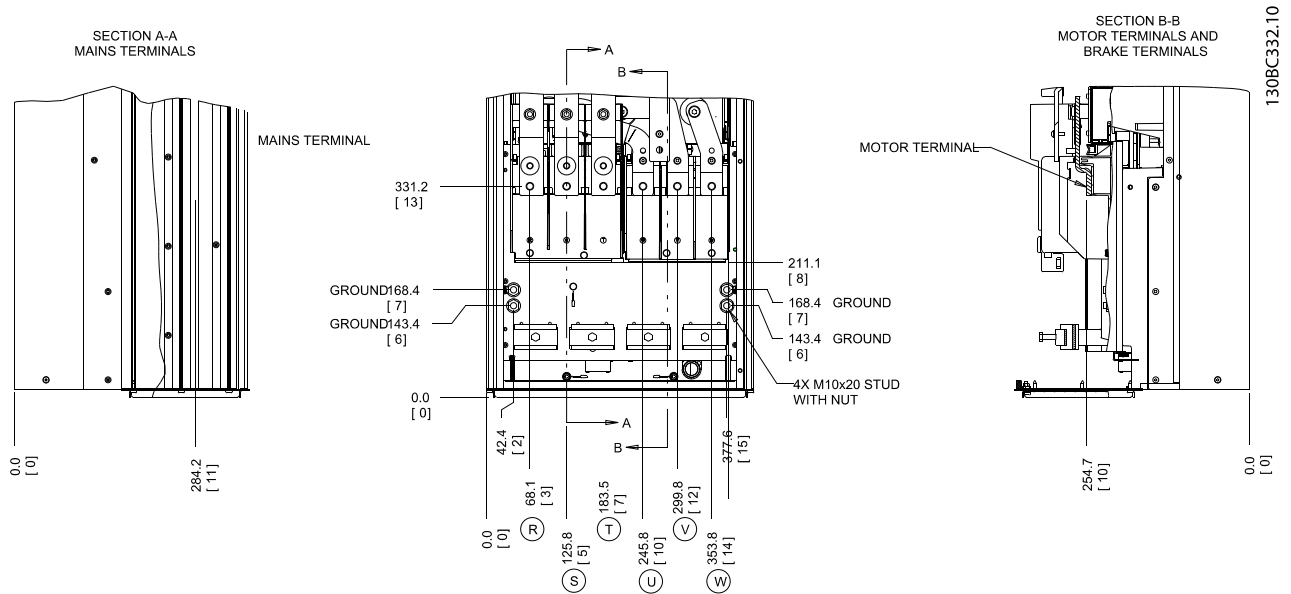


Figure 2.9 Terminal Locations D2h

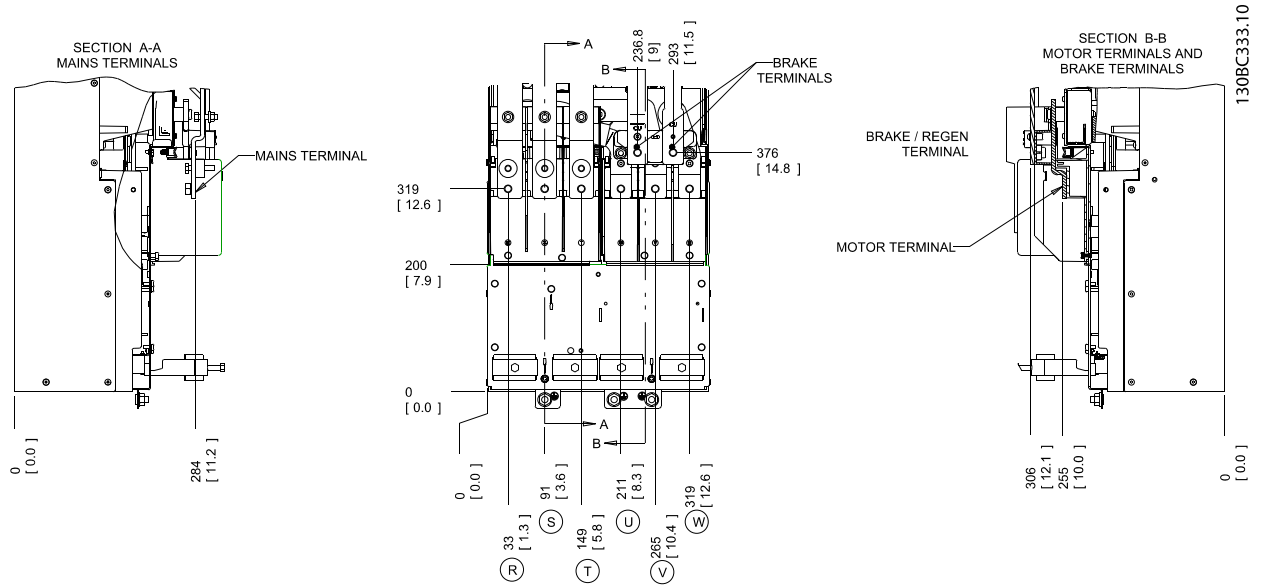


Figure 2.10 Terminal Locations D4h

### 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 2.3

### 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*.

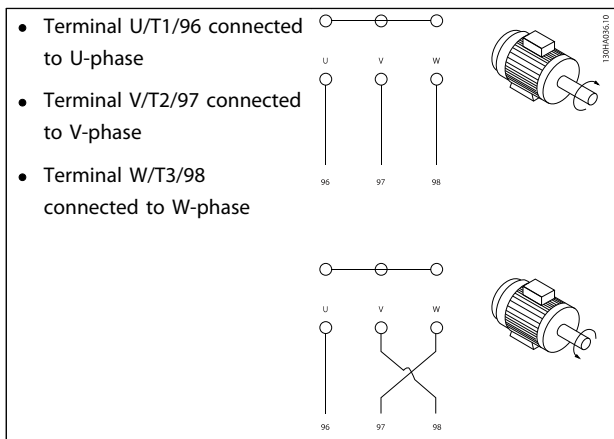


Table 2.4

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 *Figure 2.11*).

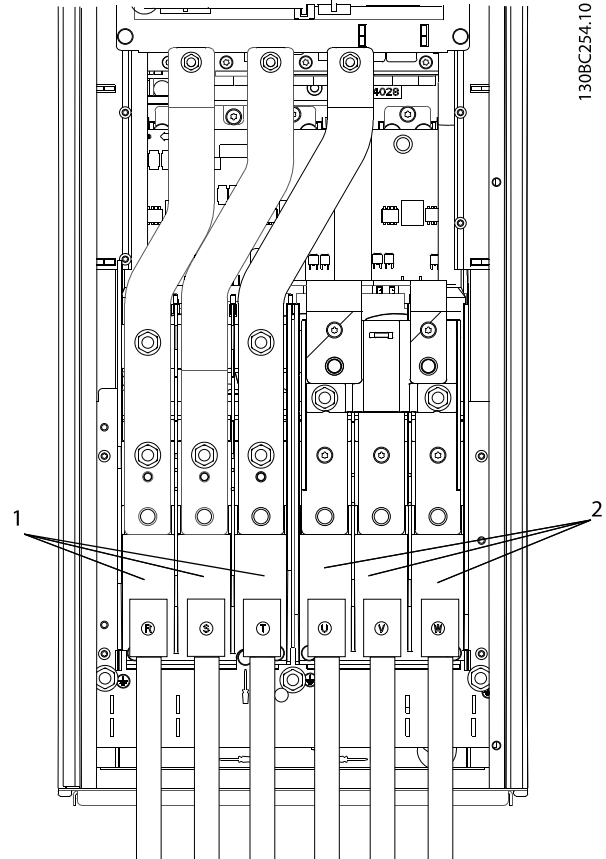


Figure 2.11 Connecting to AC Mains

1	Mains connection
2	Motor connection

Table 2.5

- 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.
- Aluminium-clad with copper wire.
  - Twisted copper wire or armoured steel wire cable.
  - Single-layer braided copper wire with varying percentage screen coverage.  
This is the typical Danfoss reference cable.

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

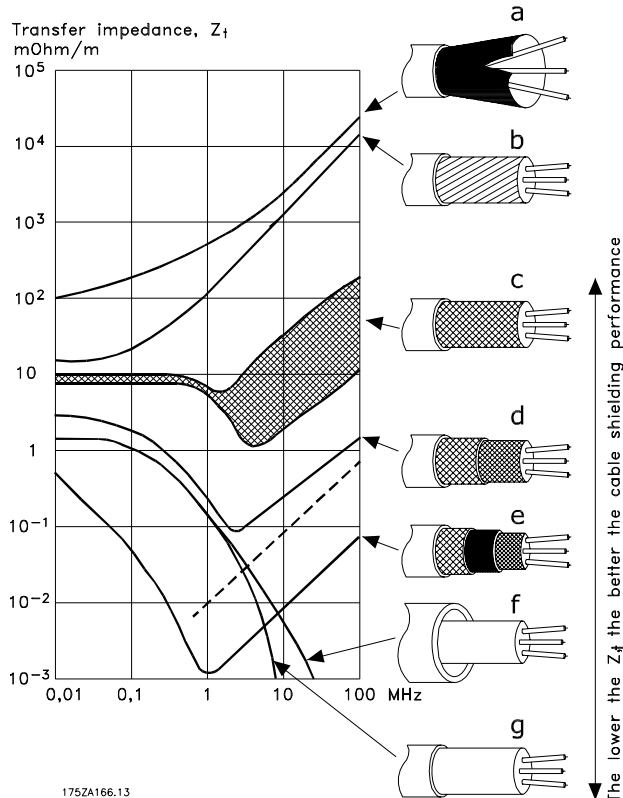


Figure 2.12

### 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 mm<sup>2</sup>.

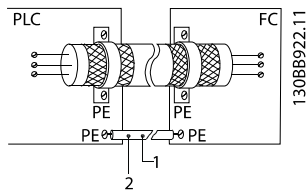


Figure 2.13

1	Min. 16 mm <sup>2</sup>
2	Equalizing cable

Table 2.6

#### 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).

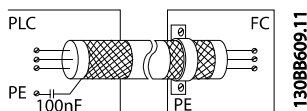


Figure 2.14

#### 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:

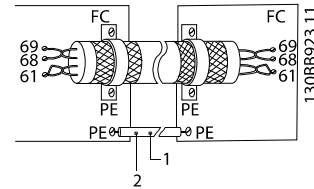


Figure 2.15

1	Min. 16 mm <sup>2</sup>
2	Equalizing cable

Table 2.7

Alternatively, the connection to terminal 61 can be omitted:

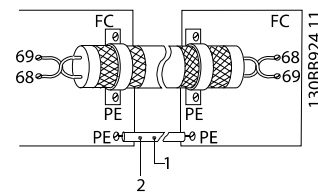


Figure 2.16

1	Min. 16 mm <sup>2</sup>
2	Equalizing cable

Table 2.8

### 2.5.4 Control Terminal Types

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

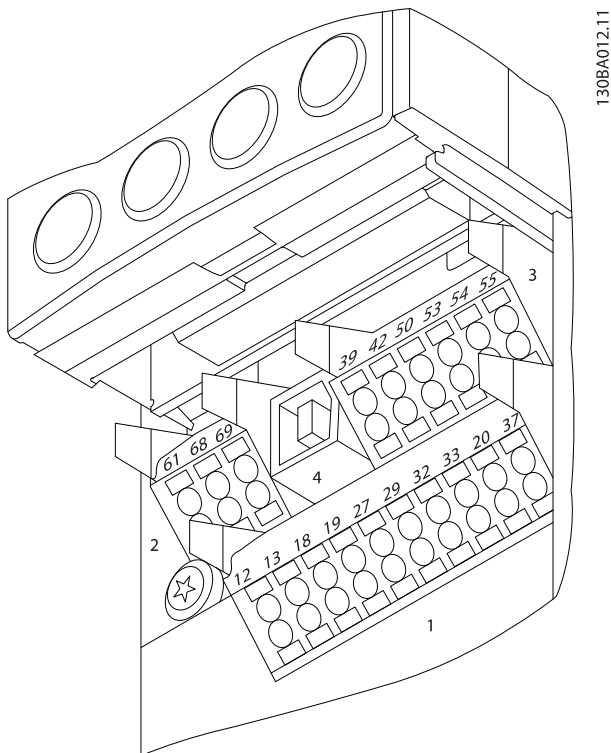


Figure 2.17 Control Terminal Locations

- **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.

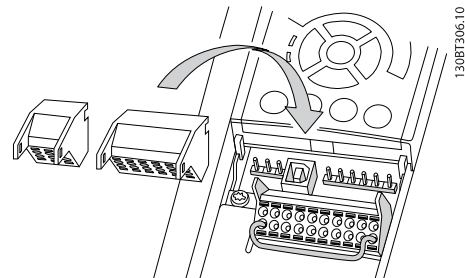


Figure 2.18

### 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.

## 2.6 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

**2**

(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 $\Omega$
Max. cable length	1200 m (including drop lines) 500 m station-to-station

**Table 2.9**



### 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.

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

Table 3.1 Start Up Check List

### 3.2 Applying Power to the Frequency Converter

#### **⚠ 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.

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!**

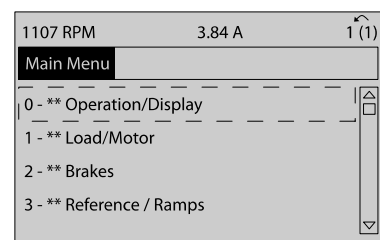
The start conditions will be ignored while in the wizard.

#### **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. Use the navigation keys to scroll to parameter group 0-\*\* *Operation/Display* and press [OK].



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Figure 3.1

### 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.

- Use navigation keys to scroll to parameter group 0-0\* *Basic Settings* and press [OK].

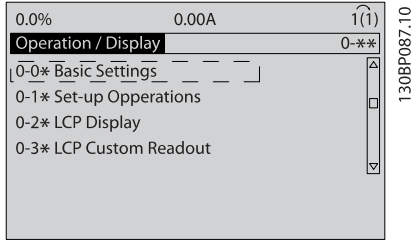


Figure 3.2

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

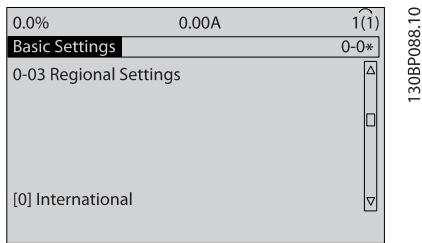


Figure 3.3

- Use 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.
- Use the navigation keys to scroll to parameter group Q2 *Quick Setup* and press [OK].

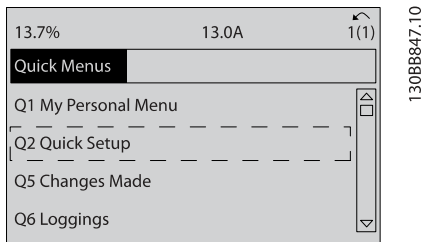


Figure 3.4

- Select language and press [OK]. Then enter the motor data in 1-20 *Motor Power [kW]* / 1-21 *Motor Power [HP]* through 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*

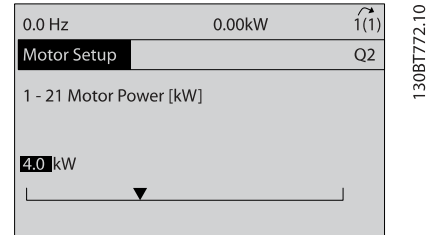


Figure 3.5

- 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 Danfoss 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.

1. Press [Hand On].
2. Accelerate the frequency converter by pressing [▲] to full speed. Moving the cursor left of the decimal point provides quicker input changes.
3. Note any acceleration problems.
4. Press [Off].
5. 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 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 .
- Check that motor data is entered correctly.
- Increase the ramp-down 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 the Frequency Converter* through *3.3 Basic Operational Programming* in this chapter concludes 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 problems.

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.

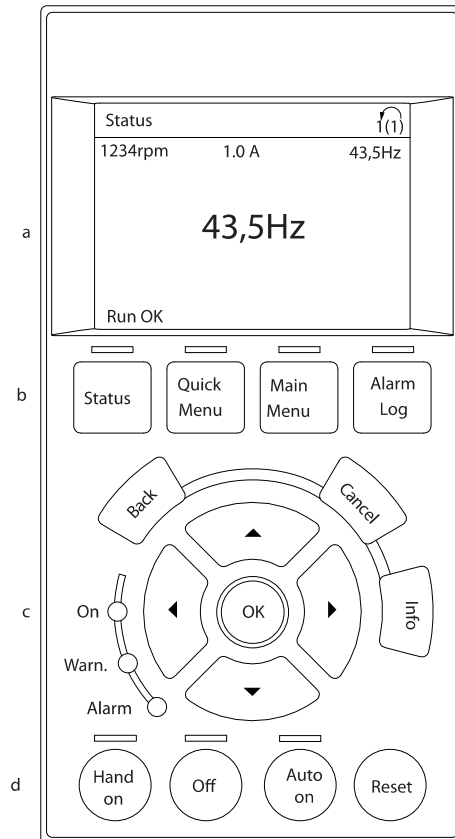
The LCP has several user functions.

- 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 *VLT® Programming Guide*, for details on use of the NLCP.

#### 4.1.1 LCP Layout

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



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Figure 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 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

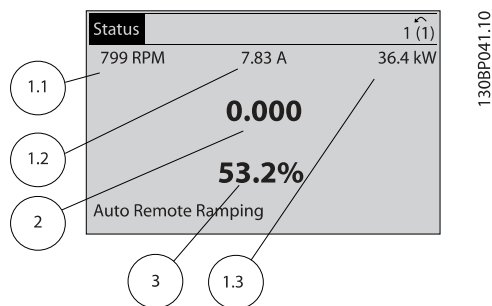


Figure 4.2

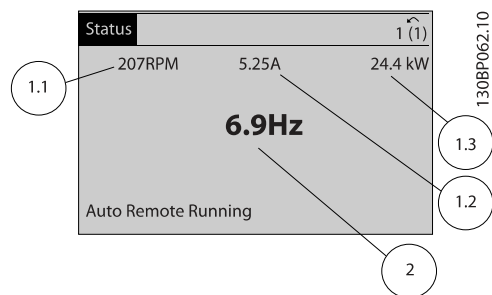


Figure 4.3

### 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.

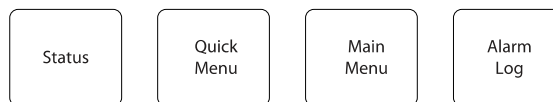


Figure 4.4

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Key	Function
<b>Status</b>	Shows operational information. <ul style="list-style-type: none"> <li>• In Auto mode, press to toggle between status read-out displays</li> <li>• Press repeatedly to scroll through each status display</li> <li>• Press [Status] plus [▲] or [▼] to adjust the display brightness</li> <li>• 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.</li> </ul>
<b>Quick Menu</b>	Allows access to programming parameters for initial set up instructions and many detailed application instructions. <ul style="list-style-type: none"> <li>• Press to access Q2 <i>Quick Setup</i> for sequenced instructions to program the basic frequency controller set up</li> <li>• Follow the sequence of parameters as presented for the function set up</li> </ul>
<b>Main Menu</b>	Allows access to all programming parameters. <ul style="list-style-type: none"> <li>• Press twice to access top-level index</li> <li>• Press once to return to the last location accessed</li> <li>• Press to enter a parameter number for direct access to that parameter</li> </ul>
<b>Alarm Log</b>	Displays a list of current warnings, the last 10 alarms, and the maintenance log. <ul style="list-style-type: none"> <li>• For details about the frequency converter before it entered the alarm mode, select the alarm number using the navigation keys and press [OK].</li> </ul>

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.

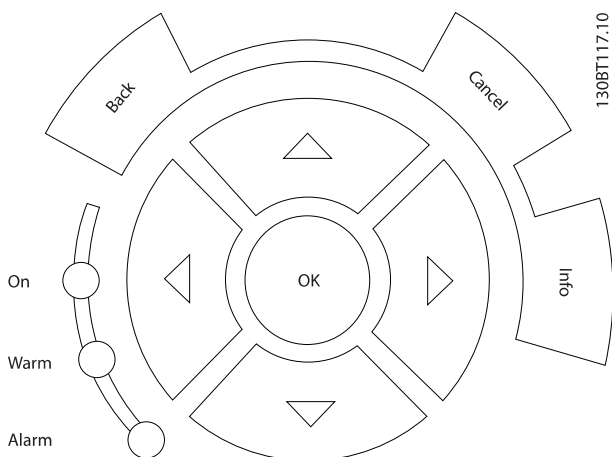


Figure 4.5

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

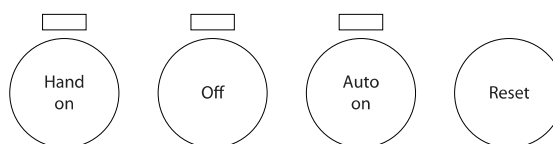


Figure 4.6

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

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

### 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

### 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

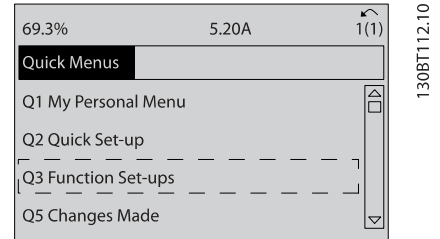


Figure 5.1

3. Q3-2 Open Loop Settings

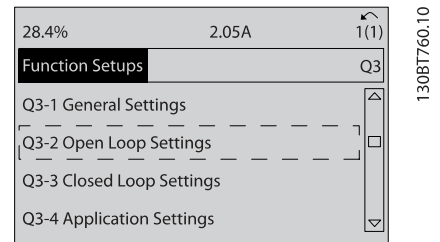


Figure 5.2

4. Q3-21 Analog Reference

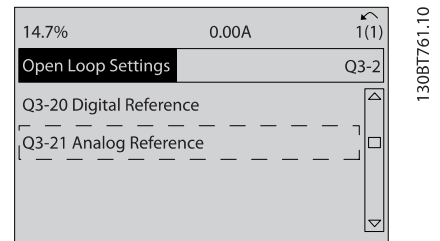


Figure 5.3

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

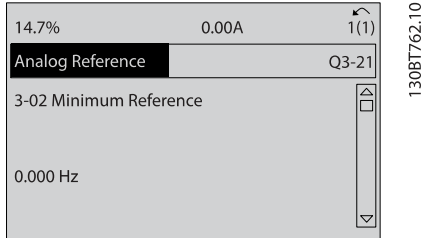


Figure 5.4

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.)

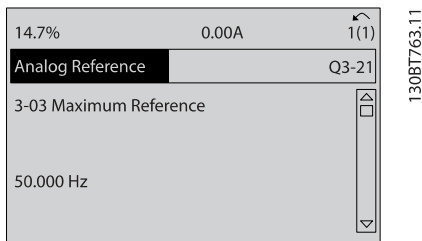


Figure 5.5

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.)

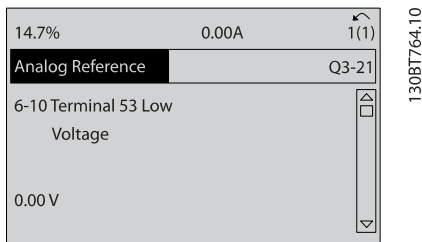


Figure 5.6

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.)

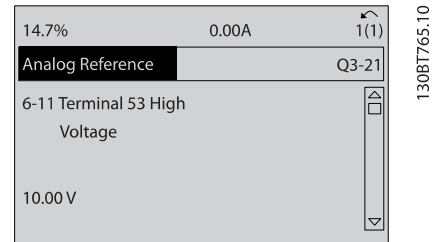


Figure 5.7

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.)

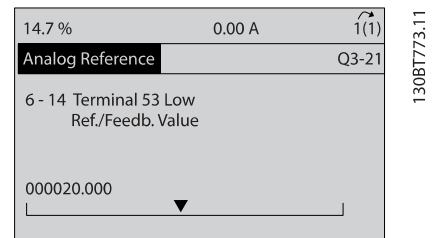


Figure 5.8

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.)

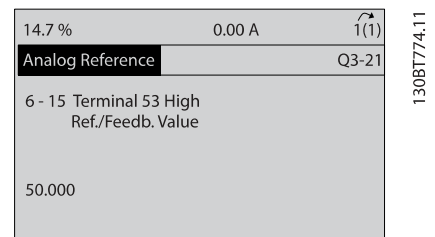


Figure 5.9

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

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

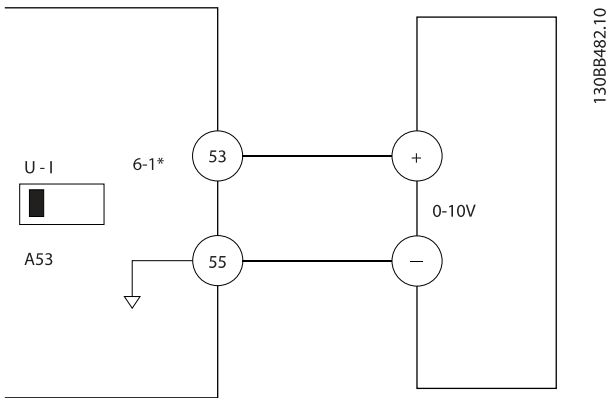


Figure 5.10 Wiring Example for External Device Providing 0-10 V Control Signal

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

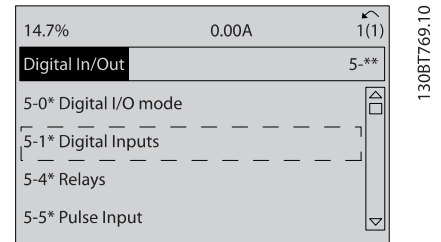


Figure 5.12

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

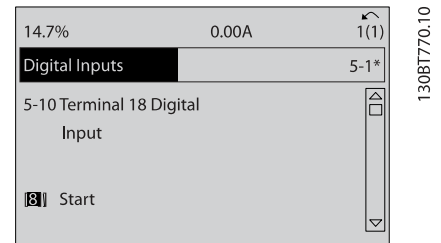


Figure 5.13

### 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 5-1\* *Digital In/Out Parameter Data Set* and press [OK].

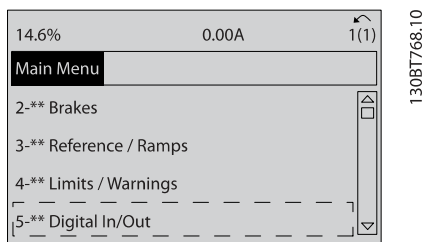


Figure 5.11

### 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

Parameter	International Default Parameter Value	North American Default Parameter Value
4-13 Motor Speed High Limit [RPM] See Note 3	1500 RPM	1800 RPM
4-14 Motor Speed High Limit [Hz] See Note 4	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 <i>Reset Mode</i>	Manual reset	Infinite auto reset
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*

Code	Operation / Display	Code	Parameter	Code	Parameter	Code	Parameter
1-0*	General Settings	1-86	Trip Speed Low [RPM]	4-13	Motor Speed High Limit [RPM]	5-60	Terminal 27 Pulse Output Variable
1-00	Configuration Mode	1-87	Trip Speed Low [Hz]	4-14	Motor Speed High Limit [Hz]	5-62	Pulse Output Max Freq #27
1-03	Torque Characteristics	1-9*	Motor Temperature	4-16	Torque Limit Motor Mode	5-63	Terminal 29 Pulse Output Variable
1-06	Clockwise Direction	1-90	Motor Thermal Protection	4-17	Torque Limit Generator Mode	5-65	Pulse Output Max Freq #29
1-1*	Motor Selection	1-91	Motor External Fan	4-18	Current Limit	5-66	Terminal X30/6 Pulse Output Variable
1-10	Motor Construction	1-93	Thermistor Source	4-19	Max Output Frequency	5-68	Pulse Output Max Freq #X30/6
1-11*	WC+ PM	2-*	Brakes	4-5*	Adj. Warnings	5-8*	I/O Options
1-14	Damping Gain	2-0*	DC Brake	4-50	Warning Current Low	5-80	AHF Cap Reconnect Delay
1-15	Low Speed Filter Time Const.	2-00	DC Hold/Preheat Current	4-51	Warning Current High	5-9*	Bus Controlled
1-16	High Speed Filter Time Const.	2-01	DC Brake Current	4-52	Warning Speed Low	5-90	Digital & Relay Bus Control
1-17	Voltage filter time const.	2-02	DC Braking Time	4-53	Warning Speed High	5-93	Pulse Out #27 Bus Control
1-20	Motor Power [kW]	2-03	DC Brake Cut In Speed [RPM]	4-54	Warning Reference Low	5-94	Pulse Out #27 Timeout Preset
1-21	Motor Power [HP]	2-04	DC Brake Cut In Speed [Hz]	4-55	Warning Reference High	5-95	Pulse Out #29 Bus Control
1-22	Motor Voltage	2-06	Parking Current	4-56	Warning Feedback Low	5-96	Pulse Out #29 Timeout Preset
1-23	Motor Frequency	2-07	Parking Time	4-57	Warning Feedback High	5-97	Pulse Out #X30/6 Bus Control
1-24	Motor Current	2-1*	Brake Energy Funct.	4-58	Missing Motor Phase Function	5-98	Pulse Out #X30/6 Timeout Preset
1-25	Motor Nominal Speed	2-10	Brake Function	4-6*	Speed Bypass	6-6*	Analog I/O Out
1-26	Motor Cont. Rated Torque	2-11	Brake Resistor (ohm)	4-60	Bypass Speed From [RPM]	6-0*	Analog I/O Mode
1-28	Motor Rotation Check	2-12	Brake Power Limit (kW)	4-61	Bypass Speed From [Hz]	6-00	Live Zero Timeout Function
1-29	Automatic Motor Adaptation (AMA)	2-13	Brake Power Monitoring	4-62	Bypass Speed To [RPM]	6-01	Live Zero Timeout Function
1-3*	Adv. Motor Data	2-15	Brake Check	4-63	Bypass Speed To [Hz]	6-02	Fire Mode Live Zero Timeout Function
1-30	Stator Resistance (Rs)	2-16	AC brake Max. Current	4-64	Semi-Auto Bypass Set-up	6-1*	Analog Input 53
1-31	Rotor Resistance (Rr)	2-17	Over-voltage Control	5-*	Digital I/O Out	6-10	Terminal 53 Low Voltage
1-35	Main Reactance (Xh)	3-*	Reference / Ramps	5-0*	Digital I/O Mode	6-11	Terminal 53 High Voltage
1-36	Iron Loss Resistance (Rfe)	3-0*	Reference Limits	5-00	Digital I/O Mode	6-12	Terminal 53 Low Current
1-37	d-axis Inductance (Ld)	3-02	Minimum Reference	5-01	Terminal 27 Mode	6-13	Terminal 53 High Current
1-39	Motor Poles	3-03	Maximum Reference	5-02	Terminal 29 Mode	6-14	Terminal 53 Low Ref./Feedb. Value
1-40	Back EMF at 1000 RPM	3-04	Reference Function	5-1*	Digital Inputs	6-15	Terminal 53 High Ref./Feedb. Value
1-50	Motor Magnetisation at Zero Speed [RPM]	3-10	References	5-10	Terminal 18 Digital Input	6-16	Terminal 53 Filter Time Constant
1-51	Min Speed Normal Magnetising [Hz]	3-11	Preset Reference	5-11	Terminal 19 Digital Input	6-17	Terminal 53 Live Zero
1-52	Min Speed Normal Magnetising [Hz]	3-13	Jog Speed [Hz]	5-12	Terminal 27 Digital Input	6-2*	Analog Input 54
1-58	Flystart Test Pulses Current	3-14	Reference Site	5-13	Terminal 29 Digital Input	6-20	Terminal 54 Low Voltage
1-59	Flystart Test Pulses Frequency	3-15	Preset Relative Reference	5-14	Terminal 32 Digital Input	6-21	Terminal 54 High Voltage
1-6*	Load Depen. Setting	3-16	Reference 1 Source	5-15	Terminal 33 Digital Input	6-22	Terminal 54 Low Current
1-60	Low Speed Load Compensation	3-17	Reference 2 Source	5-16	Terminal X30/2 Digital Input	6-23	Terminal 54 High Current
1-61	High Speed Load Compensation	3-18	Reference 3 Source	5-17	Terminal X30/3 Digital Input	6-24	Terminal 54 Low Ref./Feedb. Value
1-62	Slip Compensation	3-19	Jog Speed [RPM]	5-18	Terminal X30/4 Digital Input	6-25	Terminal 54 High Ref./Feedb. Value
1-64	Resonance Dampening	3-4*	Ramp 1	5-19	Terminal 37 Safe Stop	6-26	Terminal 54 Filter Time Constant
1-65	Resonance Dampening Time	3-41	Ramp 1 Ramp Up Time	5-3*	Digital Outputs	6-27	Terminal 54 Live Zero
1-66	Constant	3-42	Ramp 1 Ramp Down Time	5-30	Terminal 27 Digital Output	6-3*	Analog Input X30/11
1-7*	Start Adjustments	3-5*	Ramp 2	5-31	Terminal 29 Digital Output	6-30	Terminal X30/11 Low Voltage
1-70	PM Startmode	3-51	Ramp 2 Ramp Up Time	5-32	Term X30/6 Digi Out (MCB 101)	6-31	Terminal X30/11 High Voltage
1-71	Date and Time	3-52	Ramp 2 Ramp Down Time	5-33	Term X30/7 Digi Out (MCB 101)	6-34	Term. X30/11 Low Ref./Feedb. Value
1-72	Date Format	3-8*	Other Ramps	5-40	Function Relay	6-35	Term. X30/11 High Ref./Feedb. Value
1-73	Time Format	3-80	Jog Ramp Time	5-41	On Delay, Relay	6-36	Term. X30/11 Filter Time Constant
1-74	DST/Summertime	3-81	Quick Stop Ramp Time	5-42	Off Delay, Relay	6-37	Term. X30/11 Live Zero
1-75	DST/Summertime Start	3-82	Starting Ramp Up Time	5-5*	Pulse Input	6-40	Terminal X30/12 Low Voltage
1-76	DST/Summertime End	3-90	Step Size	5-50	Term. 29 Low Frequency	6-41	Terminal X30/12 High Voltage
1-79	Clock Fault	3-91	Ramp Time	5-51	Term. 29 High Frequency	6-42	Term. X30/12 Low Ref./Feedb. Value
1-81	Working Days	3-92	Power Restore	5-52	Term. 29 Low Ref./Feedb. Value	6-43	Term. X30/12 High Ref./Feedb. Value
1-82	Additional Working Days	3-93	Maximum Limit	5-53	Term. 29 High Ref./Feedb. Value	6-44	Term. X30/12 Filter Time Constant
1-83	Additional Non-Working Days	3-94	Minimum Limit	5-54	Pulse Filter Time Constant #29	6-45	Term. X30/12 Live Zero
1-84	Date and Time Readout	3-95	Ramp Delay	5-55	Term. 33 Low Frequency	6-46	Term. X30/12 Live Zero
1-85	Min Speed for Function at Stop [Hz]	4-*	Limits / Warnings	5-56	Term. 33 High Frequency	6-5*	Analog Output 42
1-86	Min Speed for Function at Stop [RPM]	4-1*	Motor Limits	5-57	Term. 33 High Ref./Feedb. Value	6-50	Terminal 42 Output
1-87	Min Speed for Function at Stop [Hz]	4-10	Motor Speed Direction [RPM]	5-58	Term. 33 Low Ref./Feedb. Value	6-51	Terminal 42 Output Min Scale
1-88	Min Speed for Function at Stop [Hz]	4-11	Motor Speed Low Limit [RPM]	5-59	Pulse Filter Time Constant #33	6-52	Terminal 42 Output Max Scale
1-89	Min Speed for Function at Stop [Hz]	4-12	Motor Speed Low Limit [Hz]	5-6*	Pulse Output	6-53	Terminal 42 Output Bus Control

5.5.1 Main Menu Structure

6-54	Terminal 42 Output Timeout Preset	8-91	Bus Jog 2 Speed	10-30	Array Index	12-9*	<b>Advanced Ethernet Services</b>	14-5*	<b>Environment</b>
6-55	Analog Output Filter	8-94	Bus Feedback 1	10-31	Store Data Values	12-90	Cable Diagnostic	14-50	RFI Filter
6-6*	<b>Analog Output X30/8</b>	8-95	Bus Feedback 2	10-32	DeviceNet Revision	12-91	Auto Cross Over	14-51	DC Link Compensation
6-60	Terminal X30/8 Output	9-96	Bus Feedback 3	10-33	Store Always	12-92	IGMP Snooping	14-52	Fan Control
6-61	Terminal X30/8 Min. Scale	9-96	<b>Profibus</b>	10-34	DeviceNet Product Code	12-93	Cable Error Length	14-53	Fan Monitor
6-62	Terminal X30/8 Max. Scale	9-96	Setpoint	10-39	DeviceNet F Parameters	12-94	Broadcast Storm Protection	14-55	Output Filter
6-63	Terminal X30/8 Output Bus Control	9-07	Actual Value	11-1*	<b>LonWorks</b>	12-95	Broadcast Storm Filter	14-59	Actual Number of Inverter Units
6-64	Terminal X30/8 Output Timeout Preset	9-15	PCD Write Configuration	11-0*	<b>LonWorks ID</b>	12-96	Port Config	14-6*	<b>Auto Derate</b>
		9-16	PCD Read Configuration	11-00	Neuron ID	12-98	Interface Counters	14-60	Function at Over Temperature
		9-18	Node Address	11-1*	<b>LON Functions</b>	12-99	Media Counters	14-61	Function at Inverter Overload
		9-22	Telegram Selection	11-10	Drive Profile	13-9*	<b>Smart Logic</b>	14-62	Inv. Overload Derate Current
8-01	Control Site	9-23	Parameters for Signals	11-15	LON Warning Word	13-0*	<b>SLC Settings</b>	15-5*	<b>Drive Information</b>
8-02	Control Source	9-27	Parameter Edit	11-17	XIF Revision	13-00	SL Controller Mode	15-0*	<b>Operating Data</b>
8-03	Control Timeout Time	9-28	Process Control	11-18	LonWorks Revision	13-01	Start Event	15-00	Operating Hours
8-04	Control Timeout Function	9-44	Fault Message Counter	11-2*	<b>LON Param. Access</b>	13-02	Stop Event	15-01	Running Hours
8-05	End-of-Timeout Function	9-45	Fault Code	12-1*	Store Data Values	13-03	Reset SLC	15-02	kWh Counter
8-06	Reset Control Timeout	9-47	Fault Number	12-2*	<b>Ethernet</b>	13-1*	<b>Comparators</b>	15-03	Power Up's
8-07	Diagnosis Trigger	9-52	Fault Situation Counter	12-0*	<b>IP Settings</b>	13-10	Comparator Operand	15-04	Over Temp's
8-08	Readout Filtering	9-53	Profibus Warning Word	12-00	IP Address Assignment	13-11	Comparator Operator	15-05	Over Volt's
8-09	Communication Chariset	9-63	Actual Baud Rate	12-01	IP Address	13-12	Comparator Value	15-06	Reset kWh Counter
8-1*	<b>Control Settings</b>	9-64	Device Identification	12-02	Subnet Mask	13-2*	<b>Timers</b>	15-07	Reset Running Hours Counter
8-10	Control Profile	9-65	Profile Number	12-04	Default Gateway	13-20	SL Controller Timer	15-08	Number of Starts
8-13	Configurable Status Word STW	9-67	Control Word 1	12-05	DHCP Server	13-4*	<b>Logic Rules</b>	15-1*	<b>Data Log Settings</b>
8-3*	<b>FC Port Settings</b>	9-68	Status Word 1	12-05	Lease Expires	13-40	Logic Rule Boolean 1	15-10	Logging Source
8-30	Protocol	9-71	Profibus Save Data Values	12-06	Name Servers	13-41	Logic Rule Operator 1	15-11	Logging Interval
8-31	Address	9-72	ProfibusDriveReset	12-07	Domain Name	13-42	Logic Rule Boolean 2	15-12	Trigger Event
8-32	Baud Rate	9-75	DO Identification	12-08	Host Name	13-43	Logic Rule Operator 2	15-13	Logging Mode
8-33	Parity / Stop Bits	9-80	Defined Parameters (1)	12-09	Physical Address	13-44	Logic Rule Boolean 3	15-14	Samples Before Trigger
8-34	Estimated cycle time	9-81	Defined Parameters (2)	12-10	<b>Ethernet Link Parameters</b>	13-5*	<b>States</b>	15-2*	<b>Historic Log</b>
8-35	Minimum Response Delay	9-82	Defined Parameters (3)	12-10	Link Status	13-51	SL Controller Event	15-20	Historic Log: Event
8-36	Maximum Response Delay	9-83	Defined Parameters (4)	12-11	Link Duration	13-52	SL Controller Action	15-21	Historic Log: Value
8-37	Maximum Inter-Char Delay	9-84	Defined Parameters (5)	12-12	Auto Negotiation	14-0*	<b>Special Functions</b>	15-22	Historic Log: Time
8-4*	<b>FC MC protocol set</b>	9-90	Changed Parameters (1)	12-13	Link Speed	14-0*	<b>Inverter Switching</b>	15-23	Historic Log: Date and Time
8-40	Telegram Selection	9-91	Changed Parameters (2)	12-2*	<b>Control Data</b>	14-01	Switching Pattern	15-3*	<b>Alarm Log</b>
8-42	PCD write configuration	9-92	Changed Parameters (3)	12-20	Control Instance	14-03	Switching Frequency	15-30	Alarm Log: Error Code
8-43	PCD read configuration	9-93	Changed Parameters (4)	12-21	Process Data Config Write	14-03	Overmodulation	15-31	Alarm Log: Value
8-5*	<b>Digital/Bus</b>	9-94	Changed Parameters (5)	12-21	Process Data Config Read	14-04	PWM Random	15-32	Alarm Log: Time
8-50	Coasting Select	9-99	Profibus Revision Counter	12-22	Process Data Config Read	14-1*	<b>Mains On/Off</b>	15-33	Alarm Log: Date and Time
8-52	DC Brake Select	10-0*	<b>CAN Fields</b>	12-27	Primary Master	14-10	Mains Failure	15-4*	<b>Drive Identification</b>
8-53	Start Select	10-0*	<b>Common Settings</b>	12-28	Store Data Values	14-11	Mains Voltage at Mains Fault	15-40	FC Type
8-54	Reversing Select	10-00	CAN Protocol	12-29	Store Always	14-12	Function at Mains Imbalance	15-41	Power Section
8-55	Set-up Select	10-01	Baud Rate Select	12-3*	<b>EtherNet/IP</b>	14-2*	<b>Reset Functions</b>	15-42	Voltage
8-56	Preset Reference Select	10-02	MAC ID	12-30	Warning Parameter	14-20	Reset Mode	15-43	Software Version
8-7*	<b>BACnet</b>	10-05	Readout Transmit Error Counter	12-31	Net Reference	14-21	Automatic Restart Time	15-44	Ordered Typecode String
8-70	BACnet Device Instance	10-06	Readout Receive Error Counter	12-32	Net Control	14-22	Operation Mode	15-45	Actual Typecode String
8-72	MS/TP Max Masters	10-07	Readout Bus Off Counter	12-33	CIP Revision	14-23	Typecode Setting	15-46	Frequency Converter Ordering No
8-73	MS/TP Max Info Frames	10-1*	<b>DeviceNet</b>	12-34	CIP Product Code	14-25	Trip Delay at Torque Limit	15-47	Power Card Ordering No
8-74	"i-Am" Service	10-10	Process Data Type Selection	12-35	EDS Parameter	14-26	Trip Delay at Inverter Fault	15-48	LCP Id No
8-75	Initialisation Password	10-11	Process Data Config Write	12-37	COS Inhibit Timer	14-28	Production Settings	15-49	SW ID Control Card
8-8*	<b>FC Port Diagnostics</b>	10-12	Process Data Config Read	12-38	COS Filter	14-29	Service Code	15-50	SW ID Power Card
8-80	Bus Message Count	10-13	Warning Parameter	12-4*	<b>Modbus TCP</b>	14-3*	<b>Current Limit Ctrl.</b>	15-51	Frequency Converter Serial Number
8-81	Bus Error Count	10-14	Net Reference	12-40	Status Parameter	14-30	Current Lim Ctrl, Proportional Gain	15-53	Power Card Serial Number
8-82	Slave Messages Rcvd	10-15	Net Control	12-41	Slave Message Count	14-31	Current Lim Ctrl, Integration Time	15-55	Vendor URL
8-83	Slave Error Count	10-20	<b>COS Filters</b>	12-42	Slave Exception Message Count	14-32	Current Lim Ctrl, Filter Time	15-56	Vendor Name
8-84	Slave Messages Sent	10-21	COS Filter 1	12-8*	<b>Other Ethernet Services</b>	14-4*	<b>Energy Optimising</b>	15-59	CSIV Filename
8-85	Slave Timeout Errors	10-22	COS Filter 2	12-80	FTP Server	14-40	VT Level	15-6*	<b>Option Ident</b>
8-89	Diagnosics Count	10-23	COS Filter 3	12-81	HTTP Server	14-41	AEO Minimum Magnetisation	15-60	Option Mounted
8-9*	<b>Bus Jog / Feedback</b>	10-23	COS Filter 4	12-82	SMTTP Service	14-42	Minimum AEO Frequency	15-61	Option SW Version
8-90	Bus Jog 1 Speed	10-3*	<b>Parameter Access</b>	12-89	Transparent Socket Channel Port	14-43	Motor Cosphi	15-62	Option Ordering No

15-63	Option Serial No	16-58	PID Output [%]	20-01	Feedback 1 Conversion	21-13	Ext. 1 Reference Source	22-32	Low Speed [RPM]
15-70	Option in Slot A	<b>16-6*</b>	<b>Inputs &amp; Outputs</b>	20-02	Feedback 1 Source Unit	21-14	Ext. 1 Feedback Source	22-33	Low Speed [Hz]
15-71	Slot A Option SW Version	16-60	Digital Input	20-03	Feedback 2 Source	21-15	Ext. 1 Setpoint	22-34	Low Speed Power [kW]
15-72	Option in Slot B	16-61	Terminal 53 Switch Setting	20-04	Feedback 2 Conversion	21-17	Ext. 1 Reference [Unit]	22-35	Low Speed Power [HP]
15-73	Slot B Option SW Version	16-62	Analogue Input 53	20-05	Feedback 2 Source Unit	21-18	Ext. 1 Feedback [Unit]	22-36	High Speed [RPM]
15-74	Option in Slot C0	16-63	Terminal 54 Switch Setting	20-06	Feedback 3 Source	21-19	Ext. 1 Output [%]	22-37	High Speed [Hz]
15-75	Slot C0 Option SW Version	16-64	Analogue Input 54	20-07	Feedback 3 Conversion	<b>21-2*</b>	<b>Ext. CL 1 PID</b>	22-38	High Speed Power [kW]
15-76	Option in Slot C1	16-65	Analogue Output 42 [mA]	20-08	Feedback 3 Source Unit	21-20	Ext. 1 Normal/Inverse Control	22-39	High Speed Power [HP]
15-77	Slot C1 Option SW Version	16-66	Digital Output [bin]	20-12	Reference/Feedback Unit	21-21	Ext. 1 Proportional Gain	<b>22-4*</b>	<b>Sleep Mode</b>
<b>15-8*</b>	<b>Operating Data II</b>	16-67	Pulse Input #29 [Hz]	20-13	Minimum Reference/Feedb.	21-22	Ext. 1 Integral Time	22-40	Minimum Run Time
15-80	Fan Running Hours	16-68	Pulse Input #33 [Hz]	20-14	Maximum Reference/Feedb.	21-23	Ext. 1 Differentiation Time	22-41	Minimum Sleep Time
15-81	Preset Fan Running Hours	16-69	Pulse Output #27 [Hz]	<b>20-2*</b>	<b>Feedback/Setpoint</b>	21-24	Ext. 1 Dif. Gain Limit	22-42	Wake-up Speed [RPM]
<b>15-9*</b>	<b>Parameter Info</b>	16-70	Relay Output #29 [bin]	20-20	Feedback Function	<b>21-3*</b>	<b>Ext. CL 2 Ref/Fb.</b>	22-43	Wake-up Speed [Hz]
15-92	Defined Parameters	16-71	Counter A	20-21	Setpoint 1	21-30	Ext. 2 Ref./Feedback Unit	22-44	Wake-up Ref/FB Difference
15-93	Modified Parameters	16-72	Counter B	20-22	Setpoint 2	21-31	Ext. 2 Minimum Reference	22-45	Setpoint Boost
15-98	Drive Identification	16-73	Parameter Metadata	20-23	Setpoint 3	21-32	Ext. 2 Maximum Reference	22-46	Maximum Boost Time
15-99	Parameter Metadata	16-75	Analogue In X30/11	<b>20-3*</b>	<b>Feedb. Adv. Conv.</b>	21-33	Ext. 2 Reference Source	<b>22-5*</b>	<b>End of Curve</b>
<b>16-1*</b>	<b>Data Readouts</b>	16-76	Analogue In X30/12	20-30	Refrigerant	21-34	Ext. 2 Feedback Source	22-50	End of Curve Function
<b>16-0*</b>	<b>General Status</b>	16-77	Analogue Out X30/8 [mA]	20-31	User Defined Refrigerant A1	21-35	Ext. 2 Setpoint	22-51	End of Curve Delay
16-00	Control Word	<b>16-8*</b>	<b>Fieldbus &amp; FC Port</b>	20-32	User Defined Refrigerant A2	21-37	Ext. 2 Reference [Unit]	<b>22-6*</b>	<b>Broken Belt Detection</b>
16-01	Reference [Unit]	16-80	Fieldbus CTW 1	20-33	User Defined Refrigerant A3	21-38	Ext. 2 Feedback [Unit]	22-60	Broken Belt Function
16-02	Reference [%]	16-82	Fieldbus REF 1	20-34	Duct 1 Area [m2]	21-39	Ext. 2 Output [%]	22-61	Broken Belt Torque
16-03	Status Word	16-84	Comm. Option STW	20-35	Duct 1 Area [m2]	<b>21-4*</b>	<b>Ext. CL 2 PID</b>	22-62	Broken Belt Delay
16-05	Main Actual Value [%]	16-85	FC Port CTW 1	20-36	Duct 2 Area [m2]	21-40	Ext. 2 Normal/Inverse Control	<b>22-7*</b>	<b>Short Cycle Protection</b>
16-09	Custom Readout	16-86	FC Port REF 1	20-37	Duct 2 Area [m2]	21-41	Ext. 2 Proportional Gain	22-75	Short Cycle Protection Interval between Starts
<b>16-1*</b>	<b>Motor Status</b>	<b>16-9*</b>	<b>Diagnosis Readouts</b>	20-38	Air Density Factor [%]	21-42	Ext. 2 Integral Time	22-76	Interval between Starts
16-10	Power [kW]	16-90	Alarm Word	<b>20-6*</b>	<b>Sensorless</b>	21-43	Ext. 2 Differentiation Time	22-77	Minimum Run Time
16-11	Power [hp]	16-91	Alarm Word 2	20-60	Sensorless Unit	21-44	Ext. 2 Dif. Gain Limit	22-78	Minimum Run Time Override
16-12	Motor Voltage	16-92	Warning Word	20-69	Sensorless Information	<b>21-5*</b>	<b>Ext. CL 3 Ref/Fb.</b>	22-79	Minimum Run Time Override Value
16-13	Frequency	16-93	Warning Word 2	<b>20-7*</b>	<b>PID Autotuning</b>	21-50	Ext. 3 Ref./Feedback Unit	<b>22-8*</b>	<b>Flow Compensation</b>
16-14	Motor Current	16-94	Ext. Status Word	20-70	Closed Loop Type	21-51	Ext. 3 Minimum Reference	22-80	Flow Compensation
16-15	Frequency [Hz]	16-95	Ext. Status Word 2	20-71	PID Performance	21-52	Ext. 3 Maximum Reference	22-81	Square-linear Curve Approximation
16-16	Torque [Nm]	16-96	Maintenance Word	20-72	PID Output Change	21-53	Ext. 3 Reference Source	22-82	Work Point Calculation
16-17	Speed [RPM]	<b>18-*</b>	<b>Info &amp; Readouts</b>	20-73	Minimum Feedback Level	21-54	Ext. 3 Feedback Source	22-83	Speed at No-Flow [RPM]
16-18	Motor Thermal	<b>18-0*</b>	<b>Maintenance Log</b>	20-74	Maximum Feedback Level	21-55	Ext. 3 Setpoint	22-84	Speed at No-Flow [Hz]
16-22	Torque [%]	18-00	Maintenance Log: Item	20-79	PID Autotuning	21-57	Ext. 3 Reference [Unit]	22-85	Speed at Design Point [RPM]
16-26	Power Filtered [kW]	18-01	Maintenance Log: Action	<b>20-8*</b>	<b>PID Basic Settings</b>	21-58	Ext. 3 Feedback [Unit]	22-86	Speed at Design Point [Hz]
16-27	Power Filtered [hp]	18-02	Maintenance Log: Time	20-81	PID Normal/ Inverse Control	21-59	Ext. 3 Output [%]	22-87	Pressure at Rated Speed
<b>16-3*</b>	<b>Drive Status</b>	18-03	Maintenance Log: Date and Time	20-82	PID Start Speed [RPM]	<b>21-6*</b>	<b>Ext. CL 3 PID</b>	22-88	Pressure at Rated Speed
16-30	DC Link Voltage	<b>18-1*</b>	<b>Fire Mode Log</b>	20-84	On Reference Bandwidth	21-60	Ext. 3 Normal/Inverse Control	22-89	Flow at Design Point
16-32	Brake Energy /s	18-10	Fire Mode Log: Event	<b>20-9*</b>	<b>PID Controller</b>	21-61	Ext. 3 Proportional Gain	22-90	Flow at Rated Speed
16-33	Brake Energy /2 min	18-11	Fire Mode Log: Time	20-91	PID Anti Windup	21-62	Ext. 3 Integral Time	<b>23-*</b>	<b>Time-based Functions</b>
16-34	Heatsink Temp.	18-12	Fire Mode Log: Date and Time	20-93	PID Proportional Gain	21-64	Ext. 3 Dif. Gain Limit	<b>23-0*</b>	<b>Timed Actions</b>
16-35	Inverter Thermal	<b>18-3*</b>	<b>Inputs &amp; Outputs</b>	20-94	PID Integral Time	<b>22-*</b>	<b>Appl. Functions</b>	23-00	ON Time
16-36	Inv. Nom. Current	18-30	Analogue Input X42/1	20-94	PID Differentiation Time	<b>22-0*</b>	<b>Miscellaneous</b>	23-01	ON Action
16-37	Inv. Max. Current	18-31	Analogue Input X42/3	20-95	PID Differentiation Time	22-00	External Interlock Delay	23-02	OFF Time
16-38	SL Controller State	18-32	Analogue Input X42/5	20-96	PID Diff. Gain Limit	22-01	Power Filter Time	23-03	OFF Action
16-39	Control Card Temp.	18-33	Analogue Out X42/7 [V]	<b>21-*</b>	<b>Ext. CL Autotuning</b>	<b>22-2*</b>	<b>No-Flow Detection</b>	23-04	Occurrence
16-40	Logging Buffer Full	18-34	Analogue Out X42/9 [V]	21-00	Closed Loop Type	22-20	Low Power Auto Set-up	23-08	Timed Actions Mode
16-41	Logging Buffer Full	18-35	Analogue Out X42/11 [V]	21-01	PID Performance	22-21	Low Power Detection	23-09	Timed Actions Reactivation
16-43	Timed Actions Status	18-36	Analogue Input X48/2 [mA]	21-02	PID Output Change	22-22	Low Speed Detection	<b>23-1*</b>	<b>Maintenance</b>
16-49	Current Fault Source	18-37	Temp. Input X48/4	21-03	Minimum Feedback Level	22-23	No-Flow Function	23-10	Maintenance Item
<b>16-5*</b>	<b>Ref. &amp; Feedb.</b>	18-38	Temp. Input X48/7	21-04	Maximum Feedback Level	22-24	No-Flow Delay	23-11	Maintenance Action
16-50	External Reference	<b>18-5*</b>	<b>Ref. &amp; Feedb.</b>	21-09	PID Autotuning	22-26	Dry Pump Function	23-12	Maintenance Time Base
16-52	Feedback [Unit]	18-50	Sensorless Readout [unit]	<b>21-1*</b>	<b>Ext. CL 1 Ref/Fb.</b>	22-27	Dry Pump Delay	23-13	Maintenance Time Interval
16-53	Digi Pot Reference	<b>20-*</b>	<b>Drive Closed Loop</b>	21-10	Ext. 1 Ref./Feedback Unit	<b>22-3*</b>	<b>No-Flow Power Tuning</b>	23-14	Maintenance Date and Time
16-54	Feedback 1 [Unit]	20-00	Feedback 1 Source	21-11	Ext. 1 Minimum Reference	22-30	No-Flow Power	<b>23-1*</b>	<b>Maintenance Reset</b>
16-55	Feedback 2 [Unit]	20-00	Feedback 2 Source	21-12	Ext. 1 Maximum Reference	22-31	Power Correction Factor	23-15	Reset Maintenance Word

23-16	Maintenance Text	25-25	OBW Time	26-35	Term. X42/5 High Ref./Feedb. Value	35-47	Term. X48/2 Live Zero
<b>23-5*</b>	<b>Energy Log</b>	25-26	Destage At No-Flow	26-36	Term. X42/5 Filter Time Constant	<b>99-*</b>	<b>Devel support</b>
23-50	Energy Log Resolution	25-27	Stage Function	26-37	Term. X42/5 Live Zero	99-00	DAC 1 selection
23-51	Period Start	25-28	Stage Function Time	<b>26-4*</b>	<b>Analog Out X42/7</b>	99-01	DAC 2 selection
23-53	Energy Log	25-29	Destage Function	26-40	Terminal X42/7 Output	99-02	DAC 3 selection
23-54	Reset Energy Log	25-30	Destage Function Time	26-41	Terminal X42/7 Min. Scale	99-03	DAC 4 selection
<b>23-6*</b>	<b>Trending</b>	<b>25-4*</b>	<b>Staging Settings</b>	26-42	Terminal X42/7 Max. Scale	99-04	DAC 1 scale
23-60	Trend Variable	25-40	Ramp Down Delay	26-43	Terminal X42/7 Bus Control	99-05	DAC 2 scale
23-61	Continuous Bin Data	25-41	Ramp Up Delay	26-44	Terminal X42/7 Timeout Preset	99-06	DAC 3 scale
23-62	Timed Bin Data	25-42	Staging Threshold	<b>26-5*</b>	<b>Analog Out X42/9</b>	99-07	DAC 4 scale
23-63	Timed Period Start	25-43	Destaging Threshold	26-50	Terminal X42/9 Output	99-08	Test param 1
23-64	Timed Period Stop	25-44	Staging Speed [RPM]	26-51	Terminal X42/9 Min. Scale	99-09	Test param 2
23-65	Minimum Bin Value	25-45	Staging Speed [Hz]	26-52	Terminal X42/9 Max. Scale	99-10	DAC Option Slot
23-66	Reset Continuous Bin Data	25-46	Destaging Speed [RPM]	26-53	Terminal X42/9 Bus Control	99-11	RFI 2
23-67	Reset Timed Bin Data	25-47	Destaging Speed [Hz]	26-54	Terminal X42/9 Timeout Preset	99-12	Fan
<b>23-8*</b>	<b>Payback Counter</b>	<b>25-5*</b>	<b>Alternation Settings</b>	<b>26-6*</b>	<b>Analog Out X42/11</b>	99-13	Idle time
23-80	Power Reference Factor	25-50	Lead Pump Alternation	26-60	Terminal X42/11 Output	99-14	Paramdb requests in queue
23-81	Energy Cost	25-51	Alternation Event	26-61	Terminal X42/11 Min. Scale	99-15	Secondary Timer at Inverter Fault
23-82	Investment	25-52	Alternation Time Interval	26-62	Terminal X42/11 Max. Scale	99-16	No of Current Sensors
23-83	Energy Savings	25-53	Alternation Timer Value	26-63	Terminal X42/11 Bus Control	99-20	HS Temp. (PC1)
23-84	Cost Savings	25-54	Alternation Predefined Time	26-64	Terminal X42/11 Timeout Preset	99-21	HS Temp. (PC2)
<b>24-*</b>	<b>Appl. Functions 2</b>	25-55	Alternate if Load < 50%	<b>31-*</b>	<b>Bypass Option</b>	99-22	HS Temp. (PC3)
<b>24-0*</b>	<b>Fire Mode</b>	25-56	Staging Mode at Alternation	31-00	Bypass Mode	99-23	HS Temp. (PC4)
24-00	Fire Mode Function	25-58	Run Next Pump Delay	31-01	Bypass Start Time Delay	99-24	HS Temp. (PC5)
24-01	Fire Mode Configuration	25-59	Run on Mains Delay	31-02	Bypass Trip Time Delay	99-25	HS Temp. (PC6)
24-02	Fire Mode Unit	<b>25-8*</b>	<b>Status</b>	31-03	Test Mode Activation	99-26	HS Temp. (PC7)
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	<b>35-*</b>	<b>Sensor Input Option</b>	99-90	Options present
24-07	Fire Mode Feedback Source	25-84	Pump ON Time	<b>35-0*</b>	<b>Temp. Input Mode</b>	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
<b>24-1*</b>	<b>Drive Bypass</b>	25-86	Reset Relay Counters	35-02	Term. X48/7 Temp. Unit	99-93	Motor Frequency Internal
24-10	Drive Bypass Function	<b>25-9*</b>	<b>Service</b>	35-03	Term. X48/7 Input Type	99-94	Imbalance derate [%]
24-11	Drive Bypass Delay Time	25-90	Pump Interlock	35-04	Term. X48/10 Temp. Unit	99-95	Temperature derate [%]
<b>24-5*</b>	<b>Multi-Motor Funct.</b>	25-91	Manual Alternation	35-05	Term. X48/10 Input Type	99-96	Overload derate [%]
24-90	Missing Motor Function	<b>26-*</b>	<b>Analog I/O Option</b>	35-06	Temperature Sensor Alarm Function		
24-91	Missing Motor Coefficient 1	<b>26-0*</b>	<b>Analog I/O Mode</b>	<b>35-1*</b>	<b>Temp. Input X48/4</b>		
24-92	Missing Motor Coefficient 2	26-00	Terminal X42/1 Mode	35-14	Term. X48/4 Filter Time Constant		
24-93	Missing Motor Coefficient 3	26-01	Terminal X42/3 Mode	35-15	Term. X48/4 Temp. Monitor		
24-94	Missing Motor Coefficient 4	26-02	Terminal X42/5 Mode	35-16	Term. X48/4 Low Temp. Limit		
24-95	Locked Rotor Function	<b>26-1*</b>	<b>Analog Input X42/1</b>	35-17	Term. X48/4 High Temp. Limit		
24-96	Locked Rotor Coefficient 1	26-10	Terminal X42/1 Low Voltage	<b>35-2*</b>	<b>Temp. Input X48/7</b>		
24-97	Locked Rotor Coefficient 2	26-11	Terminal X42/1 High Voltage	35-24	Term. X48/7 Filter Time Constant		
24-98	Locked Rotor Coefficient 3	26-14	Term. X42/1 Low Ref./Feedb. Value	35-25	Term. X48/7 Temp. Monitor		
24-99	Locked Rotor Coefficient 4	26-15	Term. X42/1 High Ref./Feedb. Value	35-26	Term. X48/7 Low Temp. Limit		
<b>25-*</b>	<b>Cascade Controller</b>	26-16	Term. X42/1 Filter Time Constant	35-27	Term. X48/7 High Temp. Limit		
<b>25-0*</b>	<b>System Settings</b>	26-17	Term. X42/1 Live Zero	<b>35-3*</b>	<b>Temp. Input X48/10</b>		
25-00	Cascade Controller	<b>26-2*</b>	<b>Analog Input X42/3</b>	35-34	Term. X48/10 Filter Time Constant		
25-02	Motor Start	26-20	Terminal X42/3 Low Voltage	35-35	Term. X48/10 Temp. Monitor		
25-04	Pump Cycling	26-21	Terminal X42/3 High Voltage	35-36	Term. X48/10 Low Temp. Limit		
25-05	Fixed Lead Pump	26-24	Term. X42/3 Low Ref./Feedb. Value	35-37	Term. X48/10 High Temp. Limit		
25-06	Number of Pumps	26-25	Term. X42/3 High Ref./Feedb. Value	<b>35-4*</b>	<b>Analog Input X48/2</b>		
<b>25-2*</b>	<b>Bandwidth Settings</b>	26-26	Term. X42/3 Filter Time Constant	35-42	Term. X48/2 Low Current		
25-20	Staging Bandwidth	26-27	Term. X42/3 Live Zero	35-43	Term. X48/2 High Current		
25-21	Override Bandwidth	<b>26-3*</b>	<b>Analog Input X42/5</b>	35-44	Term. X48/2 Low Ref./Feedb. Value		
25-22	Fixed Speed Bandwidth	26-30	Terminal X42/5 Low Voltage	35-45	Term. X48/2 High Ref./Feedb. Value		
25-23	SBW Staging Delay	26-31	Terminal X42/5 High Voltage	35-46	Term. X48/2 Filter Time Constant		
25-24	SBW Destaging Delay	26-34	Term. X42/5 Low Ref./Feedb. Value				



## 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.

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



## 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

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

Table 6.2 AMA without T27 Connected

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

Table 6.3 Analog Speed Reference (Voltage)

		Parameters	
FC		Function	Setting
+24 V	12	6-12 Terminal 53	4 mA*
+24 V	13	Low Current	
D IN	18	6-13 Terminal 53	20 mA*
D IN	19	High Current	
COM	20	6-14 Terminal 53	0 RPM
D IN	27	Low Ref./Feedb.	
D IN	29	Value	
D IN	32	6-15 Terminal 53	1500 RPM
D IN	33	High Ref./Feedb.	
D IN	37	Value	
+10 V		* = Default Value	
A IN	53	<b>Notes/comments:</b>	
A IN	54		
COM	55		
A OUT	42		
COM	39		

Table 6.4 Analog Speed Reference (Current)

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

Table 6.5 Start/Stop Command with Safe Stop

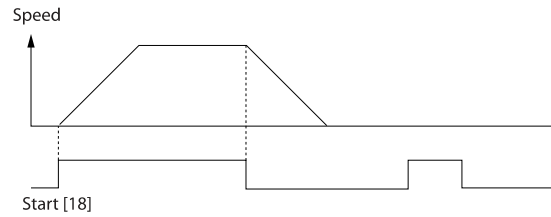


Figure 6.1

130BB805.10

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

Table 6.6 Pulse Start/Stop

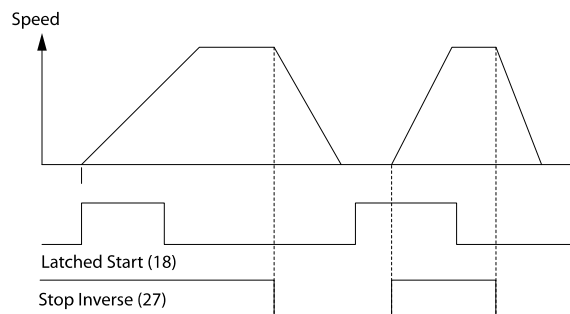


Figure 6.2

130BB806.10

FC		Parameters	
		Function	Setting
+24 V	12	5-10 Terminal 18	[8] Start
+24 V	13	Digital Input	
D IN	18	5-11 Terminal 19	[10] Reversing*
D IN	19	Digital Input	
COM	20		
D IN	27		
D IN	29		
D IN	32	5-12 Terminal 27	[0] No operation
D IN	33	Digital Input	
D IN	37	5-14 Terminal 32	[16] Preset ref bit 0
		Digital Input	
+10 V	50	5-15 Terminal 33	[17] Preset ref bit 1
A IN	53	Digital Input	
A IN	54		
COM	55	3-10 Preset Reference	
A OUT	42	Preset ref. 0	25%
COM	39	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

FC		Parameters	
		Function	Setting
+24 V	12	5-11 Terminal 19	[1] Reset
+24 V	13	Digital Input	
D IN	18		
D IN	19		
COM	20		
D IN	27		
D IN	29		
D IN	32		
D IN	33		
D IN	37		
+10 V	50		
A IN	53		
A IN	54		
COM	55		
A OUT	42		
COM	39		
		* = Default Value	
		Notes/comments:	

Table 6.8 External Alarm Reset

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

Table 6.9 Speed Reference (using a Manual Potentiometer)

FC		Parameters	
		Function	Setting
+24 V	12	5-10 Terminal 18	[8] Start*
+24 V	13	Digital Input	
D IN	18	5-12 Terminal 27	[19] Freeze Reference
D IN	19	Digital Input	
COM	20	5-13 Terminal 29	[21] Speed Up
D IN	27	Digital Input	
D IN	29	5-14 Terminal 32	[22] Speed Down
D IN	32	Digital Input	
D IN	33		
D IN	37		
+10 V	50		
A IN	53		
A IN	54		
COM	55		
A OUT	42		
COM	39		
		* = Default Value	
		Notes/comments:	

Table 6.10 Speed Up/Down

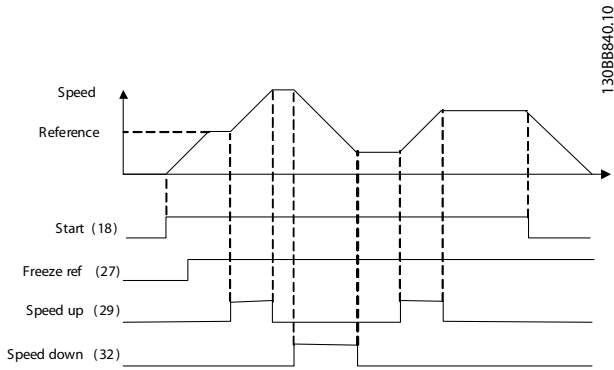


Figure 6.3

		Parameters	
FC		Function	Setting
+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	<b>Notes/comments:</b>	
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		
	01		
	02		
	03		
	04		
	05		
	06		
	61		
	68		
	69		

Table 6.11 RS-485 Network Connection

## CAUTION

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

		Parameters	
FC		Function	Setting
+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		
D IN	37		
+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																																																																																
<table border="1"> <tr><th colspan="2">FC</th></tr> <tr><td>+24 V</td><td>12</td></tr> <tr><td>+24 V</td><td>13</td></tr> <tr><td>D IN</td><td>18</td></tr> <tr><td>D IN</td><td>19</td></tr> <tr><td>COM</td><td>20</td></tr> <tr><td>D IN</td><td>27</td></tr> <tr><td>D IN</td><td>29</td></tr> <tr><td>D IN</td><td>32</td></tr> <tr><td>D IN</td><td>33</td></tr> <tr><td>D IN</td><td>37</td></tr> <tr><td colspan="2"> </td></tr> <tr><td>+10 V</td><td>50</td></tr> <tr><td>A IN</td><td>53</td></tr> <tr><td>A IN</td><td>54</td></tr> <tr><td>COM</td><td>55</td></tr> <tr><td>A OUT</td><td>42</td></tr> <tr><td>COM</td><td>39</td></tr> <tr><td colspan="2"> </td></tr> <tr><td>R1</td><td>01</td></tr> <tr><td></td><td>02</td></tr> <tr><td></td><td>03</td></tr> <tr><td colspan="2"> </td></tr> <tr><td>R2</td><td>04</td></tr> <tr><td></td><td>05</td></tr> <tr><td></td><td>06</td></tr> </table>		FC		+24 V	12	+24 V	13	D IN	18	D IN	19	COM	20	D IN	27	D IN	29	D IN	32	D IN	33	D IN	37			+10 V	50	A IN	53	A IN	54	COM	55	A OUT	42	COM	39			R1	01		02		03			R2	04		05		06	130B8839.10	<table border="1"> <tr><td>4-30 Motor Feedback Loss Function</td><td>[1] Warning</td></tr> <tr><td>4-31 Motor Feedback Speed Error</td><td>100 RPM</td></tr> <tr><td>4-32 Motor Feedback Loss Timeout</td><td>5 s</td></tr> <tr><td>7-00 Speed PID Feedback Source</td><td>[2] MCB 102</td></tr> <tr><td>17-11 Resolution (PPR)</td><td>1024*</td></tr> <tr><td>13-00 SL Controller Mode</td><td>[1] On</td></tr> <tr><td>13-01 Start Event</td><td>[19] Warning</td></tr> <tr><td>13-02 Stop Event</td><td>[44] Reset key</td></tr> <tr><td>13-10 Comparat or Operand</td><td>[21] Warning no.</td></tr> <tr><td>13-11 Comparat or Operator</td><td>[1] ≈*</td></tr> <tr><td>13-12 Comparat or Value</td><td>90</td></tr> <tr><td>13-51 SL Controller Event</td><td>[22] Comparator 0</td></tr> <tr><td>13-52 SL Controller Action</td><td>[32] Set digital out A low</td></tr> <tr><td>5-40 Function Relay</td><td>[80] SL digital output A</td></tr> </table> <p>* = Default Value</p> <p><b>Notes/comments:</b> 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.</p>	4-30 Motor Feedback Loss Function	[1] Warning	4-31 Motor Feedback Speed Error	100 RPM	4-32 Motor Feedback Loss Timeout	5 s	7-00 Speed PID Feedback Source	[2] MCB 102	17-11 Resolution (PPR)	1024*	13-00 SL Controller Mode	[1] On	13-01 Start Event	[19] Warning	13-02 Stop Event	[44] Reset key	13-10 Comparat or Operand	[21] Warning no.	13-11 Comparat or Operator	[1] ≈*	13-12 Comparat or Value	90	13-51 SL Controller Event	[22] Comparator 0	13-52 SL Controller Action	[32] Set digital out A low	5-40 Function Relay	[80] SL digital output A
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5-40 Function Relay	[80] SL digital output A																																																																																		

Table 6.13 Using SLC to Set a Relay

		Parameters																																																																					
		Function	Setting																																																																				
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Table 6.14 Mechanical Brake Control

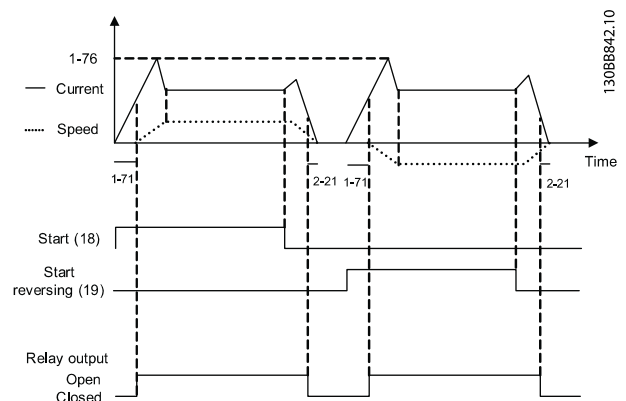


Figure 6.4

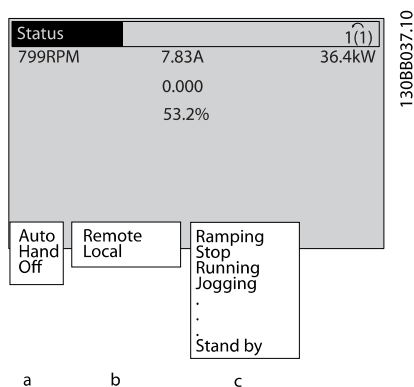




## 7 Status Messages

### 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 *Figure 7.1*).



**Figure 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.

	Operation mode
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**

	Reference site
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**

	Operation status
AC Brake	AC Brake was selected in <i>2-10 Brake Function</i> . 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 <i>2-12 Brake Power Limit (kW)</i> is reached.
Coast	<ul style="list-style-type: none"> <li>Coast inverse was selected as a function for a digital input (parameter group 5-1*). The corresponding terminal is not connected.</li> <li>Coast activated by serial communication</li> </ul>

7

	Operation status
Ctrl. Ramp-down	Control Ramp-down was selected in <i>14-10 Mains Failure</i> . <ul style="list-style-type: none"> <li>The mains voltage is below the value set in <i>14-11 Mains Voltage at Mains Fault</i> at mains fault</li> <li>The frequency converter ramps down the motor using a controlled ramp down</li> </ul>
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"> <li>DC Brake is activated in <i>2-03 DC Brake Cut In Speed [RPM]</i> and a Stop command is active.</li> <li>DC Brake (inverse) is selected as a function for a digital input (parameter group 5-1*). The corresponding terminal is not active.</li> <li>The DC Brake is activated via serial communication.</li> </ul>
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"> <li>Freeze output was selected as a function for a digital input (parameter group 5-1*). The corresponding terminal is active. Speed control is only possible via the terminal functions speed up and speed down.</li> <li>Hold ramp is activated via serial communication.</li> </ul>
Freeze output request	A freeze output command has been given, but the motor will remain stopped until a run permissive signal is received.

	Operation status
Freeze ref.	<i>Freeze Reference</i> was chosen as a function for a digital input (parameter group 5-1*). 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"> <li>Jog was selected as function for a digital input (parameter group 5-1*). The corresponding terminal (e.g. Terminal 29) is active.</li> <li>The Jog function is activated via the serial communication.</li> <li>The Jog function was selected as a reaction for a monitoring function (e.g. No signal). The monitoring function is active.</li> </ul>
Motor check	In <i>1-80 Function at Stop</i> , <i>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 control</i> 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"> <li>To avoid tripping, switching frequency is reduced to 4 kHz.</li> <li>If possible, protection mode ends after approximately 10 s.</li> <li>Protection mode can be restricted in <i>14-26 Trip Delay at Inverter Fault</i></li> </ul>

	<b>Operation status</b>
QStop	The motor is decelerating using <i>3-81 Quick Stop Ramp Time</i> . <ul style="list-style-type: none"> <li>• <i>Quick stop inverse</i> was chosen as a function for a digital input (parameter group 5-1*). The corresponding terminal is not active.</li> <li>• The quick stop function was activated via serial communication.</li> </ul>
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 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 5-1*). 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.

	<b>Operation status</b>
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**



## 8 Warnings and Alarms

### 8.1 System Monitoring

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

A trip can be reset in any of 4 ways:

- Press [RESET] on the
- Digital reset input command
- Serial communication reset input command
- Auto reset

#### 8.2.3 Alarm Trip-lock

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

### 8.3 Warning and Alarm Displays

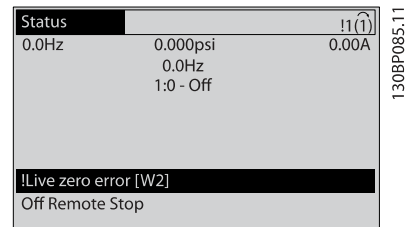


Figure 8.1

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

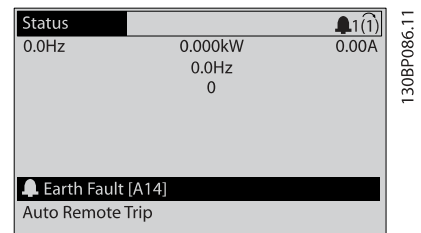


Figure 8.2

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

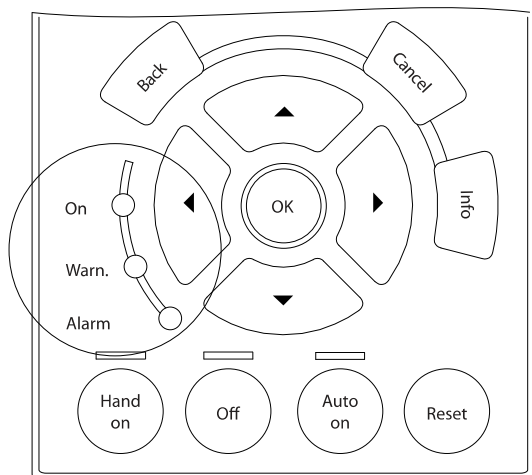


Figure 8.3

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

Table 8.1

8

8.4 Warning and Alarm Definitions

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
1	10V low	X			
2	Live zero error	(X)	(X)		6-01
3	No motor	(X)			1-80
4	Mains phase loss	(X)	(X)	(X)	14-12
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC over voltage	X	X		
8	DC under voltage	X	X		
9	Inverter overloaded	X	X		
10	Motor overload temperature	(X)	(X)		1-90
11	Motor thermistor over temperature	(X)	(X)		1-90
12	Torque limit	X	X		
13	Over current	X	X	X	
14	Earth fault	X	X	X	
15	Hardware mismatch		X	X	
16	Short circuit		X	X	
17	Control word timeout	(X)	(X)		8-04
23	Internal fan fault	X			
24	External fan fault	X			14-53
25	Brake resistor short-circuit	X			
26	Brake resistor power limit	(X)	(X)		2-13
27	Brake chopper fault	X	X		
28	Brake check failed	(X)	(X)		2-15
29	Heatsink temp	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	4-58
31	Motor phase V missing	(X)	(X)	(X)	4-58
32	Motor phase W missing	(X)	(X)	(X)	4-58

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
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		
39	Heatsink sensor		X	X	
40	Overload of digital output terminal 27	(X)			5-00, 5-01
41	Overload of digital output terminal 29	(X)			5-00, 5-02
42	Overload of digital output on X30/6 or overload of digital output on X30/7	(X)			5-32
46	Power card supply		X	X	5-33
47	24V supply low	X	X	X	
48	1.8V supply low		X	X	
49	Speed limit	X			
50	AMA calibration failed		X		
51	AMA check $U_{nom}$ and $I_{nom}$		X		
52	AMA low $I_{nom}$		X		
53	AMA motor too big		X		
54	AMA motor too small		X		
55	AMA parameter out of range		X		
56	AMA interrupted by user		X		
57	AMA timeout		X		
58	AMA internal fault	X	X		
59	Current limit	X			
60	External interlock	X			
62	Output frequency at maximum limit	X			
64	Voltage limit	X			
65	Control board over-temperature	X	X	X	
66	Heatsink temperature low	X			
67	Option configuration has changed		X		
68	Safe stop activated		X <sup>1)</sup>		
69	Power card temperature		X	X	
70	Illegal FC configuration			X	
71	PTC 1 safe stop	X	X <sup>1)</sup>		
72	Dangerous failure			X <sup>1)</sup>	
73	Safe Stop auto restart				
76	Power unit setup	X			
79	Illegal PS config		X	X	
80	Drive Initialised to Default Value		X		
91	Analog input 54 wrong settings			X	
92	No flow	X	X		22-2*
93	Dry pump	X	X		22-2*
94	End of curve	X	X		22-5*
95	Broken belt	X	X		22-6*
96	Start delayed	X			22-7*
97	Stop delayed	X			22-7*
98	Clock fault	X			0-7*
104	Mixing Fan fault	X	X		14-53
220	Overload trip		X		
243	Brake IGBT	X	X		

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
244	Heatsink temp	X	X	X	
245	Heatsink sensor		X	X	
246	Pwr. card supply		X	X	
247	Pwr. card temp		X	X	
248	Illegal PS config		X	X	
250	New spare part			X	
251	New type code		X	X	

**Table 8.2 Warning/Alarm Action List**

(X) Dependent on parameter

<sup>1)</sup> Can not be Auto reset via *14-20 Reset Mode*

A trip is the action when an alarm has appeared. The trip will coast the motor and can be reset by pressing the reset button or make a reset by a digital input (parameter group 5-1\* [1]). The origin event that caused an alarm cannot damage the or connected parts. A Trip Lock situation can only be reset by a power cycling.



## 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 through 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 if *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 through 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 your Danfoss supplier:

- 15-40 FC Type*
- 15-41 Power Section*
- 15-42 Voltage*
- 15-43 Software Version*
- 15-45 Actual Typecode String*
- 15-49 SW ID Control Card*

15-50 SW ID Power Card

15-60 Option Mounted

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 Timeout Function is NOT set to OFF.

If 8-04 Control 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 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).

For the D, E, and F Frame filters, the regulated voltage to the fans is monitored.

#### Troubleshooting

Check fan resistance.

Check soft charge fuses.

### WARNING 24, External fan fault

The fan warning function is an extra 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 Trip [2] is selected in 2-13 Brake Power Monitoring, the frequency converter will trip when the dissipated braking power reaches 100%.



**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 ininputs, see section Brake Resistor Temperature Switch.

### 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.

For the D, E, and F Frame sizes, this alarm is based on the temperature measured by the heatsink sensor mounted inside the IGBT modules. For the F Frame sizes, this alarm can also be caused by the thermal sensor in the Rectifier module.

**Troubleshooting**

Check fan resistance.

Check soft charge fuses.

IGBT thermal sensor.

**ALARM 30, Motor phase U missing**

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

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 your Danfoss supplier or service department. Note the code number for further troubleshooting directions.

No.	Text
0	Serial port cannot be initialised. Contact your 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 couldn't be sent.
1281	Digital signal processor flash timeout
1282	Power micro software version mismatch
1283	Power EEPROM data version mismatch
1284	Cannot read digital signal processor software version
1299	Option SW in slot A is too old
1300	Option SW in slot B is too old
1301	Option SW in slot C0 is too old
1302	Option SW in slot C1 is too old
1315	Option SW in slot A is not supported (not allowed)
1316	Option SW in slot B is not supported (not allowed)
1317	Option SW in slot C0 is not supported (not allowed)
1318	Option SW in slot C1 is not supported (not allowed)
1379	Option A did not respond when calculating platform version
1380	Option B did not respond when calculating platform version
1381	Option C0 did not respond when calculating platform version.
1382	Option C1 did not respond when calculating platform version.
1536	An exception in the application 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

No.	Text
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
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 your 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 your 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.

**56 ALARM, 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 your 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 through 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 cutout temperature of the control card is 80° C.

**Troubleshooting**

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

**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 the reset key).

**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/IP 54 (NEMA 1/12) frequency converters.

**ALARM 70, Illegal frequency converter configuration**

The control card and power card are incompatible. Contact your 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 T-37 again (when the motor temperature reaches an acceptable level) and when the Digital Input from the MCB 112 is deactivated. When that happens, a reset signal must be sent (via Bus, Digital I/O, or by pressing [Reset]). Note that if automatic restart is enabled, the motor may start when the fault is cleared.

**ALARM 72, Dangerous failure**

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

**WARNING 73, Safe stop auto restart**

Safe stopped. 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.

**77 WARNING, 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 parameter 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 terminal 12/13 to 20-39 or 10 V supply for terminal 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.

Symptom	Possible Cause	Test	Solution
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 5-10 <i>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 5-12 <i>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 3-13 <i>Reference Site</i> . Set preset reference active in parameter group 3-1* <i>References</i> . Check for correct wiring. Check scaling of terminals. Check reference signal.
Motor running in wrong direction	Motor rotation limit	Check that 4-10 <i>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 5-1* <i>Digital inputs</i> .	Deactivate reversing signal.
	Wrong motor phase connection		See 2.4.5 <i>Motor Rotation Check</i> in this manual.
Motor is not reaching maximum speed	Frequency limits set wrong	Check output limits in 4-13 <i>Motor Speed High Limit [RPM]</i> , 4-14 <i>Motor Speed High Limit [Hz]</i> and 4-19 <i>Max Output Frequency</i>	Program correct limits.
	Reference input signal not scaled correctly	Check reference input signal scaling in 6-* <i>Analog I/O mode</i> and parameter group 3-1* <i>References</i> . Reference limits in parameter group 3-0*.	Program correct settings.
Motor speed unstable	Possible incorrect parameter settings	Check the settings of all motor parameters, including all motor compensation settings. For closed loop operation, check PID settings.	Check settings in parameter group 1-6* <i>Analog I/O mode</i> . For closed loop operation, check settings in parameter group 20-0* <i>Feedback</i> .
Motor runs rough	Possible over-magnetization	Check for incorrect motor settings in all motor parameters.	Check motor settings in parameter groups 1-2* <i>Motor data</i> , 1-3* <i>Adv motor data</i> , and 1-5* <i>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 2-0* <i>DC brake</i> and 3-0* <i>Reference limits</i> .

Symptom	Possible Cause	Test	Solution
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.
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*.	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*.	
		Increase Resonance Dampening in 1-64 <i>Resonance Dampening</i> .	

Table 9.1



## 10 Specifications

### 10.1 Power-dependent Specifications

Mains Supply 3x380-480 VAC											
		N110	N132	N160	N200	N250	N315				
High/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 <sup>2</sup> (AWG <sup>2</sup> )] <sup>5</sup>	2 x 95 (2 x 3/0)			2 x 185 (2 x 350)						
	Max. external mains fuses [A] <sup>1</sup>	315	350	400	550	630	800				
	Estimated power loss at 400 V [W] <sup>4</sup>	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 <sup>4</sup>	0.98									
	Output frequency	0-800 Hz								0-600 Hz	

\*Normal overload = 110% current for 60 s

Table 10.1

- 1) For type of fuse see 10.3 Fuse Tables
- 2) American Wire Gauge

- 3) Measured using 5 m screened motor cables at rated load and rated frequency.
- 4) The typical power loss is at nominal load conditions and expected to be within  $\pm 15\%$  (tolerance relates to variety in voltage and cable conditions).
- 5) Field wiring terminals on FC 322 N132, N160 and N315 models are not intended to receive conductors one size larger.

Values are based on a typical motor efficiency (eff2/eff3 border line). Motors with lower efficiency will add to the power loss in the frequency converter and those with higher efficiency will decrease it.

The losses are based on the default switching frequency. The losses increase significantly at higher switching frequencies. LCP and typical control card power consumptions are included. Further options and customer load may add up to 30 W to the losses. (Though typically, only 4 W extra for a fully loaded control card, or options for slot A or slot B, each).

## 10.2 General Technical Data

### Mains supply (L1, L2, L3)

Supply voltage	380-480V $\pm$ 10%
----------------	--------------------

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

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

Supply frequency	50/60Hz $\pm$ 5%
------------------	------------------

Max. imbalance temporary between mains phases	3.0% of rated supply voltage
---	------------------------------

True Power Factor ( $\lambda$ )	$\geq$ 0.9 nominal at rated load
---------------------------------	----------------------------------

Displacement Power Factor ( $\cos \Phi$ ) near unity	(> 0.98)
--	----------

Switching on input supply L1, L2, L3 (power ups)	maximum one time/2 minutes
--	----------------------------

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 - 800 Hz*
------------------	-------------

Switching on output	Unlimited
---------------------	-----------

Ramp times	0.01 - 3600 sec.
------------	------------------

\* *Dependent on voltage and power*

### Torque Characteristics

Starting torque (Constant torque)	maximum 110% for 60 secs. *
-----------------------------------	-----------------------------

Starting torque	maximum 135% up to 0.5 sec.*
-----------------	------------------------------

Overload torque (Constant torque)	maximum 110% for 60 secs.*
-----------------------------------	----------------------------

*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 <sup>2</sup> /16 AWG (2 x 0.75 mm <sup>2</sup> )
--	---

Maximum cross section to control terminals, flexible cable	1 mm <sup>2</sup> /18 AWG
--	---------------------------

Maximum cross section to control terminals, cable with enclosed core	0.5 mm <sup>2</sup> /20 AWG
--	-----------------------------

Minimum cross section to control terminals	0.25 mm <sup>2</sup>
--	----------------------

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

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.

<b>Analog inputs</b>	
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	0V to 10V (scaleable)
Input resistance, $R_i$	approx. 10 k $\Omega$
Max. voltage	$\pm$ 20 V
Current mode	Switch A53/A54 = (I)
Current level	0/4 to 20 mA (scaleable)
Input resistance, $R_i$	approx. 200 $\Omega$
Max. current	30 mA
Resolution for analog inputs	10 bit (+ sign)
Accuracy of analog inputs	Max. error 0.5% of full scale
Bandwidth	200 Hz

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

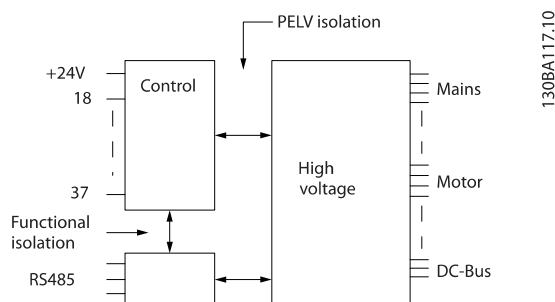


Figure 10.1

<b>Pulse inputs</b>	
Programmable pulse inputs	2
Terminal number pulse	29, 33
Max. frequency at terminal, 29, 33	110 kHz (Push-pull driven)
Max. frequency at terminal, 29, 33	5 kHz (open collector)
Min. frequency at terminal 29, 33	4 Hz
Voltage level	see section on Digital input
Maximum voltage on input	28 V DC
Input resistance, $R_i$	approx. 4 k $\Omega$
Pulse input accuracy (0.1 - 1 kHz)	Max. error: 0.1% of full scale

**Analog output**

Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4 - 20 mA
Max. resistor load to common at analog output	500 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).*

**Digital output**

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

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

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

**Control card, 24 V DC output**

Terminal number	12, 13
Max. load	200mA

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

**Relay outputs**

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



Max. terminal load (AC-15) <sup>1)</sup> on 4-6 (NC) (Inductive load @ cosφ 0.4)	240V AC, 0.2A
Max. terminal load (DC-1) <sup>1)</sup> on 4-6 (NC) (Resistive load)	50V DC, 2A
Max. terminal load (DC-13) <sup>1)</sup> on 4-6 (NC) (Inductive load)	24V DC, 0.1A
Min. terminal load on 4-6 (NC), 4-5 (NO)	24V DC 10mA, 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 300V AC 2A

**Control card, 10 V DC output**

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

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

**Control characteristics**

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

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

**Surroundings**

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

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

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

Derating for high altitude, see section on special conditions

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

See section on special conditions

**Control card performance**

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

**Control card, USB Serial Communication**

USB standard	1.1 (Full speed)
--------------	------------------

USB plug	USB type B "device" plug
----------	--------------------------

**⚠ CAUTION**

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 or an isolated USB cable/converter.

**Protection and Features**

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

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

N110 - N250	380 - 500 V	type gG
N315	380 - 500 V	type gR

Table 10.2

### 10.3.3 UL Compliance

**380-500 V:** The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), With the proper fusing, the drive Short Circuit Current Rating (SCCR) is 100,000 Arms.

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 10.3 Alternative Fuse Options**

### 10.3.4 Connection Tightening Torques

10

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	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	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

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