Operating Instructions
VLT® Refrigeration Drive FC 103
75-630 kW

www.danfoss.com/drives
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1 Introduction

1.1 Purpose of the Manual

This manual provides detailed information for the installation and start-up of the frequency converter. Chapter 3 Installation provides requirements for mechanical and electrical installation, including:

- Input
- Motor
- Control wiring
- Serial communication wiring
- Control terminal functions

Chapter 4 Start-up and Functional Testing provides detailed procedures for:

- Start-up
- Basic operational programming
- Functional testing

The remaining chapters provide supplementary details. These details include:

- User interface
- Detailed programming
- Application examples
- Start-up
- Troubleshooting
- Specifications.

VLT® is a registered trademark.

1.2 Additional Resources

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

- The VLT® Refrigeration Drive FC 103 Programming Guide provides greater detail on working with parameters and many application examples.
- The VLT® Refrigeration Drive FC 103 Design Guide provides detailed capabilities and functionality to design motor control systems.
- Optional equipment is available that may change some of the procedures described. Refer to the instructions supplied with those options for specific requirements. Contact the local Danfoss supplier or visit the Danfoss website: www.danfoss.com/BusinessAreas/DrivesSolutions/Documents/VLT+Technical+Documentation.htm, for downloads or additional information.

1.3 Approvals and Certifications

More approvals and certifications are available. Contact the local Danfoss partner.

The frequency converter complies with UL508C thermal memory retention requirements. For more information, refer to the section Motor Thermal Protection in the Design Guide.

For compliance with the European Agreement concerning International Carriage of Dangerous Goods by Inland Waterways (ADN), refer to ADN-compliant Installation in the Design Guide.

1.4 Disposal Instruction

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

A frequency converter is an electronic motor controller that converts DC 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.

The frequency converter offers many control, monitoring and efficiency functions such as:

- Monitoring the system and motor status
- Issuing warnings or alarms for fault conditions
- Starting and stopping the motor
- Optimising energy efficiency

Operation and monitoring functions are available as status indications to an outside control system or serial communication network.

1.5.1 Interior Views

Illustration 1.1 Interior Components - Enclosure Type D

Illustration 1.2 Close-up View: LCP and Control Functions

<table>
<thead>
<tr>
<th>1 LCP (Local Control Panel)</th>
<th>9 Relay 2 (04, 05, 06)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 RS-485 fieldbus connector</td>
<td>10 Lifting ring</td>
</tr>
<tr>
<td>3 Digital I/O and 24 V supply</td>
<td>11 Mounting slot</td>
</tr>
<tr>
<td>4 Analog I/O connector</td>
<td>12 Cable clamp (PE)</td>
</tr>
<tr>
<td>5 USB connector</td>
<td>13 Ground</td>
</tr>
<tr>
<td>6 Fieldbus terminal switch</td>
<td>14 Motor output terminals 96 (U), 97 (V), 98 (W)</td>
</tr>
<tr>
<td>7 Analog switches (A53), (A54)</td>
<td>15 Mains input terminals 91 (L1), 92 (L2), 93 (L3)</td>
</tr>
<tr>
<td>8 Relay 1 (01, 02, 03)</td>
<td>16 TB5 (IP21/54 only). Terminal block for anti-condensation heater</td>
</tr>
</tbody>
</table>
Illustration 1.3 Compact IP21 (NEMA 1) and IP54 (NEMA 12) Enclosure Type E1

Illustration 1.4 Compact IP00 (Chassis) with Disconnect, Fuse and RFI Filter, Enclosure Type E2

Table 1.1 Legend to Illustration 1.3 and Illustration 1.4

<table>
<thead>
<tr>
<th></th>
<th>AUX relay</th>
<th></th>
<th>Load sharing</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>01 02 03</td>
<td>5</td>
<td>-DC +DC</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>04 05 06</td>
<td></td>
<td>88 89</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Temp switch</td>
<td>6</td>
<td>SMPS fuse</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>106 104 105</td>
<td></td>
<td>7</td>
<td>Fan fuse</td>
</tr>
<tr>
<td>5</td>
<td>Mains</td>
<td>8</td>
<td>AUX fan</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>R S T</td>
<td>10</td>
<td>100 101 102 103</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>91 92 93</td>
<td></td>
<td>L1 L2 L1 L2</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>L1 L2 L3</td>
<td></td>
<td>9</td>
<td>Mains ground</td>
</tr>
<tr>
<td>9</td>
<td>Brake</td>
<td>10</td>
<td>Motor</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>-R +R</td>
<td></td>
<td>U V W</td>
<td></td>
</tr>
<tr>
<td></td>
<td>81 82</td>
<td></td>
<td>96 97 98</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>T1 T2 T3</td>
<td></td>
</tr>
</tbody>
</table>
1.6 Internal Controller Functions

Illustration 1.5 is a block diagram of the frequency converter's internal components.

<table>
<thead>
<tr>
<th>Area</th>
<th>Title</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mains input</td>
<td>• 3-phase AC mains supply to the frequency converter</td>
</tr>
<tr>
<td>2</td>
<td>Rectifier</td>
<td>• The rectifier bridge converts the AC input to DC current to supply inverter power.</td>
</tr>
<tr>
<td>3</td>
<td>DC-bus</td>
<td>• Intermediate DC-bus circuit handles the DC current.</td>
</tr>
<tr>
<td>4</td>
<td>DC reactors</td>
<td>• Filter the intermediate DC circuit voltage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Prove line transient protection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reduce RMS current.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Raise the power factor reflected back to the line.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reduce harmonics on the AC input.</td>
</tr>
<tr>
<td>5</td>
<td>Capacitor bank</td>
<td>• Stores the DC power.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provides ride-through protection for short power losses.</td>
</tr>
<tr>
<td>6</td>
<td>Inverter</td>
<td>• Converts the DC into a controlled PWM AC waveform for a controlled variable output to the motor.</td>
</tr>
<tr>
<td>7</td>
<td>Output to motor</td>
<td>• Regulated 3-phase output power to the motor</td>
</tr>
<tr>
<td>8</td>
<td>Control circuitry</td>
<td>• Input power, internal processing, output, and motor current are monitored to provide efficient operation and control.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• User interface and external commands are monitored and performed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Status output and control can be provided.</td>
</tr>
</tbody>
</table>

Table 1.2 Legend to Illustration 1.5
### 1.7 Enclosure Types and Power Ratings

**Table 1.3 kW Rated Frequency Converters**

<table>
<thead>
<tr>
<th>Normal Overload [kW]</th>
<th>55</th>
<th>75</th>
<th>90</th>
<th>110</th>
<th>132</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>315</th>
<th>355</th>
<th>400</th>
<th>450</th>
<th>500</th>
<th>560</th>
<th>630</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 V</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D2h/D4h/D7h/D8h</td>
<td>D2h/D4h/D7h/D8h</td>
<td>E1/E2</td>
<td>E1/E2</td>
<td>E1/E2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>525 V</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D2h/D4h/D7h/D8h</td>
<td>D2h/D4h/D7h/D8h</td>
<td>E1/E2</td>
<td>E1/E2</td>
<td>E1/E2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>690 V</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D2h/D4h/D7h/D8h</td>
<td>D2h/D4h/D7h/D8h</td>
<td>E1/E2</td>
<td>E1/E2</td>
<td>E1/E2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 1.4 Hp Rated Frequency Converters**

<table>
<thead>
<tr>
<th>Normal Overload [hp]</th>
<th>75</th>
<th>100</th>
<th>125</th>
<th>150</th>
<th>200</th>
<th>250</th>
<th>300</th>
<th>350</th>
<th>400</th>
<th>450</th>
<th>500</th>
<th>550/600</th>
<th>600</th>
<th>650</th>
</tr>
</thead>
<tbody>
<tr>
<td>460 V</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D2h/D4h/D7h/D8h</td>
<td>D2h/D4h/D7h/D8h</td>
<td>E1/E2</td>
<td>E1/E2</td>
<td>E1/E2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>575 V</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D1h/D3h/D5h/D6h</td>
<td>D2h/D4h/D7h/D8h</td>
<td>D2h/D4h/D7h/D8h</td>
<td>E1/E2</td>
<td>E1/E2</td>
<td>E1/E2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Introduction**

Operating Instructions
2 Safety

The following symbols are used in this document:

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

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

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

### 2.1 Qualified Personnel

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

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

### 2.2 Safety Precautions

**WARNING**

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

- Installation, start-up, and maintenance must be performed by qualified personnel only.

**WARNING**

**UNINTENDED START**
When the frequency converter is connected to AC mains, or DC power supply, the motor may start at any time. Unintended start during programming, service or repair work can result in death, serious injury, or property damage. The motor can start by means of an external switch, a serial bus command, an input reference signal from the LCP, or after a cleared fault condition. To prevent unintended motor start:

- Disconnect the frequency converter from mains.
- Press [Off/Reset] on the LCP, before programming parameters.
- The frequency converter, motor, and any driven equipment must be fully wired and assembled when the frequency converter is connected to AC mains, or DC power supply.

**WARNING**

**DISCHARGE TIME**
The frequency converter contains DC-link capacitors, which can remain charged even when the frequency converter is not powered. Failure to wait the specified time after power has been removed before performing service or repair work, could result in death or serious injury.

- Stop the motor.
- Disconnect the AC mains, permanent magnet type motors, and remote DC-link power supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters.
- Wait for the capacitors to discharge fully before performing any service or repair work. The duration of waiting time is specified in Table 2.1.

<table>
<thead>
<tr>
<th>Voltage [V]</th>
<th>Minimum waiting time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>380-480</td>
<td>110-315 kW</td>
</tr>
<tr>
<td>355-450 kW</td>
<td></td>
</tr>
<tr>
<td>525-690</td>
<td>55-400 kW</td>
</tr>
<tr>
<td>525-690</td>
<td>450-630 kW</td>
</tr>
</tbody>
</table>

High voltage may be present even when the warning LED indicator lights are off.

Table 2.1 Discharge Time
**WARNING**

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

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

**WARNING**

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

- Ensure that only trained and qualified personnel perform installation, start up, and maintenance.
- Ensure that electrical work conforms to national and local electrical codes.
- Follow the procedures in this manual.

**CAUTION**

**UNINTENDED MOTOR ROTATION**
**WINDMILLING**
Unintended rotation of permanent magnet motors can result in serious injury or equipment damage.

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

**CAUTION**

**INTERNAL FAILURE HAZARD**
An internal failure in the frequency converter can result in serious injury, when the frequency converter is not properly closed.

- Ensure that all safety covers are in place and securely fastened, before applying power.
3 Installation

3.1 Pre-Installation

3.1.1 Planning the Installation Site

**NOTICE**
Plan the installation site of the frequency converter before commencing the installation. 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 that 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.

<table>
<thead>
<tr>
<th>Voltage [V]</th>
<th>Altitude restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>380-690</td>
<td>At altitudes above 2000 m, contact Danfoss regarding PELV</td>
</tr>
</tbody>
</table>

Table 3.1 Installation at High Altitudes

3.1.2 General Considerations

**Wire access**
Ensure that proper cable access is present including necessary bending allowance. As the IP00/IP20 enclosure is open to the bottom, cables must be fixed to the back panel of the enclosure where the frequency converter is mounted, i.e. by using cable clamps.

**CAUTION**
All cable lugs/shoes must mount within the width of the terminal bus bar.

**Space**
Ensure proper space above and below the frequency converter to allow airflow and cable access. In addition space in front of the unit must be considered to enable opening of the panel door, see Illustration 3.1 to Illustration 3.3.
3.1.3 Tools Required for Installation

- Drill with 10 or 12 mm drill
- Tape measure
- Wrench with relevant metric sockets (7-17 mm)
- Extensions to wrench
- Sheet metal punch for conduits or cable glands in IP21/Nema 1 and IP54 units
- Lifting bar to lift the unit (rod or tube max. Ø 5 mm (1 inch), able to lift minimum 400 kg (880 lbs)).
- Crane or other lifting aid to place the frequency converter in position
- A Torx T50 tool is needed to install the E1 in IP21 and IP54 enclosure types.

3.2 Pre-installation Checklist

- Before unpacking the frequency converter, ensure that the packaging is intact. If any damage has occurred, immediately contact the shipping company to claim the damage.
- Unpack the frequency converter as close as possible to the final installation site.
- Ensure the model number number on the nameplate corresponds to the model number on the order.
- Ensure that each of the following are rated for the same voltage:
  - Mains (power)
  - Frequency converter
  - Motor
- Ensure that the frequency converter output current rating is equal to or greater than the 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.

3.3 Mechanical Installation

3.3.1 Cooling

- Provide top and bottom clearance for air cooling. Generally, 225 mm (9 in) is required.
- Improper mounting can result in overheating and reduced performance.
- Consider derating for temperatures starting between 45 °C (113 °F) and 50 °C (122 °F) and elevation 1000 m (3300 ft) above sea level. See VLT® Refrigeration Drive FC 103 Design Guide for detailed information.

The high-power frequency converters utilise a back-channel cooling concept that removes heat sink cooling air. Approximately 90% of the heat is lead 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 heat sink cooling air out of the panel when an IP20/chassis frequency converter 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.

**NOTICE**
A door fan(s) is required on the enclosure to remove the heat not contained in the back channel of the frequency converters and any additional losses generated by other components inside the enclosure. Calculate the total required air flow so that the appropriate fans can be selected. A cooling clearance of 225 mm is required above the frequency converter.

**Airflow**
Secure the necessary airflow over the heat sink. The flow rate is shown in Table 3.2.
NOTICE

The fan runs for the following reasons:

- AMA
- DC hold
- Pre-mag
- DC brake
- 60% of nominal current is exceeded
- Specific heat sink temperature exceeded (power size dependent)
- Specific power card ambient temperature exceeded (power size dependent)
- Specific control card ambient temperature exceeded

---

### 3.3.2 Lifting

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

#### Table 3.2 Airflow

<table>
<thead>
<tr>
<th>Enclosure type</th>
<th>Door fan/top fan</th>
<th>Heat sink fan</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1h/D3h/D5h/D6h</td>
<td>102 m³/hr (60 CFM)</td>
<td>420 m³/hr (250 CFM)</td>
</tr>
<tr>
<td>D2h/D4h/D7h/D8h</td>
<td>204 m³/hr (120 CFM)</td>
<td>840 m³/hr (500 CFM)</td>
</tr>
<tr>
<td>E1 P450T7, P500T7</td>
<td>340 m³/hr (200 CFM)</td>
<td>1105 m³/hr (650 CFM)</td>
</tr>
<tr>
<td>E1 P355-P450T4, P560-P630T7</td>
<td>340 m³/hr (200 CFM)</td>
<td>1445 m³/hr (850 CFM)</td>
</tr>
<tr>
<td>E2 P450T7, P500T7</td>
<td>255 m³/hr (150 CFM)</td>
<td>1105 m³/hr (650 CFM)</td>
</tr>
<tr>
<td>E2 P355-P450T4, P560-P630T7</td>
<td>255 m³/hr (150 CFM)</td>
<td>1445 m³/hr (850 CFM)</td>
</tr>
</tbody>
</table>

---

**WARNING**

**RISK OF INJURY OR DEATH**

The lifting bar must be able to handle the weight of the frequency converter to ensure that it will not break during lifting.

- See *Mechanical Dimensions* for the weight of the different enclosure types.
- Maximum diameter for bar is 2.5 cm (1 inch).
- The angle from the top of the frequency converter to the lifting cable should be 60° or greater.

Failure to follow recommendations could result in death or serious injury.
### 3.3.3 Mechanical Dimensions

<table>
<thead>
<tr>
<th>Enclosure type</th>
<th>D1h</th>
<th>D2h</th>
<th>D3h</th>
<th>D4h</th>
</tr>
</thead>
<tbody>
<tr>
<td>110-160 kW</td>
<td>200-315 kW</td>
<td>110-160 kW</td>
<td>200-315 kW</td>
<td></td>
</tr>
<tr>
<td>(380-480 V)</td>
<td>(380-480 V)</td>
<td>(380-480 V)</td>
<td>(380-480 V)</td>
<td></td>
</tr>
<tr>
<td>75-160 kW</td>
<td>200-400 kW</td>
<td>75-160 kW</td>
<td>200-400 kW</td>
<td></td>
</tr>
<tr>
<td>(525-690 V)</td>
<td>(525-690 V)</td>
<td>(525-690 V)</td>
<td>(525-690 V)</td>
<td></td>
</tr>
<tr>
<td>IP</td>
<td>21/54</td>
<td>21/54</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>NEMA</td>
<td>Type 1/12</td>
<td>Type 1/12</td>
<td>Chassis</td>
<td>Chassis</td>
</tr>
<tr>
<td>Shipping dimensions [mm]</td>
<td>Height</td>
<td>587</td>
<td>587</td>
<td>587</td>
</tr>
<tr>
<td></td>
<td>Width</td>
<td>997</td>
<td>1170</td>
<td>997</td>
</tr>
<tr>
<td></td>
<td>Depth</td>
<td>460</td>
<td>535</td>
<td>460</td>
</tr>
<tr>
<td>Drive dimensions [mm]</td>
<td>Height</td>
<td>901</td>
<td>1107</td>
<td>909</td>
</tr>
<tr>
<td></td>
<td>Width</td>
<td>325</td>
<td>420</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>Depth</td>
<td>378</td>
<td>378</td>
<td>375</td>
</tr>
<tr>
<td>Max weight [kg]</td>
<td>98</td>
<td>164</td>
<td>98</td>
<td>164</td>
</tr>
</tbody>
</table>

Table 3.3 Mechanical Dimensions, Enclosure Types D1h-D4h

<table>
<thead>
<tr>
<th>Enclosure type</th>
<th>D5h</th>
<th>D6h</th>
<th>D7h</th>
<th>D8h</th>
<th>E1</th>
<th>E2</th>
</tr>
</thead>
<tbody>
<tr>
<td>110-160 kW</td>
<td>200-315 kW</td>
<td>110-160 kW</td>
<td>200-315 kW</td>
<td>355-450 kW</td>
<td>355-450 kW</td>
<td></td>
</tr>
<tr>
<td>75-160 kW</td>
<td>200-400 kW</td>
<td>75-160 kW</td>
<td>200-400 kW</td>
<td>450-630 kW</td>
<td>450-630 kW</td>
<td></td>
</tr>
<tr>
<td>(525-690 V)</td>
<td>(525-690 V)</td>
<td>(525-690 V)</td>
<td>(525-690 V)</td>
<td>(525-690 V)</td>
<td>(525-690 V)</td>
<td></td>
</tr>
<tr>
<td>IP</td>
<td>21/54</td>
<td>21/54</td>
<td>21/54</td>
<td>21/54</td>
<td>21, 54</td>
<td>00, 00</td>
</tr>
<tr>
<td>NEMA</td>
<td>Type 1/12</td>
<td>Type 1/12</td>
<td>Type 1/12</td>
<td>Type 1/12</td>
<td>Type 12</td>
<td>Chassis</td>
</tr>
<tr>
<td>Shipping dimensions [mm]</td>
<td>Height</td>
<td>660</td>
<td>660</td>
<td>660</td>
<td>840</td>
<td>831</td>
</tr>
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<td></td>
<td>Width</td>
<td>1820</td>
<td>1820</td>
<td>2470</td>
<td>2470</td>
<td>2197</td>
</tr>
<tr>
<td></td>
<td>Depth</td>
<td>510</td>
<td>510</td>
<td>590</td>
<td>590</td>
<td>736</td>
</tr>
<tr>
<td>Drive dimensions [mm]</td>
<td>Height</td>
<td>1324</td>
<td>1663</td>
<td>1978</td>
<td>2284</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>Width</td>
<td>325</td>
<td>325</td>
<td>420</td>
<td>420</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>Depth</td>
<td>381</td>
<td>381</td>
<td>386</td>
<td>406</td>
<td>494</td>
</tr>
<tr>
<td>Max weight [kg]</td>
<td>116</td>
<td>129</td>
<td>200</td>
<td>225</td>
<td>313</td>
<td>277</td>
</tr>
</tbody>
</table>

Table 3.4 Mechanical Dimensions, Enclosure Types D5h-D8h, E1-E2
All dimensions are in mm [in]

### Installation

**Ceiling**

- Ceiling
- Air space outlet minimum 225 mm [8.9 in]
- Air space inlet minimum 225 mm [8.9 in]
- Floor

**NOTICE**

If using a kit to direct the airflow from the heat sink to the outside vent on the back of the frequency converter, the required ceiling clearance is 100 mm.

**Illustration 3.5 Mechanical Dimensions, D1h**

<table>
<thead>
<tr>
<th>Illustration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ceiling</td>
</tr>
<tr>
<td>2</td>
<td>Air space outlet minimum 225 mm [8.9 in]</td>
</tr>
<tr>
<td>3</td>
<td>Air space inlet minimum 225 mm [8.9 in]</td>
</tr>
<tr>
<td>4</td>
<td>Floor</td>
</tr>
</tbody>
</table>

**Illustration 3.6 Detail Dimensions, D1h**

<table>
<thead>
<tr>
<th>Illustration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bottom mounting slot detail</td>
</tr>
<tr>
<td>2</td>
<td>Top mounting hole detail</td>
</tr>
</tbody>
</table>

**NOTICE**

If using a kit to direct the airflow from the heat sink to the outside vent on the back of the frequency converter, the required ceiling clearance is 100 mm.
If using a kit to direct the airflow from the heat sink to the outside vent on the back of the frequency converter, the required ceiling clearance is 100 mm.
1 Ceiling
2 Air space outlet minimum 225 mm [8.9 in]
3 Air space inlet minimum 225 mm [8.9 in]
4 Floor

**NOTICE**

If using a kit to direct the airflow from the heat sink to the outside vent on the back of the frequency converter, the required ceiling clearance is 100 mm.

Illustration 3.9 Mechanical Dimensions, D3h

Illustration 3.10 Detail Dimensions, D3h
**NOTICE**

If using a kit to direct the airflow from the heat sink to the outside vent on the back of the frequency converter, the required ceiling clearance is 100 mm.

Illustration 3.11 Mechanical Dimensions, D4h

Illustration 3.12 Detail Dimensions, D4h
NOTICE

If using a kit to direct the airflow from the heat sink to the outside vent on the back of the frequency converter, the required ceiling clearance is 100 mm.
### NOTICE

If using a kit to direct the airflow from the heat sink to the outside vent on the back of the frequency converter, the required ceiling clearance is 100 mm.

---

**Illustration 3.15 Mechanical Dimensions, D6h**

1. Ceiling
2. Air space outlet minimum 225 mm [8.9 in]
3. Air space inlet minimum 225 mm [8.9 in]
4. Floor

---

**Illustration 3.16 Detail Dimensions, D6h**

1. Top mounting hole detail
2. Bottom mounting slot detail
1 Ceiling

2 Air space outlet minimum 225 mm [8.9 in]

Illustration 3.17 Mechanical Dimensions, D7h

NOTICE

If using a kit to direct the airflow from the heat sink to the outside vent on the back of the frequency converter, the required ceiling clearance is 100 mm.

Illustration 3.18 Top Mounting Hole Dimension Detail, D7h
1 Ceiling
2 Air space outlet minimum 225 mm [8.9 in]

Illustration 3.19 Mechanical Dimensions, D8h

NOTICE
If using a kit to direct the airflow from the heat sink to the outside vent on the back of the frequency converter, the required ceiling clearance is 100 mm.

Illustration 3.20 Top Mounting Hole Dimension Detail, D8h
Illustration 3.21 Mechanical Dimensions, E1

Lifting eye detail

F
Illustration 3.22 Mechanical Dimensions, E2
3.4 Electrical Installation

3.4.1 General Requirements

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

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

**WARNING**

EQUIPMENT HAZARD

Rotating shafts and electrical equipment can be hazardous. All electrical work must conform to national and local electrical codes. It is strongly recommended that installation, start up, and maintenance are 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 3 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 performance of the frequency converter and associated equipment.
Illustration 3.23 Interconnect Diagram

A=Analog, D=Digital
*Terminal 37 (optional) is used for Safe Torque Off. For Safe Torque Off installation instructions, refer to the VLT® Frequency Converters - Safe Torque Off Operating Instructions.
**Do not connect cable screen.
For safety, comply with the following requirements:

- Electronic controls equipment is connected to hazardous mains voltage. Take extreme 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 chapter 9 Warnings and Alarms for details on the trip function.
- Because the motor wiring carries high frequency current, it is important that wiring for mains, motor power, and control are run separately. Use metallic conduit or separated shielded wire. See Illustration 3.24. 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 overcurrent protection. Input fusing is required to provide this protection, see Illustration 3.25. If not factory supplied, fuses must be provided by the installer as part of installation. See maximum fuse ratings in chapter 11.3.1 Protection.
Illustration 3.25 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 are made with a minimum 75 °C rated copper wire.

3.4.2 Grounding Requirements

**WARNING**

GROUNDING HAZARD

- For operator safety, it is important to 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.
- Ground currents are higher than 3.5 mA.

Failure to ground the frequency converter properly could result in death or serious injury.

**NOTICE**

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

- Follow all local and national electrical codes to ground electrical equipment properly.
- Proper protective earthing for equipment with ground currents higher than 3.5 mA must be established, see chapter 3.4.2.1 Leakage Current (>3.5 mA).

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

3.4.2.1 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 generates a leakage current in the ground 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 ground current. The ground 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. Grounding must be reinforced in one of the following ways:

- Ground wire of at least 10 mm²
- 2 separate ground wires both complying with the dimensioning rules

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

The frequency converter can be grounded using conduit or shielded cable. For grounding of the power connections, use the dedicated grounding points as shown in Illustration 3.26 to Illustration 3.28.
Illustration 3.28 Position of Ground Terminals IP00, Enclosure Type E
3.4.3 Gland/Conduit Entry - IP21 (NEMA 1) and IP54 (NEMA 12)

Cables are connected through the gland plate from the bottom. Remove the plate and plan where to place the entry for the glands or conduits. Illustration 3.29 to Illustration 3.33 show the cable entry points viewed from the bottom of various frequency converters.

**NOTICE**

Fit the gland plate to the frequency converter to ensure the specified protection degree.

Illustration 3.29 D1h, Bottom View

Illustration 3.30 D2h, Bottom View

Illustration 3.31 D5h & D6h, Bottom View
3.4.4 Motor Connection

**WARNING**

**INDUCED VOLTAGE**

Induced voltage from output motor cables run together can charge equipment capacitors even with the equipment turned off and locked out.

- Run output motor cables from multiple frequency converters separately.

Failure to run output motor cables separately could result in death or serious injury.

- For maximum cable sizes, see chapter 11.1 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 (NEMA 1/12) 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).
- Ground the cable in accordance with the instructions provided.
- Torque terminals in accordance with the information provided in chapter 11.3.4 Connection Tightening Torques.
- Follow motor manufacturer wiring requirements.
3.4.4.1 Terminal Locations: D1h-D4h

Illustration 3.34 Terminal Locations D1h

Illustration 3.35 Terminal Locations D2h
Illustration 3.36 Terminal Locations D3h

Illustration 3.37 Terminal Locations D4h
### 3.4.4.2 Terminal Locations: D5h-D8h

#### Illustration 3.38 Terminal Locations, D5h with Disconnect Option

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mains terminals</td>
</tr>
<tr>
<td>2</td>
<td>Brake terminals</td>
</tr>
<tr>
<td>3</td>
<td>Motor terminals</td>
</tr>
<tr>
<td>4</td>
<td>Ground terminals</td>
</tr>
</tbody>
</table>

*Illustration 3.38 Terminal Locations, D5h with Disconnect Option*
Illustration 3.39 Terminal Locations, D5h with Brake Option

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Mains terminals</td>
</tr>
<tr>
<td>2</td>
<td>Brake terminals</td>
</tr>
<tr>
<td>3</td>
<td>Motor terminals</td>
</tr>
<tr>
<td>4</td>
<td>Ground terminals</td>
</tr>
</tbody>
</table>

1 Mains terminals
2 Brake terminals
3 Motor terminals
4 Ground terminals

Illustration 3.39 Terminal Locations, D5h with Brake Option
Illustration 3.40 Terminal Locations, D6h with Contactor Option

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mains terminals</td>
</tr>
<tr>
<td>2</td>
<td>TB6 terminal block for contactor</td>
</tr>
<tr>
<td>3</td>
<td>Brake terminals</td>
</tr>
<tr>
<td>4</td>
<td>Motor terminals</td>
</tr>
<tr>
<td>5</td>
<td>Ground terminals</td>
</tr>
</tbody>
</table>

For full details, please refer to the Installation and Operating Instructions.
Illustration 3.41 Terminal Locations, D6h with Contactor and Disconnect Options

1. Brake terminals
2. TB6 terminal block for contactor
3. Motor terminals
4. Ground terminals
5. Mains terminals
Illustration 3.42 Terminal Locations, D7h with Disconnect Option

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mains terminals</td>
</tr>
<tr>
<td>2</td>
<td>Motor terminals</td>
</tr>
<tr>
<td>3</td>
<td>Ground terminals</td>
</tr>
<tr>
<td>4</td>
<td>Brake terminals</td>
</tr>
</tbody>
</table>

130BC542.11 B-B A-A R S T U V W 1 2 3 4

Mains terminals
Motor terminals
Ground terminals
Brake terminals

1 Mains terminals  
2 Brake terminals  
3 Motor terminals  
4 Ground terminals

Illustration 3.43 Terminal Locations, D7h with Brake Option
Illustration 3.44 Terminal Locations, D8h with Contactor Option

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TB6 terminal block for contactor</td>
</tr>
<tr>
<td>2</td>
<td>Motor terminals</td>
</tr>
<tr>
<td>3</td>
<td>Ground terminals</td>
</tr>
<tr>
<td>4</td>
<td>Brake terminals</td>
</tr>
<tr>
<td>5</td>
<td>Mains terminals</td>
</tr>
</tbody>
</table>

1308C544.12
1. TB6 terminal block for contactor
2. Mains terminals
3. Brake terminals
4. Motor terminals
5. Ground terminals

Illustration 3.45 Terminal Locations, D8h with Contactor and Disconnect Options
3.4.4.3 Terminal Locations: E1-E2

Terminal Locations - E1
Consider the following position of the terminals when designing the cable access.

Illustration 3.46 IP21 (NEMA 1) and IP54 (NEMA 12) Enclosure Power Connection Positions
Illustration 3.47 IP21 (NEMA 1) and IP54 (NEMA 12) Enclosure Power Connection Positions (Detail B)
Illustration 3.48 IP21 (NEMA 1) and IP54 (NEMA 12) Enclosure Power Connection Position of Disconnect Switch

<table>
<thead>
<tr>
<th>Enclosure types</th>
<th>Unit type</th>
<th>Dimensions [mm]/(inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IP54/IP21 UL AND NEMA1/NEMA12</td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td>450-630 kW (690 V)</td>
<td>396 (15.6) 267 (10.5) 332 (13.1) 397 (15.6) 528 (20.8) N/A</td>
</tr>
<tr>
<td></td>
<td>355-450 kW (400 V)</td>
<td>408 (16.1) 246 (9.7) 326 (12.8) 406 (16.0) 419 (16.5) 459 (18.1)</td>
</tr>
</tbody>
</table>

Table 3.5 Dimensions for Disconnect Terminal
Terminal locations - enclosure type E2
Consider the following position of the terminals when designing the cable access.

Illustration 3.49 IP00 Enclosure Power Connection Positions

Illustration 3.50 IP00 Enclosure Power Connection Positions
**NOTICE**

Power connections can be made to positions A or B

<table>
<thead>
<tr>
<th>Enclosure type</th>
<th>Unit type</th>
<th>Dimensions (mm)/(inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IPOO/CHASSIS</td>
<td>A</td>
</tr>
<tr>
<td>E2</td>
<td>250/315 kW (400 V) AND 355/450-500/630 kW (690 V)</td>
<td>396 (15.6)</td>
</tr>
<tr>
<td></td>
<td>315/355-400/450 kW (400 V)</td>
<td>408 (16.1)</td>
</tr>
</tbody>
</table>

Table 3.6 Dimensions for Disconnect Terminal

### 3.4.5 Motor Cable

Connect the motor to terminals U/T1/96, V/T2/97, W/T3/98. Ground to terminal 99. All types of 3-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:

<table>
<thead>
<tr>
<th>Terminal no.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>96, 97, 98,</td>
<td>Mains U/T1, V/T2, W/T3</td>
</tr>
<tr>
<td>99</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Table 3.7 Terminals for Motor Cable Connection
3.4.6 Motor Rotation Check

The direction of rotation can be changed by switching 2 phases in the motor cable, or by changing the setting of 4-10 Motor Speed Direction.

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

Table 3.8 Wiring for Changing Motor Direction

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

3.4.7 AC Mains Connection

- All frequency converters may be used with an isolated input source as well as with 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 [0] Off. When off, the internal RFI filter capacitors between the chassis and the intermediate circuit are isolated. Isolating the capacitors prevents damage to the intermediate circuit and reduces ground capacity currents in accordance with IEC 61800-3.

- Size wiring is based upon the input current of the frequency converter.

- Comply with local and national electrical codes for cable sizes.

1. Ground the cable in accordance with the instructions provided.

2. Connect 3-phase AC input power wiring to terminals L1, L2, and L3 (see Illustration 3.52).
### 3.4.8 Shielding against Electrical Noise

To ensure best EMC performance, mount the EMC metal cover before mounting the mains power cable.

**NOTICE**

The EMC metal cover is only included in units with an RFI filter.

![Illustration 3.53 Mounting of EMC Shield.](image)

### 3.5 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.

### 3.5.2 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.

### 3.5.1 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).
3.5.3 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 ground potential between the frequency converter and the PLC is different, electric noise may occur that disturbs the entire system. Solve this problem by fitting an equalizing cable next to the control cable. Minimum cable cross section: 16 mm².

Illustration 3.54 Cable Screening Performance

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Aluminium-clad with copper wire</td>
</tr>
<tr>
<td>b</td>
<td>Twisted copper wire or armoured steel wire cable</td>
</tr>
<tr>
<td>c</td>
<td>Single-layer braided copper wire with varying percentage screen coverage (this is the typical Danfoss reference cable).</td>
</tr>
<tr>
<td>d</td>
<td>Double-layer braided copper wire</td>
</tr>
<tr>
<td>e</td>
<td>Twin layer of braided copper wire with a magnetic, screened/armoured intermediate layer</td>
</tr>
<tr>
<td>f</td>
<td>Cable that runs in copper tube or steel tube</td>
</tr>
<tr>
<td>g</td>
<td>Lead cable with 1.1 mm wall thickness</td>
</tr>
</tbody>
</table>

Illustration 3.55 Correct Screening

50/60 Hz ground loops
With very long control cables, ground loops may occur. To eliminate ground loops, connect one end of the screen-to-ground with a 100 nF capacitor (keeping leads short).

Illustration 3.56 Avoiding Ground Loops

Avoid EMC noise on serial communication
This terminal is connected to ground via an internal RC link. Use twisted-pair cables to reduce interference between conductors. The recommended method is shown below:

Illustration 3.57 Avoiding EMC Noise

Alternatively, the connection to terminal 61 can be omitted:

Illustration 3.58 Screening without Using Terminal 61
3.5.4 Control Terminal Types

Terminal functions and default settings are summarised in chapter 3.5.7 Control Terminal Functions.

- **Connector 1** provides:
  - 4 programmable digital input terminals
  - 2 additional digital terminals programmable as either input or output
  - 24 V DC terminal supply voltage
  - A common wire 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
  - 2 analog inputs
  - 1 analog output
  - 10 V DC supply voltage
  - Common wires for the inputs and output

- **Connector 4** is a USB port available for use with the MCT 10 Set-up Software.

- Some options available for ordering with the unit may provide additional terminals. See the manual provided with the equipment option.

3.5.5 Wiring to Control Terminals

Terminal plugs can be removed for easy access.

Tie down all control wires to the designated control cable routing as shown in Illustration 3.60. Remember to connect the shields in a way which ensures optimum electrical immunity.

**Fieldbus connection**

Connections are made to the relevant options on the control card. For details, see the relevant fieldbus instruction. The cable must be placed in the provided path inside the frequency converter and tied down with other control wires (see Illustration 3.61).
Illustration 3.61 Control Card Wiring Path for E-enclosures

In the Chassis (IP00) and NEMA 1 units, it is also possible to connect the fieldbus from the top of the unit. On the NEMA 1 unit, a cover plate must be removed.

Kit number for fieldbus top connection: 176F1742

3.5.6 Safe Torque Off (STO)

Safe Torque Off is an option. To run Safe Torque Off, additional wiring for the frequency converter is required. Refer to VLT® Frequency Converters Safe Torque Off Operating Instructions for further information.

3.5.7 Control Terminal Functions

Frequency converter functions are commanded by receiving control input signals.

- Each terminal must be programmed for the function it is supporting in the parameters associated with that terminal. See chapter 6 Programming and chapter 7 Application Examples for terminals and associated parameters.
- It is important to confirm that the control terminal is programmed for the correct function. See chapter 6 Programming for details on accessing parameters and programming.

- The default terminal programming is intended to initiate frequency converter functioning in a typical operational mode.

3.5.7.1 Terminal 53 and 54 Switches

- Analog input terminals 53 and 54 can select either voltage (0 to 10 V) or current (0/4-20 mA) input signals.
- Remove power to the frequency converter before changing switch positions.
- Set switches A53 and A54 to select the signal type. U selects voltage, I selects current.
- The switches are accessible when the LCP has been removed (see Illustration 3.62).

**NOTICE**

Some option cards available for the unit may cover these switches and must be removed to change switch settings. Always remove power to the unit before removing option cards. Observe the discharge time in Table 2.1.

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

Illustration 3.62 Location of Terminals 53 and 54 Switches and Bus Termination Switch
3.6 Serial Communication

RS-485 is a 2-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 1 network segment. Repeaters divide network segments. Each repeater functions as a node within the segment it is installed in. 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.
- Always follow good common installation practice. Low-impedance ground connection of the screen at every node is important, including at high frequencies.
- Connect a large surface of the screen to 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 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.

<table>
<thead>
<tr>
<th>Cable</th>
<th>Screened twisted pair (STP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impedance</td>
<td>120 Ω</td>
</tr>
<tr>
<td>Max. cable length [m]</td>
<td>1200 (including drop lines)</td>
</tr>
<tr>
<td></td>
<td>500 station-to-station</td>
</tr>
</tbody>
</table>

Table 3.9 Cable Information

3.7 Optional Equipment

3.7.1 Anti-condensation Heater

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

3.7.2 Mains Shield

The mains shield is a Lexan cover installed inside the enclosure to provide protection according to BGV A3 (former VBG-4) accident-prevention requirements.

**NOTICE**

Mains shield is only available for IP21/IP54 (NEMA 1/ NEMA 12).
4 Start-up and Functional Testing

4.1 Pre-start

4.1.1 Safety Inspection

**WARNING**

HIGH VOLTAGE

If input and output connections have been connected improperly, there is potential for high voltage on these terminals. If power leads for multiple motors are improperly run in same conduit, there is potential for leakage current to charge capacitors within the frequency converter, even when disconnected from mains input.

- For initial start-up, make no assumptions about power components.
- Follow pre-start procedures.

Failure to follow pre-start procedures could result in personal injury or damage to equipment.

1. Switch off the Input power to the unit and ensure that it is locked out. Do not rely on the frequency converter disconnect switches for input power isolation.
2. Verify that there is no voltage on input terminals L1 (91), L2 (92), and L3 (93), phase-to-phase and phase-to-ground.
3. Verify that there is no voltage on output terminals 96 (U), 97 (V), and 98 (W), phase-to-phase and phase-to-ground.
4. Confirm continuity of the motor by measuring ohm values on U-V (96-97), V-W (97-98), and W-U (98-96).
5. Check for proper grounding of the frequency converter as well as the motor.
6. Inspect the frequency converter for loose connections on terminals.
7. Record the following motor-nameplate data
   
   7a  Power
   
   7b  Voltage
   
   7c  Frequency
   
   7d  Full load current
   
   7e  Nominal speed.

   These values are needed to program the motor nameplate data later.
8. Confirm that the supply voltage matches the voltage of the frequency converter and the motor.

**CAUTION**

Before applying power to the unit, inspect the entire installation as detailed in Table 4.1. Check mark those items when completed.

<table>
<thead>
<tr>
<th>Inspect for</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary equipment</td>
<td>• Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers on the input power side of the frequency converter or output side to the motor. Ensure that they are ready for full speed operation.</td>
</tr>
<tr>
<td></td>
<td>• Check function and installation of any sensors used for feedback to the frequency converter.</td>
</tr>
<tr>
<td></td>
<td>• Remove power factor correction caps on motors, if present.</td>
</tr>
</tbody>
</table>
## Inspect for

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
</table>

### Cable routing
- Use separate metallic conduits for each of the following:
  - Input power
  - Motor wiring
  - Control wiring

### Control wiring
- Check for broken or damaged wires and loose connections.
- Check that control wiring is isolated from power and motor wiring for noise immunity.
- Check the voltage source of the signals, if necessary.
- Use shielded or twisted pair cable. Ensure that the shield is terminated correctly.

### Cooling clearance
- Measure that top and bottom clearance is adequate to ensure proper air flow for cooling.

### EMC considerations
- Check for proper installation regarding electromagnetic compatibility.

### Environmental considerations
- See equipment label for the maximum ambient operating temperature limits.
- Humidity levels must be 5–95%, non-condensing.

### Fusing and circuit breakers
- Check for proper fusing or circuit breakers.
- Check that all fuses are inserted firmly and in operational condition and that all circuit breakers are in the open position.

### Grounding
- The unit requires a ground wire from its chassis to the building ground.
- Check for good ground connections that are tight and free of oxidation.
- Grounding to conduit or mounting the back panel to a metal surface is not sufficient.

### Input and output power wiring
- Check for loose connections.
- Check that motor and mains are in separate conduit or separated screened cables.

### Panel interior
- Inspect that the unit interior is free of debris and corrosion.

### Switches
- Ensure that all switch and disconnect settings are in the proper positions.

### Vibration
- Check that the unit is mounted solidly or that shock mounts are used, as necessary.
- Check for an unusual amount of vibration.

**Table 4.1 Start-up Checklist**
4.2 Applying Power

**WARNING**

HIGH VOLTAGE

Frequency converters contain high voltage when connected to AC mains.

- Only qualified personnel should perform installation, start-up and maintenance.

Failure to comply 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.

- Ensure that the frequency converter, motor, and any driven equipment are in operational readiness.

Failure to comply could result in death, serious injury, equipment, or property damage.

1. Confirm that the input voltage is balanced within 3%. If not, correct input voltage imbalance before proceeding. Repeat this procedure after the voltage correction.

2. Ensure that optional equipment wiring, if present, matches the installation application.

3. Ensure that all operator devices are in the OFF position. Panel doors should be 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.

**NOTICE**

If the status line at the bottom of the display reads AUTO REMOTE COASTING or Alarm 60 External Interlock is displayed, this indicates that the unit is ready to operate, but is missing an input signal on terminal 27.

4.3 Basic Operational Programming

4.3.1 Set-up Wizard

**NOTICE**

RISK OF EQUIPMENT DAMAGE

Always stop the frequency converter before using the wizard. Failure to stop the frequency converter may cause equipment damage.

The built-in wizard menu guides the installer through the set-up of the frequency converter in a clear and structured manner, and has been constructed with reference to the industries refrigeration engineers, to ensure that the text and language is known within that specific business area. At start-up, the FC 103 asks the user to run the VLT® Drive Application Guide or to skip it (until it has been run, the FC 103 asks every time at start-up), thereafter in the event of power failure, the application guide is accessed via the Quick Menu screen.

If [Cancel] is pressed, the FC 103 returns to the status screen. An automatic timer cancels the wizard after 5 min. of inactivity (no keys pressed). The wizard must be re-entered via the Quick Menu when it has been run once. Answering the questions on the screens takes the user though a complete set-up for the FC 103. Most standard refrigeration applications can be set up by using this application guide. Access advanced features via the menu structure (Quick Menu or Main Menu) in the frequency converter.

The FC 103 Wizard covers all standard settings for:

- Compressors
- Single fan and pump
- Condenser fans

These applications are then further expanded to allow control of the frequency converter via its own internal PID controllers or from an external control signal.

After completing set-up, re-run the wizard or start the application.

The application guide can be cancelled at any time by pressing [Back]. The application guide can be re-entered via the Quick Menu. When re-entering the application guide, either keep previous changes to the factory set-up or restore default values.

On power-up, the FC 103 launches an application guide. In the event of power failure, the application guide is accessed via the Quick Menu screen.

Illustration 4.1 Quick Menu Screen

If [Cancel] is pressed, the FC 103 returns to the status screen. An automatic timer cancels the wizard after 5 min. of inactivity (no keys pressed). Re-enter the wizard via the Quick Menu as described in this section.
If [OK] is pressed, the application guide starts with the following screen:

![Illustration 4.2 Start-up of Application Guide]

**NOTICE**

Numbering of steps in wizard (e.g. 1/12) can change depending on choices in the workflow.

This screen automatically changes to the first input screen of the application guide:

![Illustration 4.3 Language Selection]

![Illustration 4.4 Application Selection]

**Compressor pack set-up**

As an example, see screens below for a compressor pack set-up:

![Illustration 4.5 Voltage and Frequency Set-up]

![Illustration 4.6 Current and Nominal Speed Set-up]

![Illustration 4.7 Min. and Max. Frequency Set-up]

![Illustration 4.8 Min. Time between 2 Starts]

![Illustration 4.9 Select with/without Bypass Valve]

![Illustration 4.10 Select Open Loop or Closed Loop]

Start-up and Functional Test...
NOTICE

Internal/closed loop: The FC 103 controls the application directly using the internal PID control and needs an input from an external input, such as a temperature or other sensor, which is wired directly into the frequency converter and controls from the sensor signal.

External/open loop: The FC 103 takes its control signal from another controller (such as a pack controller), which gives the frequency converter e.g. 0-10 V, 4-20 mA or FC 103 Lon. The frequency converter changes its speed depending on this reference signal.

Illustration 4.11 Select Sensor Type

Illustration 4.12 Settings for Sensor

Illustration 4.13 Info: 4-20 mA Feedback Chosen - Connect Accordingly

Illustration 4.14 Info: Set Switch Accordingly

Illustration 4.15 Select Unit and Conversion from Pressure

Illustration 4.16 Select Fixed or Floating Setpoint

Illustration 4.17 Set Setpoint

Illustration 4.18 Set High/Low Limit for Setpoint
After completing set-up, re-run the wizard or start the application. Select between the following options:

- Re-run wizard
- Go to main menu
- Go to status
- Run AMA - Note this is a reduced AMA if compressor application is selected, and full AMA if single fan and pump is selected.
- If condenser fan is selected in application NO AMA can be run.
- Run application - this mode starts the frequency converter in either hand/local mode or via an external control signal if open loop is selected in an earlier screen.

The application guide can be cancelled at any time by pressing [Back]. The application guide can be re-entered via the Quick Menu:

When re-entering the application guide, select between previous changes to the factory set-up or restore default values.

**NOTICE**

If the system requirement is to have the internal pack controller for 3 compressors plus bypass valve connected, specify FC 103 with the extra relay card (MCB 105) mounted inside the frequency converter.

Programme the bypass valve to operate from one of the extra relay outputs on the MCB 105 board.

This is needed because the standard relay outputs in the FC 103 are used to control the compressors in the pack.
### 4.3.2 Required Initial Frequency Converter Programming

**NOTICE**

If the wizard is run, ignore the following.

Frequency converters require basic operational programming before running for best performance. This requires entering motor-nameplate data for the motor being operated and the minimum and maximum motor speeds. Enter data in accordance with the following procedure. Parameter settings recommended are intended for start-up and checkout purposes. Application settings may vary. See chapter 5 User Interface for detailed instructions on entering data via the LCP.

Enter data with power ON, but before operating the frequency converter.

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

![Illustration 4.26 Main Menu](image)

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

![Illustration 4.27 Operation/Display](image)

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

![Illustration 4.28 Basic Settings](image)

5. Press the navigation keys to select [0] International or [1] North America as appropriate and press [OK]. (This changes the default settings for a number of basic parameters. See chapter 6.4 International/North American Default Parameter Settings for a complete list.)

6. Press [Quick Menu] on the LCP.

7. Press the navigation keys to scroll to parameter group Q2 Quick Setup and press [OK].

![Illustration 4.29 Quick Menus](image)

8. Select the language and press [OK].

9. 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.

10. Set 3-02 Minimum Reference

11. Set 3-03 Maximum Reference

12. Set 3-41 Ramp 1 Ramp Up Time

13. Set 3-42 Ramp 1 Ramp Down Time

4.4 Automatic Motor Adaptation

Automatic motor adaptation (AMA) is a test procedure, which measures the electrical characteristics of the motor to optimise compatibility between the frequency converter and the motor.

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

• The motor shaft does not turn and no harm is done to the motor while running the AMA.

• Some motors may be unable to run the complete version of the test. In that case, select [2] Enable reduced AMA.

• If an output filter is connected to the motor, select Enable reduced AMA.

• If warnings or alarms occur, see chapter 9 Warnings and Alarms.

• Run this procedure on a cold motor for best results.

NOTICE

The AMA algorithm does not work when using PM motors.

To run AMA
1. Press [Main Menu] to access parameters.
2. Scroll to parameter group 1-* Load and Motor.
3. Press [OK].
5. Press [OK].
6. Scroll to 1-29 Automatic Motor Adaptation (AMA).
7. Press [OK].
8. Select [1] Enable complete AMA.
9. Press [OK].
10. Follow the on-screen instructions.
11. The test runs automatically and indicates when it is complete.

4.5 Check Motor Rotation

Before running the frequency converter, check the motor rotation. The motor runs briefly at 5 Hz or the minimum frequency set in 4-12 Motor Speed Low Limit [Hz].

1. Press [Quick Menu].
2. Scroll to Q2 Quick Setup.
3. Press [OK].
4. Scroll to 1-28 Motor Rotation Check.
5. Press [OK].

The following text appears:

Note! Motor may run in wrong direction.

7. Press [OK].
8. Follow the on-screen instructions.

To change the direction of rotation, remove power to the frequency converter and wait for the discharge time to elapse, see Table 2.1. Reverse the connection of any 2 of the 3 motor cables on the motor or frequency converter side of the connection.

4.6 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.

NOTICE

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 chapter 9 Warnings and Alarms.
• Check that motor data is entered correctly.
• Increase the ramp-up time in 3-41 Ramp 1 Ramp Up Time.
• Increase the current limit in 4-18 Current Limit.
• Increase the torque limit in 4-16 Torque Limit Motor Mode.
If deceleration problems were encountered:

- If warnings or alarms occur, see chapter 9 Warnings and Alarms.
- 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.

See chapter 5.1.1 Local Control Panel for resetting the frequency converter after a trip.

**NOTICE**

Chapter 4.2 Applying Power and chapter 4.3 Basic Operational Programming conclude the procedures for applying power to the frequency converter, basic programming, set-up, and functional testing.

### 4.7 System Start-up

The procedure in this section requires user-wiring and application programming to be completed. Chapter 7 Application Examples is intended to help with this task. Other aids to application set-up are listed in chapter 1.2 Additional Resources. 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 the 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 chapter 9 Warnings and Alarms.
5 User Interface

5.1 Local Control Panel

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

The LCP has several user functions.

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

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

5.1.1 LCP Layout

The LCP is divided into 4 functional groups (see Illustration 5.1).

A. Display area
B. Display menu keys
C. Navigation keys and indicator lights (LEDs)
D. Operation keys and reset

Illustration 5.1 Local Control Panel (LCP)

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

The information displayed on the LCP can be customised for user application. Select options in the Quick Menu Q3-13 Display Settings.
Table 5.1 Legend to Illustration 5.1, Display Area

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

<table>
<thead>
<tr>
<th>Callout</th>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Status</td>
<td>Shows operational information.</td>
</tr>
<tr>
<td>7</td>
<td>Quick Menu</td>
<td>Allows access to programming parameters for initial set-up instructions and many detailed application instructions.</td>
</tr>
<tr>
<td>8</td>
<td>Main Menu</td>
<td>Allows access to all programming parameters.</td>
</tr>
<tr>
<td>9</td>
<td>Alarm Log</td>
<td>Displays a list of current warnings, the last 10 alarms, and the maintenance log.</td>
</tr>
</tbody>
</table>

Table 5.2 Legend to Illustration 5.1, Display Menu Keys

C. Navigation Keys and Indicator Lights (LEDs)
Navigation keys are used for programming functions and moving the display cursor. The navigation keys also provide speed control in local (hand) operation. There are also 3 frequency converter status indicator lights in this area.

<table>
<thead>
<tr>
<th>Callout</th>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Back</td>
<td>Reverts to the previous step or list in the menu structure.</td>
</tr>
<tr>
<td>11</td>
<td>Cancel</td>
<td>Cancels the last change or command as long as the display mode has not changed.</td>
</tr>
<tr>
<td>12</td>
<td>Info</td>
<td>Press for a definition of the function being displayed.</td>
</tr>
<tr>
<td>13</td>
<td>Navigation keys</td>
<td>Press to move between items in the menu.</td>
</tr>
<tr>
<td>14</td>
<td>OK</td>
<td>Press to access parameter groups or to enable a choice.</td>
</tr>
</tbody>
</table>

Table 5.3 Legend to Illustration 5.1, Navigation Keys

D. Operation Keys and Reset
Operation keys are located at the bottom of the LCP.

<table>
<thead>
<tr>
<th>Callout</th>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
</table>
| 18      | Hand On | Starts the frequency converter in local control.  
|         |        | • An external stop signal by control input or serial communication overrides the local hand on. |
| 19      | Off    | Stops the motor but does not remove power to the frequency converter. |
| 20      | Auto On | Puts the system in remote operational mode.  
|         |        | • Responds to an external start command by control terminals or serial communication. |
| 21      | Reset  | Resets the frequency converter manually after a fault has been cleared. |

Table 5.4 Legend to Illustration 5.1, Indicator Lights (LEDs)

NOTICE
The display contrast can be adjusted by pressing [Status] and [▲]/[▼] keys.
5.1.2 Setting LCP Display Values

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

The information displayed on the LCP can be customised 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.

Illustration 5.2 Display Readouts

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter number</th>
<th>Default setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>0-20</td>
<td>Reference %</td>
</tr>
<tr>
<td>1.2</td>
<td>0-21</td>
<td>Motor current</td>
</tr>
<tr>
<td>1.3</td>
<td>0-22</td>
<td>Power [kW]</td>
</tr>
<tr>
<td>2</td>
<td>0-23</td>
<td>Frequency</td>
</tr>
<tr>
<td>3</td>
<td>0-24</td>
<td>kWh counter</td>
</tr>
</tbody>
</table>

5.1.3 Display Menu Keys

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

Illustration 5.3 Menu Keys

<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>Shows operational information.</td>
</tr>
<tr>
<td></td>
<td>- In Auto mode, press to toggle between status readout displays.</td>
</tr>
<tr>
<td></td>
<td>- Press repeatedly to scroll through each status display.</td>
</tr>
<tr>
<td></td>
<td>- Press [Status] plus [▲] or [▼] to adjust the display brightness.</td>
</tr>
<tr>
<td></td>
<td>- 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.</td>
</tr>
<tr>
<td>Quick Menu</td>
<td>Allows access to programming parameters for initial set-up instructions and many detailed application instructions.</td>
</tr>
<tr>
<td></td>
<td>- Press to access Q2 Quick Set-up for sequenced instructions to program the basic frequency controller set-up.</td>
</tr>
<tr>
<td></td>
<td>- Follow the sequence of parameters as presented for the function set-up.</td>
</tr>
<tr>
<td>Main Menu</td>
<td>Allows access to all programming parameters.</td>
</tr>
<tr>
<td></td>
<td>- Press twice to access top-level index.</td>
</tr>
<tr>
<td></td>
<td>- Press once to return to the last location accessed.</td>
</tr>
<tr>
<td></td>
<td>- Press to enter a parameter number for direct access to that parameter.</td>
</tr>
<tr>
<td>Alarm Log</td>
<td>Displays a list of current warnings, the last 10 alarms, and the maintenance log.</td>
</tr>
<tr>
<td></td>
<td>- For details about the frequency converter before it entered the alarm mode, select the alarm number using the navigation keys and press [OK].</td>
</tr>
</tbody>
</table>

Table 5.6 Function Description Menu Keys
5.1.4 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. There are also 3 frequency converter status indicator lights in this area.

![Illustration 5.4 Navigation Keys]

<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back</td>
<td>Reverts to the previous step or list in the menu structure.</td>
</tr>
<tr>
<td>Cancel</td>
<td>Cancels the last change or command as long as the display mode has not changed.</td>
</tr>
<tr>
<td>Info</td>
<td>Press for a definition of the function being displayed.</td>
</tr>
<tr>
<td>Navigation Keys</td>
<td>Press the 4 navigation keys to move between items in the menu.</td>
</tr>
<tr>
<td>OK</td>
<td>Press to access parameter groups or to enable a choice.</td>
</tr>
</tbody>
</table>

Table 5.7 Navigation Keys Functions

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

Table 5.8 Indicator Lights Functions

5.1.5 Operation Keys

Operation keys are located at the bottom of the LCP.

![Illustration 5.5 Operation Keys]

<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand On</td>
<td>Starts the frequency converter in local control.</td>
</tr>
<tr>
<td></td>
<td>• Use the navigation keys to control frequency converter speed.</td>
</tr>
<tr>
<td></td>
<td>• An external stop signal by control input or serial communication overrides the local hand on.</td>
</tr>
<tr>
<td>Off</td>
<td>Stops the motor, but does not remove power to the frequency converter.</td>
</tr>
<tr>
<td>Auto On</td>
<td>Puts the system in remote operational mode.</td>
</tr>
<tr>
<td></td>
<td>• Responds to an external start command by control terminals or serial communication.</td>
</tr>
<tr>
<td></td>
<td>• Speed reference is from an external source.</td>
</tr>
<tr>
<td>Reset</td>
<td>Resets the frequency converter manually after a fault has been cleared.</td>
</tr>
</tbody>
</table>

Table 5.9 Operation Keys Functions

5.2 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, or DC power supply, the motor may start at any time. Unintended start during programming, service or repair work can result in death, serious injury, or property damage. The motor can start by means of an external switch, a serial bus command, an input reference signal from the LCP, or after a cleared fault condition.
To prevent unintended motor start:
- Disconnect the frequency converter from mains.
- Press [Off/Reset] on the LCP, before programming parameters.
- The frequency converter, motor, and any driven equipment must be fully wired and assembled when the frequency converter is connected to AC mains, or DC power supply.

5.2.1 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.

5.2.2 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.

5.3 Restoring Default Settings
NOTICE
Initialisation restores the unit to factory default settings. Any programming, motor data, localisation, and monitoring records are lost. Uploading data to the LCP provides a back-up before initialisation.
Restoring the frequency converter parameter settings back to default values is done by initialisation of the frequency converter. Initialisation can be carried out via 14-22 Operation Mode or manually.
- Initialisation using 14-22 Operation Mode does not change frequency converter data such as operating hours, serial communication selections, personal menu settings, fault log, alarm log, and other monitoring functions.
- Using 14-22 Operation Mode is generally recommended.
- Manual initialisation erases all motor, programming, localisation, and monitoring data and restores factory default settings.

5.3.1 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.

5.3.2 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 reset the following frequency converter information:
- 15-00 Operating hours
- 15-03 Power Up's
- 15-04 Over Temp's
- 15-05 Over Volt's
6 Programming

6.1 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 chapter 5.1 Local Control Panel for details on using the LCP function keys). Parameters may also be accessed via a PC using the MCT 10 Set-up Software (see chapter 6.6.1 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.

6.2 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 responds by providing 6-60 Hz output to the motor proportional to the input signal (0-10 V DC=6-60 Hz).

Select the following parameters using the navigation keys to scroll to the titles and press [OK] after each action.

1. 3-15 Reference 1 Source

   Illustration 6.1 Programming Example Step 1

2. 3-02 Minimum Reference. Set the minimum internal frequency converter reference to 0 Hz. (This sets the minimum frequency converter speed at 0 Hz).

   Illustration 6.2 Programming Example Step 2

3. 3-03 Maximum Reference. Set the 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).

   Illustration 6.3 Programming Example Step 3

4. 6-10 Terminal 53 Low Voltage. Set the minimum external voltage reference on terminal 53 to 0 V. (This sets the minimum input signal at 0 V).

   Illustration 6.4 Programming Example Step 4
5. **6-11 Terminal 53 High Voltage.** Set the maximum external voltage reference on Terminal 53 to 10 V. (This sets the maximum input signal at 10 V).

   ![Illustration 6.5 Programming Example Step 5](image)

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

   ![Illustration 6.6 Programming Example Step 6](image)

7. **6-15 Terminal 53 High Ref./Feedb. Value.** Set the maximum speed reference on terminal 53 to 60 Hz. (This tells the frequency converter that the maximum voltage received on terminal 53 (10 V) equals 60 Hz output).

   ![Illustration 6.7 Programming Example Step 7](image)

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.

*Illustration 6.8* shows the wiring connections used to enable this set-up.

### 6.3 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 6.1 for control terminal parameter number and default setting. (Default setting can change based on the selection in 0-03 Regional Settings).

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

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

   ![Illustration 6.9 Main Menu Display Example](image)
2. Scroll to parameter group 5-1* Digital Inputs and press [OK].

Illustration 6.10 Parameter Group Display Example

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

Illustration 6.11 Function Choice Display Example

6.4 International/North American Default Parameter Settings

Setting 0-03 Regional Settings to [0] International or [1] North America changes the default settings for some parameters. Table 6.1 lists those parameters that are effected.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>International default parameter value</th>
<th>North American default parameter value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-03 Regional Settings</td>
<td>International</td>
<td>North America</td>
</tr>
<tr>
<td>0-71 Date Format</td>
<td>DD-MM-YYYY</td>
<td>MM/DD/YYYY</td>
</tr>
<tr>
<td>0-72 Time Format</td>
<td>24 h</td>
<td>12 h</td>
</tr>
<tr>
<td>1-20 Motor Power [kW]</td>
<td>See Note 1</td>
<td>See Note 1</td>
</tr>
<tr>
<td>1-21 Motor Power [HP]</td>
<td>See Note 2</td>
<td>See Note 2</td>
</tr>
<tr>
<td>1-22 Motor Voltage</td>
<td>230 V/400 V/575 V</td>
<td>208 V/460 V/575 V</td>
</tr>
<tr>
<td>1-23 Motor Frequency</td>
<td>50 Hz</td>
<td>60 Hz</td>
</tr>
<tr>
<td>3-03 Maximum Reference</td>
<td>50 Hz</td>
<td>60 Hz</td>
</tr>
<tr>
<td>3-04 Reference Function</td>
<td>Sum</td>
<td>External/Preset</td>
</tr>
<tr>
<td>4-13 Motor Speed High Limit [RPM]</td>
<td>1500 RPM</td>
<td>1800 RPM</td>
</tr>
<tr>
<td>4-14 Motor Speed High Limit [Hz]</td>
<td>50 Hz</td>
<td>60 Hz</td>
</tr>
<tr>
<td>4-19 Max Output Frequency</td>
<td>100 Hz</td>
<td>120 Hz</td>
</tr>
<tr>
<td>4-53 Warning Speed High</td>
<td>1500 RPM</td>
<td>1800 RPM</td>
</tr>
<tr>
<td>5-12 Terminal 27 Digital Input</td>
<td>Coast inverse</td>
<td>External interlock</td>
</tr>
<tr>
<td>5-40 Function Relay [2] Drive ready</td>
<td>No alarm</td>
<td></td>
</tr>
<tr>
<td>6-15 Terminal 53 High Ref./Feedb. Value</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>6-50 Terminal 42 Output</td>
<td>Output frequency</td>
<td>Speed 4-20 mA</td>
</tr>
<tr>
<td>14-20 Reset Mode</td>
<td>Manual reset</td>
<td>Infinite auto reset</td>
</tr>
<tr>
<td>22-85 Speed at Design Point [RPM]</td>
<td>1500 RPM</td>
<td>1800 RPM</td>
</tr>
<tr>
<td>22-86 Speed at Design Point [Hz]</td>
<td>50 Hz</td>
<td>60 Hz</td>
</tr>
</tbody>
</table>

Table 6.1 International/North American Default Parameter Settings

Note 1: 1-20 Motor Power [kW] is only visible when 0-03 Regional Settings is set to [0] International.
Note 2: 1-21 Motor Power [HP], is only visible when 0-03 Regional Settings is set to [1] North America.
Note 3: This parameter is only visible when 0-02 Motor Speed Unit is set to [0] RPM.
Note 4: This parameter is only visible when 0-02 Motor Speed Unit is set to [1] Hz.
Note 5: The default value depends on the number of motor poles. For a 4 poled motor, the international default value is 1500 RPM and for a 2 poled motor, 3000 RPM. The corresponding values for North America is 1800 and 3600 RPM.

Changes made to default settings are stored and available for viewing in the Quick Menu along with any programming entered into parameters.

1. Press [Quick Menu].
2. Scroll to QS Changes Made and press [OK].
3. Select QS-2 Since Factory Setting to view all programming changes or QS-1 Last 10 Changes for the most recent.
6.4.1 Parameter Data Check

1. Press [Quick Menu].
2. Scroll to Q5 Changes Made and press [OK].
3. Select Q5-2 Since Factory Setting to view all programming changes or Q5-1 Last 10 Changes for the most recent.

6.5 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 the 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
- 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 chapter 7 Application Examples.
<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-64</td>
<td>Terminal X30/8 Output Timeout Preset</td>
<td>9-52</td>
</tr>
<tr>
<td>8-9</td>
<td>Control and Options</td>
<td>9-53</td>
</tr>
<tr>
<td>9-0</td>
<td>General Settings</td>
<td>9-54</td>
</tr>
<tr>
<td>8-11</td>
<td>AK LonWorks</td>
<td>9-55</td>
</tr>
<tr>
<td>8-12</td>
<td>LonDevice</td>
<td>9-56</td>
</tr>
<tr>
<td>8-13</td>
<td>LonWorks</td>
<td>9-57</td>
</tr>
<tr>
<td>8-14</td>
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<td>LoNet Access</td>
<td>9-59</td>
</tr>
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</tr>
<tr>
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</tr>
<tr>
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<td>10-0</td>
</tr>
</tbody>
</table>

### 11. **Function at Over Temperature**
- 12-10 Comparator Operands
- 12-11 Comparator Value
- 12-12 Comparator Value
- 12-13 Comparator Value
- 12-14 Comparator Value
- 12-15 Comparator Value
- 12-16 Comparator Value
- 12-17 Comparator Value
- 12-18 Comparator Value
- 12-19 Comparator Value
- 12-20 Comparator Value
- 12-21 Comparator Value
- 12-22 Comparator Value
- 12-23 Comparator Value
- 12-24 Comparator Value
- 12-25 Comparator Value
- 12-26 Comparator Value
- 12-27 Comparator Value
- 12-28 Comparator Value
- 12-29 Comparator Value
- 12-30 Comparator Value
- 12-31 Comparator Value
- 12-32 Comparator Value
- 12-33 Comparator Value
- 12-34 Comparator Value
- 12-35 Comparator Value
- 12-36 Comparator Value
- 12-37 Comparator Value
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- 12-42 Comparator Value
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- 12-49 Comparator Value
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- 12-51 Comparator Value
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- 12-63 Comparator Value
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- 12-68 Comparator Value
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- 12-72 Comparator Value
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- 13-18 Comparator Operands
- 13-19 Comparator Operands
- 13-20 Comparator Operands
- 13-21 Comparator Operands
- 13-22 Comparator Operands
- 13-23 Comparator Operands
- 13-24 Comparator Operands
- 13-25 Comparator Operands
- 13-26 Comparator Operands
- 13-27 Comparator Operands
- 13-28 Comparator Operands
- 13-29 Comparator Operands
- 13-30 Comparator Operands
- 13-31 Comparator Operands
- 13-32 Comparator Operands
- 13-33 Comparator Operands
- 13-34 Comparator Operands
- 13-35 Comparator Operands
- 13-36 Comparator Operands
- 13-37 Comparator Operands
- 13-38 Comparator Operands
- 13-39 Comparator Operands
- 13-40 Comparator Operands
- 13-41 Comparator Operands
- 13-42 Comparator Operands
- 13-43 Comparator Operands
- 13-44 Comparator Operands
- 13-45 Comparator Operands
- 13-46 Comparator Operands
- 13-47 Comparator Operands
- 13-48 Comparator Operands
- 13-49 Comparator Operands
- 13-50 Comparator Operands
- 13-51 Comparator Operands
- 13-52 Comparator Operands
- 13-53 Comparator Operands
- 13-54 Comparator Operands
- 13-55 Comparator Operands
- 13-56 Comparator Operands
- 13-57 Comparator Operands
- 13-58 Comparator Operands
- 13-59 Comparator Operands
- 13-60 Comparator Operands
- 13-61 Comparator Operands
- 13-62 Comparator Operands
- 13-63 Comparator Operands
- 13-64 Comparator Operands
- 13-65 Comparator Operands
- 13-66 Comparator Operands
- 13-67 Comparator Operands
- 13-68 Comparator Operands
- 13-69 Comparator Operands
- 13-70 Comparator Operands
- 13-71 Comparator Operands
- 13-72 Comparator Operands
- 13-73 Comparator Operands
- 13-74 Comparator Operands
- 13-75 Comparator Operands
- 13-76 Comparator Operands
- 13-77 Comparator Operands
- 13-78 Comparator Operands
- 13-79 Comparator Operands
- 13-80 Comparator Operands
- 13-81 Comparator Operands
- 13-82 Comparator Operands
- 13-83 Comparator Operands
- 13-84 Comparator Operands
- 13-85 Comparator Operands
- 13-86 Comparator Operands
- 13-87 Comparator Operands
- 13-88 Comparator Operands
- 13-89 Comparator Operands
- 13-90 Comparator Operands
- 13-91 Comparator Operands
- 13-92 Comparator Operands
- 13-93 Comparator Operands
- 13-94 Comparator Operands
- 13-95 Comparator Operands
- 13-96 Comparator Operands
- 13-97 Comparator Operands
- 13-98 Comparator Operands
- 13-99 Comparator Operands
<table>
<thead>
<tr>
<th>Term. X42/5 Live Zero</th>
<th>Analog Out X42/7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal X42/7 Output</td>
<td>Terminal X42/7 Min. Scale</td>
</tr>
<tr>
<td>Terminal X42/7 Max. Scale</td>
<td>Terminal X42/7 Bus Control</td>
</tr>
<tr>
<td>Terminal X42/7 Timeout Preset</td>
<td>Analog Out X42/9</td>
</tr>
<tr>
<td>Terminal X42/9 Output</td>
<td>Terminal X42/9 Min. Scale</td>
</tr>
<tr>
<td>Terminal X42/9 Max. Scale</td>
<td>Terminal X42/9 Bus Control</td>
</tr>
<tr>
<td>Terminal X42/9 Timeout Preset</td>
<td>Analog Out X42/11</td>
</tr>
<tr>
<td>Terminal X42/11 Output</td>
<td>Terminal X42/11 Min. Scale</td>
</tr>
<tr>
<td>Terminal X42/11 Max. Scale</td>
<td>Terminal X42/11 Bus Control</td>
</tr>
<tr>
<td>Terminal X42/11 Timeout Preset</td>
<td>Compressor Functions</td>
</tr>
<tr>
<td>Oil Return Management</td>
<td>Low Speed Running Time</td>
</tr>
<tr>
<td>Fixed Boost Interval</td>
<td>Boost Duration</td>
</tr>
<tr>
<td>Discharge Temperature Monitor</td>
<td>Temperature Source</td>
</tr>
<tr>
<td>Temperature Unit</td>
<td>Warning Level</td>
</tr>
<tr>
<td>Warning Action</td>
<td>Emergency Level</td>
</tr>
<tr>
<td>Discharge Temperature</td>
<td>Day/Night Settings</td>
</tr>
<tr>
<td>Day/Night Bus Indicator</td>
<td>Day/Night Bus Indicator</td>
</tr>
<tr>
<td>Enable Day/Night Via Bus</td>
<td>Night Setback</td>
</tr>
<tr>
<td>Night Speed Drop [RPM]</td>
<td>Night Speed Drop Override</td>
</tr>
<tr>
<td>Night Speed Drop [Hz]</td>
<td>Bypass Status Word</td>
</tr>
<tr>
<td>P0 Optimization</td>
<td>Injection Control</td>
</tr>
<tr>
<td>Injection On</td>
<td>Advanced Start Adjust</td>
</tr>
<tr>
<td>Locked Rotor Protection</td>
<td>Locked Rotor Detection Time [s]</td>
</tr>
<tr>
<td>Bypass Mode</td>
<td>Bypass Option</td>
</tr>
<tr>
<td>Bypass Start Time Delay</td>
<td>Bypass Trip Time Delay</td>
</tr>
<tr>
<td>Test Mode Activation</td>
<td></td>
</tr>
</tbody>
</table>
6.6 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 the PC to the frequency converter.
7 Application Examples

7.1 Introduction

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

- Parameter settings are the regional default values unless otherwise indicated (selected in 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.

7.2 Application Examples

<table>
<thead>
<tr>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FC</strong></td>
</tr>
<tr>
<td>+24 V</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>+24 V</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>19</td>
</tr>
<tr>
<td>COM</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>27</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>29</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>32</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>33</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>37</td>
</tr>
<tr>
<td>+10 V</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>A IN</td>
</tr>
<tr>
<td>53</td>
</tr>
<tr>
<td>A IN</td>
</tr>
<tr>
<td>54</td>
</tr>
<tr>
<td>COM</td>
</tr>
<tr>
<td>55</td>
</tr>
<tr>
<td>A OUT</td>
</tr>
<tr>
<td>42</td>
</tr>
<tr>
<td>COM</td>
</tr>
<tr>
<td>39</td>
</tr>
</tbody>
</table>

Table 7.1 AMA with T27 Connected

<table>
<thead>
<tr>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FC</strong></td>
</tr>
<tr>
<td>+24 V</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>+24 V</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>19</td>
</tr>
<tr>
<td>COM</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>27</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>29</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>32</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>33</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>37</td>
</tr>
<tr>
<td>+10 V</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>A IN</td>
</tr>
<tr>
<td>53</td>
</tr>
<tr>
<td>A IN</td>
</tr>
<tr>
<td>54</td>
</tr>
<tr>
<td>COM</td>
</tr>
<tr>
<td>55</td>
</tr>
<tr>
<td>A OUT</td>
</tr>
<tr>
<td>42</td>
</tr>
<tr>
<td>COM</td>
</tr>
<tr>
<td>39</td>
</tr>
</tbody>
</table>

Table 7.2 AMA without T27 Connected

<table>
<thead>
<tr>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FC</strong></td>
</tr>
<tr>
<td>+24 V</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>+24 V</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>19</td>
</tr>
<tr>
<td>COM</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>27</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>29</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>32</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>33</td>
</tr>
<tr>
<td>D IN</td>
</tr>
<tr>
<td>37</td>
</tr>
<tr>
<td>+10 V</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>A IN</td>
</tr>
<tr>
<td>53</td>
</tr>
<tr>
<td>A IN</td>
</tr>
<tr>
<td>54</td>
</tr>
<tr>
<td>COM</td>
</tr>
<tr>
<td>55</td>
</tr>
<tr>
<td>A OUT</td>
</tr>
<tr>
<td>42</td>
</tr>
<tr>
<td>COM</td>
</tr>
<tr>
<td>39</td>
</tr>
</tbody>
</table>

Table 7.3 Analog Speed Reference (Voltage)
### Table 7.4 Analog Speed Reference (Current)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Function</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-12 Terminal 53</td>
<td>Low Current</td>
<td>4 mA*</td>
</tr>
<tr>
<td>6-13 Terminal 53</td>
<td>High Current</td>
<td>20 mA*</td>
</tr>
<tr>
<td>6-14 Terminal 53</td>
<td>Low Ref./Feedb. Value</td>
<td>0 Hz</td>
</tr>
<tr>
<td>6-15 Terminal 53</td>
<td>High Ref./Feedb. Value</td>
<td>50 Hz</td>
</tr>
</tbody>
</table>

Notes/comments:
- D IN 37 is an option.

* = Default Value

### Table 7.6 Pulse Start/Stop

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Function</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-10 Terminal 18</td>
<td>Digital Input</td>
<td>[8] Start*</td>
</tr>
<tr>
<td>5-12 Terminal 27</td>
<td>Digital Input</td>
<td>[0] No operation</td>
</tr>
<tr>
<td>5-19 Terminal 37</td>
<td>Safe Stop</td>
<td>[1] Safe Stop Alarm</td>
</tr>
</tbody>
</table>

Notes/comments:
- If 5-12 Terminal 27 Digital Input is set to [0] No operation, a jumper wire to terminal 27 is not needed. D IN 37 is an option.

* = Default Value
**Table 7.7 Start/Stop with Reversing and 4 Preset Speeds**

<table>
<thead>
<tr>
<th>Function</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-10 Terminal 18</td>
<td>Start</td>
</tr>
<tr>
<td>5-11 Terminal 19</td>
<td>Reversing*</td>
</tr>
<tr>
<td>5-12 Terminal 27</td>
<td>(0) No operation</td>
</tr>
<tr>
<td>5-14 Terminal 32</td>
<td>Preset ref bit 0</td>
</tr>
<tr>
<td>5-15 Terminal 33</td>
<td>Preset ref bit 1</td>
</tr>
<tr>
<td>5-10 Preset Reference</td>
<td></td>
</tr>
<tr>
<td>Preset ref. 0</td>
<td>25%</td>
</tr>
<tr>
<td>Preset ref. 1</td>
<td>50%</td>
</tr>
<tr>
<td>Preset ref. 2</td>
<td>75%</td>
</tr>
<tr>
<td>Preset ref. 3</td>
<td>100%</td>
</tr>
</tbody>
</table>

* = Default Value

**Notes/comments:**
D IN 37 is an option.

**Table 7.8 External Alarm Reset**

<table>
<thead>
<tr>
<th>Function</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-10 Terminal 53</td>
<td>Low Voltage 0.07 V*</td>
</tr>
<tr>
<td>6-11 Terminal 53</td>
<td>High Voltage 10 V*</td>
</tr>
<tr>
<td>6-14 Terminal 53</td>
<td>Low Ref./Feedb. Value 0 Hz</td>
</tr>
<tr>
<td>6-15 Terminal 53</td>
<td>High Ref./Feedb. Value 1500 Hz</td>
</tr>
</tbody>
</table>

* = Default Value

**Notes/comments:**
D IN 37 is an option.

**Table 7.9 Speed Reference (using a Manual Potentiometer)**

<table>
<thead>
<tr>
<th>Function</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-10 Terminal 18</td>
<td>Start*</td>
</tr>
<tr>
<td>5-12 Terminal 27</td>
<td>Freeze Reference</td>
</tr>
<tr>
<td>5-13 Terminal 29</td>
<td>Speed Up</td>
</tr>
<tr>
<td>5-14 Terminal 32</td>
<td>Speed Down</td>
</tr>
</tbody>
</table>

* = Default Value

**Notes/comments:**
D IN 37 is an option.

**Table 7.10 Speed Up/Down**

<table>
<thead>
<tr>
<th>Function</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-10 Terminal 18</td>
<td>Start*</td>
</tr>
<tr>
<td>5-12 Terminal 27</td>
<td>Freeze Reference</td>
</tr>
<tr>
<td>5-13 Terminal 29</td>
<td>Speed Up</td>
</tr>
<tr>
<td>5-14 Terminal 32</td>
<td>Speed Down</td>
</tr>
</tbody>
</table>

* = Default Value

**Notes/comments:**
D IN 37 is an option.
Illustration 7.3 Speed Up/Down

Function
Setting
8-30 Protocol
FC
8-31 Address
1
8-32 Baud Rate
9600

Notes/comments:
Select protocol, address and baud rate in the above mentioned parameters.
D IN 37 is an option.

Table 7.11 RS-485 Network Connection

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

Table 7.12 Motor Thermistor

Function
Setting
1-90 Motor
[2]
Thermal Protection

Notes/comments:
If only a warning is desired, 1-90 Motor Thermal Protection should be set to [1] Thermistor warning.
D IN 37 is an option.

NOTICE
Danfoss recommends using 24 V DC as thermistor supply voltage.
8 Status Messages

8.1 Status Display
When the frequency converter is in Status mode, status messages are generated automatically and appear in the bottom line of the display (see Illustration 8.1).

Illustration 8.1 Status Display

8.2 Status Message Definitions

Table 8.1, Table 8.2 and Table 8.3 define the meaning of the status message display words.

<table>
<thead>
<tr>
<th>Operation mode</th>
<th>Operation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>The frequency converter does not react to any control signal until [Auto On] or [Hand On] is pressed.</td>
</tr>
<tr>
<td>Auto On</td>
<td>The frequency converter is controlled from the control terminals and/or the serial communication.</td>
</tr>
<tr>
<td>Hand On</td>
<td>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.</td>
</tr>
</tbody>
</table>

Table 8.1 Operation Mode

<table>
<thead>
<tr>
<th>Reference Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote</td>
</tr>
<tr>
<td>Local</td>
</tr>
</tbody>
</table>

Table 8.2 Reference Site

<table>
<thead>
<tr>
<th>Status Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Brake</td>
</tr>
<tr>
<td>AC Brake was selected in 2-10 Brake Function. The AC brake overmagnetises the motor to achieve a controlled slow down.</td>
</tr>
<tr>
<td>AMA finish OK</td>
</tr>
<tr>
<td>Automatic motor adaptation (AMA) was carried out successfully.</td>
</tr>
<tr>
<td>AMA ready</td>
</tr>
<tr>
<td>AMA is ready to start. Press [Hand On] to start.</td>
</tr>
<tr>
<td>AMA running</td>
</tr>
<tr>
<td>AMA process is in progress.</td>
</tr>
<tr>
<td>Coast</td>
</tr>
<tr>
<td>Coast inverse was selected as a function for a digital input (parameter group 5-1* Digital Inputs). The corresponding terminal is not connected.</td>
</tr>
<tr>
<td>Ctrl. Ramp-down</td>
</tr>
<tr>
<td>Control ramp-down was selected in 14-10 Mains Failure.</td>
</tr>
<tr>
<td>Current High</td>
</tr>
<tr>
<td>The frequency converter output current is above the limit set in 4-51 Warning Current High.</td>
</tr>
<tr>
<td>Current Low</td>
</tr>
<tr>
<td>The frequency converter output current is below the limit set in 4-52 Warning Speed Low.</td>
</tr>
<tr>
<td>DC Hold</td>
</tr>
<tr>
<td>DC hold is selected in 1-80 Function at Stop and a stop command is active. The motor is held by a DC current set in 2-00 DC Hold/Preheat Current.</td>
</tr>
<tr>
<td>DC Stop</td>
</tr>
<tr>
<td>The motor is held with a DC current (2-01 DC Brake Current) for a specified time (2-02 DC Braking Time).</td>
</tr>
<tr>
<td>Feedback high</td>
</tr>
<tr>
<td>The sum of all active feedbacks is above the feedback limit set in 4-57 Warning Feedback High.</td>
</tr>
<tr>
<td>Feedback low</td>
</tr>
<tr>
<td>The sum of all active feedbacks is below the feedback limit set in 4-56 Warning Feedback Low.</td>
</tr>
</tbody>
</table>
| Freeze output | The remote reference is active, which holds the present speed.  
|               | - Freeze output was selected as a function for a digital input (parameter group 5-1* Digital Inputs). The corresponding terminal is active. Speed control is only possible via the terminal functions speed up and speed down.  
|               | - Hold ramp is activated via serial communication.  

| Freeze output request | A freeze output command has been given, but the motor remains stopped until a run permissive signal is received.  

| Freeze ref. | Freeze Reference was selected as a function for a digital input (parameter group 5-1* Digital Inputs). 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 is stopped until a run permissive signal is received via a digital input.  

| Jogging | The motor is running as programmed in 3-19 Jog Speed [RPM]:  
|         | - Jog was selected as function for a digital input (parameter group 5-1* Digital Inputs). The corresponding terminal (e.g. terminal 29) is active.  
|         | - The Jog function is activated via the serial communication.  
|         | - The Jog function was selected as a reaction for a monitoring function (e.g. No signal). The monitoring function is active.  

| Motor check | In 1-80 Function at Stop, Motor Check 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 | Overvoltage control was activated in 2-17 Over-voltage Control. 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.  

| Power Unit 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).  
|               | - To avoid tripping, switching frequency is reduced to 4 kHz.  
|               | - If possible, protection mode ends after approximately 10 s.  
|               | - Protection mode can be restricted in 14-26 Trip Delay at Inverter Fault.  

| 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 4-55 Warning Reference High.  

| Ref. low | The sum of all active references is below the reference limit set in 4-54 Warning Reference Low.  

| 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 4-53 Warning Speed High.  

| Speed low | Motor speed is below the value set in 4-52 Warning Speed Low.  

| Standby | In Auto On mode, the frequency converter starts the motor with a start signal from a digital input or serial communication.  

| Start delay | In 1-71 Start Delay, a delay starting time was set. A start command is activated and the motor starts after the start delay time expires.  

| Start fwd/rev | Start forward and start reverse were selected as functions for 2 different digital inputs (parameter group 5-1* Digital Inputs). The motor starts in forward or reverse depending on which corresponding terminal is activated.  

| Stop | The frequency converter has received a stop command from the LCP, digital input, or serial communication.  

| Trip | An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, the frequency converter can be reset manually by pressing [Reset] or remotely by control terminals or serial communication.  

| Trip lock | An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, power must be cycled to the frequency converter. The frequency converter can then be reset manually by pressing [Reset] or remotely by control terminals or serial communication.  

Table 8.3 Operation Status
9 Warnings and Alarms

9.1 System Monitoring

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

9.2 Warning and Alarm Types

9.2.1 Warnings

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

9.2.2 Alarm Trip

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

A trip can be reset in any of 4 ways:

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

9.2.3 Alarm Trip-lock

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

9.3 Warning and Alarm Displays

An alarm or trip-lock alarm flashes in the display along with the alarm number.

In addition to the text and alarm code on the frequency converter display, there are 3 status indicator lights.

- Warn. LED
- Alarm LED
- Trip-Lock LED

<table>
<thead>
<tr>
<th></th>
<th>Warn. LED</th>
<th>Alarm LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warning</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Alarm</td>
<td>OFF</td>
<td>ON (Flashing)</td>
</tr>
<tr>
<td>Trip-Lock</td>
<td>ON</td>
<td>ON (Flashing)</td>
</tr>
</tbody>
</table>

Illustration 9.1 Warning Display Example

Illustration 9.2 Alarm Display Example

Illustration 9.3 Indicator Lights
### 9.4 Warning and Alarm Definitions

Table 9.1 defines whether a warning is issued before an alarm, and whether the alarm trips the unit or trip locks the unit.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Warning</th>
<th>Alarm/Trip</th>
<th>Alarm/Trip lock</th>
<th>Parameter reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10 Volts low</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Live zero error</td>
<td>(X)</td>
<td>(X)</td>
<td></td>
<td>6-01 Live Zero Timeout Function</td>
</tr>
<tr>
<td>4</td>
<td>Mains phase loss</td>
<td>(X)</td>
<td>(X)</td>
<td>(X)</td>
<td>14-12 Function at Mains Imbalance</td>
</tr>
<tr>
<td>5</td>
<td>DC link voltage high</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>DC link voltage low</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>DC over voltage</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>DC under voltage</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Inverter overloaded</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Motor ETR over temperature</td>
<td>(X)</td>
<td>(X)</td>
<td></td>
<td>1-90 Motor Thermal Protection</td>
</tr>
<tr>
<td>11</td>
<td>Motor thermistor over temperature</td>
<td>(X)</td>
<td>(X)</td>
<td></td>
<td>1-90 Motor Thermal Protection</td>
</tr>
<tr>
<td>12</td>
<td>Torque limit</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Over Current</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Earth (ground) fault</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Hardware mismatch</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Short Circuit</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Control word timeout</td>
<td>(X)</td>
<td>(X)</td>
<td></td>
<td>8-04 Control Timeout Function</td>
</tr>
<tr>
<td>18</td>
<td>Start Failed</td>
<td>X</td>
<td></td>
<td></td>
<td>1-77 Compressor Start Max Speed (RPM), 1-79 Pump Start Max Time to Trip</td>
</tr>
<tr>
<td>19</td>
<td>Discharge Temperature High</td>
<td>X</td>
<td></td>
<td></td>
<td>28-25 Warning Action</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28-26 Emergency Level</td>
</tr>
<tr>
<td>23</td>
<td>Internal Fan Fault</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>External Fan Fault</td>
<td>X</td>
<td></td>
<td></td>
<td>14-53 Fan Monitor</td>
</tr>
<tr>
<td>29</td>
<td>Drive over temperature</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Motor phase U missing</td>
<td>(X)</td>
<td>(X)</td>
<td>(X)</td>
<td>4-58 Missing Motor Phase Function</td>
</tr>
<tr>
<td>31</td>
<td>Motor phase V missing</td>
<td>(X)</td>
<td>(X)</td>
<td>(X)</td>
<td>4-58 Missing Motor Phase Function</td>
</tr>
<tr>
<td>32</td>
<td>Motor phase W missing</td>
<td>(X)</td>
<td>(X)</td>
<td>(X)</td>
<td>4-58 Missing Motor Phase Function</td>
</tr>
<tr>
<td>33</td>
<td>Inrush fault</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Fieldbus communication fault</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Out of frequency range</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Mains failure</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Internal fault</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Heat sink sensor</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Overload of Digital Output Terminal 27</td>
<td>(X)</td>
<td></td>
<td></td>
<td>5-00 Digital I/O Mode, 5-01 Terminal 27 Mode</td>
</tr>
<tr>
<td>41</td>
<td>Overload of Digital Output Terminal 29</td>
<td>(X)</td>
<td></td>
<td></td>
<td>5-00 Digital I/O Mode, 5-02 Terminal 29 Mode</td>
</tr>
<tr>
<td>42</td>
<td>Overload of Digital Output On X30/6</td>
<td>(X)</td>
<td></td>
<td></td>
<td>5-32 Term X30/6 Digi Out (MCB 101)</td>
</tr>
<tr>
<td>42</td>
<td>Overload of Digital Output On X30/7</td>
<td>(X)</td>
<td></td>
<td></td>
<td>5-33 Term X30/7 Digi Out (MCB 101)</td>
</tr>
<tr>
<td>46</td>
<td>Pwr. card supply</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>24 V supply low</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>1.8 V supply low</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 9.1 Alarm/Warning Code List

(X) Dependent on parameter
1) Cannot be Auto reset via 14-20 Reset Mode

9.5 Fault Messages

The following warning/alarm information 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 an 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 in 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 the value in 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 back-up supply is connected. If no 24 V DC back-up 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 an input voltage test.

Troubleshooting

- Perform a soft charge circuit test.

WARNING/ALARM 9, Inverter overload
The frequency converter is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection gives a warning at 98% and trips at 100%, while giving an alarm. The frequency converter cannot be reset until the counter is below 90%.

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

Troubleshooting

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

WARNING/ALARM 10, Motor overload temperature
According to the electronic thermal protection (ETR), the motor is too hot. Select whether the frequency converter gives a warning or an alarm when the counter reaches 100% in 1-90 Motor Thermal Protection. The fault occurs when the motor is overloaded by more than 100% for too long.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the motor current set in 1-24 Motor Current is correct
- Ensure that motor data in parameters 1-20 to 1-25 are set correctly.
- If an external fan is in use, ensure that is is selected in 1-91 Motor External Fan.
- 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 using a thermal switch or thermistor, check that the programming if matches 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 s, then the frequency converter trips and issues an alarm. This fault may be caused by shock loading or fast acceleration with high inertia loads. If extended mechanical brake control is selected, trip can be reset externally.

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

**ALARM 14, Earth (ground) fault**
There is current from the output phases to ground, 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 ground fault.
- Check for ground faults in the motor by measuring the resistance to ground of the motor leads and the motor with a megohmmeter.
- Perform current sensor test.

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

Record the value of the following parameters and contact the Danfoss supplier:
- 15-40 FC Type
- 15-41 Power Section
- 15-42 Voltage
- 15-43 Software Version
- 15-45 Actual Typecode String
- 15-49 SW ID Control Card
- 15-50 SW ID Power Card
- 15-60 Option Mounted
- 15-61 Option SW Version (for each option slot)

**ALARM 16, Short circuit**
There is short-circuiting in the motor or motor wiring.
- Remove power to the frequency converter and repair the short circuit.

**WARNING/ALARM 17, Control word timeout**
There is no communication to the frequency converter. The warning is only active when 8-04 Control Timeout Function is NOT set to OFF.
If 8-04 Control Timeout Function is set to [5] 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 the value in 8-03 Control Timeout Time.
- Check the operation of the communication equipment.
- Verify a proper installation based on EMC requirements.

**ALARM 18, Start failed**
The speed has not exceeded 1-77 Compressor Start Max Speed [RPM] during start within the allowed time. (set in 1-79 Pump Start Max Time to Trip). This may be caused by a blocked motor.

**Warning/Alarm 19, Discharge Temperature High**
**Warning:**
The discharge temperature exceeds the level programmed in 28-25 Warning Action.

**Alarm:**
The discharge temperature exceeds the level programmed in 28-26 Emergency Level.

**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).
Warnings and Alarms

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.

ALARM 29, Heat Sink temp
The maximum temperature of the heat sink has been exceeded. The temperature fault does not reset until the temperature drops below a defined heat sink temperature. The trip and reset points are different based on the frequency converter power size.

Troubleshooting
- Check 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 heat sink fan
  - Dirty heat sink

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

Troubleshooting
- Check fan resistance.
- Check soft charge fuses.

ALARM 30, Motor phase U missing
Motor phase U between the frequency converter and the motor is missing.

Troubleshooting
- 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.

Troubleshooting
- 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.

Troubleshooting
- 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.

Troubleshooting
- 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 35, Option fault
Option fault. Please contact your supplier.

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.

Troubleshooting
- 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 Table 9.2 is displayed.

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

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

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

#### Table 9.2 Internal Fault Code Numbers

<table>
<thead>
<tr>
<th>No.</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>2836</td>
<td>cfListMempool too small</td>
</tr>
<tr>
<td>3072-5122</td>
<td>Parameter value is outside its limits.</td>
</tr>
<tr>
<td>5123</td>
<td>Option in slot A: Hardware incompatible with control board hardware.</td>
</tr>
<tr>
<td>5124</td>
<td>Option in slot B: Hardware incompatible with control board hardware.</td>
</tr>
<tr>
<td>5376-6231</td>
<td>Out of memory</td>
</tr>
</tbody>
</table>

**ALARM 39, Heat sink sensor**

No feedback from the heat sink temperature sensor.

The signal from the IGBT thermal sensor is not available on the power card. The problem could be on the power card, on the 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 3 power supplies generated by the switch mode power supply (SMPS) on the power card: 24 V, 5 V, and ±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 3-phase mains voltage, all 3 supplies are monitored.

**WARNING 47, 24 V supply low**

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

**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 trips.

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

ALARM 51, AMA check U_{nom} and I_{nom}
The settings for motor voltage, motor current, and motor power are wrong. 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 does not run.

ALARM 56,AMA interrupted by user
The user has interrupted the AMA.

ALARM 57,AMA internal fault
Try to restart AMA again a number of times, until the AMA is carried out. Note that repeated runs may heat the motor to a level where the resistance R_s and R_r are increased. In most cases, however, this is not critical.

ALARM 58,AMA internal fault
Contact Danfoss.

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

Troubleshooting
- Ensure that motor data in parameters 1-20 to 1-25 are set correctly.
- Possibly increase the current limit. Be sure that the system can operate safely at a higher limit.

WARNING 60,External interlock
External interlock has been activated. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock and reset the frequency converter (via serial communication, digital I/O, or by pressing [Reset]).

WARNING 61,Tracking error
An error has been detected between the calculated motor speed and the speed measurement from the feedback device. The function for Warning/Alarm/Disable is set in 4-30 Motor Feedback Loss Function, error setting in 4-31 Motor Feedback Speed Error, and the allowed error time 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 63, Mechanical brake low
The actual motor current has not exceeded the release brake current within the start delay time window.

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

WARNING/ALARM 65, Control card over temperature
The control card has reached its trip temperature of 75 °C.

WARNING 66, Heat sink temperature low
The frequency converter is too cold to operate. This warning is based on the temperature sensor in the IGBT module.

Troubleshooting
- 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

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 Torque Off has been activated.

Troubleshooting
- To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal (via bus, digital I/O, or by pressing [Reset]).

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

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

ALARM 70, Illegal FC configuration
The control card and power card are incompatible.

Troubleshooting
- Contact the supplier with the type code of the unit from the nameplate and the part numbers of the cards to check compatibility.
WARNING 77, Reduced power mode
This warning indicates that the frequency converter is operating in reduced power mode (i.e. less than the allowed number of inverter sections). This warning is generated on power cycle when the frequency converter is set to run with fewer inverters and remains 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.

Troubleshooting
- Reset the unit to clear the alarm.

ALARM 91, Analog input 54 wrong settings
Switch S202 has to be set in position OFF (voltage input) when a KTY sensor is connected to analog input terminal 54.

ALARM 92, No flow
A no-flow condition has been detected in the system. 22-23 No-Flow Function is set for alarm.

Troubleshooting
- Troubleshoot the system and reset the frequency converter after the fault has been cleared.

ALARM 93, Dry pump
A no-flow condition in the system with the frequency converter operating at high speed may indicate a dry pump. 22-26 Dry Pump Function is set for alarm.

Troubleshooting
- Troubleshoot the system and reset the frequency converter after the fault has been cleared.

ALARM 94, End of curve
Feedback is lower than the set point. This may indicate leakage in the system. 22-50 End of Curve Function is set for alarm.

Troubleshooting
- Troubleshoot the system and reset the frequency converter after the fault has been cleared.

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

Troubleshooting
- Troubleshoot the system and reset the frequency converter after the fault has been cleared.

ALARM 96, Start delayed
Motor start has been delayed due to short-cycle protection. 22-76 Interval between Starts is enabled.

Troubleshooting
- Troubleshoot the system and reset the frequency converter after the fault has been cleared.

WARNING 97, Stop delayed
Stopping the motor has been delayed due to short-cycle protection. 22-76 Interval between Starts is enabled.

Troubleshooting
- Troubleshoot the system and reset the frequency converter after the fault has been cleared.

WARNING 98, Clock fault
Time is not set or the RTC clock has failed.

Troubleshooting
- Reset the clock in 0-70 Date and Time.

ALARM 99, Locked rotor
Rotor is blocked.

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

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

ALARM 220, Overload trip
Motor overload has tripped. Indicates excess motor load.

Troubleshooting
- Check motor and driven load.
- To reset, press [Off Reset].
- Then, to restart the system press [Auto on] or [Hand on].

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.

Troubleshooting
- Reset to remove the warning and resume normal operation.
## 10 Basic Troubleshooting

### 10.1 Start-up and Operation

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Test</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Display dark/No function</strong></td>
<td>Missing input power</td>
<td>See Table 4.1.</td>
<td>Check the input power source.</td>
</tr>
<tr>
<td></td>
<td>Missing or open fuses or circuit breaker tripped</td>
<td>See Open fuses and Tripped circuit breaker in this table for possible causes.</td>
<td>Follow the recommendations provided.</td>
</tr>
<tr>
<td></td>
<td>No power to the LCP</td>
<td>Check the LCP cable for proper connection or damage.</td>
<td>Replace the faulty LCP or connection cable.</td>
</tr>
<tr>
<td></td>
<td>Shortcut on control voltage (terminal 12 or 50) or at control terminals</td>
<td>Check the 24 V control voltage supply for terminals 12/13 to 20-39 or 10 V supply for terminals 50 to 55.</td>
<td>Wire the terminals properly.</td>
</tr>
<tr>
<td></td>
<td>Wrong LCP (LCP from VLT® 2800 or 5000/6000/8000/ FCD or FCM)</td>
<td>LCP 102 (P/N 130B1107)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wrong contrast setting</td>
<td>Press [Status] + [▲]/[▼] to adjust the contrast.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Display (LCP) is defective</td>
<td>Test using a different LCP.</td>
<td>Replace the faulty LCP or connection cable.</td>
</tr>
<tr>
<td></td>
<td>Internal voltage supply fault or SMPS is defective</td>
<td></td>
<td>Contact supplier.</td>
</tr>
<tr>
<td><strong>Intermittent display</strong></td>
<td>Overloaded power supply (SMPS) due to improper control wiring or a fault within the frequency converter</td>
<td>To rule out a problem in the control wiring, disconnect all control wiring by removing the terminal blocks.</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Motor not running</strong></td>
<td>Service switch open or missing motor connection</td>
<td>Check if the motor is connected and the connection is not interrupted (by a service switch or other device).</td>
<td>Connect the motor and check the service switch.</td>
</tr>
<tr>
<td></td>
<td>No mains power with 24 V DC option card</td>
<td>If the display is functioning but no output, check that mains power is applied to the frequency converter.</td>
<td>Apply mains power to run the unit.</td>
</tr>
<tr>
<td></td>
<td>LCP Stop</td>
<td>Check if [Off] has been pressed.</td>
<td>Press [Auto On] or [Hand On] (depending on operation mode) to run the motor.</td>
</tr>
<tr>
<td></td>
<td>Missing start signal (Standby)</td>
<td>Check 3-10 Terminal 18 Digital Input for correct setting for terminal 18 (use default setting).</td>
<td>Apply a valid start signal to start the motor.</td>
</tr>
<tr>
<td></td>
<td>Motor coast signal active (Coasting)</td>
<td>Check . for correct setting for terminal 27 (use default setting).</td>
<td>Apply 24 V on terminal 27 or program this terminal to no operation.</td>
</tr>
<tr>
<td>Symptom</td>
<td>Possible cause</td>
<td>Test</td>
<td>Solution</td>
</tr>
<tr>
<td>---------</td>
<td>---------------</td>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>Motor running in wrong direction</td>
<td>Motor rotation limit</td>
<td>Check that 4-10 Motor Speed Direction is programmed correctly.</td>
<td>Program correct settings.</td>
</tr>
<tr>
<td></td>
<td>Active reversing signal</td>
<td>Check if a reversing command is programmed for the terminal in parameter group 5-1* Digital inputs.</td>
<td>Deactivate reversing signal.</td>
</tr>
<tr>
<td></td>
<td>Wrong motor phase connection</td>
<td>See chapter 3.4.6 Motor Rotation Check in this manual.</td>
<td></td>
</tr>
<tr>
<td>Motor is not reaching maximum speed</td>
<td>Frequency limits set wrong</td>
<td>Check output limits in 4-13 Motor Speed High Limit [RPM], 4-14 Motor Speed High Limit [Hz] and 4-19 Max Output Frequency.</td>
<td>Program correct limits.</td>
</tr>
<tr>
<td></td>
<td>Reference input signal not scaled correctly</td>
<td>Check reference input signal scaling in parameter groups 6-0* Analog I/O Mode and 3-1* References. Reference limits in parameter group 3-0* Reference Limit.</td>
<td>Program correct settings.</td>
</tr>
<tr>
<td>Motor speed unstable</td>
<td>Possible incorrect parameter settings</td>
<td>Check the settings of all motor parameters, including all motor compensation settings. For closed loop operation, check PID settings.</td>
<td>Check settings in parameter group 1-6* Load Depen. Setting. For closed loop operation, check settings in parameter group 20-0* Feedback.</td>
</tr>
<tr>
<td>Motor runs rough</td>
<td>Possible overmagnetisation</td>
<td>Check for incorrect motor settings in all motor parameters.</td>
<td>Check motor settings in parameter groups 1-2* Motor Data, 1-3* Adv Motor Data, and 1-5* Load Indep. Setting.</td>
</tr>
<tr>
<td>Motor does not brake</td>
<td>Possible incorrect settings in the brake parameters. Possible too short ramp down times</td>
<td>Check brake parameters. Check ramp time settings.</td>
<td>Check parameter groups 2-0* DC Brake and 3-0* Reference Limits.</td>
</tr>
<tr>
<td>Open power fuses or circuit breaker trip</td>
<td>Phase-to-phase short</td>
<td>Motor or panel has a short phase to phase. Check motor and panel phase for shorts.</td>
<td>Eliminate any shorts detected.</td>
</tr>
<tr>
<td></td>
<td>Motor overload</td>
<td>Motor is overloaded for the application.</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>Loose connections</td>
<td>Perform pre-start-up check for loose connections.</td>
<td>Tighten loose connections.</td>
</tr>
<tr>
<td>Mains current imbalance greater than 3%</td>
<td>Problem with mains power (See Alarm 4 Mains phase loss description)</td>
<td>Rotate input power leads into the frequency converter one position: A to B, B to C, C to A.</td>
<td>If imbalanced leg follows the wire, it is a power problem. Check mains power supply.</td>
</tr>
<tr>
<td></td>
<td>Problem with the frequency converter</td>
<td>Rotate input power leads into the frequency converter one position: A to B, B to C, C to A.</td>
<td>If imbalance leg stays on same input terminal, it is a problem with the unit. Contact the supplier.</td>
</tr>
<tr>
<td>Motor current imbalance greater than 3%</td>
<td>Problem with motor or motor wiring</td>
<td>Rotate output motor leads one position: U to V, V to W, W to U.</td>
<td>If imbalanced leg follows the wire, the problem is in the motor or motor wiring. Check motor and motor wiring.</td>
</tr>
<tr>
<td></td>
<td>Problem with the frequency converters</td>
<td>Rotate output motor leads one position: U to V, V to W, W to U.</td>
<td>If imbalance leg stays on same output terminal, it is a problem with the unit. Contact the supplier.</td>
</tr>
<tr>
<td>Symptom</td>
<td>Possible cause</td>
<td>Test</td>
<td>Solution</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Acoustic noise or vibration (e.g. a fan blade is making noise or vibrations at certain frequencies)</td>
<td>Resonances, e.g. in the motor/fan system</td>
<td>Bypass critical frequencies by using parameters in parameter group 4-6* Speed Bypass.</td>
<td>Check if noise and/or vibration have been reduced to an acceptable limit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Turn off overmodulation in 14-03 Overmodulation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change switching pattern and frequency in parameter group 14-0* Inverter Switching.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase Resonance Dampening in 1-64 Resonance Damping.</td>
<td></td>
</tr>
</tbody>
</table>

Table 10.1 Troubleshooting
# 11 Specifications

## 11.1 Power-dependent Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>N110</th>
<th>N132</th>
<th>N160</th>
<th>N200</th>
<th>N250</th>
<th>N315</th>
<th>P355</th>
<th>P400</th>
<th>P450</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Load*</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Typical Shaft output at 400 V [kW]</td>
<td>110</td>
<td>132</td>
<td>160</td>
<td>200</td>
<td>250</td>
<td>315</td>
<td>355</td>
<td>400</td>
<td>450</td>
</tr>
<tr>
<td>Typical Shaft output at 460 V [hp]</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>350</td>
<td>450</td>
<td>500</td>
<td>550</td>
<td>600</td>
</tr>
<tr>
<td>Enclosure IP21</td>
<td>D1h</td>
<td>D1h</td>
<td>D1h</td>
<td>D2h</td>
<td>D2h</td>
<td>D2h</td>
<td>E1</td>
<td>E1</td>
<td>E1</td>
</tr>
<tr>
<td>Enclosure IP54</td>
<td>D1h</td>
<td>D1h</td>
<td>D1h</td>
<td>D2h</td>
<td>D2h</td>
<td>D2h</td>
<td>E1</td>
<td>E1</td>
<td>E1</td>
</tr>
<tr>
<td>Enclosure IP20</td>
<td>D3h</td>
<td>D3h</td>
<td>D3h</td>
<td>D4h</td>
<td>D4h</td>
<td>D4h</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Enclosure IP00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>E2</td>
<td>E2</td>
<td>E2</td>
<td>E2</td>
</tr>
<tr>
<td><strong>Output current</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous (at 400 V) [A]</td>
<td>212</td>
<td>260</td>
<td>315</td>
<td>395</td>
<td>480</td>
<td>588</td>
<td>658</td>
<td>745</td>
<td>800</td>
</tr>
<tr>
<td>Intermittent (60 s overload) (at 400 V) [A]</td>
<td>233</td>
<td>286</td>
<td>347</td>
<td>435</td>
<td>528</td>
<td>647</td>
<td>724</td>
<td>820</td>
<td>880</td>
</tr>
<tr>
<td>Continuous (at 460/480 V) [A]</td>
<td>190</td>
<td>240</td>
<td>302</td>
<td>361</td>
<td>443</td>
<td>535</td>
<td>590</td>
<td>678</td>
<td>730</td>
</tr>
<tr>
<td>Intermittent (60 s overload) (at 460/480 V) [kVA]</td>
<td>209</td>
<td>264</td>
<td>332</td>
<td>397</td>
<td>487</td>
<td>588</td>
<td>649</td>
<td>746</td>
<td>803</td>
</tr>
<tr>
<td>Continuous kVA (at 400 V) [kVA]</td>
<td>147</td>
<td>180</td>
<td>218</td>
<td>274</td>
<td>333</td>
<td>407</td>
<td>456</td>
<td>516</td>
<td>554</td>
</tr>
<tr>
<td>Continuous kVA (at 460 V) [kVA]</td>
<td>151</td>
<td>191</td>
<td>241</td>
<td>288</td>
<td>353</td>
<td>426</td>
<td>470</td>
<td>540</td>
<td>582</td>
</tr>
<tr>
<td><strong>Max. Input current</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous (at 400 V) [A]</td>
<td>204</td>
<td>251</td>
<td>304</td>
<td>381</td>
<td>463</td>
<td>567</td>
<td>647</td>
<td>733</td>
<td>787</td>
</tr>
<tr>
<td>Continuous (at 460/480 V) [A]</td>
<td>183</td>
<td>231</td>
<td>291</td>
<td>348</td>
<td>427</td>
<td>516</td>
<td>580</td>
<td>667</td>
<td>718</td>
</tr>
<tr>
<td>Max. external mains fuses [A]</td>
<td>315</td>
<td>350</td>
<td>400</td>
<td>550</td>
<td>630</td>
<td>800</td>
<td>900</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Max. cable size</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. cable size: mains, motor and load share mm (AWG)</td>
<td>2 x95 (2x3/0)</td>
<td>2x185 (2x350)</td>
<td>4x240 (4x500 mcm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. cable size: brake mm (AWG)</td>
<td>2 x95 (2x3/0)</td>
<td>2x185 (2x350)</td>
<td>2x185 (2x350 mcm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated power loss at 400 V [W]</td>
<td>2555</td>
<td>2949</td>
<td>3764</td>
<td>4109</td>
<td>5129</td>
<td>6663</td>
<td>7532</td>
<td>8677</td>
<td>9473</td>
</tr>
<tr>
<td>Estimated power loss at 460 V [W]</td>
<td>2257</td>
<td>2719</td>
<td>3612</td>
<td>3561</td>
<td>4558</td>
<td>5703</td>
<td>6724</td>
<td>7819</td>
<td>8527</td>
</tr>
<tr>
<td>Weight, enclosure IP21, IP54 kg (lbs.)</td>
<td>62 (135)</td>
<td>125 (275)</td>
<td>270 (594)</td>
<td>272 (596)</td>
<td>277 (609)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight, enclosure IP20 kg (lbs.)</td>
<td>62 (135)</td>
<td>125 (275)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight, enclosure IP00 kg (lbs.)</td>
<td>-</td>
<td>234 (515)</td>
<td>236 (519)</td>
<td>313 (689)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Efficiency</strong></td>
<td>0.98</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Output frequency [Hz]</strong></td>
<td>0-590 Hz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Heat sink overtemp. trip [°C]</strong></td>
<td>110</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Power card ambient trip [°C]</strong></td>
<td>75</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Normal overload=110% current for 60 s

Table 11.1 Mains Supply 3x380-480 V AC
## Specifications

<table>
<thead>
<tr>
<th>Normal Load*</th>
<th>N75K NO</th>
<th>N90K NO</th>
<th>N110 NO</th>
<th>N132 NO</th>
<th>N160 NO</th>
<th>N200 NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Shaft output at 550 V [kW]</td>
<td>55</td>
<td>75</td>
<td>90</td>
<td>110</td>
<td>132</td>
<td>160</td>
</tr>
<tr>
<td>Typical Shaft output at 575 V [hp]</td>
<td>75</td>
<td>100</td>
<td>125</td>
<td>150</td>
<td>200</td>
<td>250</td>
</tr>
<tr>
<td>Typical Shaft output at 690 V [kW]</td>
<td>75</td>
<td>90</td>
<td>110</td>
<td>132</td>
<td>160</td>
<td>200</td>
</tr>
<tr>
<td>Enclosure IP21</td>
<td>D1h</td>
<td>D1h</td>
<td>D1h</td>
<td>D1h</td>
<td>D1h</td>
<td>D2h</td>
</tr>
<tr>
<td>Enclosure IP54</td>
<td>D1h</td>
<td>D1h</td>
<td>D1h</td>
<td>D1h</td>
<td>D1h</td>
<td>D2h</td>
</tr>
<tr>
<td>Enclosure IP20</td>
<td>D3h</td>
<td>D3h</td>
<td>D3h</td>
<td>D3h</td>
<td>D3h</td>
<td>D4h</td>
</tr>
<tr>
<td>Enclosure IP00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Output Current

| Continuous (at 550 V) [A]       | 90     | 113    | 137    | 162    | 201    | 253    |
| Intermittent (60 s overload) (at 550 V) [A] | 99     | 124    | 151    | 178    | 221    | 278    |
| Continuous (at 575/690 V) [A]   | 86     | 108    | 131    | 155    | 192    | 242    |
| Intermittent (60 s overload) (at 575/690 V) [kVA] | 95     | 119    | 144    | 171    | 211    | 266    |
| Continuous kVA (at 550 V) [kVA] | 86     | 108    | 131    | 154    | 191    | 241    |
| Continuous kVA (at 575 V) [kVA] | 86     | 108    | 130    | 154    | 191    | 241    |
| Continuous kVA (at 690 V) [kVA] | 103    | 129    | 157    | 185    | 229    | 289    |

### Max. Input Current

| Continuous (at 550 V) [A]       | 89     | 110    | 130    | 158    | 198    | 245    |
| Continuous (at 575 V) [A]       | 85     | 106    | 124    | 151    | 189    | 234    |
| Continuous (at 690 V) [A]       | 87     | 109    | 128    | 155    | 197    | 240    |

#### Max. Cable Size

| Max. cable size: mains, motor and load share [mm (AWG)] | 2x95 (2x3/0) |
| Max. cable size: brake [mm (AWG)]                     | 2x95 (2x3/0) |
| Max. external mains fuses [A]                         | 160     | 315    | 315    | 315    | 350    | 350    |
| Estimated power loss at 575 V [W]                     | 1161    | 1426   | 1739   | 2099   | 2646   | 3071   |
| Estimated power loss at 690 V [W]                     | 1203    | 1476   | 1796   | 2165   | 2738   | 3172   |
| Weight, enclosure IP21, IP54 kg (lbs.)                 | 62 (135)| 125 (275)| |
| Weight, enclosure IP20 kg (lbs.)                       | 62 (135)| 125 (275)| |
| Weight, enclosure IP00 kg (lbs.)                       | -       | -      | -      | -      | -      | -      |
| Efficiency                                            | 0.98    |        |        |        |        |        |
| Output frequency                                      | 0-590 Hz|        |        |        |        |        |
| Heat sink overtemp. trip                              | 110 °C  |        |        |        |        |        |
| Power card ambient trip                               | 75 °C   |        |        |        |        |        |

*Normal overload=110% current for 60 s

---

**Table 11.2 Mains Supply 3x525-690 V AC**
### Table 11.3 Mains Supply 3x525-690 V AC

- The typical power loss is at nominal load conditions and expected to be within ±15% (tolerance relates to variety in voltage and cable conditions).
- The losses are based on the default switching frequency. The losses increase significantly at higher switching frequencies.

<table>
<thead>
<tr>
<th>Normal Load*</th>
<th>N250</th>
<th>N315</th>
<th>N400</th>
<th>P450</th>
<th>P500</th>
<th>P560</th>
<th>P630</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Typical Shaft output at 550 V [kW]</td>
<td>200</td>
<td>250</td>
<td>315</td>
<td>355</td>
<td>400</td>
<td>450</td>
<td>500</td>
</tr>
<tr>
<td>Typical Shaft output at 575 V [hp]</td>
<td>300</td>
<td>350</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>600</td>
<td>650</td>
</tr>
<tr>
<td>Typical Shaft output at 690 V [kW]</td>
<td>250</td>
<td>315</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>560</td>
<td>630</td>
</tr>
<tr>
<td>Enclosure IP21</td>
<td>D2h</td>
<td>D2h</td>
<td>D2h</td>
<td>E1</td>
<td>E1</td>
<td>E1</td>
<td>E1</td>
</tr>
<tr>
<td>Enclosure IP54</td>
<td>D2h</td>
<td>D2h</td>
<td>D2h</td>
<td>E1</td>
<td>E1</td>
<td>E1</td>
<td>E1</td>
</tr>
<tr>
<td>Enclosure IP20</td>
<td>D4h</td>
<td>D4h</td>
<td>D4h</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Enclosure IP00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>E2</td>
<td>E2</td>
<td>E2</td>
<td>E2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous (at 550 V) [A]</td>
</tr>
<tr>
<td>Intermittent (60 s overload) (at 550 V) [A]</td>
</tr>
<tr>
<td>Continuous (at 575/690 V) [A]</td>
</tr>
<tr>
<td>Intermittent (60 s overload) (at 575/690 V) [kVA]</td>
</tr>
<tr>
<td>Continuous kVA (at 550 V) [kVA]</td>
</tr>
<tr>
<td>Continuous kVA (at 575 V) [kVA]</td>
</tr>
<tr>
<td>Continuous kVA (at 690 V) [kVA]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max. Input current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous (at 550 V) [A]</td>
</tr>
<tr>
<td>Continuous (at 575 V) [A]</td>
</tr>
<tr>
<td>Continuous (at 690 V) [A]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max. cable size: mains, motor and load share, mm (AWG)</th>
<th>2x185 (2x350 mcm)</th>
<th>4x240 (4x500 mcm)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Max. cable size: brake, mm (AWG)</th>
<th>2x185 (2x350 mcm)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Max. external mains fuses [A]</th>
<th>400</th>
<th>500</th>
<th>550</th>
<th>700</th>
<th>700</th>
<th>900</th>
<th>900</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated power loss at 575 V [W]</td>
<td>3719</td>
<td>4460</td>
<td>5023</td>
<td>5323</td>
<td>6010</td>
<td>7395</td>
<td>8209</td>
</tr>
<tr>
<td>Estimated power loss at 690 V [W]</td>
<td>3848</td>
<td>4610</td>
<td>5150</td>
<td>5529</td>
<td>6239</td>
<td>7653</td>
<td>8495</td>
</tr>
<tr>
<td>Weight, enclosure IP21, IP54 kg (lbs.)</td>
<td>125 (275)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight, enclosure IP20 kg (lbs.)</td>
<td>125 (275)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight, enclosure IP00 kg (lbs.)</td>
<td>221 (487)</td>
<td>221 (487)</td>
<td>236 (520)</td>
<td>277 (611)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency</td>
<td>0.98</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output frequency [Hz]</td>
<td>0-590</td>
<td>0-525</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heatsink overtemp. trip [°C]</td>
<td>110</td>
<td>95</td>
<td>110</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power card ambient trip [°C]</td>
<td>80</td>
<td>85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
11.2 General Technical Data

Mains supply (L1, L2, L3)

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

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

Supply frequency: 50/60 Hz ±5%
Max. imbalance temporary between mains phases: 3.0% of rated supply voltage
True power factor (λ): ≥0.9 nominal at rated load
Displacement power factor (cos Φ) near unity: (>0.98)
Switching on input supply L1, L2, L3 (power ups): maximum one time/2 min

Environment according to EN60664-1
overvoltage category III/pollution degree 2
The unit is suitable for use on a circuit capable of delivering not more than 100000 RMS symmetrical Amperes, 480/600 V

Motor output (U, V, W)

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

1) From software version 1.10 the output frequency of the frequency converter is limited to 590 Hz. Contact local Danfoss partner for further information.

Torque characteristics

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

1) 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 and mains: 1.5 mm²/16 AWG (2x0.75 mm²)
Maximum cross section to control terminals, rigid wire: 1 mm²/18 AWG
Maximum cross section to control terminals, flexible cable: 0.5 mm²/20 AWG
Minimum cross section to control terminals: 0.25 mm²

1) Depending on voltage and power.

Digital inputs

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

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

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

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

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

Pulse inputs

- Programmable pulse inputs: 2
- Terminal number pulse: 29, 33
- Max. frequency at terminal, 29, 33: 110 kHz (Push-pull driven)
- Max. frequency at terminal, 29, 33: 5 kHz (open collector)
- Min. frequency at terminal 29, 33: 4 Hz
- Voltage level: see chapter 11.2.1 Digital Inputs
- Maximum voltage on input: 28 V DC
- Input resistance, $R_i$: approx. 4 kΩ
- Pulse input accuracy (0.1-1 kHz): Max. error: 0.1% of full scale

Analog output

- Number of programmable analog outputs: 1
- Terminal number: 42
- Current range at analog output: 0/4-20 mA
- Max. resistor load to common at analog output: 500 Ω
- Accuracy on analog output: Max. error: 0.8% of full scale
- Resolution on analog output: 8 bit

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

Control card, RS-485 serial communication

- Terminal number: 68 (P,TX+, RX+), 69 (N,TX-, RX-)
- Terminal number 61: Common for terminals 68 and 69

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

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

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

Control card, 24 V DC output
Terminal number 12, 13
Max. load 200 mA

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

Relay outputs
Programmable relay outputs

Relay 01 Terminal number
Max. terminal load (AC-1)\(^1\) on 1-2 (NO) (Resistive load)\(^2,3\) 400 V AC, 2 A
Max. terminal load (AC-15)\(^1\) on 1-2 (NO) (Inductive load @ cosφ 0.4) 240 V AC, 0.2 A
Max. terminal load (DC-1)\(^1\) on 1-2 (NO) (Resistive load) 80 V DC, 2 A
Max. terminal load (DC-13)\(^1\) on 1-2 (NO) (Inductive load) 24 V DC, 0.1 A
Max. terminal load (AC-1)\(^1\) on 1-3 (NC) (Resistive load) 240 V AC, 2 A
Max. terminal load (AC-15)\(^1\) on 1-3 (NC) (Inductive load @ cosφ 0.4) 240 V AC, 0.2 A
Max. terminal load (DC-1)\(^1\) on 1-3 (NC) (Resistive load) 50 V DC, 2 A
Max. terminal load (DC-13)\(^1\) on 1-3 (NC) (Inductive load) 24 V DC, 0.1 A
Min. terminal load on 1-3 (NC), 1-2 (NO) 24 V DC 10 mA, 24V AC 2 mA

Environment according to EN 60664-1 overvoltage category III/pollution degree 2

Relay 02 Terminal number
Max. terminal load (AC-1)\(^1\) on 4-5 (NO) (Resistive load)\(^2,3\) 400 V AC, 2 A
Max. terminal load (AC-15)\(^1\) on 4-5 (NO) (Inductive load @ cosφ 0.4) 240 V AC, 0.2 A
Max. terminal load (DC-1)\(^1\) on 4-5 (NO) (Resistive load) 80 V DC, 2 A
Max. terminal load (DC-13)\(^1\) on 4-5 (NO) (Inductive load) 24 V DC, 0.1 A
Max. terminal load (AC-1)\(^1\) on 4-6 (NC) (Resistive load) 240 V AC, 2 A
Max. terminal load (AC-15)\(^1\) on 4-6 (NC) (Inductive load @ cosφ 0.4) 240 V AC, 0.2 A
Max. terminal load (DC-1)\(^1\) on 4-6 (NC) (Resistive load) 50 V DC, 2 A
Max. terminal load (DC-13)\(^1\) on 4-6 (NC) (Inductive load) 24 V DC, 0.1 A
Min. terminal load on 4-6 (NC), 4-5 (NO) 24 V DC 10 mA, 24V AC 2 mA

Environment according to EN 60664-1 overvoltage category III/pollution degree 2

1) IEC 60947 t 4 and 5
2) Overvoltage Category II
3) UL applications 300 V AC 2 A

Control card, 10 V DC output
Terminal number 50
Output voltage 10.5 V ±0.5 V
Max. load 25 mA

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

Resolution of output frequency at 0-590 Hz \( \pm 0.003 \) Hz

System response time (terminals 18, 19, 27, 29, 32, 33) \( \leq 2 \) ms

Speed control range (open loop) 1:100 of synchronous speed

Speed accuracy (open loop) 30-4000 RPM: Maximum error of \( \pm 8 \) RPM

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

Surroundings

Enclosure type D1h/D2h/D3h/D6h/D7h/D8h/E1 IP21/NEMA 1, IP54/NEMA 12

Enclosure type D3h/D4h IP20/Chassis

Enclosure type E2 IP00

Vibration test all enclosures 1.0 g

Relative humidity 5%-95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation

Aggressive environment (IEC 60068-2-43) H2S test class Kd

Test method according to IEC 60068-2-43 H2S (10 days)

Ambient temperature (at 60 AVM switching mode)
- with derating max. 55°C¹
- with full output power of typical EFF2 motors (up to 90% output current) max. 50 °C¹
- at full continuous FC output current max. 45 °C¹

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

Minimum ambient temperature during full-scale operation 0 °C

Minimum ambient temperature at reduced performance -10 °C

Temperature during storage/transport -25 to +65/70 °C

Maximum altitude above sea level without derating 1000 m

Maximum altitude above sea level with derating 2000 m

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

EMC standards, Emission EN 61800-3, EN 61000-6-3/4, EN 55011, IEC 61800-3

EMC standards, Immunity EN 61800-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6

See the Design Guide, section on Special Conditions.

Control card performance

Scan interval 5 ms

Control card, USB Serial Communication

USB standard 1.1 (Full speed)

USB plug USB type B “device” plug

⚠️ 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 frequency converter or an isolated USB cable/converter.
Protection and Features

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

11.3 Fuse Tables

11.3.1 Protection

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

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

Overcurrent 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 overcurrent 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 overcurrent protection in the installation. Overcurrent protection must always be carried out according to national regulations.

11.3.2 Fuse Selection

Non-UL compliance
Danfoss recommends using the following fuses, which ensure compliance with EN 50178. In case of malfunction, not following the recommendation may result in unnecessary damage to the frequency converter.

<table>
<thead>
<tr>
<th>Fuse Code</th>
<th>Voltage Range</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>N110-N315</td>
<td>380–480 V</td>
<td>aR</td>
</tr>
<tr>
<td>N75K-N400</td>
<td>525–690 V</td>
<td>aR</td>
</tr>
<tr>
<td>P355-P450</td>
<td>380–480 V</td>
<td>gG</td>
</tr>
</tbody>
</table>

Table 11.4 EN50178 Fuses

UL compliance
The fuses below are suitable for use on a circuit capable of delivering 100000 A<sub>rms</sub> (symmetrical). With the proper fusing, the frequency converter Short Circuit Current Rating (SCCR) is 100000 A<sub>rms</sub>.
### Table 11.5 Fuse Options for 380-480 V Frequency Converters

<table>
<thead>
<tr>
<th>Power Size</th>
<th>Bussmann PN</th>
<th>Littelfuse PN</th>
<th>Littelfuse PN</th>
<th>Bussmann PN</th>
<th>Siba PN</th>
<th>Ferraz-Shawmut PN (Europe)</th>
<th>Ferraz-Shawmut PN (North America)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N110</td>
<td>170M2619</td>
<td>LA50QS300-4</td>
<td>L50S-300</td>
<td>FWH-300A</td>
<td>20 610 31.315</td>
<td>A50QS300-4</td>
<td>6,9URD31D08A0315 A070URD31KI0315</td>
</tr>
<tr>
<td>N160</td>
<td>170M2621</td>
<td>LA50QS400-4</td>
<td>L50S-400</td>
<td>FWH-400A</td>
<td>20 610 31.400</td>
<td>A50QS400-4</td>
<td>6,9URD31D08A0400 A070URD31KI0400</td>
</tr>
<tr>
<td>N200</td>
<td>170M4015</td>
<td>LA50QS500-4</td>
<td>L50S-500</td>
<td>FWH-500A</td>
<td>20 610 31.550</td>
<td>A50QS500-4</td>
<td>6,9URD31D08A0550 A070URD31KI0550</td>
</tr>
<tr>
<td>N250</td>
<td>170M4016</td>
<td>LA50QS600-4</td>
<td>L50S-600</td>
<td>FWH-600A</td>
<td>20 610 31.630</td>
<td>A50QS600-4</td>
<td>6,9URD31D08A0630 A070URD31KI0630</td>
</tr>
<tr>
<td>N315</td>
<td>170M4017</td>
<td>LA50QS800-4</td>
<td>L50S-800</td>
<td>FWH-800A</td>
<td>20 610 31.800</td>
<td>A50QS800-4</td>
<td>6,9URD32D08A0800 A070URD31KI0800</td>
</tr>
<tr>
<td>P355</td>
<td>170M6013</td>
<td>20 630 32.900</td>
<td>20 630 32.900</td>
<td>6,9URD33D08A0900</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P400</td>
<td>170M6013</td>
<td>20 630 32.900</td>
<td>20 630 32.900</td>
<td>6,9URD33D08A0900</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P450</td>
<td>170M6013</td>
<td>20 630 32.900</td>
<td>20 630 32.900</td>
<td>6,9URD33D08A0900</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 11.6 Fuse Options for 525-690 V Frequency Converters

For UL compliance, for units supplied without a contactor-only option, the Bussmann 170M series fuses must be used.

<table>
<thead>
<tr>
<th>VLT Model</th>
<th>Bussmann PN</th>
<th>Siba PN</th>
<th>Ferraz-Shawmut European PN</th>
<th>Ferraz-Shawmut North American PN</th>
</tr>
</thead>
<tbody>
<tr>
<td>N75k T7</td>
<td>170M2616</td>
<td>20 610 31.160</td>
<td>6,9URD30D08A0160</td>
<td>A070URD30KI0160</td>
</tr>
<tr>
<td>N90k T7</td>
<td>170M2619</td>
<td>20 610 31.315</td>
<td>6,9URD31D08A0315</td>
<td>A070URD31KI0315</td>
</tr>
<tr>
<td>N110 T7</td>
<td>170M2619</td>
<td>20 610 31.315</td>
<td>6,9URD31D08A0315</td>
<td>A070URD31KI0315</td>
</tr>
<tr>
<td>N132 T7</td>
<td>170M2619</td>
<td>20 610 31.315</td>
<td>6,9URD31D08A0315</td>
<td>A070URD31KI0315</td>
</tr>
<tr>
<td>N160 T7</td>
<td>170M2619</td>
<td>20 610 31.315</td>
<td>6,9URD31D08A0315</td>
<td>A070URD31KI0315</td>
</tr>
<tr>
<td>N200 T7</td>
<td>170M4015</td>
<td>20 620 31.550</td>
<td>6,9URD32D08A0550</td>
<td>A070URD32KI0550</td>
</tr>
<tr>
<td>N250 T7</td>
<td>170M4015</td>
<td>20 620 31.550</td>
<td>6,9URD32D08A0550</td>
<td>A070URD32KI0550</td>
</tr>
<tr>
<td>N315 T7</td>
<td>170M4015</td>
<td>20 620 31.550</td>
<td>6,9URD32D08A0550</td>
<td>A070URD32KI0550</td>
</tr>
<tr>
<td>N400 T7</td>
<td>170M4015</td>
<td>20 620 31.550</td>
<td>6,9URD32D08A0550</td>
<td>A070URD32KI0550</td>
</tr>
<tr>
<td>P450</td>
<td>170M4017</td>
<td>20 610 32.700</td>
<td>6,9URD31D08A0700</td>
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</tr>
<tr>
<td>P500</td>
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<tr>
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</tr>
<tr>
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<td>20 630 32.900</td>
<td>6,9URD33D08A0900</td>
<td>A070URD32KI0550</td>
</tr>
</tbody>
</table>
11.3.3 Short Circuit Current Rating (SCCR)

The Short Circuit Current Rating (SCCR) of the frequency converters is 100,000 amps at all voltages (380–690 V).

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

11.3.4 Connection Tightening Torques

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

<table>
<thead>
<tr>
<th>Frame Size</th>
<th>Terminal</th>
<th>Torque [Nm] (in-lbs)</th>
<th>Bolt size</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1h/D3h/D5h/D6h</td>
<td>Mains Motor</td>
<td>19-40 (168-354)</td>
<td>M10</td>
</tr>
<tr>
<td></td>
<td>Ground Brake</td>
<td>8.5-20.5 (75-181)</td>
<td>M8</td>
</tr>
<tr>
<td>D2h/D4h/D7h/D8h</td>
<td>Mains Motor Ground</td>
<td>19-40 (168-354)</td>
<td>M10</td>
</tr>
<tr>
<td></td>
<td>Brake</td>
<td>8.5-20.5 (75-181)</td>
<td>M8</td>
</tr>
<tr>
<td>E1/E2</td>
<td>Mains Motor Ground</td>
<td>19-40 (168-354)</td>
<td>M10</td>
</tr>
<tr>
<td></td>
<td>Brake</td>
<td>8.5-20.5 (75-181)</td>
<td>M8</td>
</tr>
</tbody>
</table>

Table 11.7 Torque for Terminals
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