



# Operating Instructions

VLT<sup>®</sup> HVAC Drive

## Safety

### Safety

#### **⚠ WARNING**

##### **HIGH VOLTAGE!**

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

##### **High Voltage**

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

#### **⚠ WARNING**

##### **UNINTENDED START!**

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

##### **Unintended Start**

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

#### **⚠ WARNING**

##### **DISCHARGE TIME!**

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

| Voltage (V) | Minimum waiting time (minutes) |           |
|-------------|--------------------------------|-----------|
|             | 4                              | 15        |
| 200-240     | 0.25-3.7 kW                    | 5.5-37 kW |
| 380-480     | 0.25-7.5 kW                    | 11-75 kW  |
| 525-600     | 0.75-7.5 kW                    | 11-75 kW  |
| 525-690     | n/a                            | 11-75 kW  |

High voltage may be present even when the warning LEDs are off!

##### **Discharge Time**

##### **Symbols**

The following symbols are used in this manual.

#### **⚠ WARNING**

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

#### **⚠ CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

#### **CAUTION**

Indicates a situation that may result in equipment or property-damage-only accidents.

##### **NOTE**

Indicates highlighted information that should be regarded with attention to avoid mistakes or operate equipment at less than optimal performance.

##### **Approvals**



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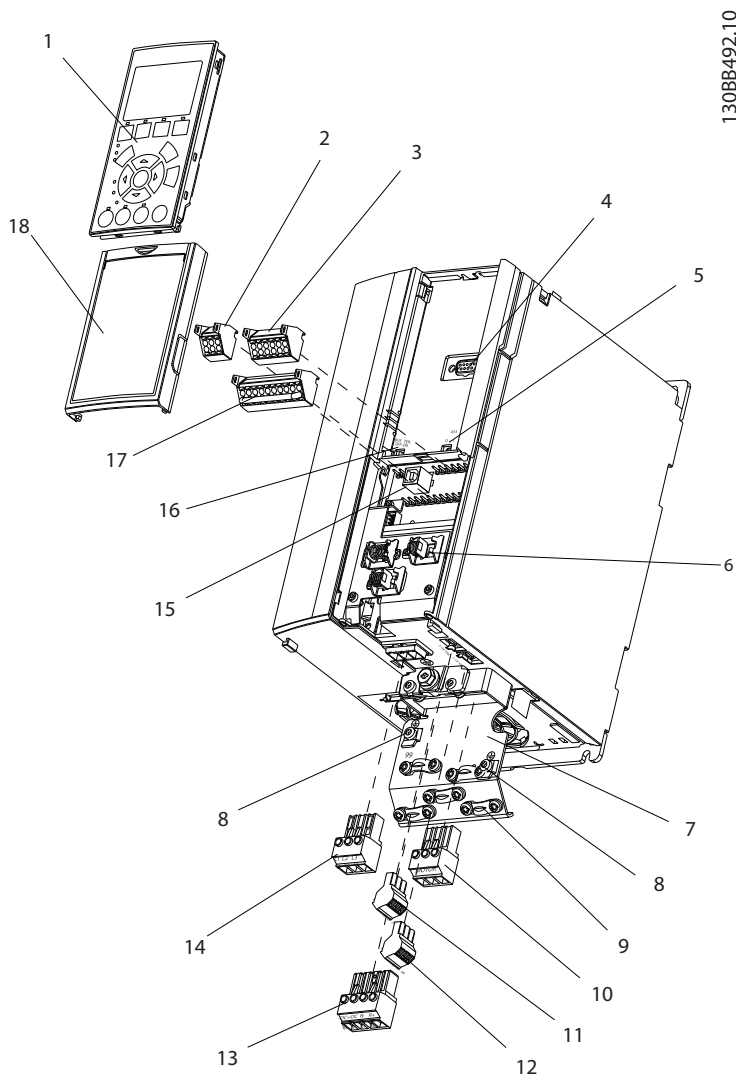
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# 1 Introduction

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Illustration 1.1 Exploded View A Size

|   |  |    |  |
|---|--|----|--|
| 1 | LCP  | 10 | Motor output terminals 96 (U), 97 (V), 98 (W)          |
| 2 | RS-485 serial bus connector (+68, -69)           | 11 | Relay 1 (01, 02, 03)                                   |
| 3 | Analog I/O connector                             | 12 | Relay 2 (04, 05, 06)                                   |
| 4 | LCP input plug                                   | 13 | Brake (-81, +82) and load sharing (-88, +89) terminals |
| 5 | Analog switches (A53), (A54)                     | 14 | Mains input terminals 91 (L1), 92 (L2), 93 (L3)        |
| 6 | Cable strain relief / PE ground                  | 15 | USB connector  |
| 7 | Decoupling plate                                 | 16 | Serial bus terminal switch                             |
| 8 | Grounding clamp (PE)                             | 17 | Digital I/O and 24 V power supply                      |
| 9 | Shielded cable grounding clamp and strain relief | 18 | Control cable cover plate                              |

Table 1.1

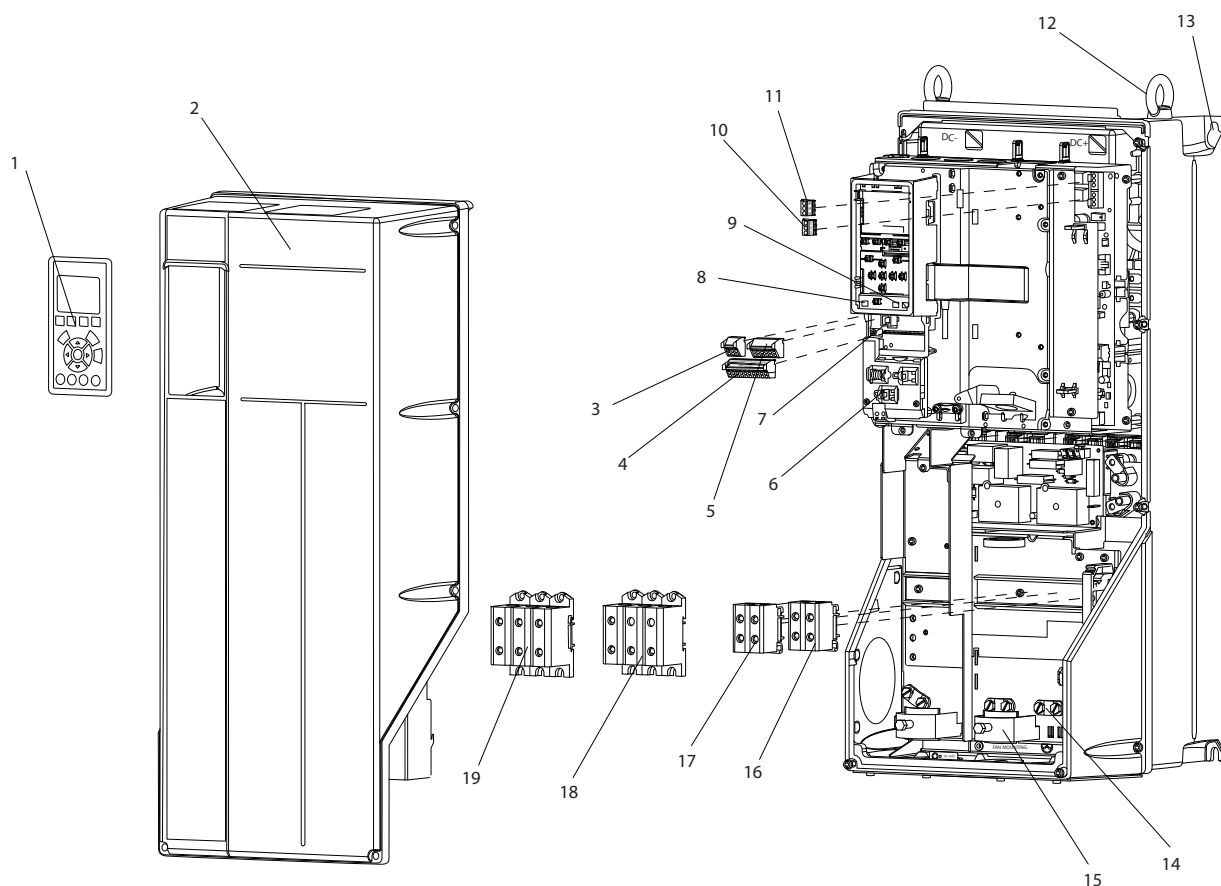


Illustration 1.2 Exploded View B and C Sizes

|    |                                   |    |   |
|----|-----------------------------------|----|---|
| 1  | LCP                               | 11 | Relay 2 (04, 05, 06)                            |
| 2  | Cover                             | 12 | Lifting ring                                    |
| 3  | RS-485 serial bus connector       | 13 | Mounting slot                                   |
| 4  | Digital I/O and 24 V power supply | 14 | Grounding clamp (PE)                            |
| 5  | Analog I/O connector              | 15 | Cable strain relief / PE ground                 |
| 6  | Cable strain relief / PE ground   | 16 | Brake terminal (-81, +82)                       |
| 7  | USB connector                     | 17 | Load sharing terminal (DC bus) (-88, +89)       |
| 8  | Serial bus terminal switch        | 18 | Motor output terminals 96 (U), 97 (V), 98 (W)   |
| 9  | Analog switches (A53), (A54)      | 19 | Mains input terminals 91 (L1), 92 (L2), 93 (L3) |
| 10 | Relay 1 (01, 02, 03)              |    |   |

Table 1.2



## 1.1 Purpose of the Manual

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

## 1.2 Additional Resources

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

- The *VLT® Programming Guide, MG33MXYY* provides greater detail on working with parameters and many application examples.
- The *VLT® Design Guide, MG33BXYY* is intended to provide detailed capabilities and functionality to design motor control systems.
- Supplemental publications and manuals are available from Danfoss. See <http://www.danfoss.com/Products/Literature/Technical+Documentation.htm> for listings.
- Optional equipment is available that may change some of the procedures described. Reference the instructions supplied with those options for specific requirements. Contact the local Danfoss supplier or go to <http://www.danfoss.com/Products/Literature/Technical+Documentation.htm> for downloads or additional information.

## 1.3 Product Overview

A frequency converter is an electronic motor controller that converts AC mains input into a variable AC waveform output. The frequency and voltage of the output are regulated to control the motor speed or torque. The frequency converter can vary the speed of the motor in response to system feedback, such as changing temperature or pressure for controlling fan, compressor, or pump motors. The frequency converter can also regulate the motor by responding to remote commands from external controllers.

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

## 1.4 Internal Frequency Converter Controller Functions

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

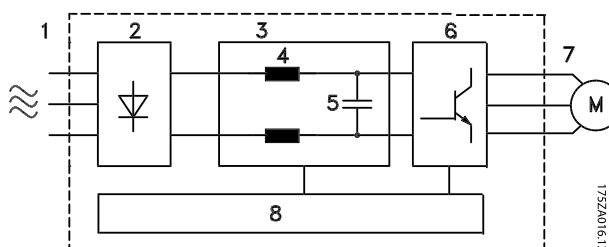


Illustration 1.3 Frequency Converter Block Diagram

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

Table 1.3 Frequency Converter Internal Components

## 1.5 Frame Sizes and Power Ratings

References to frames sizes used in this manual are defined in *Table 1.4*.

| Volts   | Frame Size (kW) |         |          |         |         |       |         |         |         |       |       |       |
|---------|-----------------|---------|----------|---------|---------|-------|---------|---------|---------|-------|-------|-------|
|         | A2              | A3      | A4       | A5      | B1      | B2    | B3      | B4      | C1      | C2    | C3    | C4    |
| 200-240 | 1.1-2.2         | 3.0-3.7 | 0.25-2.2 | 1.1-3.7 | 5.5-11  | 15    | 5.5-11  | 15-18.5 | 18.5-30 | 37-45 | 22-30 | 37-45 |
| 380-480 | 1.1-4.0         | 5.5-7.5 | 0.37-4.0 | 1.1-7.5 | 11-18.5 | 22-30 | 11-18.5 | 22-37   | 37-55   | 75-90 | 45-55 | 75-90 |
| 525-600 | n/a             | 1.1-7.5 | n/a      | 1.1-7.5 | 11-18.5 | 22-30 | 11-18.5 | 22-37   | 37-55   | 75-90 | 45-55 | 75-90 |
| 525-690 | n/a             | n/a     | n/a      | n/a     | n/a     | 11-30 | n/a     | n/a     | n/a     | 37-90 | n/a   | n/a   |

**Table 1.4** Frames Sizes and Power Ratings

## 2 Installation

### 2.1 Installation Site Check List

- The frequency converter relies on the ambient air for cooling. Observe the limitations on ambient air temperature for optimal operation
- Ensure that the installation location has sufficient support strength to mount the frequency converter
- Keep the frequency converter interior free from dust and dirt. Ensure that the components stay as clean as possible. In construction areas, provide a protective covering. Optional IP54 (NEMA 12) or IP66 (NEMA 4) enclosures may be necessary.
- Keep the manual, drawings, and diagrams accessible for detailed installation and operation instructions. It is important that the manual is available for equipment operators.
- Locate equipment as near to the motor as possible. Keep motor cables as short as possible. Check the motor characteristics for actual tolerances. Do not exceed
  - 300 m (1000 ft) for unshielded motor leads
  - 150 m (500 ft) for shielded cable.

### 2.2 Frequency Converter and Motor Pre-installation Check List

- Compare the model number of unit on the nameplate to what was ordered to verify the proper equipment
- Ensure each of the following are rated for same voltage:
  - Mains (power)
  - Frequency converter
  - Motor
- Ensure that frequency converter output current rating is equal to or greater than motor full load current for peak motor performance
  - Motor size and frequency converter power must match for proper overload protection
  - If frequency converter rating is less than motor, full motor output cannot be achieved

### 2.3 Mechanical Installation

#### 2.3.1 Cooling

- To provide cooling airflow, mount the unit to a solid flat surface or to the optional back plate (see 2.3.3 Mounting)
- Top and bottom clearance for air cooling must be provided. Generally, 100-225 mm (4-10 in) is required. See *Illustration 2.1* for clearance requirements
- Improper mounting can result in over heating and reduced performance
- Derating for temperatures starting between 40° C (104° F) and 50° C (122° F) and elevation 1000 m (3300 ft) above sea level must be considered. See the equipment Design Guide for detailed information.

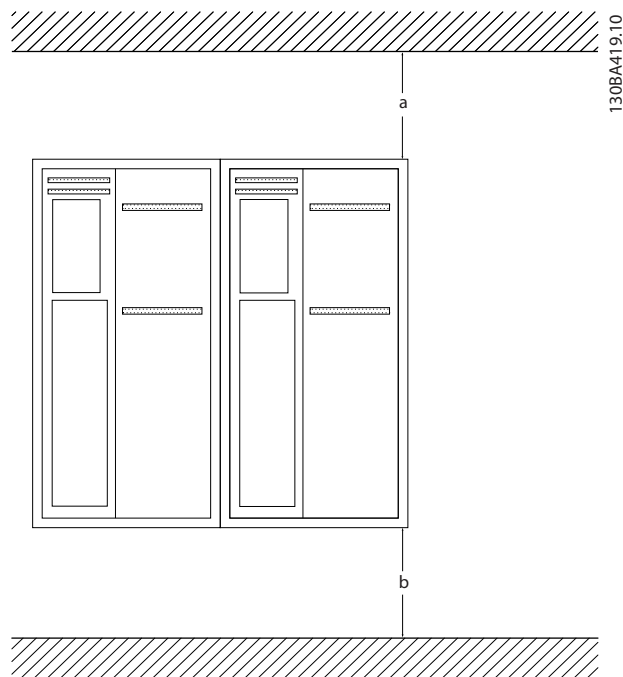


Illustration 2.1 Top and Bottom Cooling Clearance

| Enclosure | A1-A5 | B1-B4 | C1, C3 | C2, C4 |
|-----------|-------|-------|--------|--------|
| a/b [mm]  | 100   | 200   | 200    | 225    |

Table 2.1 Minimum Airflow Clearance Requirements

### 2.3.2 Lifting

- Check the weight of the unit to determine a safe lifting method
- Ensure that the lifting device is suitable for the task
- If necessary, plan for a hoist, crane, or forklift with the appropriate rating to move the unit
- For lifting, use hoist rings on the unit, when provided

### 2.3.3 Mounting

- Mount the unit vertically
- The frequency converter allows side by side installation
- Ensure that the strength of the mounting location will support the unit weight
- Mount the unit to a solid flat surface or to the optional back plate to provide cooling airflow (see *Illustration 2.2* and *Illustration 2.3*)
- Improper mounting can result in over heating and reduced performance
- Use the slotted mounting holes on the unit for wall mounting, when provided

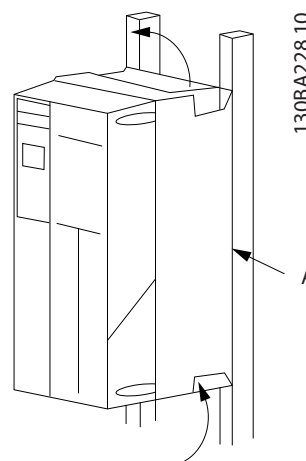


Illustration 2.3 Proper Mounting with Railings

#### NOTE

Back plate is needed when mounted on railings.

### 2.3.4 Tightening Torques

See 10.4 Connection Tightening Torques for proper tightening specifications.

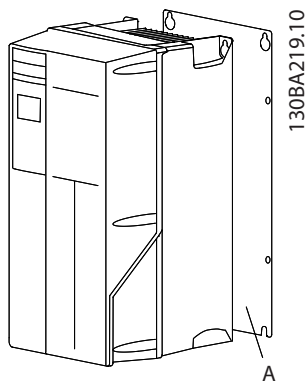


Illustration 2.2 Proper Mounting with Back Plate

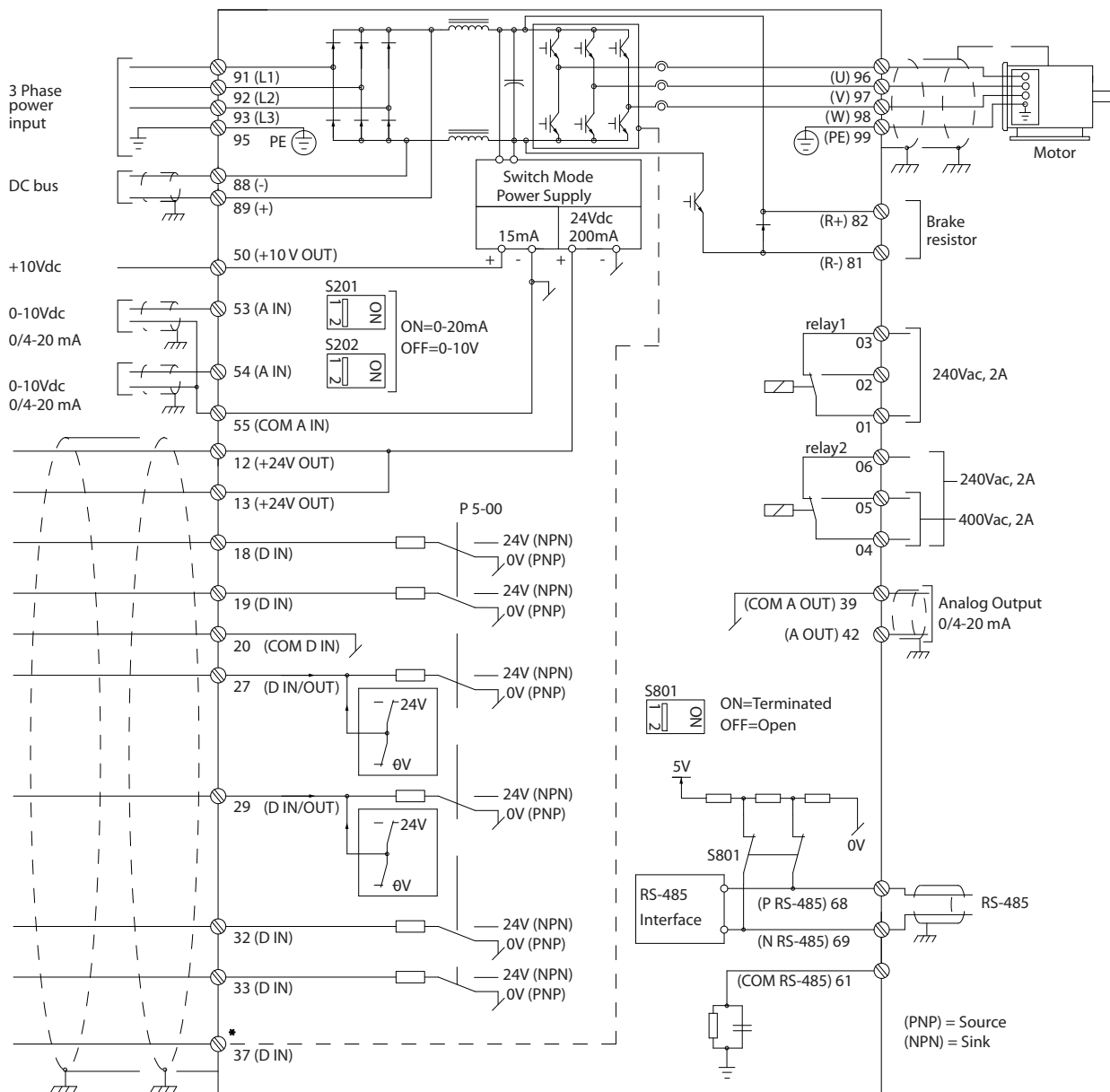
Item A is a back plate properly installed for required airflow to cool the unit.

## 2.4 Electrical Installation

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

Illustration 2.4 shows a basic electrical connection.



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Illustration 2.4 Basic Wiring Schematic Drawing

\* Terminal 37 is an option

2

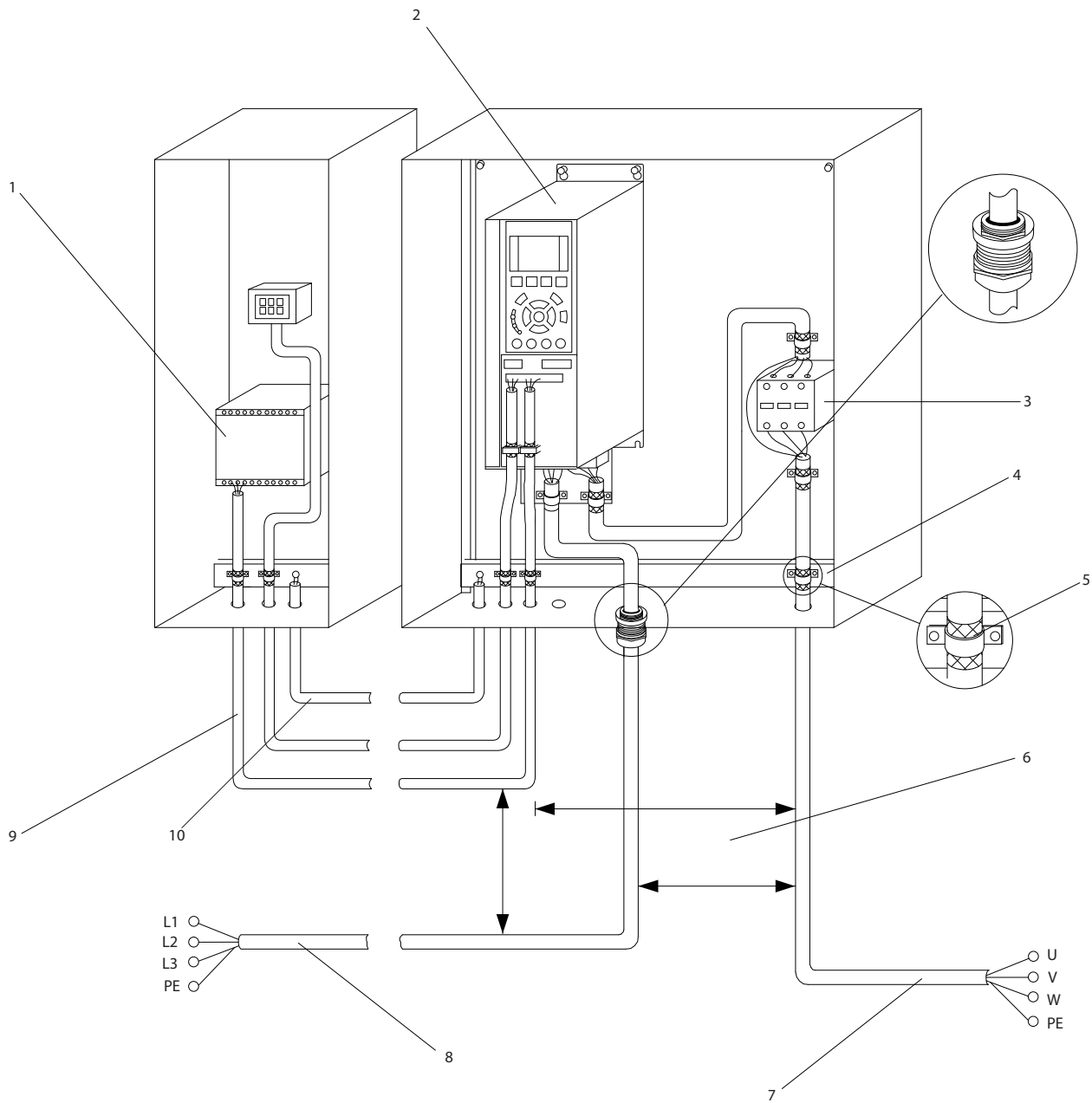


Illustration 2.5 Typical Electrical Connection

|   |  |    |  |
|---|--|----|--|
| 1 | PLC  | 6  | Min. 200 mm (7.9 in) between control cables, motor and mains |
| 2 | Frequency converter                          | 7  | Motor, 3-phase and PE  |
| 3 | Output contactor (Generally not recommended) | 8  | Mains, 3-phase and reinforced PE                             |
| 4 | Earth (grounding) rail (PE)                  | 9  | Control wiring   |
| 5 | Cable insulation (stripped)                  | 10 | Equalising min. 16 mm <sup>2</sup> (0.025 in)                |

Table 2.2

### 2.4.1 Requirements

#### **⚠ WARNING**

##### **EQUIPMENT HAZARD!**

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

#### **CAUTION**

##### **WIRING ISOLATION!**

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

For your safety, comply with the following requirements.

- Electronic controls equipment is connected to hazardous mains voltage. Extreme care should be taken to protect against electrical hazards when applying power to the unit.
- Run motor cables from multiple frequency converters separately. Induced voltage from output motor cables run together can charge equipment capacitors even with the equipment turned off and locked out.

##### **Overload and Equipment Protection**

- An electronically activated function within the frequency converter provides overload protection for the motor. The overload calculates the level of increase to activate timing for the trip (controller output stop) function. The higher the current draw, the quicker the trip response. The overload provides Class 20 motor protection. See *8 Warnings and Alarms* for details on the trip function.
- Because the motor wiring carries high frequency current, it is important that wiring for mains, motor power, and control are run separately. Use metallic conduit or separated shielded wire. Failure to isolate power, motor, and control wiring could result in less than optimum equipment performance. See *Illustration 2.6*.

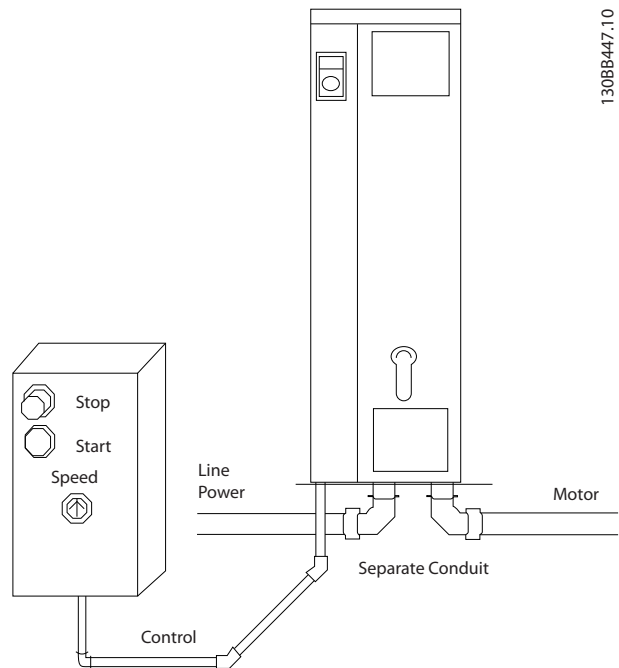


Illustration 2.6 Proper Electrical Installation Using Conduit

- All frequency converters must be provided with short-circuit and over-current protection. Input fusing is required to provide this protection, see *Illustration 2.7*. If not factory supplied, fuses must be provided by the installer as part of installation. See maximum fuse ratings in *10.3 Fuse Tables*.

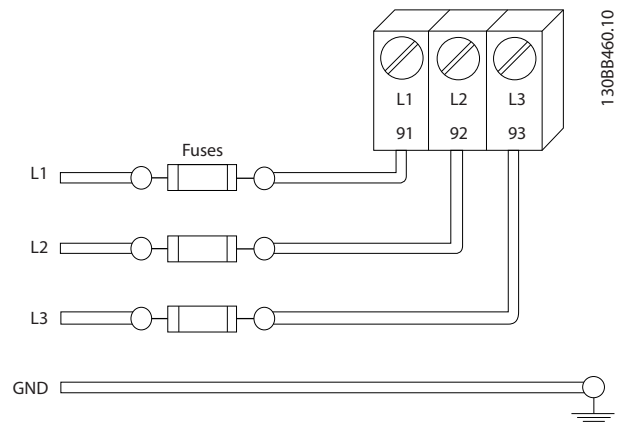


Illustration 2.7 Frequency converter Fuses

##### **Wire Type and Ratings**

- All wiring must comply with local and national regulations regarding cross-section and ambient temperature requirements.
- Danfoss recommends that all power connections be made with a minimum 75° C rated copper wire.
- See *10.1 Power-dependent Specifications* for recommended wire sizes.



## 2.4.2 Earth (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. Ground currents are higher than 3.5 mA. Failure to ground the frequency converter properly could result in death or serious injury.

### NOTE

It is the responsibility of the user or certified electrical installer to ensure correct grounding (earthing) 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 grounding for equipment with ground currents higher than 3.5 mA must be established, see *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
- Using high-strand wire to reduce electrical noise is recommended
- Follow motor manufacturer wiring requirements

### 2.4.2.1 Leakage Current (>3.5 mA)

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

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

- Earth ground wire of at least 10 mm<sup>2</sup>
- Two separate earth ground wires both complying with the dimensioning rules

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

#### Using RCDs

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

Use RCDs of type B only which are capable of detecting AC and DC currents

Use RCDs with an inrush delay to prevent faults due to transient earth currents

Dimension RCDs according to the system configuration and environmental considerations

### 2.4.2.2 Grounding Using Shielded Cable

Earthing (grounding) clamps are provided for motor wiring (see *Illustration 2.8*).

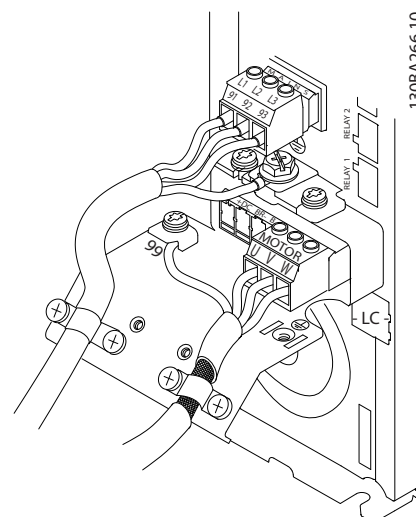


Illustration 2.8 Grounding with Shielded Cable

2.4.3 Motor Connection

**⚠ WARNING**

**INDUCED VOLTAGE!**

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

- For maximum wire sizes see 10.1 Power-dependent Specifications
- Comply with local and national electrical codes for cable sizes
- Motor wiring knockouts or access panels are provided at the base of IP21 and higher (NEMA1/12) units
- Do not install power factor correction capacitors between the frequency converter and the motor
- Do not wire a starting or pole-changing device between the frequency converter and the motor
- Connect the 3-phase motor wiring to terminals 96 (U), 97 (V), and 98 (W)
- Ground the cable in accordance with grounding instructions provided
- Torque terminals in accordance with the information provided in 10.4.1 Connection Tightening Torques
- Follow motor manufacturer wiring requirements

The three following illustrations represent mains input, motor, and earth grounding for basic frequency converters. Actual configurations vary with unit types and optional equipment.

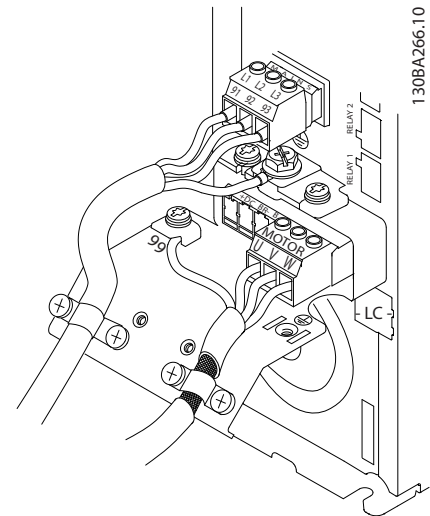


Illustration 2.9 Motor, Mains and Earth Wiring for A-Frame Sizes

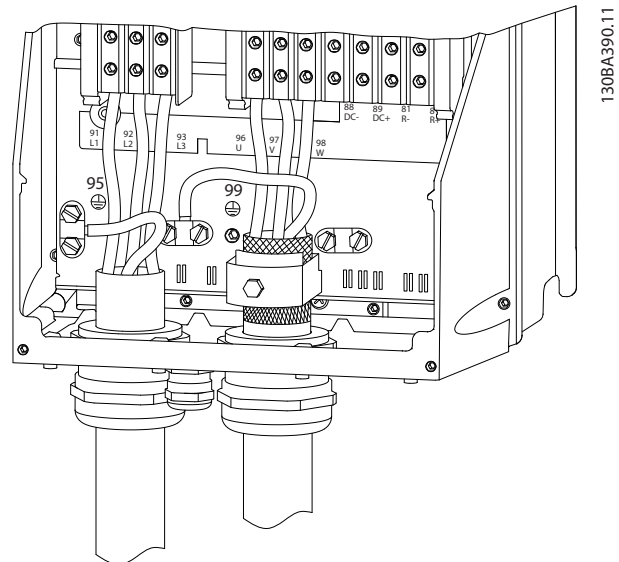


Illustration 2.10 Motor, Mains and Earth Wiring for B-Frame Sizes and Above Using Shielded Cable

2

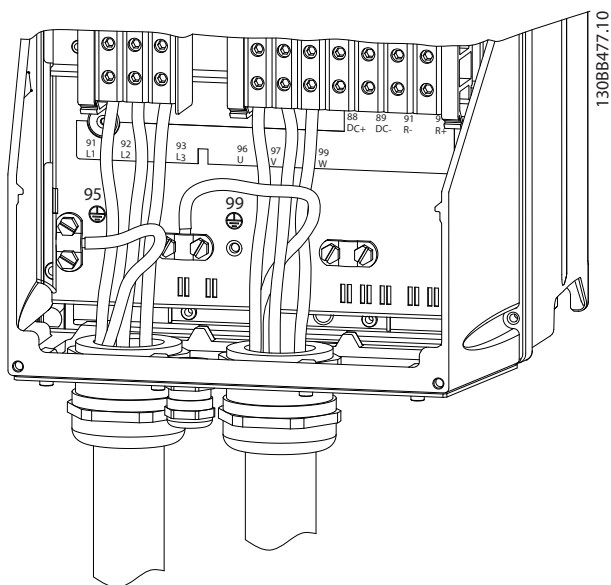


Illustration 2.11 Motor, Mains and Earth Wiring for B-Frame Sizes and Above Using Conduit

### 2.4.4 AC Mains Connection

- Size wiring based upon the input current of the frequency converter. For maximum wire sizes see 10.1 Power-dependent Specifications.
- Comply with local and national electrical codes for cable sizes.
- Connect 3-phase AC input power wiring to terminals L1, L2, and L3 (see Illustration 2.12).
- Depending on the configuration of the equipment, input power will be connected to the mains input terminals or the input disconnect.

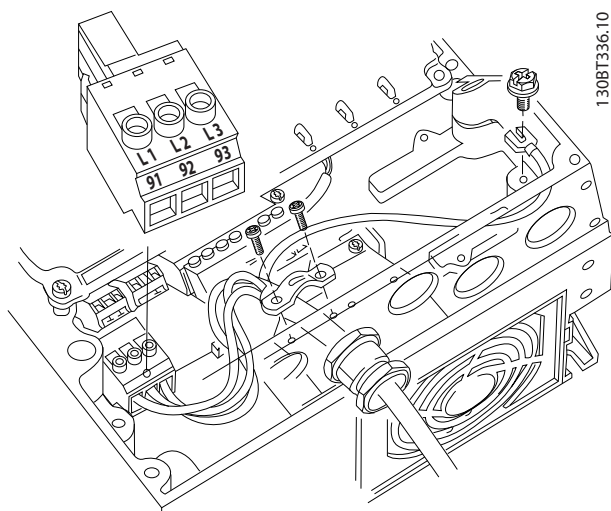


Illustration 2.12 Connecting to AC Mains

- Ground the cable in accordance with grounding instructions provided in 2.4.2 Earth (Grounding) Requirements
- 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 OFF. When off, the internal RFI filter capacitors between the chassis and the intermediate circuit are isolated to avoid damage to the intermediate circuit and to reduce earth capacity currents in accordance with IEC 61800-3.

### 2.4.5 Control Wiring

- 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 VDC supply voltage is recommended.

#### 2.4.5.1 Access

- Remove access cover plate with a screw driver. See Illustration 2.13.
- Or remove front cover by loosening attaching screws. See Illustration 2.14.

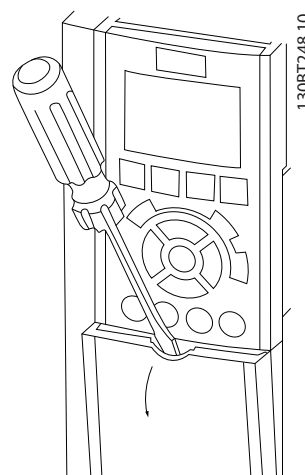


Illustration 2.13 Control Wiring Access for A2, A3, B3, B4, C3 and C4 Enclosures

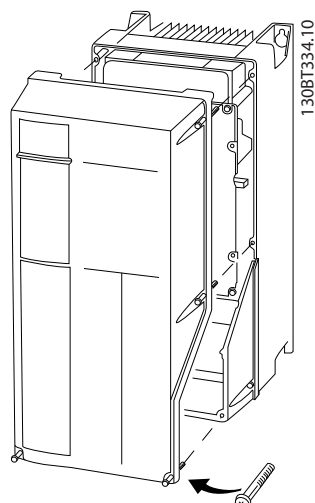


Illustration 2.14 Control Wiring Access for A4, A5, B1, B2, C1 and C2 Enclosures

See *Table 2.3* before tightening the covers.

| Frame | IP20 | IP21 | IP55 | IP66 |
|-------|------|------|------|------|
| A4/A5 | -    | -    | 2    | 2    |
| B1    | -    | *    | 2.2  | 2.2  |
| B2    | -    | *    | 2.2  | 2.2  |
| C1    | -    | *    | 2.2  | 2.2  |
| C2    | -    | *    | 2.2  | 2.2  |

\* No screws to tighten  
 - Does not exist

Table 2.3 Tightening Torques for Covers (Nm)

### 2.4.5.2 Control Terminal Types

*Illustration 2.15* shows the removable frequency converter connectors. Terminal functions and default settings are summarized in *Table 2.4*.

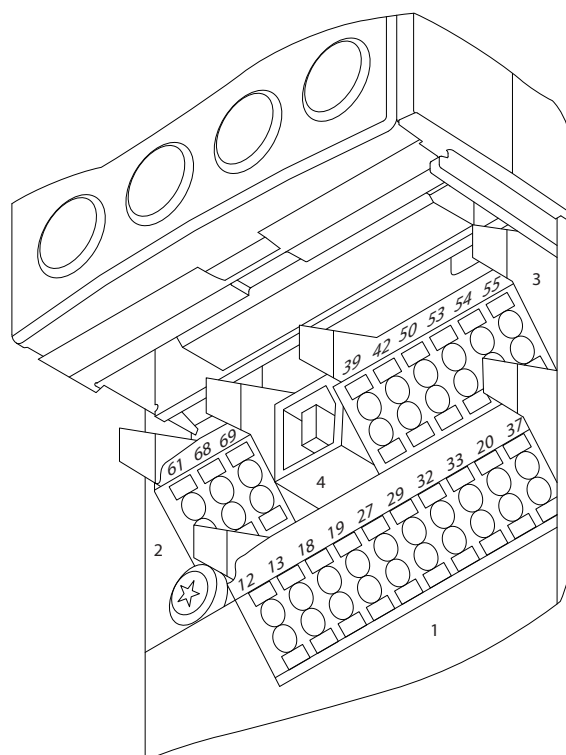


Illustration 2.15 Control Terminal Locations

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

See *10.2 General Technical Data* for terminal ratings details.

| Terminal Description   |           |                       |   |
|------------------------|-----------|-----------------------|---|
| Digital Inputs/Outputs |           |                       |   |
| Terminal               | Parameter | Default Setting       | Description   |
| 12, 13                 | -         | +24 V DC              | 24 V DC supply voltage. Maximum output current is 200 mA total for all 24 V loads. Useable for digital inputs and external transducers. |
| 18                     | 5-10      | [8] Start             | Digital inputs.   |
| 19                     | 5-11      | [0] No operation      |   |
| 32                     | 5-14      | [0] No operation      |   |
| 33                     | 5-15      | [0] No operation      |   |
| 27                     | 5-12      | [2] Coast inverse     | Selectable for either digital input or output. Default setting is input.  |
| 29                     | 5-13      | [14] JOG              |   |
| 20                     | -         |                       | Common for digital inputs and 0 V potential for 24 V supply.  |
| 37                     | -         | Safe Torque Off (STO) | (optional) Safe input. Used for STO   |
| Analog Inputs/Outputs  |           |                       |   |
| 39                     | -         |                       | Common for analog output  |
| 42                     | 6-50      | Speed 0-High Limit    | Programmable analog output. The analog signal is 0-20 mA or 4-20 mA at a maximum of 500 Ω   |
| 50                     | -         | +10 V DC              | 10 V DC analog supply voltage. 15 mA maximum commonly used for potentiometer or thermistor.   |
| 53                     | 6-1       | Reference             | Analog input. Selectable for voltage or current. Switches A53 and A54 select mA or V.   |
| 54                     | 6-2       | Feedback              |   |
| 55                     | -         |                       | Common for analog input   |
| Serial Communication   |           |                       |   |
| 61                     | -         |                       | Integrated RC-Filter for cable screen. ONLY for connecting the screen when experiencing EMC problems.                                   |

| Terminal Description   |           |                 |  |
|------------------------|-----------|-----------------|--|
| Digital Inputs/Outputs |           |                 |  |
| Terminal               | Parameter | Default Setting | Description  |
| 68 (+)                 | 8-3       |                 | RS-485 Interface. A control card switch is provided for termination resistance.    |
| 69 (-)                 | 8-3       |                 |  |
| Relays                 |           |                 |  |
| 01, 02, 03             | 5-40 [0]  | [0] Alarm       | Form C relay output. Usable for AC or DC voltage and resistive or inductive loads. |
| 04, 05, 06             | 5-40 [1]  | [0] Running     |  |

Table 2.4 Terminal Description

### 2.4.5.3 Wiring to Control Terminals

Control terminal connectors can be unplugged from the frequency converter for ease of installation, as shown in *Illustration 2.16*.

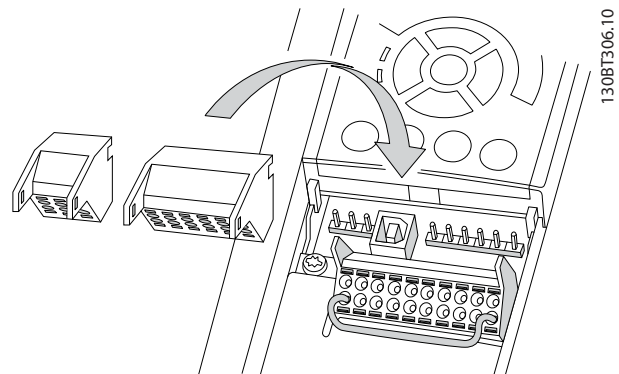


Illustration 2.16 Unplugging Control Terminals

1. Open the contact by inserting a small screwdriver into the slot above or below the contact, as shown in *Illustration 2.17*.
2. Insert the bared control wire into the contact.
3. Remove the screwdriver to fasten the control wire into the contact.
4. Ensure the contact is firmly established and not loose. Loose control wiring can be the source of equipment faults or less than optimal operation.

See 10.1 *Power-dependent Specifications* for control terminal wiring sizes.

See 6 *Application Set-Up Examples* for typical control wiring connections.

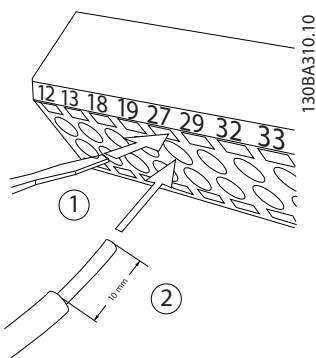


Illustration 2.17 Connecting Control Wiring

### 2.4.5.4 Using Screened Control Cables

#### Correct screening

The preferred method in most cases is to secure control and serial communication cables with screening clamps provided at both ends to ensure best possible high frequency cable contact.

If the earth potential between the frequency converter and the PLC is different, electric noise may occur that will disturb the entire system. Solve this problem by fitting an equalizing cable next to the control cable. Minimum cable cross section: 16 mm<sup>2</sup>.

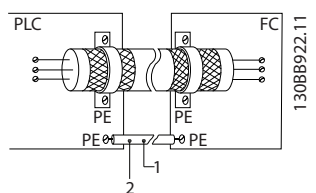


Illustration 2.18

#### 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 100nF capacitor (keeping leads short).

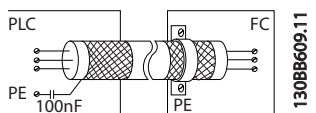


Illustration 2.19

#### Avoid EMC noise on serial communication

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

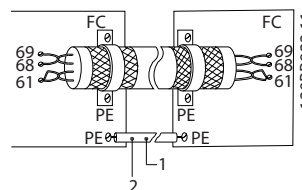


Illustration 2.20

Alternatively, the connection to terminal 61 can be omitted:

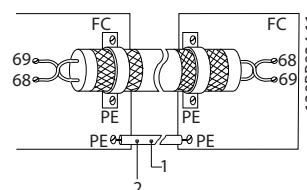


Illustration 2.21

### 2.4.5.5 Control Terminal Functions

Frequency converter functions are commanded by receiving control input signals.

- Each terminal must be programmed for the function it will be supporting in the parameters associated with that terminal. See *Table 2.4* for terminals and associated parameters.
- It is important to confirm that the control terminal is programmed for the correct function. See *4 User Interface* for details on accessing parameters and *5 About Frequency Converter Programming* for details on programming.
- The default terminal programming is intended to initiate frequency converter functioning in a typical operational mode.

### 2.4.5.6 Jumper Terminals 12 and 27

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

- Digital input terminal 27 is designed to receive an 24 V DC external interlock command. In many applications, the user wires an external interlock device to terminal 27
- When no interlock device is used, wire a jumper between control terminal 12 (recommended) or 13 to terminal 27. This provides an internal 24 V signal on terminal 27
- No signal present prevents the unit from operating
- When the status line at the bottom of the LCP 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.

- When factory installed optional equipment is wired to terminal 27, do not remove that wiring.

### 2.4.5.7 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 2.22*). Note that some option cards available for the unit may cover these switches and must be removed to change switch settings. Always remove power to the unit before removing option cards.
- Terminal 53 default is for a speed reference signal in open loop set in *16-61 Terminal 53 Switch Setting*
- Terminal 54 default is for a feedback signal in closed loop set in *16-63 Terminal 54 Switch Setting*

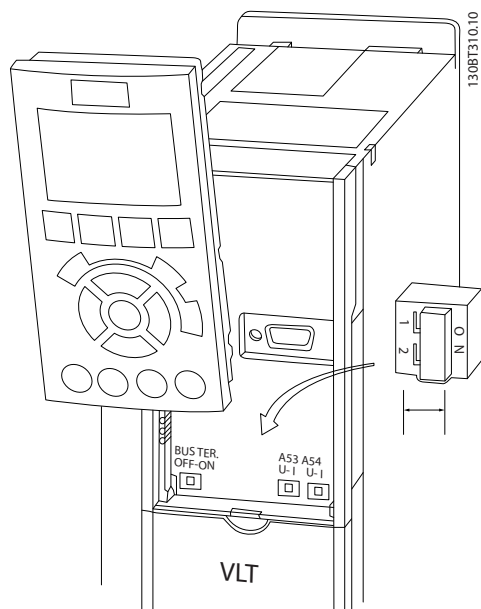


Illustration 2.22 Location of Terminals 53 and 54 Switches

### 2.4.5.8 Terminal 37

#### Terminal 37 Safe Stop Function

The frequency converter is available with optional safe stop functionality via control terminal 37. Safe stop disables the control voltage of the power semiconductors

of the frequency converter output stage which in turn prevents generating the voltage required to rotate the motor. When the Safe Stop (T37) is activated, the frequency converter issues an alarm, trips the unit, and coasts the motor to a stop. Manual restart is required. The safe stop function can be used for stopping the frequency converter in emergency stop situations. In the normal operating mode when safe stop is not required, use the frequency converter's regular stop function instead. When automatic restart is used – the requirements according to ISO 12100-2 paragraph 5.3.2.5 must be fulfilled.

#### Liability Conditions

It is the responsibility of the user to ensure personnel installing and operating the Safe Stop function:

- Read and understand the safety regulations concerning health and safety/accident prevention
- Understand the generic and safety guidelines given in this description and the extended description in the *Design Guide*
- Have a good knowledge of the generic and safety standards applicable to the specific application

User is defined as: integrator, operator, servicing, maintenance staff.

#### Standards

Use of safe stop on terminal 37 requires that the user satisfies all provisions for safety including relevant laws, regulations and guidelines. The optional safe stop function complies with the following standards.

- EN 954-1: 1996 Category 3
- IEC 60204-1: 2005 category 0 – uncontrolled stop
- IEC 61508: 1998 SIL2
- IEC 61800-5-2: 2007 – safe torque off (STO) function
- IEC 62061: 2005 SIL CL2
- ISO 13849-1: 2006 Category 3 PL d
- ISO 14118: 2000 (EN 1037) – prevention of unexpected start up

The information and instructions of the instruction manual are not sufficient for a proper and safe use of the safe stop functionality. The related information and instructions of the relevant *Design Guide* must be followed.

#### Protective Measures

- Safety engineering systems may only be installed and commissioned by qualified and skilled personnel
- The unit must be installed in an IP54 cabinet or in an equivalent environment
- The cable between terminal 37 and the external safety device must be short circuit protected according to ISO 13849-2 table D.4

- If any external forces influence the motor axis (e.g. suspended loads), additional measures (e.g., a safety holding brake) are required in order to eliminate hazards

#### Safe Stop Installation and Set-Up

### **⚠ WARNING**

#### SAFE STOP FUNCTION!

The safe stop function does NOT isolate mains voltage to the frequency converter or auxiliary circuits. Perform work on electrical parts of the frequency converter or the motor only after isolating the mains voltage supply and waiting the length of time specified under Safety in this manual. Failure to isolate the mains voltage supply from the unit and waiting the time specified could result in death or serious injury.

- It is not recommended to stop the frequency converter by using the Safe Torque Off function. If a running frequency converter is stopped by using the function, the unit will trip and stop by coasting. If this is not acceptable, e.g. causes danger, the frequency converter and machinery must be stopped using the appropriate stopping mode before using this function. Depending on the application a mechanical brake may be required.
- Concerning synchronous and permanent magnet motor frequency converters in case of a multiple IGBT power semiconductor failure: In spite of the activation of the Safe torque off function, the frequency converter system can produce an alignment torque which maximally rotates the motor shaft by  $180/p$  degrees.  $p$  denotes the pole pair number.
- This function is suitable for performing mechanical work on the frequency converter system or affected area of a machine only. It does not provide electrical safety. This function should not be used as a control for starting and/or stopping the frequency converter.

The following requirements have to be met to perform a safe installation of the frequency converter:

1. Remove the jumper wire between control terminals 37 and 12 or 13. Cutting or breaking the jumper is not sufficient to avoid short-circuiting. (See jumper on *Illustration 2.23*.)
2. Connect an external Safety monitoring relay via a NO safety function (the instruction for the safety device must be followed) to terminal 37 (safe stop) and either terminal 12 or 13 (24 V DC). The Safety monitoring relay must comply with Category 3 (EN 954-1) / PL "d" (ISO 13849-1).

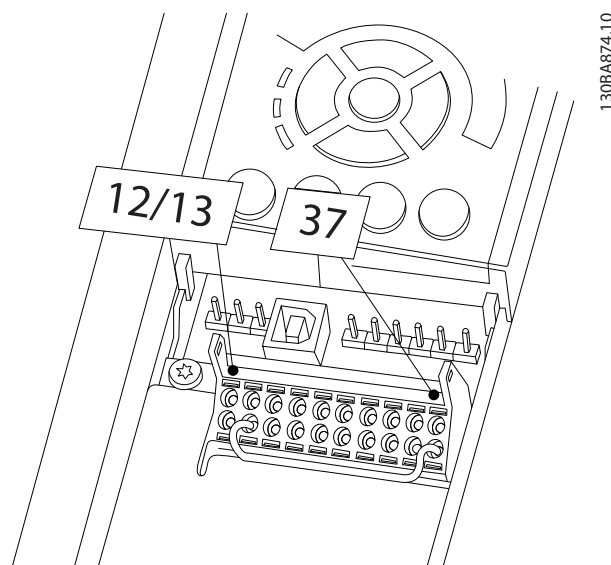
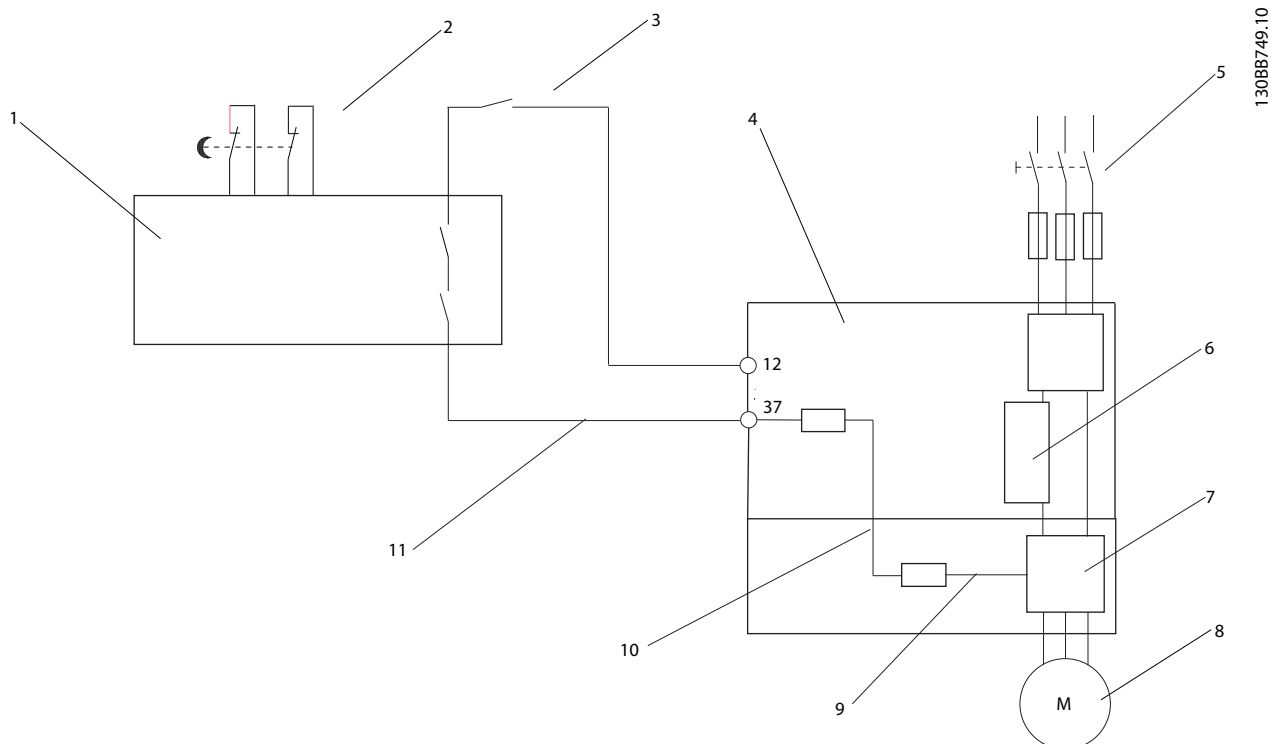


Illustration 2.23 Jumper between Terminal 12/13 (24 V) and 37

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2



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Illustration 2.24 Installation to Achieve a Stopping Category 0 (EN 60204-1) with Safety Cat. 3 (EN 954-1) / PL "d" (ISO 13849-1).

|   |  |    |  |
|---|--|----|--|
| 1 | Safety device Cat. 3 (circuit interrupt device, possibly with release input) | 7  | Inverter   |
| 2 | Door contact   | 8  | Motor  |
| 3 | Contactora (Coast)   | 9  | 5 V DC   |
| 4 | Frequency converter  | 10 | Safe channel   |
| 5 | Mains  | 11 | Short-circuit protected cable (if not inside installation cabinet) |
| 6 | Control board  |    |  |

Table 2.5

**Safe Stop Commissioning Test**

After installation and before first operation, perform a commissioning test of the installation making use of safe stop. Moreover, perform the test after each modification of the installation.

### 2.4.5.9 Mechanical Brake Control

In hoisting/lowering applications, it is necessary to be able to control an electro-mechanical brake:

- Control the brake using any relay output or digital output (terminal 27 or 29).
- Keep the output closed (voltage-free) as long as the frequency converter is unable to 'support' the motor, for example due to the load being too heavy.
- Select *Mechanical brake control* [32] in parameter group 5-4\* for applications with an electro-mechanical brake.
- The brake is released when the motor current exceeds the preset value in *2-20 Release Brake Current*.
- The brake is engaged when the output frequency is less than the frequency set in *2-21 Activate Brake Speed [RPM]* or *2-22 Activate Brake Speed [Hz]*, and only if the frequency converter carries out a stop command.

If the frequency converter is in alarm mode or in an over-voltage situation, the mechanical brake immediately cuts in.

In the vertical movement, the key point is that the load must be held, stopped, controlled (raised, lowered) in a perfectly safe mode during the entire operation. Because the frequency converter is not a safety device, the crane/lift designer (OEM) must decide on the type and number of safety devices (e.g. speed switch, emergency brakes etc.) to be used, in order to be able to stop the load in case of emergency or malfunction of the system, according to relevant national crane/lift regulations.

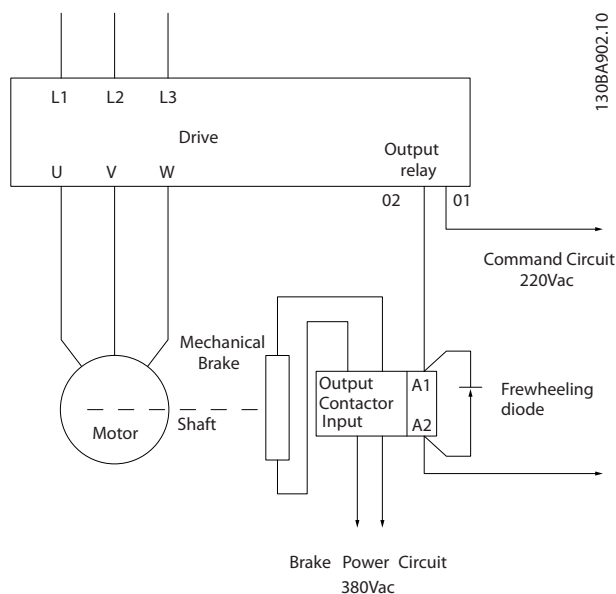


Illustration 2.25 Connecting the Mechanical Brake to the Frequency Converter

### 2.4.6 Serial Communication

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

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

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

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

Table 2.6

## 3 Start Up and Functional Testing

### 3.1 Pre-start

#### 3.1.1 Safety Inspection

3

#### **⚠ 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. Input power to the unit must be OFF and 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: power, voltage, frequency, full load current, and nominal speed. These values are needed to program motor nameplate data later.
8. Confirm that the supply voltage matches voltage of frequency converter and motor.

## CAUTION

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

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

Table 3.1 Start Up Check List

### 3.2 Applying Power to the Frequency Converter

#### **WARNING**

##### HIGH VOLTAGE!

Frequency converters contain high voltage when connected to AC mains. Installation, start-up and maintenance should be performed by qualified personnel only. Failure to 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. The frequency converter, motor, and any driven equipment must be in operational readiness. Failure to comply could result in death, serious injury, equipment, or property damage.

1. Confirm 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.

#### NOTE

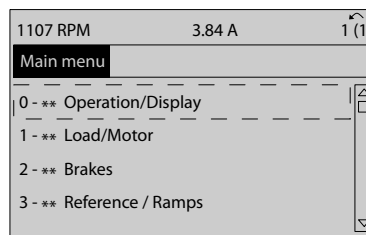
If the status line at the bottom of the LCP reads **AUTO REMOTE COASTING** or **Alarm 60 External Interlock** is displayed, this indicates that the unit is ready to operate but is missing an input signal on terminal 27. See *Illustration 2.23* for details.

### 3.3 Basic Operational Programming

Frequency converters require basic operational programming before running for best performance. Basic operational programming requires entering motor-nameplate data for the motor being operated and the minimum and maximum motor speeds. Enter data in accordance with the following procedure. Parameter settings recommended are intended for start up and checkout purposes. Application settings may vary. See *4 User Interface* for detailed instructions on entering data through the LCP.

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

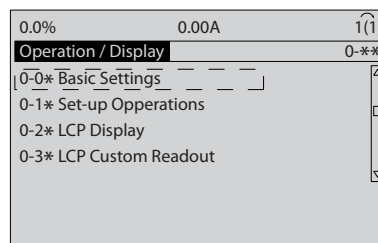
1. Press [Main Menu] twice on the LCP.
2. Use the navigation keys to scroll to parameter group 0-\*\* *Operation/Display* and press [OK].



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Illustration 3.1

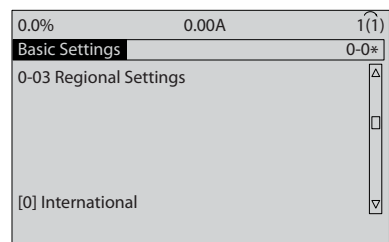
3. Use navigation keys to scroll to parameter group 0-0\* *Basic Settings* and press [OK].



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Illustration 3.2

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



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Illustration 3.3

5. Use 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 *5.4 International/North American Default Parameter Settings* for a complete list.)
6. Press [Quick Menu] on the LCP.

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

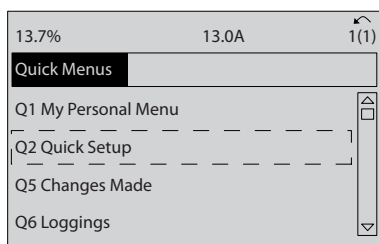


Illustration 3.4

- Select language and press [OK]. Then enter the motor data in parameters 1-20/1-21 through 1-25. The information can be found on the motor nameplate.

- 1-20 Motor Power [kW] or 1-21 Motor Power [HP]
- 1-22 Motor Voltage
- 1-23 Motor Frequency
- 1-24 Motor Current
- 1-25 Motor Nominal Speed

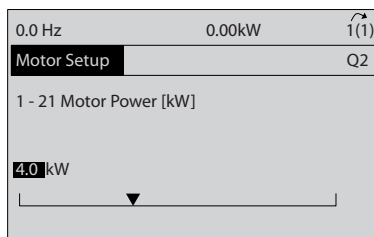


Illustration 3.5

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

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

### 3.4 PM Motor Setup

This section is only relevant when using a PM motor.

Set up the basic motor parameters:

- 1-10 Motor Construction
- 1-14 Damping Gain
- 1-15 Low Speed Filter Time Const.
- 1-16 High Speed Filter Time Const.
- 1-17 Voltage filter time const.
- 1-24 Motor Current
- 1-25 Motor Nominal Speed
- 1-26 Motor Cont. Rated Torque
- 1-30 Stator Resistance (Rs)
- 1-37 d-axis Inductance (Ld)
- 1-39 Motor Poles
- 1-40 Back EMF at 1000 RPM
- 1-66 Min. Current at Low Speed
- 4-13 Motor Speed High Limit [RPM]
- 4-19 Max Output Frequency

Note concerning advanced motor data:

Stator resistance and d-axis inductance values are often described differently in technical specifications. For programming resistance and d-axis inductance values in Danfoss frequency converters, always use line to common (starpoint) values. This is valid for both asynchronous and PM motors.

|           |   |  |
|-----------|---|--|
| Par. 1-30 | Stator Resistance (Line to common)            | This parameter gives stator winding resistance (Rs) similar to asynchronous motor stator resistance. When line-line data (where stator resistance is measured between any two lines) are available, you need to divide it with 2.  |
| Par. 1-37 | d-axis Inductance (Line to common)            | This parameter gives direct axis inductance of the PM motor. When line-line data are available, you need to divide it with 2.  |
| Par. 1-40 | Back EMF at 1000RPM RMS (Line to Line Value ) | This parameter gives back EMF across stator terminal of PM Motor at 1000RPM mechanical speed specifically. It is defined between line to line and expressed in RMS Value. In case the PM Motor specifications provides this value related to another motor speed, the voltage must be recalculated for 1000 RPM. |

Table 3.2

Note concerning Back-EMF:

Back-EMF is the voltage generated by a PM motor when no drive is connected and the shaft is turned externally. Technical specifications usually notes this voltage related to nominal motor speed or to 1000 RPM measured between two lines.

### 3.5 Automatic Motor Adaptation

Automatic motor adaptation (AMA) is a test procedure that measures the electrical characteristics of the motor to optimize 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.
- It does not cause the motor to run or harm to the motor
- Some motors may be unable to run the complete version of the test. In that case, select *Enable reduced AMA*
- If an output filter is connected to the motor, select *Enable reduced AMA*
- If warnings or alarms occur, see *8 Warnings and Alarms*
- Run this procedure on a cold motor for best results

#### NOTE

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].
4. Scroll to parameter group 1-2\* *Motor Data*.
5. Press [OK].
6. Scroll to 1-29 *Automatic Motor Adaptation (AMA)*.
7. Press [OK].
8. Select *Enable complete AMA*.
9. Press [OK].
10. Follow on-screen instructions.
11. The test will run automatically and indicate when it is complete.

### 3.6 Check Motor Rotation

before running the frequency converter, check the motor rotation. The motor will run briefly at 5Hz 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].
6. Scroll to *Enable*.

The following text will appear: *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 power to discharge. Reverse the connection of any two of the three motor cables on the motor or frequency converter side of the connection.

### 3.7 Local-control Test



#### 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 ensure that the motor, system, and any attached equipment is ready for start could result in personal injury or equipment damage.

#### NOTE

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

When operating in local mode, [▲] and [▼] arrows on the LCP increase and decrease the speed output of the frequency converter. [◀] and [▶] move the display cursor in the numeric display.

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

If acceleration problems were encountered

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

If deceleration problems were encountered

- If warnings or alarms occur, see *8 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*.

## NOTE

The OVC algorithm does not work when using PM motors.

See *8.4 Warning and Alarm Definitions* for resetting the frequency converter after a trip.

## NOTE

*3.1 Pre-start* through *3.7 Local-control Test* in this chapter concludes the procedures for applying power to the frequency converter, basic programming, set-up, and functional testing.

## 3.8 System Start Up

The procedure in this section requires user-wiring and application programming to be completed. *6 Application Set-Up Examples* is intended to help with this task. Other aids to application set-up are listed in *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 external control functions are properly wired to the frequency converter and all programming is completed.
3. Apply an external run command.
4. Adjust the speed reference throughout the speed range.
5. Remove the external run command.
6. Note any problems.

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

## 3.9 Acoustic Noise or Vibration

If the motor or the equipment driven by the motor - e.g. a fan blade - is making noise or vibrations at certain frequencies, try the following:

- Speed Bypass, parameter group 4-6\*
- Over-modulation, *14-03 Overmodulation* set to off
- Switching pattern and switching frequency parameter group 14-0\*
- Resonance Dampening, *1-64 Resonance Dampening*



## 4 User Interface

### 4.1 Local Control Panel

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

The LCP has several user functions.

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

An optional numeric LCP (NLCP) is also available. The NLCP operates in a manner similar to the LCP. See the Programming Guide MG11XXYY for details on use of the NLCP.

#### NOTE

The display contrast can be adjusted by pressing [Status] and the up/ down key.

#### 4.1.1 LCP Layout

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

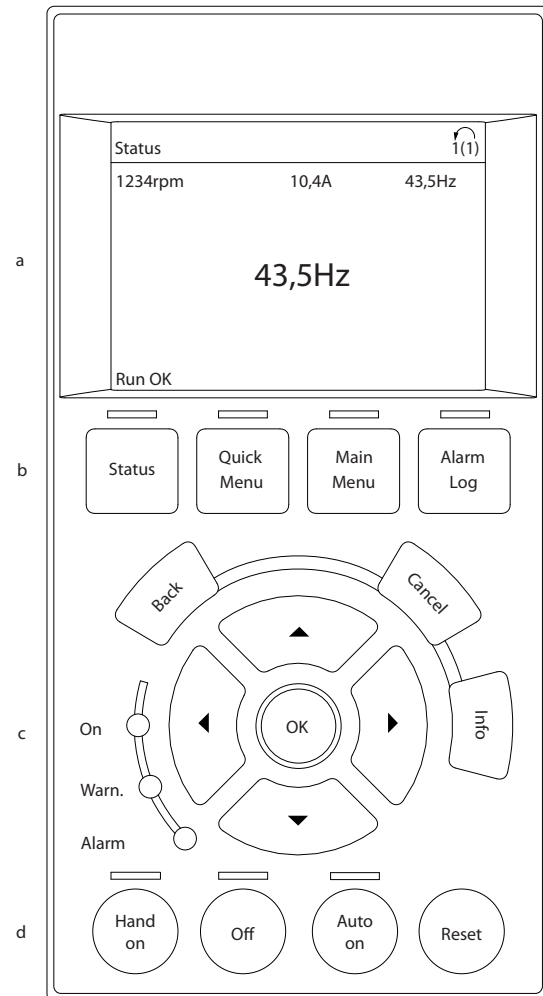


Illustration 4.1 LCP

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

### 4.1.2 Setting LCP Display Values

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

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

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

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

Table 4.1

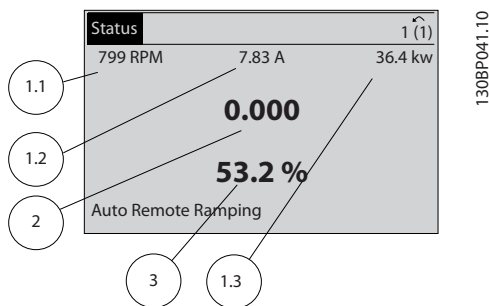


Illustration 4.2

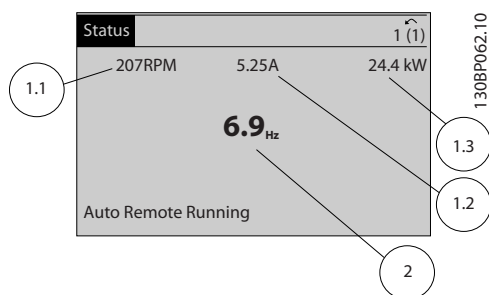


Illustration 4.3

### 4.1.3 Display Menu Keys

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



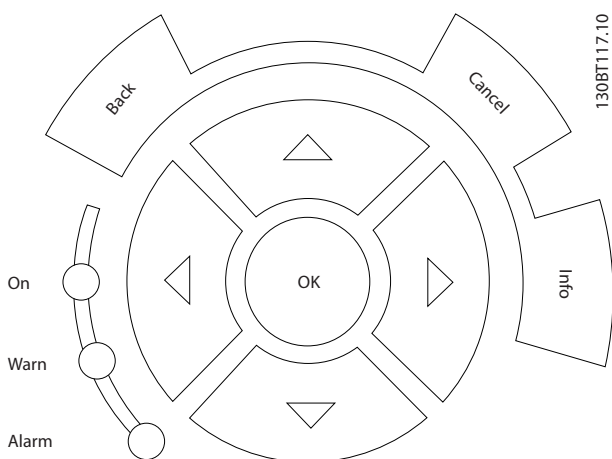
Illustration 4.4

| Key               | Function   |
|-------------------|--|
| <b>Status</b>     | <p>Press to show operational information.</p> <ul style="list-style-type: none"> <li>• In Auto mode, press and hold to toggle between status read-out displays</li> <li>• Press repeatedly to scroll through each status display</li> <li>• Press and hold [Status] plus [▲] or [▼] to adjust the display brightness</li> <li>• The symbol in the upper right corner of the display shows the direction of motor rotation and which set-up is active. This is not programmable.</li> </ul> |
| <b>Quick Menu</b> | <p>Allows access to programming parameters for initial set up instructions and many detailed application instructions.</p> <ul style="list-style-type: none"> <li>• Press to access Q2 <i>Quick Setup</i> for sequenced instructions to program the basic frequency controller set up</li> <li>• Press to access Q3 <i>Function Setups</i> for sequenced instructions to program applications</li> <li>• Follow the sequence of parameters as presented for the function set up</li> </ul> |
| <b>Main Menu</b>  | <p>Allows access to all programming parameters.</p> <ul style="list-style-type: none"> <li>• Press twice to access top-level index</li> <li>• Press once to return to the last location accessed</li> <li>• Press and hold to enter a parameter number for direct access to that parameter</li> </ul>  |
| <b>Alarm Log</b>  | <p>Displays a list of current warnings, the last 10 alarms, and the maintenance log.</p> <ul style="list-style-type: none"> <li>• For details about the frequency converter before it entered the alarm mode, select the alarm number using the navigation keys and press [OK].</li> </ul>   |

Table 4.2

### 4.1.4 Navigation Keys

Navigation keys are used for programming functions and moving the display cursor. The navigation keys also provide speed control in local (hand) operation. Three frequency converter status indicator lights are also located in this area.



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Illustration 4.5

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

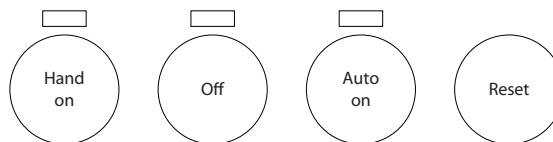
Table 4.3

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

Table 4.4

### 4.1.5 Operation Keys

Operation keys are found at the bottom of the LCP.



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Illustration 4.6

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

Table 4.5

## 4.2 Back Up and Copying Parameter Settings

Programming data is stored internally in the frequency converter.

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

**⚠ WARNING****UNINTENDED START!**

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

## 4.2.1 Uploading Data to the LCP

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

## 4.2.2 Downloading Data from the LCP

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

## 4.3 Restoring Default Settings

**CAUTION**

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

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

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

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

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

## 4.3.1 Recommended Initialisation

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

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

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

## 4.3.2 Manual Initialisation

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

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

Manual initialisation does not 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*

# 5 About Frequency Converter Programming

## 5.1 Introduction

The frequency converter is programmed for its application functions using parameters. Parameters are accessed by pressing either [Quick Menu] or [Main Menu] on the LCP. (See 4 *User Interface* for details on using the LCP function keys.) Parameters may also be accessed through a PC using the MCT 10 Set-up Software (see 5.6 *Remote Programming with* ).

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

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

## 5.2 Programming Example

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

- This procedure programs the frequency converter to receive a 0-10 V DC analog control signal on input terminal 53
- The frequency converter will respond by providing 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 Resource 1*

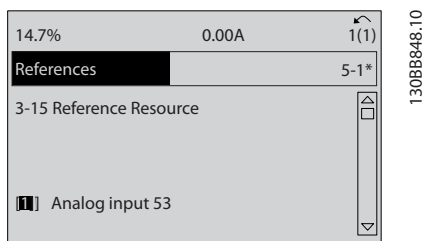


Illustration 5.1

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

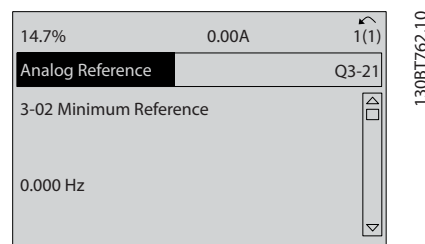


Illustration 5.2

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

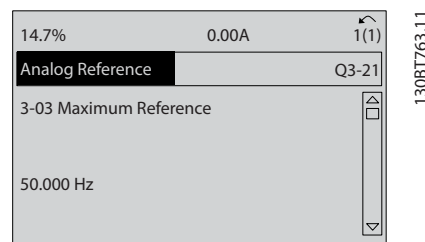


Illustration 5.3

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

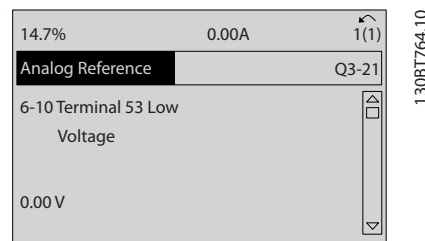
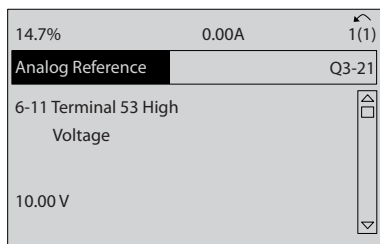


Illustration 5.4

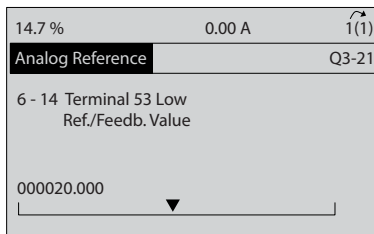
- 6-11 Terminal 53 High Voltage. Set maximum external voltage reference on Terminal 53 at 10 V. (This sets the maximum input signal at 10 V.)



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Illustration 5.5

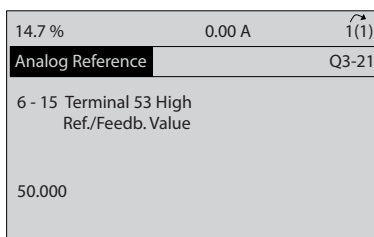
- 6-14 Terminal 53 Low Ref./Feedb. Value. Set minimum speed reference on Terminal 53 at 6Hz. (This tells the frequency converter that the minimum voltage received on Terminal 53 (0 V) equals 6 Hz output.)



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Illustration 5.6

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



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Illustration 5.7

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 5.8 shows the wiring connections used to enable this set up.

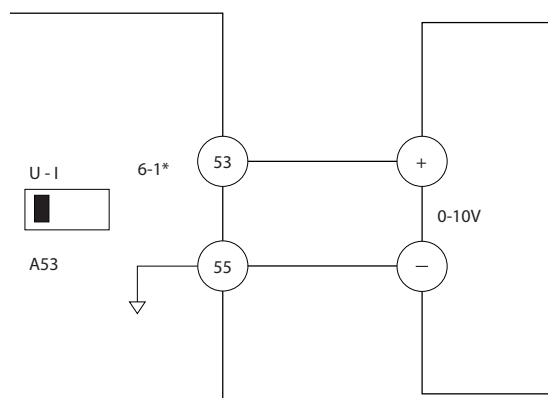


Illustration 5.8 Wiring Example for External Device Providing 0-10 V Control Signal (frequency converter left, external device right)

### 5.3 Control Terminal Programming Examples

Control terminals can be programmed.

- Each terminal has specified functions it is capable of performing
- Parameters associated with the terminal enable the function
- For proper frequency converter functioning, the control terminals must be

Wired properly

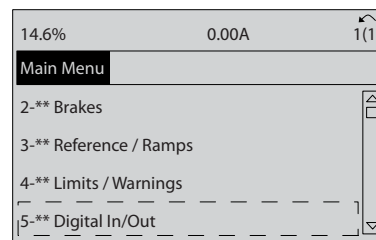
Programmed for the intended function

Receiving a signal

See Table 2.4 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.

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



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Illustration 5.9

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

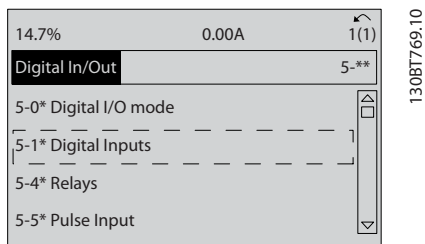


Illustration 5.10

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

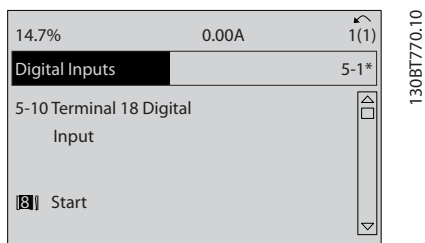


Illustration 5.11

## 5.4 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 5.1 lists those parameters that are effected.

| Parameter  | International default parameter value | North American default parameter value |
|--|---------------------------------------|--|
| 0-03 Regional Settings                             | International                         | North America                          |
| 1-20 Motor Power [kW]                              | See Note 1                            | See Note 1                             |
| 1-21 Motor Power [HP]                              | See Note 2                            | See Note 2                             |
| 1-22 Motor Voltage                                 | 230 V/400 V/575 V                     | 208 V/460 V/575 V                      |
| 1-23 Motor Frequency                               | 50 Hz                                 | 60 Hz                                  |
| 3-03 Maximum Reference                             | 50 Hz                                 | 60 Hz                                  |
| 3-04 Reference Function                            | Sum                                   | External/Preset                        |
| 4-13 Motor Speed High Limit [RPM] See Note 3 and 5 | 1500 RPM                              | 1800 RPM                               |

| Parameter                                   | International default parameter value | North American default parameter value |
|---|---------------------------------------|--|
| 4-14 Motor Speed High Limit [Hz] See Note 4 | 50 Hz                                 | 60 Hz                                  |
| 4-19 Max Output Frequency                   | 132 Hz                                | 120 Hz                                 |
| 4-53 Warning Speed High                     | 1500 RPM                              | 1800 RPM                               |
| 5-12 Terminal 27 Digital Input              | Coast inverse                         | External interlock                     |
| 5-40 Function Relay                         | No operation                          | No alarm                               |
| 6-15 Terminal 53 High Ref./Feedb. Value     | 50                                    | 60                                     |
| 6-50 Terminal 42 Output                     | No operation                          | Speed 4-20 mA                          |
| 14-20 Reset Mode                            | Manual reset                          | Infinite auto reset                    |

Table 5.1 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 1500RPM and for a 2 poled motor 3000RPM. The corresponding values for North America is 1800 and 3600RPM, respectively.

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 *Q5 Changes Made* and press [OK].

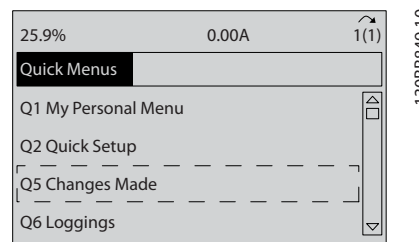


Illustration 5.12

3. Select *Q5-2 Since Factory Setting* to view all programming changes or *Q5-1 Last 10 Changes* for the most recent.

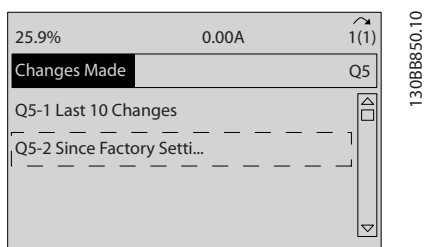


Illustration 5.13

### 5.4.1 Parameter Data Check

1. Press [Quick Menu].
2. Scroll to *Q5 Changes Made* and press [OK].

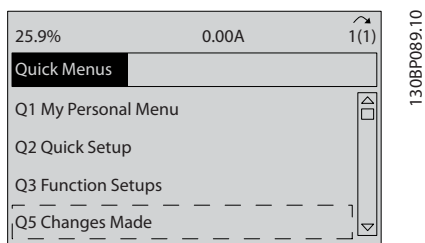


Illustration 5.14

3. Select *Q5-2 Since Factory Setting* to view all programming changes or *Q5-1 Last 10 Changes* for the most recent.

## 5.5 Parameter Menu Structure

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

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



5.5.1 Quick Menu Structure

5

|                                       |   |   |   |                                |
|---------------------------------------|---|---|---|--------------------------------|
| <b>Q3-1 General Settings</b>          | 0-24 Display Line 3 Large               | 1-00 Configuration Mode                 | <b>Q3-31 Single Zone Ext. Set Point</b> | 20-70 Closed Loop Type         |
| <b>Q3-10 Adv. Motor Settings</b>      | 0-37 Display Text 1                     | 20-12 Reference/Feedback Unit           | 1-00 Configuration Mode                 | 20-71 PID Performance          |
| 1-90 Motor Thermal Protection         | 0-38 Display Text 2                     | 20-13 Minimum Reference/Feedb.          | 20-12 Reference/Feedback Unit           | 20-72 PID Output Change        |
| 1-93 Thermistor Source                | 0-39 Display Text 3                     | 20-14 Maximum Reference/Feedb.          | 20-13 Minimum Reference/Feedb.          | 20-73 Minimum Feedback Level   |
| 1-29 Automatic Motor Adaptation (AMA) | <b>Q3-2 Open Loop Settings</b>          | 6-22 Terminal 54 Low Current            | 20-14 Maximum Reference/Feedb.          | 20-74 Maximum Feedback Level   |
| 14-01 Switching Frequency             | <b>Q3-20 Digital Reference</b>          | 6-24 Terminal 54 Low Ref./Feedb. Value  | 6-10 Terminal 53 Low Voltage            | 20-79 PID Autotuning           |
| 4-53 Warning Speed High               | 3-02 Minimum Reference                  | 6-25 Terminal 54 High Ref./Feedb. Value | 6-11 Terminal 53 High Voltage           | <b>Q3-32 Multi Zone / Adv</b>  |
| <b>Q3-11 Analog Output</b>            | 3-03 Maximum Reference                  | 6-26 Terminal 54 Filter Time Constant   | 6-12 Terminal 53 Low Current            | 1-00 Configuration Mode        |
| 6-50 Terminal 42 Output               | 3-10 Preset Reference                   | 6-27 Terminal 54 Live Zero              | 6-13 Terminal 53 High Current           | 3-15 Reference 1 Source        |
| 6-51 Terminal 42 Output Min Scale     | 5-13 Terminal 29 Digital Input          | 6-00 Live Zero Timeout Time             | 6-14 Terminal 53 Low Ref./Feedb. Value  | 3-16 Reference 2 Source        |
| 6-52 Terminal 42 Output Max Scale     | 5-14 Terminal 32 Digital Input          | 6-01 Live Zero Timeout Function         | 6-15 Terminal 53 High Ref./Feedb. Value | 20-00 Feedback 1 Source        |
| <b>Q3-12 Clock Settings</b>           | 5-15 Terminal 33 Digital Input          | 20-21 Setpoint 1                        | 6-22 Terminal 54 Low Current            | 20-01 Feedback 1 Conversion    |
| 0-70 Date and Time                    | <b>Q3-21 Analog Reference</b>           | 20-81 PID Normal/ Inverse Control       | 6-24 Terminal 54 Low Ref./Feedb. Value  | 20-02 Feedback 1 Source Unit   |
| 0-71 Date Format                      | 3-02 Minimum Reference                  | 20-82 PID Start Speed [RPM]             | 6-25 Terminal 54 High Ref./Feedb. Value | 20-03 Feedback 2 Source        |
| 0-72 Time Format                      | 3-03 Maximum Reference                  | 20-83 PID Start Speed [Hz]              | 6-26 Terminal 54 Filter Time Constant   | 20-04 Feedback 2 Conversion    |
| 0-74 DST/Summertime                   | 6-10 Terminal 53 Low Voltage            | 20-93 PID Proportional Gain             | 6-27 Terminal 54 Live Zero              | 20-05 Feedback 2 Source Unit   |
| 0-76 DST/Summertime Start             | 6-11 Terminal 53 High Voltage           | 20-94 PID Integral Time                 | 6-00 Live Zero Timeout Time             | 20-06 Feedback 3 Source        |
| 0-77 DST/Summertime End               | 6-12 Terminal 53 Low Current            | 20-70 Closed Loop Type                  | 6-01 Live Zero Timeout Function         | 20-07 Feedback 3 Conversion    |
| <b>Q3-13 Display Settings</b>         | 6-13 Terminal 53 High Current           | 20-71 PID Performance                   | 20-81 PID Normal/ Inverse Control       | 20-08 Feedback 3 Source Unit   |
| 0-20 Display Line 1.1 Small           | 6-14 Terminal 53 Low Ref./Feedb. Value  | 20-72 PID Output Change                 | 20-82 PID Start Speed [RPM]             | 20-12 Reference/Feedback Unit  |
| 0-21 Display Line 1.2 Small           | 6-15 Terminal 53 High Ref./Feedb. Value | 20-73 Minimum Feedback Level            | 20-83 PID Start Speed [Hz]              | 20-13 Minimum Reference/Feedb. |
| 0-22 Display Line 1.3 Small           | <b>Q3-3 Closed Loop Settings</b>        | 20-74 Maximum Feedback Level            | 20-93 PID Proportional Gain             | 20-14 Maximum Reference/Feedb. |
| 0-23 Display Line 2 Large             | <b>Q3-30 Single Zone Int. Set Point</b> | 20-79 PID Autotuning                    | 20-94 PID Integral Time                 | 6-10 Terminal 53 Low Voltage   |

Table 5.2

|   |                                   |                                  |   |                                   |
|---|-----------------------------------|----------------------------------|---|-----------------------------------|
| 6-11 Terminal 53 High Voltage           | 20-21 Setpoint 1                  | 22-22 Low Speed Detection        | 22-21 Low Power Detection               | 22-87 Pressure at No-Flow Speed   |
| 6-12 Terminal 53 Low Current            | 20-22 Setpoint 2                  | 22-23 No-Flow Function           | 22-22 Low Speed Detection               | 22-88 Pressure at Rated Speed     |
| 6-13 Terminal 53 High Current           | 20-81 PID Normal/ Inverse Control | 22-24 No-Flow Delay              | 22-23 No-Flow Function                  | 22-89 Flow at Design Point        |
| 6-14 Terminal 53 Low Ref./Feedb. Value  | 20-82 PID Start Speed [RPM]       | 22-40 Minimum Run Time           | 22-24 No-Flow Delay                     | 22-90 Flow at Rated Speed         |
| 6-15 Terminal 53 High Ref./Feedb. Value | 20-83 PID Start Speed [Hz]        | 22-41 Minimum Sleep Time         | 22-40 Minimum Run Time                  | 1-03 Torque Characteristics       |
| 6-16 Terminal 53 Filter Time Constant   | 20-93 PID Proportional Gain       | 22-42 Wake-up Speed [RPM]        | 22-41 Minimum Sleep Time                | 1-73 Flying Start                 |
| 6-17 Terminal 53 Live Zero              | 20-94 PID Integral Time           | 22-43 Wake-up Speed [Hz]         | 22-42 Wake-up Speed [RPM]               | <b>Q3-42 Compressor Functions</b> |
| 6-20 Terminal 54 Low Voltage            | 20-70 Closed Loop Type            | 22-44 Wake-up Ref./FB Difference | 22-43 Wake-up Speed [Hz]                | 1-03 Torque Characteristics       |
| 6-21 Terminal 54 High Voltage           | 20-71 PID Performance             | 22-45 Setpoint Boost             | 22-44 Wake-up Ref./FB Difference        | 1-71 Start Delay                  |
| 6-22 Terminal 54 Low Current            | 20-72 PID Output Change           | 22-46 Maximum Boost Time         | 22-45 Setpoint Boost                    | 22-75 Short Cycle Protection      |
| 6-23 Terminal 54 High Current           | 20-73 Minimum Feedback Level      | 2-10 Brake Function              | 22-46 Maximum Boost Time                | 22-76 Interval between Starts     |
| 6-24 Terminal 54 Low Ref./Feedb. Value  | 20-74 Maximum Feedback Level      | 2-16 AC brake Max. Current       | 22-26 Dry Pump Function                 | 22-77 Minimum Run Time            |
| 6-25 Terminal 54 High Ref./Feedb. Value | 20-79 PID Autotuning              | 2-17 Over-voltage Control        | 22-27 Dry Pump Delay                    | 5-01 Terminal 27 Mode             |
| 6-26 Terminal 54 Filter Time Constant   | <b>Q3-4 Application Settings</b>  | 1-73 Flying Start                | 22-80 Flow Compensation                 | 5-02 Terminal 29 Mode             |
| 6-27 Terminal 54 Live Zero              | <b>Q3-40 Fan Functions</b>        | 1-71 Start Delay                 | 22-81 Square-linear Curve Approximation | 5-12 Terminal 27 Digital Input    |
| 6-00 Live Zero Timeout Time             | 22-60 Broken Belt Function        | 1-80 Function at Stop            | 22-82 Work Point Calculation            | 5-13 Terminal 29 Digital Input    |
| 6-01 Live Zero Timeout Function         | 22-61 Broken Belt Torque          | 2-00 DC Hold/Preheat Current     | 22-83 Speed at No-Flow [RPM]            | 5-40 Function Relay               |
| 4-56 Warning Feedback Low               | 22-62 Broken Belt Delay           | 4-10 Motor Speed Direction       | 22-84 Speed at No-Flow [Hz]             | 1-73 Flying Start                 |
| 4-57 Warning Feedback High              | 4-64 Semi-Auto Bypass Set-up      | <b>Q3-41 Pump Functions</b>      | 22-85 Speed at Design Point [RPM]       | 1-86 Trip Speed Low [RPM]         |
| 20-20 Feedback Function                 | 1-03 Torque Characteristics       | 22-20 Low Power Auto Set-up      | 22-86 Speed at Design Point [Hz]        | 1-87 Trip Speed Low [Hz]          |

Table 5.3

### 5.5.2 Main menu structure

| Code  | Operation / Display                  | Code | Motor Thermal Protection     | Code | Torque Limit Generator Mode       | Code | Pulse Output Max Freq #29            |
|-------|--------------------------------------|------|------------------------------|------|-----------------------------------|------|--------------------------------------|
| 1-0*  | General Settings                     | 1-90 | Motor Thermal Protection     | 4-17 | Torque Limit Generator Mode       | 5-55 | Pulse Output Max Freq #29            |
| 1-00  | Configuration Mode                   | 1-91 | Motor External Fan           | 4-18 | Current Limit                     | 5-66 | Terminal X30/6 Pulse Output Variable |
| 1-03  | Torque Characteristics               | 1-93 | Thermistor Source            | 4-19 | Max Output Frequency              | 5-68 | Pulse Output Max Freq #X30/6         |
| 1-06  | Clockwise Direction                  | 2-0* | Brakes                       | 4-5* | Adj. Warnings                     | 5-8* | I/O Options                          |
| 1-1*  | Motor Selection                      | 2-00 | DC Hold/Preheat Current      | 4-50 | Warning Current Low               | 5-80 | AHF Cap Reconnect Delay              |
| 1-10  | Motor Construction                   | 2-01 | DC Brake Current             | 4-51 | Warning Current High              | 5-9* | Bus Controlled                       |
| 1-11* | WC+ PM                               | 2-02 | DC Braking Time              | 4-52 | Warning Speed Low                 | 5-93 | Digital & Relay Bus Control          |
| 1-14  | Damping Gain                         | 2-03 | DC Brake Cut In Speed [RPM]  | 4-53 | Warning Speed High                | 5-90 | Pulse Out #27 Bus Control            |
| 1-15  | Low Speed Filter Time Const.         | 2-04 | DC Brake Cut In Speed [Hz]   | 4-54 | Warning Reference Low             | 5-94 | Pulse Out #27 Timeout Preset         |
| 1-16  | High Speed Filter Time Const.        | 2-05 | DC Brake Cut In Speed [Hz]   | 4-55 | Warning Reference High            | 5-95 | Pulse Out #29 Bus Control            |
| 1-17  | Voltage filter time const.           | 2-06 | Parking Current              | 4-56 | Warning Feedback Low              | 5-96 | Pulse Out #29 Timeout Preset         |
| 1-20  | Motor Data                           | 2-07 | Parking Time                 | 4-57 | Warning Feedback High             | 5-97 | Pulse Out #X30/6 Bus Control         |
| 1-20  | Programming Set-up                   | 2-1* | Brake Energy Funct.          | 4-58 | Missing Motor Phase Function      | 5-98 | Pulse Out #X30/6 Timeout Preset      |
| 1-12  | This Set-up Linked to                | 2-10 | Brake Function               | 4-6* | Speed Bypass                      | 6-5* | Analog In/Out                        |
| 1-13  | Readout: Linked Set-ups              | 2-11 | Brake Resistor (ohm)         | 4-60 | Bypass Speed From [RPM]           | 6-0* | Analog I/O Mode                      |
| 1-14  | Readout: Prog. Set-ups / Channel     | 2-12 | Brake Power Limit (kW)       | 4-61 | Bypass Speed From [Hz]            | 6-00 | Live Zero Timeout Time               |
| 0-2*  | LCP Display                          | 2-13 | Brake Power Monitoring       | 4-62 | Bypass Speed To [RPM]             | 6-01 | Live Zero Timeout Function           |
| 0-20  | Display Line 1.1 Small               | 2-15 | Brake Check                  | 4-63 | Bypass Speed To [Hz]              | 6-02 | Fire Mode Live Zero Timeout Function |
| 0-21  | Display Line 1.2 Small               | 2-16 | AC brake Max. Current        | 5-5* | Semi-Auto Bypass Set-up           | 6-1* | Analog Input 53                      |
| 0-22  | Display Line 1.3 Small               | 2-17 | Over-voltage Control         | 5-0* | Digital In/Out mode               | 6-10 | Terminal 53 Low Voltage              |
| 0-23  | Display Line 2 Large                 | 3-0* | Reference / Ramps            | 5-00 | Digital I/O mode                  | 6-11 | Terminal 53 High Voltage             |
| 0-24  | Display Line 3 Large                 | 3-02 | Minimum Reference            | 5-01 | Digital I/O Mode                  | 6-12 | Terminal 53 Low Current              |
| 0-25  | My Personal Menu                     | 3-03 | Maximum Reference            | 5-02 | Terminal 27 Mode                  | 6-13 | Terminal 53 High Current             |
| 0-30  | LCP Custom Readout                   | 3-04 | Reference Function           | 5-1* | Digital Inputs                    | 6-14 | Terminal 53 Low Ref./Feedb. Value    |
| 0-31  | Custom Readout Unit                  | 3-10 | References                   | 5-10 | Terminal 18 Digital Input         | 6-15 | Terminal 53 High Ref./Feedb. Value   |
| 0-32  | Custom Readout Min Value             | 3-10 | Preset Reference             | 5-11 | Terminal 19 Digital Input         | 6-16 | Terminal 53 Filter Time Constant     |
| 0-37  | Display Text 1                       | 3-11 | Jog Speed [Hz]               | 5-12 | Terminal 27 Digital Input         | 6-17 | Terminal 53 Live Zero                |
| 0-38  | Display Text 2                       | 3-13 | Reference Site               | 5-13 | Terminal 29 Digital Input         | 6-20 | Terminal 54 Low Voltage              |
| 0-39  | Display Text 3                       | 3-14 | Preset Relative Reference    | 5-15 | Terminal 32 Digital Input         | 6-21 | Terminal 54 High Voltage             |
| 0-40  | [Hand on] Key on LCP                 | 3-15 | Reference 1 Source           | 5-16 | Terminal 33 Digital Input         | 6-22 | Terminal 54 Low Current              |
| 0-41  | [Off] Key on LCP                     | 3-16 | Reference 2 Source           | 5-17 | Terminal X30/2 Digital Input      | 6-23 | Terminal 54 High Current             |
| 0-42  | [Auto on] Key on LCP                 | 3-17 | Reference 3 Source           | 5-18 | Terminal X30/3 Digital Input      | 6-24 | Terminal 54 Low Ref./Feedb. Value    |
| 0-43  | [Reset] Key on LCP                   | 3-19 | Jog Speed [RPM]              | 5-19 | Terminal X30/4 Digital Input      | 6-25 | Terminal 54 High Ref./Feedb. Value   |
| 0-44  | [Drive Bypass] Key on LCP            | 3-4* | Ramp 1                       | 5-19 | Terminal 37 Safe Stop             | 6-26 | Terminal 54 Filter Time Constant     |
| 0-45  | [Copy/Save] Key on LCP               | 3-41 | Ramp 1 Ramp Up Time          | 5-3* | Digital Outputs                   | 6-27 | Terminal 54 Live Zero                |
| 0-50  | LCP Copy                             | 3-42 | Ramp 1 Ramp Down Time        | 5-30 | Terminal 27 Digital Output        | 6-3* | Analog Input X30/11                  |
| 0-51  | Set-up Copy                          | 3-5* | Ramp 2                       | 5-31 | Terminal 29 Digital Output        | 6-30 | Terminal X30/11 Low Voltage          |
| 0-6*  | Password                             | 3-51 | Ramp 2 Ramp Up Time          | 5-32 | Term X30/6 Digi Out (MCB 101)     | 6-31 | Terminal X30/11 High Voltage         |
| 0-60  | Main Menu Password                   | 3-52 | Ramp 2 Ramp Down Time        | 5-33 | Term X30/7 Digi Out (MCB 101)     | 6-34 | Term. X30/11 Low Ref./Feedb. Value   |
| 0-61  | Access to Main Menu w/o Password     | 3-8* | Other Ramps                  | 5-4* | Relays                            | 6-35 | Term. X30/11 High Ref./Feedb. Value  |
| 0-65  | Personal Menu Password               | 3-80 | Jog Ramp Time                | 5-40 | Function Relay                    | 6-36 | Term. X30/11 Filter Time Constant    |
| 0-66  | Access to Personal Menu w/o Password | 3-81 | Quick Stop Ramp Up Time      | 5-41 | On Delay, Relay                   | 6-37 | Term. X30/11 Live Zero               |
| 0-7*  | Clock Settings                       | 3-82 | Starting Ramp Up Time        | 5-42 | Off Delay, Relay                  | 6-4* | Analog Input X30/12                  |
| 0-70  | Date and Time                        | 3-90 | Step Size                    | 5-5* | Pulse Input                       | 6-40 | Terminal X30/12 Low Voltage          |
| 0-71  | Date Format                          | 3-91 | Ramp Time                    | 5-50 | Term. 29 Low Frequency            | 6-41 | Terminal X30/12 High Voltage         |
| 0-72  | Time Format                          | 3-92 | Power Restore                | 5-51 | Term. 29 High Frequency           | 6-44 | Term. X30/12 Low Ref./Feedb. Value   |
| 0-74  | DST/Summertime                       | 3-93 | Maximum Limit                | 5-52 | Term. 29 Low Ref./Feedb. Value    | 6-45 | Term. X30/12 High Ref./Feedb. Value  |
| 0-76  | DST/Summertime Start                 | 3-94 | Minimum Limit                | 5-54 | Pulse Filter Time Constant #29    | 6-46 | Term. X30/12 Filter Time Constant    |
| 0-77  | DST/Summertime End                   | 3-95 | Ramp Delay                   | 5-55 | Term. 33 Low Frequency            | 6-47 | Term. X30/12 Live Zero               |
| 0-79  | Clock Fault                          | 4-1* | Motor Limits                 | 5-56 | Term. 33 High Frequency           | 6-5* | Analog Output 42                     |
| 0-81  | Working Days                         | 4-10 | Motor Speed Direction        | 5-57 | Term. 33 Low Ref./Feedb. Value    | 6-50 | Terminal 42 Output                   |
| 0-82  | Additional Working Days              | 4-11 | Motor Speed Low Limit [RPM]  | 5-58 | Term. 33 High Ref./Feedb. Value   | 6-51 | Terminal 42 Output Min Scale         |
| 0-83  | Additional Non-Working Days          | 4-12 | Motor Speed Low Limit [Hz]   | 5-59 | Pulse Filter Time Constant #33    | 6-52 | Terminal 42 Output Max Scale         |
| 0-89  | Date and Time Readout                | 4-13 | Motor Speed High Limit [RPM] | 5-6* | Pulse Output                      | 6-53 | Terminal 42 Output Bus Control       |
|       |                                      | 4-14 | Motor Speed High Limit [Hz]  | 5-60 | Terminal 27 Pulse Output Variable | 6-54 | Terminal 42 Output Timeout Preset    |
|       |                                      | 4-16 | Torque Limit Motor Mode      | 5-62 | Pulse Output Max Freq #27         | 6-55 | Analog Output Filter                 |
|       |                                      |      |                              | 5-63 | Terminal 29 Pulse Output Variable | 6-6* | Analog Output X30/8                  |
|       |                                      |      |                              |      |                                   | 6-60 | Terminal X30/8 Output                |

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

|       |                             |       |                                |        |                                |        |                               |       |                                   |
|-------|-----------------------------|-------|--------------------------------|--------|--------------------------------|--------|-------------------------------|-------|-----------------------------------|
| 15-74 | Option in Slot C0           | 16-66 | Digital Output [bin]           | 20-12  | Reference/Feedback Unit        | 21-21  | Ext. 1 Proportional Gain      | 22-4* | <b>Sleep Mode</b>                 |
| 15-75 | Slot C0 Option SW Version   | 16-67 | Pulse Input #29 [Hz]           | 20-13  | Minimum Reference/Feedb.       | 21-22  | Ext. 1 Integral Time          | 22-40 | Minimum Run Time                  |
| 15-76 | Option in Slot C1           | 16-68 | Pulse Input #33 [Hz]           | 20-14  | Maximum Reference/Feedb.       | 21-23  | Ext. 1 Differentiation Time   | 22-41 | Minimum Sleep Time                |
| 15-77 | Slot C1 Option SW Version   | 16-69 | Pulse Output #27 [Hz]          | 20-20* | <b>Feedback/Setpoint</b>       | 21-24  | Ext. 1 Dif. Gain Limit        | 22-42 | Wake-up Speed [RPM]               |
| 15-9* | <b>Parameter Info</b>       | 16-70 | Pulse Output #29 [Hz]          | 20-21  | Feedback Function              | 21-30* | <b>Ext. CL 2 Ref/Fb.</b>      | 22-43 | Wake-up Speed [Hz]                |
| 15-92 | Defined Parameters          | 16-71 | Relay Output [bin]             | 20-21  | Setpoint 1                     | 21-30  | Ext. 2 Ref./Feedback Unit     | 22-44 | Wake-up Ref./FB Difference        |
| 15-93 | Modified Parameters         | 16-72 | Counter A                      | 20-22  | Setpoint 2                     | 21-31  | Ext. 2 Minimum Reference      | 22-45 | Setpoint Boost                    |
| 15-98 | Drive Identification        | 16-73 | Counter B                      | 20-23  | Setpoint 3                     | 21-32  | Ext. 2 Maximum Reference      | 22-46 | Maximum Boost Time                |
| 15-99 | Parameter Metadata          | 16-75 | Analog In X30/11               | 20-3*  | <b>Feedb. Adv. Conv.</b>       | 21-33  | Ext. 2 Reference Source       | 22-5* | <b>End of Curve</b>               |
| 16-0* | <b>Data Readouts</b>        | 16-76 | Analog In X30/12               | 20-30  | Refrigerant                    | 21-34  | Ext. 2 Feedback Source        | 22-50 | End of Curve Function             |
| 16-0* | <b>General Status</b>       | 16-77 | Analog Out X30/8 [mA]          | 20-31  | User Defined Refrigerant A1    | 21-35  | Ext. 2 Setpoint               | 22-51 | End of Curve Delay                |
| 16-00 | Control Word                | 16-8* | <b>Fieldbus &amp; FC Port</b>  | 20-32  | User Defined Refrigerant A2    | 21-37  | Ext. 2 Reference [Unit]       | 22-6* | <b>Broken Belt Detection</b>      |
| 16-01 | Reference [Unit]            | 16-80 | Fieldbus CTW 1                 | 20-33  | User Defined Refrigerant A3    | 21-38  | Ext. 2 Feedback [Unit]        | 22-60 | Broken Belt Function              |
| 16-02 | Reference [%]               | 16-82 | Fieldbus REF 1                 | 20-34  | Duct 1 Area [m <sup>2</sup> ]  | 21-39  | Ext. 2 Output [%]             | 22-61 | Broken Belt Torque                |
| 16-03 | Status Word                 | 16-84 | Comm. Option STW               | 20-35  | Duct 1 Area [in <sup>2</sup> ] | 21-4*  | <b>Ext. CL 2 PID</b>          | 22-62 | Broken Belt Delay                 |
| 16-05 | Main Actual Value [%]       | 16-85 | FC Port CTW 1                  | 20-36  | Duct 2 Area [m <sup>2</sup> ]  | 21-40  | Ext. 2 Normal/Inverse Control | 22-7* | <b>Short Cycle Protection</b>     |
| 16-09 | Custom Readout              | 16-86 | FC Port REF 1                  | 20-37  | Duct 2 Area [in <sup>2</sup> ] | 21-41  | Ext. 2 Proportional Gain      | 22-75 | Short Cycle Protection            |
| 16-1* | <b>Motor Status</b>         | 16-9* | <b>Diagnosis Readouts</b>      | 20-38  | Air Density Factor [%]         | 21-42  | Ext. 2 Integral Time          | 22-76 | Interval between Starts           |
| 16-10 | Power [kW]                  | 16-90 | Alarm Word                     | 20-6*  | <b>Sensorless</b>              | 21-43  | Ext. 2 Differentiation Time   | 22-77 | Minimum Run Time                  |
| 16-11 | Power [hp]                  | 16-91 | Alarm Word 2                   | 20-60  | Sensorless Unit                | 21-44  | Ext. 2 Dif. Gain Limit        | 22-78 | Minimum Run Time Override         |
| 16-12 | Motor Voltage               | 16-92 | Warning Word                   | 20-69  | Sensorless Information         | 21-45  | Ext. 2 Dif. Gain Limit        | 22-79 | Minimum Run Time Override Value   |
| 16-13 | Frequency                   | 16-93 | Warning Word 2                 | 20-70* | <b>PID Autotuning</b>          | 21-50  | Ext. 3 Ref./Feedback Unit     | 22-8* | <b>Flow Compensation</b>          |
| 16-14 | Motor Current               | 16-94 | Ext. Status Word               | 20-70* | Closed Loop Type               | 21-51  | Ext. 3 Minimum Reference      | 22-80 | Flow Compensation                 |
| 16-15 | Frequency [%]               | 16-95 | Ext. Status Word 2             | 20-71  | PID Performance                | 21-52  | Ext. 3 Maximum Reference      | 22-81 | Square-linear Curve Approximation |
| 16-16 | Torque [Nm]                 | 16-96 | Maintenance Word               | 20-72  | PID Output Change              | 21-53  | Ext. 3 Reference Source       | 22-82 | Work Point Calculation            |
| 16-17 | Speed [RPM]                 | 18-*  | <b>Info &amp; Readouts</b>     | 20-73  | Minimum Feedback Level         | 21-54  | Ext. 3 Feedback Source        | 22-83 | Speed at No-Flow [RPM]            |
| 16-18 | Motor Thermal               | 18-0* | <b>Maintenance Log</b>         | 20-74  | Maximum Feedback Level         | 21-55  | Ext. 3 Setpoint               | 22-84 | Speed at No-Flow [Hz]             |
| 16-22 | Torque [%]                  | 18-00 | Maintenance Log: Item          | 20-79  | PID Autotuning                 | 21-57  | Ext. 3 Reference [Unit]       | 22-85 | Speed at Design Point [RPM]       |
| 16-26 | Power Filtered [kW]         | 18-01 | Maintenance Log: Action        | 20-8*  | <b>PID Basic Settings</b>      | 21-58  | Ext. 3 Feedback [Unit]        | 22-86 | Speed at Design Point [Hz]        |
| 16-27 | Power Filtered [hp]         | 18-02 | Maintenance Log: Date and Time | 20-81  | PID Normal/ Inverse Control    | 21-59  | Ext. 3 Output [%]             | 22-87 | Pressure at Rated Speed           |
| 16-3* | <b>Drive Status</b>         | 18-1* | <b>Fire Mode Log</b>           | 20-82  | PID Start Speed [RPM]          | 21-60  | Ext. 3 Normal/Inverse Control | 22-88 | Pressure at Design Point          |
| 16-30 | DC Link Voltage             | 18-10 | Fire Mode Log: Event           | 20-83  | PID Start Speed [Hz]           | 21-61  | Ext. 3 Proportional Gain      | 22-89 | Flow at Design Point              |
| 16-32 | Brake Energy /s             | 18-11 | Fire Mode Log: Time            | 20-84  | PID Start Speed [Hz]           | 21-62  | Ext. 3 Integral Time          | 22-90 | Flow at Rated Speed               |
| 16-33 | Brake Energy /2 min         | 18-12 | Fire Mode Log: Date and Time   | 20-9*  | <b>PID Controller</b>          | 21-63  | Ext. 3 Differentiation Time   | 23-*  | <b>Time-based Functions</b>       |
| 16-34 | Heatsink Temp.              | 18-3* | <b>Inputs &amp; Outputs</b>    | 20-91  | PID Anti Windup                | 21-64  | Ext. 3 Dif. Gain Limit        | 23-0* | ON Time                           |
| 16-35 | Inverter Thermal            | 18-30 | Analog Input X42/1             | 20-93  | PID Proportional Gain          | 22-0*  | <b>Apppl. Functions</b>       | 23-01 | ON Action                         |
| 16-36 | Inv. Max. Current           | 18-31 | Analog Input X42/3             | 20-94  | PID Integral Time              | 22-0*  | <b>Miscellaneous</b>          | 23-02 | OFF Time                          |
| 16-37 | Inv. Max. Current           | 18-32 | Analog Input X42/5             | 20-95  | PID Differentiation Time       | 22-00  | External Interlock Delay      | 23-03 | OFF Action                        |
| 16-39 | Control Card Temp.          | 18-33 | Analog Out X42/7 [V]           | 20-96  | PID Diff. Gain Limit           | 22-01  | Power Filter Time             | 23-04 | Occurrence                        |
| 16-40 | Logging Buffer Full         | 18-34 | Analog Out X42/9 [V]           | 21-0*  | <b>Ext. CL Autotuning</b>      | 22-2*  | <b>No-Flow Detection</b>      | 23-0* | <b>Timed Actions Settings</b>     |
| 16-41 | Logging Buffer Full         | 18-35 | Analog Out X42/11 [V]          | 21-00  | Closed Loop Type               | 22-20  | Low Power Auto Set-up         | 23-08 | Timed Actions Mode                |
| 16-43 | Timed Actions Status        | 18-36 | Analog Input X48/2 [mA]        | 21-01  | PID Performance                | 22-21  | Low Power Detection           | 23-09 | Timed Actions Reactivation        |
| 16-49 | Current Fault Source        | 18-37 | Temp. Input X48/4              | 21-02  | PID Output Change              | 22-22  | Low Speed Detection           | 23-1* | <b>Maintenance</b>                |
| 16-5* | <b>Ref. &amp; Feedb.</b>    | 18-38 | Temp. Input X48/7              | 21-03  | Minimum Feedback Level         | 22-23  | No-Flow Function              | 23-10 | Maintenance Item                  |
| 16-50 | External Reference          | 18-39 | Temp. Input X48/10             | 21-04  | Maximum Feedback Level         | 22-24  | No-Flow Delay                 | 23-11 | Maintenance Action                |
| 16-52 | Feedback [Unit]             | 18-50 | Sensorless Readout [unit]      | 21-09  | PID Autotuning                 | 22-26  | Dry Pump Function             | 23-12 | Maintenance Time Base             |
| 16-53 | Digi Pot Reference          | 20-*  | <b>Drive Closed Loop</b>       | 21-1*  | <b>Ext. CL 1 Ref/Fb.</b>       | 22-27  | Dry Pump Delay                | 23-13 | Maintenance Time Interval         |
| 16-54 | Feedback 1 [Unit]           | 20-0* | <b>Feedback</b>                | 21-10  | Ext. 1 Ref./Feedback Unit      | 22-3*  | <b>No-Flow Power Tuning</b>   | 23-14 | Maintenance Date and Time         |
| 16-55 | Feedback 2 [Unit]           | 20-00 | Feedback 1 Source              | 21-11  | Ext. 1 Minimum Reference       | 22-30  | No-Flow Power                 | 23-15 | <b>Maintenance Reset</b>          |
| 16-56 | Feedback 3 [Unit]           | 20-01 | Feedback 1 Conversion          | 21-12  | Ext. 1 Maximum Reference       | 22-31  | Power Correction Factor       | 23-15 | Reset Maintenance Word            |
| 16-58 | PID Output [%]              | 20-02 | Feedback 2 Source Unit         | 21-13  | Ext. 1 Reference Source        | 22-32  | Low Speed [RPM]               | 23-16 | Maintenance Text                  |
| 16-6* | <b>Inputs &amp; Outputs</b> | 20-03 | Feedback 2 Source              | 21-14  | Ext. 1 Feedback Source         | 22-33  | Low Speed [Hz]                | 23-5* | <b>Energy Log</b>                 |
| 16-60 | Digital Input               | 20-04 | Feedback 2 Conversion          | 21-15  | Ext. 1 Setpoint                | 22-34  | Low Speed Power [kW]          | 23-50 | Energy Log Resolution             |
| 16-61 | Terminal 53 Switch Setting  | 20-05 | Feedback 2 Source Unit         | 21-17  | Ext. 1 Reference [Unit]        | 22-35  | Low Speed Power [HP]          | 23-51 | Period Start                      |
| 16-62 | Analog Input 53             | 20-06 | Feedback 3 Source              | 21-18  | Ext. 1 Feedback [Unit]         | 22-36  | High Speed [RPM]              | 23-53 | Energy Log                        |
| 16-63 | Terminal 54 Switch Setting  | 20-07 | Feedback 3 Conversion          | 21-19  | Ext. 1 Output [%]              | 22-37  | High Speed [Hz]               | 23-54 | Reset Energy Log                  |
| 16-64 | Analog Input 54             | 20-08 | Feedback 3 Source Unit         | 21-2*  | <b>Ext. CL 1 PID</b>           | 22-38  | High Speed Power [kW]         | 23-6* | <b>Trending</b>                   |
| 16-65 | Analog Output 42 [mA]       |       |                                | 21-20  | Ext. 1 Normal/Inverse Control  | 22-39  | High Speed Power [HP]         | 23-60 | Trend Variable                    |

|                                 |                             |                                   |                                    |                                 |                                    |       |                                   |
|---------------------------------|-----------------------------|-----------------------------------|------------------------------------|---------------------------------|------------------------------------|-------|-----------------------------------|
| 23-61                           | Continuous Bin Data         | 25-41                             | Ramp Up Delay                      | 26-44                           | Terminal X42/7 Timeout Preset      | 99-06 | DAC 3 scale                       |
| 23-62                           | Timed Bin Data              | 25-42                             | Staging Threshold                  | <b>26-5* Analog Out X42/9</b>   | <b>26-5* Analog Out X42/9</b>      | 99-07 | DAC 4 scale                       |
| 23-63                           | Timed Period Start          | 25-43                             | Destaging Threshold                | 26-50                           | Terminal X42/9 Output              | 99-08 | Test param 1                      |
| 23-64                           | Timed Period Stop           | 25-44                             | Staging Speed [RPM]                | 26-51                           | Terminal X42/9 Min. Scale          | 99-09 | Test param 2                      |
| 23-65                           | Minimum Bin Value           | 25-45                             | Staging Speed [Hz]                 | 26-52                           | Terminal X42/9 Max. Scale          | 99-10 | DAC Option Slot                   |
| 23-66                           | Reset Continuous Bin Data   | 25-46                             | Destaging Speed [RPM]              | 26-53                           | Terminal X42/9 Bus Control         | 99-11 | RFI 2                             |
| 23-67                           | Reset Timed Bin Data        | 25-47                             | Destaging Speed [Hz]               | 26-54                           | Terminal X42/9 Timeout Preset      | 99-12 | Fan                               |
| <b>23-8* Payback Counter</b>    |                             | <b>25-5* Alternation Settings</b> |                                    | <b>26-6* Analog Out X42/11</b>  |                                    | 99-13 | Idle time                         |
| 23-80                           | Power Reference Factor      | 25-50                             | Lead Pump Alternation              | 26-60                           | Terminal X42/11 Output             | 99-14 | Paramdb requests in queue         |
| 23-81                           | Energy Cost                 | 25-51                             | Alternation Event                  | 26-61                           | Terminal X42/11 Min. Scale         | 99-15 | Secondary Timer at Inverter Fault |
| 23-82                           | Investment                  | 25-52                             | Alternation Time Interval          | 26-62                           | Terminal X42/11 Max. Scale         | 99-16 | No of Current Sensors             |
| 23-83                           | Energy Savings              | 25-53                             | Alternation Timer Value            | 26-63                           | Terminal X42/11 Bus Control        | 99-20 | HS Temp. (PC1)                    |
| 23-84                           | Cost Savings                | 25-54                             | Alternation Predefined Time        | 26-64                           | Terminal X42/11 Timeout Preset     | 99-21 | HS Temp. (PC2)                    |
| <b>24** Appl. Functions 2</b>   |                             | 25-55                             | Alternate if Load < 50%            | <b>31** Bypass Option</b>       |                                    | 99-22 | HS Temp. (PC3)                    |
| <b>24-0* Fire Mode</b>          |                             | 25-56                             | Staging Mode at Alternation        | 31-00                           | Bypass Mode                        | 99-23 | HS Temp. (PC4)                    |
| 24-00                           | Fire Mode Function          | 25-58                             | Run Next Pump Delay                | 31-01                           | Bypass Start Time Delay            | 99-24 | HS Temp. (PC5)                    |
| 24-01                           | Fire Mode Configuration     | 25-59                             | Run on Mains Delay                 | 31-02                           | Bypass Trip Time Delay             | 99-25 | HS Temp. (PC6)                    |
| 24-02                           | Fire Mode Unit              | <b>25-8* Status</b>               |                                    | 31-03                           | Test Mode Activation               | 99-26 | HS Temp. (PC7)                    |
| 24-03                           | Fire Mode Min Reference     | 25-80                             | Cascade Status                     | 31-10                           | Bypass Status Word                 | 99-27 | HS Temp. (PC8)                    |
| 24-04                           | Fire Mode Max Reference     | 25-81                             | Pump Status                        | 31-11                           | Bypass Running Hours               | 99-29 | Platform Version                  |
| 24-05                           | Fire Mode Preset Reference  | 25-82                             | Lead Pump                          | 31-19                           | Remote Bypass Activation           | 99-40 | StartupWizardState                |
| 24-06                           | Fire Mode Reference Source  | 25-83                             | Relay Status                       | <b>35** Sensor Input Option</b> |                                    | 99-90 | Options present                   |
| 24-07                           | Fire Mode Feedback Source   | 25-84                             | Pump ON Time                       | <b>35-0* Temp. Input Mode</b>   |                                    | 99-91 | Motor Power Internal              |
| 24-09                           | Fire Mode Alarm Handling    | 25-85                             | Relay ON Time                      | 35-00                           | Term. X48/4 Temp. Unit             | 99-92 | Motor Voltage Internal            |
| <b>24-1* Drive Bypass</b>       |                             | <b>25-9* Service</b>              |                                    | 35-01                           | Term. X48/4 Input Type             | 99-93 | Motor Frequency Internal          |
| 24-10                           | Drive Bypass Function       | 25-90                             | Pump Interlock                     | 35-02                           | Term. X48/7 Temp. Unit             | 99-94 | Imbalance derate [%]              |
| 24-11                           | Drive Bypass Delay Time     | 25-91                             | Manual Alternation                 | 35-03                           | Term. X48/7 Input Type             | 99-95 | Temperature derate [%]            |
| <b>24-9* Multi-Motor Funct.</b> |                             | 25-91                             | Manual Alternation                 | 35-04                           | Term. X48/10 Temp. Unit            | 99-96 | Overload derate [%]               |
| 24-90                           | Missing Motor Function      | <b>25-6* Analog I/O Option</b>    |                                    | 35-05                           | Term. X48/10 Input Type            |       |                                   |
| 24-91                           | Missing Motor Coefficient 1 | <b>26-0* Analog I/O Mode</b>      |                                    | 35-06                           | Temperature Sensor Alarm Function  |       |                                   |
| 24-92                           | Missing Motor Coefficient 2 | 26-00                             | Terminal X42/1 Mode                | <b>35-1* Temp. Input X48/4</b>  |                                    |       |                                   |
| 24-93                           | Missing Motor Coefficient 3 | 26-01                             | Terminal X42/3 Mode                | 35-14                           | Term. X48/4 Filter Time Constant   |       |                                   |
| 24-94                           | Missing Motor Coefficient 4 | 26-02                             | Terminal X42/5 Mode                | 35-15                           | Term. X48/4 Temp. Monitor          |       |                                   |
| 24-95                           | Locked Rotor Function       | <b>26-1* Analog Input X42/1</b>   |                                    | 35-16                           | Term. X48/4 Low Temp. Limit        |       |                                   |
| 24-96                           | Locked Rotor Coefficient 1  | 26-10                             | Terminal X42/1 Low Voltage         | 35-17                           | Term. X48/4 High Temp. Limit       |       |                                   |
| 24-97                           | Locked Rotor Coefficient 2  | 26-11                             | Terminal X42/1 High Voltage        | <b>35-2* Temp. Input X48/7</b>  |                                    |       |                                   |
| 24-98                           | Locked Rotor Coefficient 3  | 26-14                             | Term. X42/1 Low Ref./Feedb. Value  | 35-24                           | Term. X48/7 Filter Time Constant   |       |                                   |
| 24-99                           | Locked Rotor Coefficient 4  | 26-15                             | Term. X42/1 High Ref./Feedb. Value | 35-25                           | Term. X48/7 Temp. Monitor          |       |                                   |
| <b>25** Cascade Controller</b>  |                             | 26-16                             | Term. X42/1 Filter Time Constant   | 35-26                           | Term. X48/7 Low Temp. Limit        |       |                                   |
| <b>25-0* System Settings</b>    |                             | 26-17                             | Term. X42/1 Live Zero              | 35-27                           | Term. X48/7 High Temp. Limit       |       |                                   |
| 25-00                           | Cascade Controller          | <b>26-2* Analog Input X42/3</b>   |                                    | <b>35-3* Temp. Input X48/10</b> |                                    |       |                                   |
| 25-02                           | Motor Start                 | 26-20                             | Terminal X42/3 Low Voltage         | 35-34                           | Term. X48/10 Filter Time Constant  |       |                                   |
| 25-04                           | Pump Cycling                | 26-21                             | Terminal X42/3 High Voltage        | 35-35                           | Term. X48/10 Temp. Monitor         |       |                                   |
| 25-05                           | Fixed Lead Pump             | 26-24                             | Term. X42/3 Low Ref./Feedb. Value  | 35-36                           | Term. X48/10 Low Temp. Limit       |       |                                   |
| 25-06                           | Number of Pumps             | 26-25                             | Term. X42/3 High Ref./Feedb. Value | 35-37                           | Term. X48/10 High Temp. Limit      |       |                                   |
| <b>25-2* Bandwidth Settings</b> |                             | 26-26                             | Term. X42/3 Filter Time Constant   | <b>35-4* Analog Input X48/2</b> |                                    |       |                                   |
| 25-20                           | Staging Bandwidth           | 26-27                             | Term. X42/3 Live Zero              | 35-42                           | Term. X48/2 Low Current            |       |                                   |
| 25-21                           | Override Bandwidth          | <b>26-3* Analog Input X42/5</b>   |                                    | 35-43                           | Term. X48/2 High Current           |       |                                   |
| 25-22                           | Fixed Speed Bandwidth       | 26-30                             | Terminal X42/5 Low Voltage         | 35-44                           | Term. X48/2 Low Ref./Feedb. Value  |       |                                   |
| 25-23                           | SBW Staging Delay           | 26-31                             | Terminal X42/5 High Voltage        | 35-45                           | Term. X48/2 High Ref./Feedb. Value |       |                                   |
| 25-24                           | SBW Destaging Delay         | 26-34                             | Term. X42/5 Low Ref./Feedb. Value  | 35-46                           | Term. X48/2 Filter Time Constant   |       |                                   |
| 25-25                           | OBW Time                    | 26-35                             | Term. X42/5 High Ref./Feedb. Value | 35-47                           | Term. X48/2 Live Zero              |       |                                   |
| 25-26                           | Destage At No-Flow          | 26-36                             | Term. X42/5 Filter Time Constant   | <b>99** Devol support</b>       |                                    |       |                                   |
| 25-27                           | Stage Function              | 26-37                             | Term. X42/5 Live Zero              | 99-00                           | DAC 1 selection                    |       |                                   |
| 25-28                           | Stage Function Time         | <b>26-4* Analog Out X42/7</b>     |                                    | 99-01                           | DAC 2 selection                    |       |                                   |
| 25-29                           | Destage Function            | 26-40                             | Terminal X42/7 Output              | 99-02                           | DAC 3 selection                    |       |                                   |
| 25-30                           | Destage Function Time       | 26-41                             | Terminal X42/7 Min. Scale          | 99-03                           | DAC 4 selection                    |       |                                   |
| <b>25-4* Staging Settings</b>   |                             | 26-42                             | Terminal X42/7 Max. Scale          | 99-04                           | DAC 1 scale                        |       |                                   |
| 25-40                           | Ramp Down Delay             | 26-43                             | Terminal X42/7 Bus Control         | 99-05                           | DAC 2 scale                        |       |                                   |

## 5.6 Remote Programming with MCT 10 Set-up Software

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

**5**

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

MCT 10 Set-up Software is available for free download at [www.VLT-software.com](http://www.VLT-software.com). A CD is also available by requesting part number 130B1000. A user's manual provides detailed operation instructions.

## 6 Application Set-Up Examples

### 6.1 Introduction

#### NOTE

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

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

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

### 6.2 Application Examples

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

Table 6.1 AMA with T27 Connected

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

Table 6.2 AMA without T27 Connected

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

Table 6.3 Analog Speed Reference (Voltage)



|                         |    | Parameters             |         |
|-------------------------|----|------------------------|---------|
| FC                      |    | Function               | Setting |
| +24 V                   | 12 |                        |         |
| +24 V                   | 13 |                        |         |
| D IN                    | 18 | 6-12 Terminal 53       | 4mA*    |
| D IN                    | 19 | 6-13 Terminal 53       | 20mA*   |
| COM                     | 20 | 6-14 Terminal 53       | ORPM    |
| D IN                    | 27 | 6-15 Terminal 53       | 1500RPM |
| D IN                    | 29 |                        |         |
| D IN                    | 32 |                        |         |
| D IN                    | 33 |                        |         |
| D IN                    | 37 |                        |         |
| +10 V                   | 50 |                        |         |
| A IN                    | 53 |                        |         |
| A IN                    | 54 |                        |         |
| COM                     | 55 |                        |         |
| A OUT                   | 42 |                        |         |
| COM                     | 39 |                        |         |
|                         |    |                        |         |
| <p>U - I</p> <p>A53</p> |    |                        |         |
|                         |    | * = Default Value      |         |
|                         |    | <b>Notes/comments:</b> |         |

Table 6.4 Analog Speed Reference (Current)

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

Table 6.5 Start/Stop Command with Safe Stop

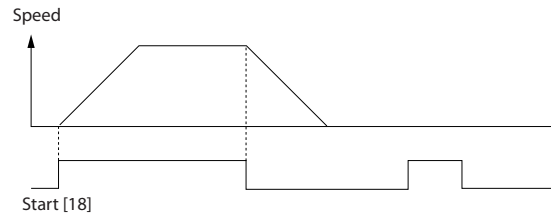


Illustration 6.1

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

Table 6.6 Pulse Start/Stop

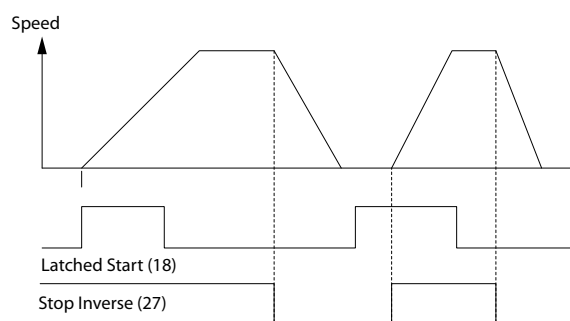


Illustration 6.2

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

Table 6.7 Start/Stop with Reversing and 4 Preset Speeds

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

Table 6.8 External Alarm Reset

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

Table 6.9 Speed Reference (using a manual potentiometer)

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

Table 6.10 Speed Up/Down

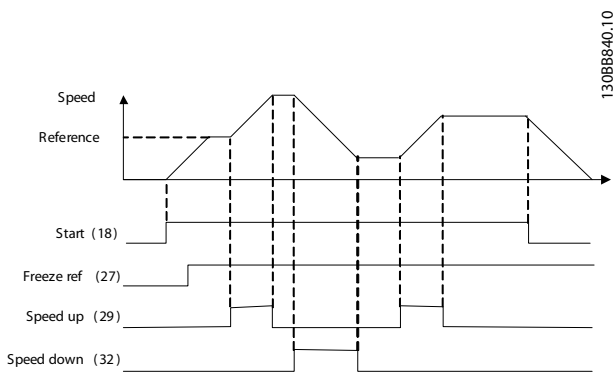


Illustration 6.3

6

|   |    | Parameters        |         |
|---|----|-------------------|---------|
| FC  |    | Function          | Setting |
| +24 V   | 12 |                   |         |
| +24 V   | 13 |                   |         |
| D IN  | 18 | 8-30 Protocol     | FC*     |
| D IN  | 19 | 8-31 Address      | 1*      |
| D IN  | 27 | 8-32 Baud Rate    | 9600*   |
| COM 20  |    | * = Default Value |         |
| <b>Notes/comments:</b>  |    |                   |         |
| Select protocol, address and baud rate in the above mentioned parameters. |    |                   |         |
| D IN  | 29 |                   |         |
| D IN  | 32 |                   |         |
| D IN  | 33 |                   |         |
| D IN  | 37 |                   |         |
| +10 V   | 50 |                   |         |
| A IN  | 53 |                   |         |
| A IN  | 54 |                   |         |
| COM   | 55 |                   |         |
| A OUT   | 42 |                   |         |
| COM   | 39 |                   |         |
| R1  | 01 |                   |         |
|   | 02 |                   |         |
|   | 03 |                   |         |
| R2  | 04 |                   |         |
|   | 05 |                   |         |
|   | 06 |                   |         |
|   | 61 |                   |         |
|   | 68 |                   |         |
|   | 69 |                   |         |

130BB85.10

RS-485

Table 6.11 RS-485 Network Connection

## CAUTION

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

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

130BB86.11

Table 6.12 Motor Thermistor

|       |    | Parameters  |                            |
|-------|----|---|----------------------------|
|       |    | Function  | Setting                    |
| FC    |    |   |                            |
| +24 V | 12 | 4-30 Motor Feedback Loss Function   | [1] Warning                |
| +24 V | 13 | 4-31 Motor Feedback Speed Error   | 100RPM                     |
| D IN  | 18 | 4-32 Motor Feedback Loss Timeout  | 5 sec                      |
| D IN  | 19 | 7-00 Speed PID Feedback Source  | [2] MCB 102                |
| COM   | 20 | 17-11 Resolution (PPR)  | 1024*                      |
| D IN  | 27 | 13-00 SL Controller Mode  | [1] On                     |
| D IN  | 29 | 13-01 Start Event   | [19] Warning               |
| D IN  | 32 | 13-02 Stop Event  | [44] Reset key             |
| D IN  | 33 | 13-10 Comparator Operand  | [21] Warning no.           |
| D IN  | 37 | 13-11 Comparator Operator   | [1] ≈*                     |
| +10 V | 50 | 13-12 Comparator Value  | 90                         |
| A IN  | 53 | 13-51 SL Controller Event   | [22] Comparator 0          |
| A IN  | 54 | 13-52 SL Controller Action  | [32] Set digital out A low |
| COM   | 55 | 5-40 Function Relay   | [80] SL digital output A   |
| A OUT | 42 |   |                            |
| COM   | 39 |   |                            |
| R1    |    |   |                            |
|       | 01 |   |                            |
|       | 02 |   |                            |
|       | 03 |   |                            |
| R2    |    |   |                            |
|       | 04 |   |                            |
|       | 05 |   |                            |
|       | 06 |   |                            |
|       |    | * = Default Value   |                            |
|       |    | <b>Notes/comments:</b><br>If the limit in the feedback monitor is exceeded, Warning 90 will be issued. The SLC monitors Warning 90 and in the case that Warning 90 becomes TRUE then Relay 1 is triggered. External equipment may then indicate that service may be required. If the feedback error goes below the limit again within 5 sec. then the drive continues and the warning disappears. But Relay 1 will still be triggered until [Reset] on the LCP. |                            |

Table 6.13 Using SLC to Set a Relay

|       |    | Parameters                      |   |
|-------|----|---------------------------------|---|
|       |    | Function                        | Setting                                 |
| FC    |    |                                 |   |
| +24 V | 12 | 5-40 Function Relay             | [32] Mech. brake ctrl.                  |
| +24 V | 13 | 5-10 Terminal 18 Digital Input  | [8] Start*                              |
| D IN  | 18 | 5-11 Terminal 19 Digital Input  | [11] Start reversing                    |
| D IN  | 19 | 1-71 Start Delay                | 0.2                                     |
| COM   | 20 | 1-72 Start Function             | [5] VVC <sup>plus</sup> /FLUX Clockwise |
| D IN  | 27 | 1-76 Start Current              | Im,n                                    |
| D IN  | 29 | 2-20 Release Brake Current      | App. dependent                          |
| D IN  | 32 | 2-21 Activate Brake Speed [RPM] | Half of nominal slip of the motor       |
| D IN  | 33 |                                 |   |
| D IN  | 37 |                                 |   |
| +10 V | 50 |                                 |   |
| A IN  | 53 |                                 |   |
| A IN  | 54 |                                 |   |
| COM   | 55 |                                 |   |
| A OUT | 42 |                                 |   |
| COM   | 39 |                                 |   |
| R1    |    |                                 |   |
|       | 01 |                                 |   |
|       | 02 |                                 |   |
|       | 03 |                                 |   |
| R2    |    |                                 |   |
|       | 04 |                                 |   |
|       | 05 |                                 |   |
|       | 06 |                                 |   |
|       |    | * = Default Value               |   |
|       |    | <b>Notes/comments:</b>          |   |

Table 6.14 Mechanical Brake Control

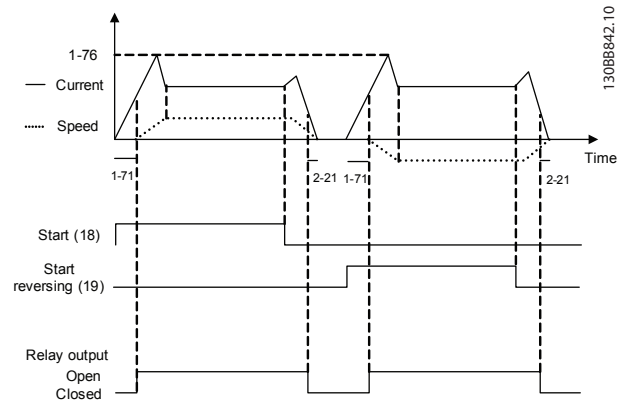


Illustration 6.4

## 7 Status Messages

### 7.1 Status Display

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

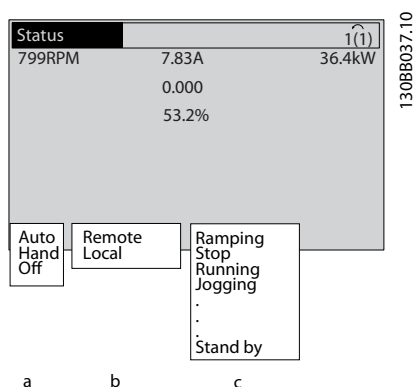


Illustration 7.1 Status Display

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

### NOTE

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

### 7.2 Status Message Definitions Table

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

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

Table 7.1

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

Table 7.2

|               | Operation Status   |
|---------------|--|
| AC Brake      | AC Brake was selected in 2-10 Brake Function. The AC brake over-magnetizes the motor to achieve a controlled slow down.  |
| AMA finish OK | Automatic motor adaptation (AMA) was carried out successfully.   |
| AMA ready     | AMA is ready to start. Press [Hand On] to start.   |
| AMA running   | AMA process is in progress.  |
| Braking       | The brake chopper is in operation. Generative energy is absorbed by the brake resistor.  |
| Braking max.  | The brake chopper is in operation. The power limit for the brake resistor defined in 2-12 Brake Power Limit (kW) has been reached.   |
| Coast         | <ul style="list-style-type: none"> <li>Coast inverse was selected as a function for a digital input (parameter group 5-1*). The corresponding terminal is not connected.</li> <li>Coast activated by serial communication</li> </ul> |

|                       | <b>Operation Status</b>  |
|-----------------------|--|
| Ctrl. Ramp-down       | Control Ramp-down was selected in <i>14-10 Mains Failure</i> . <ul style="list-style-type: none"> <li>The mains voltage is below the value set in <i>14-11 Mains Voltage at Mains Fault at mains fault</i></li> <li>The frequency converter ramps down the motor using a controlled ramp down</li> </ul>   |
| Current High          | The frequency converter output current is above the limit set in <i>4-51 Warning Current High</i> .  |
| Current Low           | The frequency converter output current is below the limit set in <i>4-52 Warning Speed Low</i>   |
| DC Hold               | DC hold is selected in <i>1-80 Function at Stop</i> and a stop command is active. The motor is held by a DC current set in <i>2-00 DC Hold/ Preheat Current</i> .  |
| DC Stop               | The motor is held with a DC current ( <i>2-01 DC Brake Current</i> ) for a specified time ( <i>2-02 DC Braking Time</i> ). <ul style="list-style-type: none"> <li>DC Brake is activated in <i>2-03 DC Brake Cut In Speed [RPM]</i> and a Stop command is active.</li> <li>DC Brake (inverse) is selected as a function for a digital input (parameter group 5-1*). The corresponding terminal is not active.</li> <li>The DC Brake is activated via serial communication.</li> </ul> |
| Feedback high         | The sum of all active feedbacks is above the feedback limit set in <i>4-57 Warning Feedback High</i> .   |
| Feedback low          | The sum of all active feedbacks is below the feedback limit set in <i>4-56 Warning Feedback Low</i> .  |
| Freeze output         | The remote reference is active, which holds the present speed. <ul style="list-style-type: none"> <li>Freeze output was selected as a function for a digital input (Group 5-1*). The corresponding terminal is active. Speed control is only possible via the terminal functions Speed Up and Speed Down.</li> <li>Hold ramp is activated via serial communication.</li> </ul>   |
| Freeze output request | A freeze output command has been given, but the motor will remain stopped until a run permissive signal is received.   |
| Freeze ref.           | <i>Freeze Reference</i> was chosen as a function for a digital input (parameter group 5-1*). The corresponding terminal is active. The frequency converter saves the actual reference. Changing the reference is now only possible via terminal functions Speed Up and Speed Down.   |

|               | <b>Operation Status</b>   |
|---------------|---|
| Jog request   | A jog command has been given, but the motor will be stopped until a run permissive signal is received via a digital input.  |
| Jogging       | The motor is running as programmed in <i>3-19 Jog Speed [RPM]</i> . <ul style="list-style-type: none"> <li><i>Jog</i> was selected as function for a digital input (parameter group 5-1*). The corresponding terminal (e.g. Terminal 29) is active.</li> <li>The Jog function is activated via the serial communication.</li> <li>The Jog function was selected as a reaction for a monitoring function (e.g. No signal). The monitoring function is active.</li> </ul> |
| Motor check   | In <i>1-80 Function at Stop, Motor Check</i> was selected. A stop command is active. To ensure that a motor is connected to the frequency converter, a permanent test current is applied to the motor.  |
| OVC control   | <i>Overvoltage</i> control was activated in <i>2-17 Overvoltage Control</i> . The connected motor is supplying the frequency converter with generative energy. The overvoltage control adjusts the V/Hz ratio to run the motor in controlled mode and to prevent the frequency converter from tripping.   |
| PowerUnit Off | (For frequency converters with an external 24 V power supply installed only.) Mains supply to the frequency converter is removed, but the control card is supplied by the external 24 V.  |
| Protection md | Protection mode is active. The unit has detected a critical status (an overcurrent or overvoltage). <ul style="list-style-type: none"> <li>To avoid tripping, switching frequency is reduced to 4 kHz.</li> <li>If possible, protection mode ends after approximately 10 sec.</li> <li>Protection mode can be restricted in <i>14-26 Trip Delay at Inverter Fault</i></li> </ul>  |
| QStop         | The motor is decelerating using <i>3-81 Quick Stop Ramp Time</i> . <ul style="list-style-type: none"> <li><i>Quick stop inverse</i> was chosen as a function for a digital input (parameter group 5-1*). The corresponding terminal is not active.</li> <li>The quick stop function was activated via serial communication.</li> </ul>  |
| Ramping       | The motor is accelerating/decelerating using the active Ramp Up/Down. The reference, a limit value or a standstill is not yet reached.  |
| Ref. high     | The sum of all active references is above the reference limit set in <i>4-55 Warning Reference High</i> .   |

|               | <b>Operation Status</b>   |
|---------------|---|
| Ref. low      | The sum of all active references is below the reference limit set in <i>4-54 Warning Reference Low</i> .  |
| Run on ref.   | The frequency converter is running in the reference range. The feedback value matches the setpoint value.   |
| Run request   | A start command has been given, but the motor is stopped until a run permissive signal is received via digital input.   |
| Running       | The motor is driven by the frequency converter.   |
| Sleep Mode    | The energy saving function is enabled. This means that at present the motor has stopped, but that it will restart automatically when required.  |
| Speed high    | Motor speed is above the value set in <i>4-53 Warning Speed High</i> .  |
| Speed low     | Motor speed is below the value set in <i>4-52 Warning Speed Low</i> .   |
| Standby       | In Auto On mode, the frequency converter will start the motor with a start signal from a digital input or serial communication.   |
| Start delay   | In <i>1-71 Start Delay</i> , a delay starting time was set. A start command is activated and the motor will start after the start delay time expires.   |
| Start fwd/rev | Start forward and start reverse were selected as functions for two different digital inputs (parameter group 5-1*). The motor will start in forward or reverse depending on which corresponding terminal is activated.  |
| Stop          | The frequency converter has received a stop command from the LCP, digital input or serial communication.  |
| Trip          | An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, the frequency converter can be reset manually by pressing [Reset] or remotely by control terminals or serial communication.   |
| Trip lock     | An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, power must be cycled to the frequency converter. The frequency converter can then be reset manually by pressing [Reset] or remotely by control terminals or serial communication. |

**Table 7.3**

## 8 Warnings and Alarms

### 8.1 System Monitoring

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

### 8.2 Warning and Alarm Types

#### Warnings

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

#### Alarms

##### Trip

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

A trip can be reset in any of 4 ways:

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

##### Trip-lock

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

### 8.3 Warning and Alarm Displays

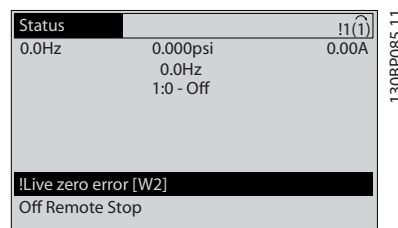


Illustration 8.1

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

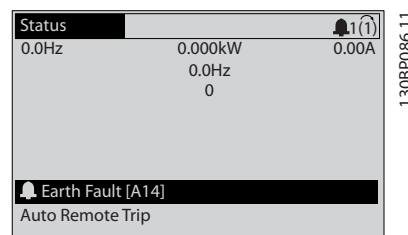


Illustration 8.2

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

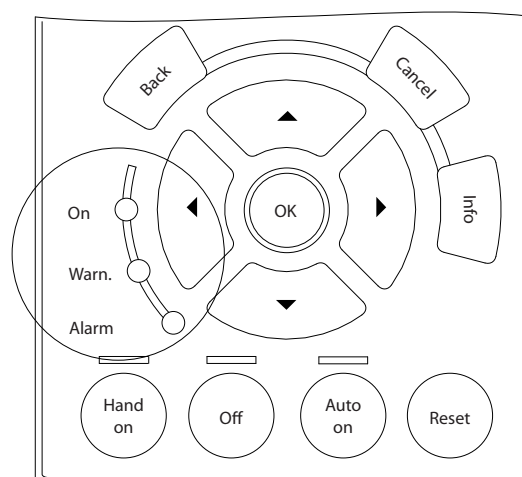


Illustration 8.3



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

**Table 8.1**

## 8.4 Warning and Alarm Definitions

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

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

| No. | Description                                     | Warning | Alarm/Trip      | Alarm/Trip Lock | Parameter Reference                |
|-----|---|---------|-----------------|-----------------|------------------------------------|
| 42  | Overload of Digital Output On X30/6             | (X)     |                 |                 | 5-32 Term X30/6 Digi Out (MCB 101) |
| 42  | Overload of Digital Output On X30/7             | (X)     |                 |                 | 5-33 Term X30/7 Digi Out (MCB 101) |
| 46  | Pwr. card supply                                |         | X               | X               |                                    |
| 47  | 24V supply low                                  | X       | X               | X               |                                    |
| 48  | 1.8V supply low                                 |         | X               | X               |                                    |
| 49  | Speed limit                                     | X       | (X)             |                 | 1-86 Trip Speed Low [RPM]          |
| 50  | AMA calibration failed                          |         | X               |                 |                                    |
| 51  | AMA check U <sub>nom</sub> and I <sub>nom</sub> |         | X               |                 |                                    |
| 52  | AMA low I <sub>nom</sub>                        |         | X               |                 |                                    |
| 53  | AMA motor too big                               |         | X               |                 |                                    |
| 54  | AMA motor too small                             |         | X               |                 |                                    |
| 55  | AMA Parameter out of range                      |         | X               |                 |                                    |
| 56  | AMA interrupted by user                         |         | X               |                 |                                    |
| 57  | AMA timeout                                     |         | X               |                 |                                    |
| 58  | AMA internal fault                              | X       | X               |                 |                                    |
| 59  | Current limit                                   | X       |                 |                 |                                    |
| 60  | External Interlock                              | X       |                 |                 |                                    |
| 62  | Output Frequency at Maximum Limit               | X       |                 |                 |                                    |
| 64  | Voltage Limit                                   | X       |                 |                 |                                    |
| 65  | Control Board Over-temperature                  | X       | X               | X               |                                    |
| 66  | Heat sink Temperature Low                       | X       |                 |                 |                                    |
| 67  | Option Configuration has Changed                |         | X               |                 |                                    |
| 69  | Pwr. Card Temp                                  |         | X               | X               |                                    |
| 70  | Illegal FC configuration                        |         |                 | X               |                                    |
| 71  | PTC 1 Safe Stop                                 | X       | X <sup>1)</sup> |                 |                                    |
| 72  | Dangerous Failure                               |         |                 | X <sup>1)</sup> |                                    |
| 73  | Safe Stop Auto Restart                          |         |                 |                 |                                    |
| 76  | Power Unit Setup                                | X       |                 |                 |                                    |
| 77  | Reduced Power Mode                              |         |                 |                 |                                    |
| 79  | Illegal PS config                               |         | X               | X               |                                    |
| 80  | Drive Initialized to Default Value              |         | X               |                 |                                    |
| 91  | Analog input 54 wrong settings                  |         |                 | X               |                                    |
| 92  | NoFlow  | X       | X               |                 | 22-2*                              |
| 93  | Dry Pump  | X       | X               |                 | 22-2*                              |
| 94  | End of Curve                                    | X       | X               |                 | 22-5*                              |
| 95  | Broken Belt                                     | X       | X               |                 | 22-6*                              |
| 96  | Start Delayed                                   | X       |                 |                 | 22-7*                              |
| 97  | Stop Delayed                                    | X       |                 |                 | 22-7*                              |
| 98  | Clock Fault                                     | X       |                 |                 | 0-7*                               |
| 201 | Fire M was Active                               |         |                 |                 |                                    |
| 202 | Fire M Limits Exceeded                          |         |                 |                 |                                    |
| 203 | Missing Motor                                   |         |                 |                 |                                    |
| 204 | Locked Rotor                                    |         |                 |                 |                                    |
| 243 | Brake IGBT                                      | X       | X               |                 |                                    |
| 244 | Heatsink temp                                   | X       | X               | X               |                                    |
| 245 | Heatsink sensor                                 |         | X               | X               |                                    |
| 246 | Pwr.card supply                                 |         | X               | X               |                                    |
| 247 | Pwr.card temp                                   |         | X               | X               |                                    |
| 248 | Illegal PS config                               |         | X               | X               |                                    |
| 250 | New spare parts                                 |         |                 | X               |                                    |

| No. | Description   | Warning | Alarm/Trip | Alarm/Trip Lock | Parameter Reference |
|-----|---------------|---------|------------|-----------------|---------------------|
| 251 | New Type Code |         | X          | X               |                     |

**Table 8.2 Alarm/Warning Code List**

(X) *Dependent on parameter*

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

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

**WARNING 1, 10 Volts low**

The control card voltage is below 10 V from terminal 50. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Max. 15 mA or minimum 590 Ω.

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

**Troubleshooting**

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

**WARNING/ALARM 2, Live zero error**

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

**Troubleshooting**

Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. MCB 101 terminals 11 and 12 for signals, terminal 10 common. MCB 109 terminals 1, 3, 5 for signals, terminals 2, 4, 6 common).

Check that the frequency converter programming and switch settings match the analog signal type.

Perform Input Terminal Signal Test.

**WARNING/ALARM 4, Mains phase loss**

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

**Troubleshooting**

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

**WARNING 5, DC link voltage high**

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

**WARNING 6, DC link voltage low**

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

**WARNING/ALARM 7, DC overvoltage**

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

**Troubleshooting**

Connect a brake resistor

Extend the ramp time

Change the ramp type

Activate the functions in *2-10 Brake Function*

Increase *14-26 Trip Delay at Inverter Fault*

**WARNING/ALARM 8, DC under voltage**

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

**Troubleshooting**

Check that the supply voltage matches the frequency converter voltage.

Perform input voltage test.

Perform soft charge circuit test.

**WARNING/ALARM 9, Inverter overload**

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

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

**Troubleshooting**

Compare the output current shown on the LCP with the frequency converter rated current.

Compare the output current shown on the LCP with measured motor current.

Display the Thermal Drive Load on the LCP and monitor the value. When running above the frequency converter continuous current rating, the counter should increase. When running below the frequency converter continuous current rating, the counter should decrease.

**WARNING/ALARM 10, Motor overload temperature**

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

**Troubleshooting**

Check for motor overheating.

Check if the motor is mechanically overloaded

Check that the motor current set in *1-24 Motor Current* is correct.

Ensure that Motor data in parameters 1-20 through 1-25 are set correctly.

If an external fan is in use, check in *1-91 Motor External Fan* that it is selected.

Running AMA in *1-29 Automatic Motor Adaptation (AMA)* tunes the frequency converter to the motor more accurately and reduces thermal loading.

**WARNING/ALARM 11, Motor thermistor over temp**

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

**Troubleshooting**

Check for motor overheating.

Check if the motor is mechanically overloaded.

When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply) 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. Check *1-93 Thermistor Source* selects terminal 18 or 19.

**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 through 1-25 for correct motor data.

**ALARM 14, Earth (ground) fault**

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

**Troubleshooting:**

Remove power to the frequency converter and repair the earth fault.

Check for earth faults in the motor by measuring the resistance to ground of the motor leads and the motor with a megohmmeter.

**ALARM 15, Hardware mismatch**

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

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

*15-40 FC Type*

*15-41 Power Section*

*15-42 Voltage*

*15-43 Software Version*

*15-45 Actual Typecode String*

*15-49 SW ID Control Card*

*15-50 SW ID Power Card*

*15-60 Option Mounted*

*15-61 Option SW Version* (for each option slot)

**ALARM 16, Short circuit**

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

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

**WARNING/ALARM 17, Control word timeout**

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

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

**Troubleshooting:**

Check connections on the serial communication cable.

Increase *8-03 Control Word Timeout Time*

Check the operation of the communication equipment.

Verify a proper installation based on EMC requirements.

**WARNING 23, Internal fan fault**

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

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

**Troubleshooting**

Check for proper fan operation.

Cycle power to the frequency converter and check that the fan operates briefly at start up.

Check the sensors on the heatsink and control card.

**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 for proper fan operation.

Cycle power to the frequency converter and check that the fan operates briefly at start up.

Check the sensors on the heatsink and control card.

**WARNING 25, Brake resistor short circuit**

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

**WARNING/ALARM 26, Brake resistor power limit**

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

converter will trip when the dissipated braking power reaches 100%.

**WARNING/ALARM 27, Brake chopper fault**

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

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

**WARNING/ALARM 28, Brake check failed**

The brake resistor is not connected or not working. Check *2-15 Brake Check*.

**ALARM 29, Heatsink temp**

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

**Troubleshooting**

Check for the following conditions.

Ambient temperature too high.

Motor cable too long.

Incorrect airflow clearance above and below the frequency converter

Blocked airflow around the frequency converter.

Damaged heatsink fan.

Dirty heatsink.

**ALARM 30, Motor phase U missing**

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

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

**ALARM 31, Motor phase V missing**

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

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

**ALARM 32, Motor phase W missing**

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

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

**ALARM 33, Inrush fault**

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

**WARNING/ALARM 34, communication fault**

The fieldbus on the communication option card is not working.

**WARNING/ALARM 36, Mains failure**

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

**ALARM 38, Internal fault**

When an internal fault occurs, a code number defined in *Table 8.3* is displayed.

**Troubleshooting**

Cycle power

Check that the option is properly installed

Check for loose or missing wiring

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

| No.       | Text  |
|-----------|---|
| 0         | Serial port cannot be initialised. Contact your Danfoss supplier or Danfoss Service Department. |
| 256-258   | Power EEPROM data is defective or too old   |
| 512-519   | Internal fault. Contact your Danfoss supplier or Danfoss Service Department.                    |
| 783       | Parameter value outside of min/max limits   |
| 1024-1284 | Internal fault. Contact your Danfoss supplier or the Danfoss Service Department.                |
| 1299      | Option SW in slot A is too old  |
| 1300      | Option SW in slot B is too old  |
| 1302      | Option SW in slot C1 is too old   |
| 1315      | Option SW in slot A is not supported (not allowed)  |
| 1316      | Option SW in slot B is not supported (not allowed)  |
| 1318      | Option SW in slot C1 is not supported (not allowed)   |
| 1379-2819 | Internal fault. Contact your Danfoss supplier or Danfoss Service Department.                    |
| 2820      | LCP stack overflow  |
| 2821      | Serial port overflow  |
| 2822      | USB port overflow   |
| 3072-5122 | Parameter value is outside its limits   |
| 5123      | Option in slot A: Hardware incompatible with control board hardware                             |
| 5124      | Option in slot B: Hardware incompatible with control board hardware                             |
| 5125      | Option in slot C0: Hardware incompatible with control board hardware                            |
| 5126      | Option in slot C1: Hardware incompatible with control board hardware                            |
| 5376-6231 | Internal fault. Contact your Danfoss supplier or Danfoss Service Department.                    |

**Table 8.3 Internal Fault Codes**

**ALARM 39, Heatsink sensor**

No feedback from the heatsink temperature sensor.

The signal from the IGBT thermal sensor is not available on the power card. The problem could be on the power card,

on the gate drive card, or the ribbon cable between the power card and gate drive card.

**WARNING 40, Overload of digital output terminal 27**

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

**WARNING 41, Overload of digital output terminal 29**

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

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

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

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

**ALARM 45, Earth fault 2**

Earth (ground) fault on start up.

**Troubleshooting**

Check for proper earthing (grounding) and loose connections.

Check for proper wire size.

Check motor cables for short-circuits or leakage currents.

**ALARM 46, Power card supply**

The supply on the power card is out of range.

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

**Troubleshooting**

Check for a defective power card.

Check for a defective control card.

Check for a defective option card.

If a 24 V DC power supply is used, verify proper supply power.

**WARNING 47, 24V supply low**

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

**WARNING 48, 1.8V supply low**

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

**WARNING 49, Speed limit**

When the speed is not within the specified range in *4-11 Motor Speed Low Limit [RPM]* and *4-13 Motor Speed High Limit [RPM]*, the frequency converter shows a warning. When the speed is below the specified limit in *1-86 Trip Speed Low [RPM]* (except when starting or stopping) the frequency converter will trip.

**ALARM 50, AMA calibration failed**

Contact your Danfoss supplier or Danfoss Service Department.

**ALARM 51, AMA check  $U_{nom}$  and  $I_{nom}$** 

The settings for motor voltage, motor current, and motor power are wrong. Check the settings in parameters 1-20 to 1-25.

**ALARM 52, AMA low  $I_{nom}$** 

The motor current is too low. Check the settings.

**ALARM 53, AMA motor too big**

The motor is too big for the AMA to operate.

**ALARM 54, AMA motor too small**

The motor is too small for the AMA to operate.

**ALARM 55, AMA Parameter out of range**

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

**56 ALARM, AMA interrupted by user**

The user has interrupted the AMA.

**ALARM 57, AMA internal fault**

Try to restart AMA again. Repeated restarts may over heat the motor.

**ALARM 58, AMA internal fault**

Contact your Danfoss supplier.

**WARNING 59, Current limit**

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

**WARNING 60, External interlock**

A digital input signal is indicating a fault condition external to the frequency converter. An external interlock has commanded the frequency converter to trip. Clear the external fault condition. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock. Reset the frequency converter.

**WARNING 62, Output frequency at maximum limit**

The output frequency has reached the value set in *4-19 Max Output Frequency*. Check the application to determine the cause. Possibly increase the output frequency limit. Be sure the system can operate safely at a higher output frequency. The warning will clear when the output drops below the maximum limit.

**WARNING/ALARM 65, Control card over temperature**

The cutout temperature of the control card is 80° C.

**Troubleshooting**

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

**WARNING 66, Heatsink temperature low**

The frequency converter is too cold to operate. This warning is based on the temperature sensor in the IGBT module.

Increase the ambient temperature of the unit. Also, a trickle amount of current can be supplied to the frequency converter whenever the motor is stopped by setting *2-00 DC Hold/Preheat Current* at 5% and *1-80 Function at Stop*

**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**

Loss of the 24 V DC signal on terminal 37 has caused the filter to trip. To resume normal operation, apply 24 V DC to terminal 37 and reset the filter.

**ALARM 69, Power card temperature**

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

**Troubleshooting**

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

**ALARM 70, Illegal frequency converter configuration**

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

**ALARM 80, Drive initialised to default value**

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

**ALARM 92, No flow**

A no-flow condition has been detected in the system. *22-23 No-Flow Function* is set for alarm. 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. 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. 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. 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. 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. 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. Reset the clock in *0-70 Date and Time*.

**WARNING 200, Fire mode**

This indicates the frequency converter is operating in fire mode. The warning clears when fire mode is removed. See the fire mode data in the alarm log.

**WARNING 201, Fire mode was active**

This indicates the frequency converter had entered fire mode. Cycle power to the unit to remove the warning. See the fire mode data in the alarm log.

**WARNING 202, Fire mode limits exceeded**

While operating in fire mode one or more alarm conditions have been ignored which would normally trip the unit. Operating in this condition voids unit warranty. Cycle power to the unit to remove the warning. See the fire mode data in the alarm log.

**WARNING 203, Missing motor**

With a frequency converter operating multi-motors, an under-load condition was detected. This could indicate a missing motor. Inspect the system for proper operation.

**WARNING 204, Locked rotor**

With a frequency converter operating multi-motors, an overload condition was detected. This could indicate a locked rotor. Inspect the motor for proper operation.

**WARNING 250, New spare part**

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

**WARNING 251, New typecode**

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



## 9 Basic Troubleshooting

### 9.1 Start Up and Operation

| Symptom                    | Possible Cause  | Test  | Solution   |
|----------------------------|---|---|--|
| Display dark / No function | Missing input power   | See <i>Table 3.1</i> .  | Check the input power source.  |
|                            | Missing or open fuses or circuit breaker tripped  | See open fuses and tripped circuit breaker in this table for possible causes.   | Follow the recommendations provided  |
|                            | No power to the LCP   | Check the LCP cable for proper connection or damage.  | Replace the faulty LCP or connection cable.  |
|                            | Shortcut on control voltage (terminal 12 or 50) or at control terminals                                 | Check the 24 V control voltage supply for terminal 12/13 to 20-39 or 10 V supply for terminal 50 to 55.   | Wire the terminals properly.   |
|                            | Wrong LCP (LCP from VLT® 2800 or 5000/6000/8000/ FCD or FCM)  |   | Use only LCP 101 (P/N 130B1124) or LCP 102 (P/N 130B1107).   |
|                            | Wrong contrast setting  |   | Press [Status] + [▲]/[▼] to adjust the contrast.   |
|                            | Display (LCP) is defective  | Test using a different LCP.   | Replace the faulty LCP or connection cable.  |
|                            | Internal voltage supply fault or SMPS is defective  |   | Contact supplier.  |
| Intermittent display       | Overloaded power supply (SMPS) due to improper control wiring or a fault within the frequency converter | To rule out a problem in the control wiring, disconnect all control wiring by removing the terminal blocks.   | If the display stays lit, then the problem is in the control wiring. Check the wiring for shorts or incorrect connections. If the display continues to cut out, follow the procedure for display dark.             |
| Motor not running          | Service switch open or missing motor connection   | Check if the motor is connected and the connection is not interrupted (by a service switch or other device).  | Connect the motor and check the service switch.  |
|                            | No mains power with 24 V DC option card   | If the display is functioning but no output, check that mains power is applied to the frequency converter.  | Apply mains power to run the unit.   |
|                            | LCP Stop  | Check if [Off] has been pressed.  | Press [Auto On] or [Hand On] (depending on your operation mode) to run the motor.  |
|                            | Missing start signal (Standby)  | Check <i>5-10 Terminal 18 Digital Input</i> for correct setting for terminal 18 (use default setting).  | Apply a valid start signal to start the motor.   |
|                            | Motor coast signal active (Coasting)  | Check <i>5-12 Coast inv.</i> for correct setting for terminal 27 (use default setting).   | Apply 24 V on terminal 27 or program this terminal to <i>No operation</i> .  |
|                            | Wrong reference signal source   | Check reference signal: Local, remote or bus reference? Preset reference active? Terminal connection correct? Scaling of terminals correct? Reference signal available? | Program correct settings. Check <i>3-13 Reference Site</i> . Set preset reference active in parameter group <i>3-1* References</i> . Check for correct wiring. Check scaling of terminals. Check reference signal. |

| Symptom                                  | Possible Cause   | Test   | Solution  |
|--|--|--|---|
| Motor running in wrong direction         | Motor rotation limit   | Check that 4-10 <i>Motor Speed Direction</i> is programmed correctly.  | Program correct settings.   |
|  | Active reversing signal  | Check if a reversing command is programmed for the terminal in parameter group 5-1* <i>Digital inputs</i> .  | Deactivate reversing signal.  |
|  | Wrong motor phase connection   |  | See in this manual.   |
| Motor is not reaching maximum speed      | Frequency limits set wrong   | Check output limits in 4-13 <i>Motor Speed High Limit [RPM]</i> , 4-14 <i>Motor Speed High Limit [Hz]</i> and 4-19 <i>Max Output Frequency</i>             | Program correct limits.   |
|  | Reference input signal not scaled correctly  | Check reference input signal scaling in 6-* <i>Analog I/O mode</i> and parameter group 3-1* <i>References</i> . Reference limits in parameter group 3-0*.. | Program correct settings.   |
| Motor speed unstable                     | Possible incorrect parameter settings  | Check the settings of all motor parameters, including all motor compensation settings. For closed loop operation, check PID settings.                      | Check settings in parameter group 1-6* <i>Analog I/O mode</i> . For closed loop operation, check settings in parameter group 20-0* <i>Feedback</i> .  |
| Motor runs rough                         | Possible over-magnetization  | Check for incorrect motor settings in all motor parameters.  | Check motor settings in parameter groups 1-2* <i>Motor data</i> , 1-3* <i>Adv motor data</i> , and 1-5* <i>Load indep. setting</i> .  |
| Motor will not brake                     | Possible incorrect settings in the brake parameters. Possible too short ramp down times. | Check brake parameters. Check ramp time settings.  | Check parameter group 2-0* <i>DC brake</i> and 3-0* <i>Reference limits</i> .   |
| Open power fuses or circuit breaker trip | Phase to phase short   | Motor or panel has a short phase to phase. Check motor and panel phase for shorts.   | Eliminate any shorts detected.  |
|  | Motor overload   | Motor is overloaded for the application.   | Perform startup test and verify motor current is within specifications. If motor current is exceeding nameplate full load current, motor may run only with reduced load. Review the specifications for the application. |
|  | Loose connections  | Perform pre-startup check for loose connections.   | Tighten loose connections.  |
| Mains current imbalance greater than 3%  | Problem with mains power (See <i>Alarm 4 Mains phase loss</i> description)               | Rotate input power leads into the frequency converter one position: A to B, B to C, C to A.  | If imbalanced leg follows the wire, it is a power problem. Check mains power supply.  |
|  | Problem with the frequency converter   | Rotate input power leads into the frequency converter one position: A to B, B to C, C to A.  | If imbalance leg stays on same input terminal, it is a problem with the unit. Contact the supplier.   |
| Motor current imbalance greater than 3%  | Problem with motor or motor wiring   | Rotate output motor leads one position: U to V, V to W, W to U.  | If imbalanced leg follows the wire, the problem is in the motor or motor wiring. Check motor and motor wiring.  |
|  | Problem with the frequency converters  | Rotate output motor leads one position: U to V, V to W, W to U.  | If imbalance leg stays on same output terminal, it is a problem with the unit. Contact the supplier.  |

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

Table 9.1

## 10 Specifications

### 10.1 Power-dependent Specifications

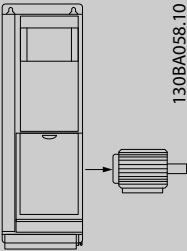
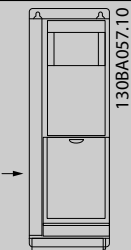
| Mains supply 200 - 240 V AC - Normal overload 110% for 1 minute   |                                     |          |          |      |      |      |
|---|-------------------------------------|----------|----------|------|------|------|
| Frequency converter   | P1K1                                | P1K5     | P2K2     | P3K0 | P3K7 |      |
| Typical Shaft Output [kW]   | 1.1                                 | 1.5      | 2.2      | 3    | 3.7  |      |
| IP20/Chassis<br>(A2+A3 may be converted to IP21 using a conversion kit. (Please also see <i>Mechanical mounting</i> and <i>IP21/Type 1 Enclosure kit</i> in the Design Guide.)) | A2                                  | A2       | A2       | A3   | A3   |      |
| IP55/Type 12  | A4/A5                               | A4/A5    | A4/A5    | A5   | A5   |      |
| IP66/NEMA 4X  | A4/A5                               | A4/A5    | A4/A5    | A5   | A5   |      |
| Typical Shaft Output [HP] at 208 V  | 1.5                                 | 2.0      | 2.9      | 4.0  | 4.9  |      |
| Output current  |                                     |          |          |      |      |      |
|   | Continuous<br>(3 x 200-240 V) [A]   | 6.6      | 7.5      | 10.6 | 12.5 | 16.7 |
|   | Intermittent<br>(3 x 200-240 V) [A] | 7.3      | 8.3      | 11.7 | 13.8 | 18.4 |
|   | Continuous<br>kVA (208 V AC) [kVA]  | 2.38     | 2.70     | 3.82 | 4.50 | 6.00 |
| Max. input current  |                                     |          |          |      |      |      |
|    | Continuous<br>(3 x 200-240 V) [A]   | 5.9      | 6.8      | 9.5  | 11.3 | 15.0 |
|   | Intermittent<br>(3 x 200-240 V) [A] | 6.5      | 7.5      | 10.5 | 12.4 | 16.5 |
| Additional specifications   |                                     |          |          |      |      |      |
| Estimated power loss at rated max. load [W] <sup>4)</sup>   | 63                                  | 82       | 116      | 155  | 185  |      |
| Max. cable size (mains, motor, brake)<br>[mm <sup>2</sup> /AWG] <sup>2)</sup>   | 4/10                                |          |          |      |      |      |
| Weight enclosure IP20 [kg]  | 4.9                                 | 4.9      | 4.9      | 6.6  | 6.6  |      |
| Weight enclosure IP21 [kg]  | 5.5                                 | 5.5      | 5.5      | 7.5  | 7.5  |      |
| Weight enclosure IP55 [kg]<br>(A4/A5)   | 9.7/13.5                            | 9.7/13.5 | 9.7/13.5 | 13.5 | 13.5 |      |
| Weight enclosure IP66 [kg]<br>(A4/A5)   | 9.7/13.5                            | 9.7/13.5 | 9.7/13.5 | 13.5 | 13.5 |      |
| Efficiency <sup>3)</sup>  | 0.96                                | 0.96     | 0.96     | 0.96 | 0.96 |      |

Table 10.1 Mains Supply 200 - 240 V AC

| Mains Supply 3x200-240 V AC - Normal overload 110% for 1 minute   |                                     |      |      |      |      |      |                     |      |       |        |                  |
|---|-------------------------------------|------|------|------|------|------|---------------------|------|-------|--------|------------------|
| IP20/Chassis  | B3                                  | B3   | B3   | B3   | B4   | B4   | B4                  | C3   | C4    |        |                  |
| (B3+4 and C3+4 may be converted to IP21 using a conversion kit. (Please see also items Mechanical mounting and IP21/Type 1 Enclosure kit in the Design Guide.)) |                                     |      |      |      |      |      |                     |      |       |        |                  |
| IP21/NEMA 1   | B1                                  | B1   | B1   | B1   | C1   | C1   | C1                  | C2   | C2    |        |                  |
| IP55/Type 12  | B1                                  | B1   | B1   | B1   | C1   | C1   | C1                  | C2   | C2    |        |                  |
| IP66/NEMA 4X  | B1                                  | B1   | B1   | B1   | C1   | C1   | C1                  | C2   | C2    |        |                  |
| Frequency converter   | P5K5                                | P7K5 | P11K | P15K | P18K | P22K | P30K                | P37K | P45K  |        |                  |
| Typical Shaft Output [kW]   | 5.5                                 | 7.5  | 11   | 15   | 18.5 | 22   | 30                  | 37   | 45    |        |                  |
| Typical Shaft Output [HP] at 208 V  | 7.5                                 | 10   | 15   | 20   | 25   | 30   | 40                  | 50   | 60    |        |                  |
| Output current  |                                     |      |      |      |      |      |                     |      |       |        |                  |
| <p>130BA058.10</p>  | Continuous<br>(3 x 200-240 V) [A]   |      | 24.2 | 30.8 | 46.2 | 59.4 | 74.8                | 88.0 | 115   | 143    | 170              |
|   | Intermittent<br>(3 x 200-240 V) [A] |      | 26.6 | 33.9 | 50.8 | 65.3 | 82.3                | 96.8 | 127   | 157    | 187              |
|   | Continuous<br>kVA (208 V AC) [kVA]  |      | 8.7  | 11.1 | 16.6 | 21.4 | 26.9                | 31.7 | 41.4  | 51.5   | 61.2             |
| Max. input current  |                                     |      |      |      |      |      |                     |      |       |        |                  |
| <p>130BA057.10</p>  | Continuous<br>(3 x 200-240 V) [A]   |      | 22.0 | 28.0 | 42.0 | 54.0 | 68.0                | 80.0 | 104.0 | 130.0  | 154.0            |
|   | Intermittent<br>(3 x 200-240 V) [A] |      | 24.2 | 30.8 | 46.2 | 59.4 | 74.8                | 88.0 | 114.0 | 143.0  | 169.0            |
| Additional Specifications   |                                     |      |      |      |      |      |                     |      |       |        |                  |
| Estimated power loss at rated max. load [W] <sup>4)</sup>   |                                     |      | 269  | 310  | 447  | 602  | 737                 | 845  | 1140  | 1353   | 1636             |
| Max. cable size (mains, motor, brake) [mm <sup>2</sup> /AWG] <sup>2)</sup>  |                                     |      | 10/7 |      |      | 35/2 | 50/1/0<br>(B4=35/2) |      |       | 95/4/0 | 120/250<br>MCM   |
| With mains disconnect switch included:  |                                     |      | 16/6 |      |      | 35/2 | 35/2                |      |       | 70/3/0 | 185/<br>kcmil350 |
| Weight enclosure IP20 [kg]  |                                     |      | 12   | 12   | 12   | 23.5 | 23.5                | 35   | 35    | 50     | 50               |
| Weight enclosure IP21 [kg]  |                                     |      | 23   | 23   | 23   | 27   | 45                  | 45   | 45    | 65     | 65               |
| Weight enclosure IP55 [kg]  |                                     |      | 23   | 23   | 23   | 27   | 45                  | 45   | 45    | 65     | 65               |
| Weight enclosure IP66 [kg]  |                                     |      | 23   | 23   | 23   | 27   | 45                  | 45   | 45    | 65     | 65               |
| Efficiency <sup>3)</sup>  |                                     |      | 0.96 | 0.96 | 0.96 | 0.96 | 0.96                | 0.97 | 0.97  | 0.97   | 0.97             |

Table 10.2 Mains Supply 3x200-240 V AC

| Mains Supply 3 x 380 - 480 V AC - Normal overload 110% for 1 minute  |                                  |       |       |       |       |      |      |      |    |
|--|----------------------------------|-------|-------|-------|-------|------|------|------|----|
| Frequency converter  | PIK1                             | PIK5  | P2K2  | P3K0  | P4K0  | P5K5 | P7K5 |      |    |
| Typical Shaft Output [kW]  | 1.1                              | 1.5   | 2.2   | 3     | 4     | 5.5  | 7.5  |      |    |
| Typical Shaft Output [HP] at 460 V   | 1.5                              | 2.0   | 2.9   | 4.0   | 5.0   | 7.5  | 10   |      |    |
| IP 20 / Chassis  | A2                               | A2    | A2    | A2    | A2    | A3   | A3   | A3   | A3 |
| (A2+A3 may be converted to IP21 using a conversion kit. (Please see also items Mechanical mounting and IP 21/Type 1 Enclosure kit in the Design Guide.)) |                                  |       |       |       |       |      |      |      |    |
| IP 55 / Type 12  | A4/A5                            | A4/A5 | A4/A5 | A4/A5 | A4/A5 | A5   | A5   | A5   | A5 |
| IP 66 / NEMA 4X  | A4/A5                            | A4/A5 | A4/A5 | A4/A5 | A4/A5 | A5   | A5   | A5   | A5 |
| <b>Output current</b>  |                                  |       |       |       |       |      |      |      |    |
|  | Continuous (3 x 380-440 V) [A]   | 3     | 4.1   | 5.6   | 7.2   | 10   | 13   | 16   |    |
|  | Intermittent (3 x 380-440 V) [A] | 3.3   | 4.5   | 6.2   | 7.9   | 11   | 14.3 | 17.6 |    |
|  | Continuous (3 x 441-480 V) [A]   | 2.7   | 3.4   | 4.8   | 6.3   | 8.2  | 11   | 14.5 |    |
|  | Intermittent (3 x 441-480 V) [A] | 3.0   | 3.7   | 5.3   | 6.9   | 9.0  | 12.1 | 15.4 |    |
|  | Continuous kVA (400 V AC) [kVA]  | 2.1   | 2.8   | 3.9   | 5.0   | 6.9  | 9.0  | 11.0 |    |
| Continuous kVA (460 V AC) [kVA]  |                                  |       |       |       |       |      |      |      |    |
| <b>Max. input current</b>  |                                  |       |       |       |       |      |      |      |    |
|  | Continuous (3 x 380-440 V) [A]   | 2.7   | 3.7   | 5.0   | 6.5   | 9.0  | 11.7 | 14.4 |    |
|  | Intermittent (3 x 380-440 V) [A] | 3.0   | 4.1   | 5.5   | 7.2   | 9.9  | 12.9 | 15.8 |    |
|  | Continuous (3 x 441-480 V) [A]   | 2.7   | 3.1   | 4.3   | 5.7   | 7.4  | 9.9  | 13.0 |    |
|  | Intermittent (3 x 441-480 V) [A] | 3.0   | 3.4   | 4.7   | 6.3   | 8.1  | 10.9 | 14.3 |    |
|  | Additional specifications        |       |       |       |       |      |      |      |    |
| Estimated power loss at rated max. load [W] <sup>4)</sup>  |                                  |       |       |       |       |      |      |      |    |
| (mains, motor, brake) [mm <sup>2</sup> /AWG] <sup>2)</sup>   |                                  |       |       |       |       |      |      |      |    |
| Weight enclosure IP20 [kg]   |                                  |       |       |       |       |      |      |      |    |
| Weight enclosure IP21 [kg]   |                                  |       |       |       |       |      |      |      |    |
| Weight enclosure IP55 [kg] (A4/A5)   |                                  |       |       |       |       |      |      |      |    |
| Weight enclosure IP66 [kg] (A4/A5)   |                                  |       |       |       |       |      |      |      |    |
| Efficiency <sup>3)</sup>   |                                  |       |       |       |       |      |      |      |    |

Table 10.3 Mains Supply 3 x 380 - 480 V AC

| Mains Supply 3 x 380 - 480 V AC - Normal overload 110% for 1 minute                                   |                                  |      |      |      |      |      |      |      |                  |      |      |        |             |
|---|----------------------------------|------|------|------|------|------|------|------|------------------|------|------|--------|-------------|
| Frequency converter   | P11K                             | P15K | P18K | P22K | P30K | P37K | P45K | P55K | P75K             | P90K |      |        |             |
| Typical Shaft Output [kW]   | 11                               | 15   | 18.5 | 22   | 30   | 37   | 45   | 55   | 75               | 90   |      |        |             |
| Typical Shaft Output [HP] at 460 V  | 15                               | 20   | 25   | 30   | 40   | 50   | 60   | 75   | 100              | 125  |      |        |             |
| IP20/Chassis (B3+4 and C3+4 may be converted to IP21 using a conversion kit (Please contact Danfoss)) | B3                               | B3   | B3   | B4   | B4   | B4   | C3   | C3   | C4               | C4   |      |        |             |
| IP21/NEMA 1   | B1                               | B1   | B1   | B2   | B2   | C1   | C1   | C1   | C2               | C2   |      |        |             |
| IP55/Type 12  | B1                               | B1   | B1   | B2   | B2   | C1   | C1   | C1   | C2               | C2   |      |        |             |
| IP66/NEMA 4X  | B1                               | B1   | B1   | B2   | B2   | C1   | C1   | C1   | C2               | C2   |      |        |             |
| Output current  |                                  |      |      |      |      |      |      |      |                  |      |      |        |             |
|   | Continuous (3 x 380-439 V) [A]   |      |      | 44   | 61   | 73   | 90   | 106  | 147              | 177  |      |        |             |
|   | Intermittent (3 x 380-439 V) [A] |      |      | 48.4 | 67.1 | 80.3 | 99   | 117  | 162              | 195  |      |        |             |
|   | Continuous (3 x 440-480 V) [A]   |      |      | 40   | 52   | 65   | 80   | 105  | 130              | 160  |      |        |             |
|   | Intermittent (3 x 440-480 V) [A] |      |      | 44   | 61.6 | 71.5 | 88   | 116  | 143              | 176  |      |        |             |
|   | Continuous kVA (400 V AC) [kVA]  |      |      | 30.5 | 42.3 | 50.6 | 62.4 | 73.4 | 102              | 123  |      |        |             |
| Continuous kVA 460 V AC [kVA]   |                                  |      | 16.7 | 21.5 | 27.1 | 31.9 | 41.4 | 63.7 | 83.7             | 104  | 128  |        |             |
| Max. input current  |                                  |      |      |      |      |      |      |      |                  |      |      |        |             |
|   | Continuous (3 x 380-439 V) [A]   |      |      | 40   | 55   | 66   | 82   | 96   | 133              | 161  |      |        |             |
|   | Intermittent (3 x 380-439 V) [A] |      |      | 44   | 60.5 | 72.6 | 90.2 | 106  | 146              | 177  |      |        |             |
|   | Continuous (3 x 440-480 V) [A]   |      |      | 36   | 47   | 59   | 73   | 95   | 118              | 145  |      |        |             |
|   | Intermittent (3 x 440-480 V) [A] |      |      | 39.6 | 51.7 | 64.9 | 80.3 | 105  | 130              | 160  |      |        |             |
| Additional specifications   |                                  |      |      |      |      |      |      |      |                  |      |      |        |             |
| Estimated power loss at rated max. load [W] <sup>4)</sup>   |                                  |      | 278  | 392  | 465  | 525  | 698  | 739  | 843              | 1083 | 1384 | 1474   |             |
| Max. cable size (mains, motor, brake) [mm <sup>2</sup> /AWG] <sup>2)</sup>                            |                                  |      | 10/7 |      |      | 35/2 |      |      | 50/1/0 (B4=35/2) |      |      | 95/4/0 | 120/MCM250  |
| With mains disconnect switch included:  |                                  |      | 16/6 |      |      | 35/2 |      |      | 35/2             |      |      | 70/3/0 | 185/kcml350 |
| Weight enclosure IP20 [kg]  |                                  |      | 12   | 12   | 12   | 23.5 | 23.5 | 35   | 35               | 50   | 50   | 50     |             |
| Weight enclosure IP21 [kg]  |                                  |      | 23   | 23   | 23   | 27   | 27   | 45   | 45               | 65   | 65   | 65     |             |
| Weight enclosure IP55 [kg]  |                                  |      | 23   | 23   | 23   | 27   | 27   | 45   | 45               | 65   | 65   | 65     |             |
| Weight enclosure IP66 [kg]  |                                  |      | 23   | 23   | 23   | 27   | 27   | 45   | 45               | 65   | 65   | 65     |             |
| Efficiency <sup>3)</sup>  |                                  |      | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98             | 0.98 | 0.98 | 0.99   |             |

Table 10.4 Mains Supply 3 x 380 - 480 V AC

| Mains supply 3 x 525 - 600 V AC Normal overload 110% for 1 minute                        |                                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |
|--|------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-------|
| Size:  | P1K1                               | P1K5 | P2K2 | P3K0 | P3K7 | P4K0 | P5K5 | P7K5 | P11K | P15K | P18K | P22K | P30K | P37K | P45K | P55K | P75K | P90K |      |       |       |
| Typical Shaft Output [kW]  | 1.1                                | 1.5  | 2.2  | 3    | 3.7  | 4    | 5.5  | 7.5  | 11   | 15   | 18.5 | 22   | 30   | 37   | 45   | 55   | 75   | 90   |      |       |       |
| IP20/Chassis   | A3                                 | A3   | A3   | A3   | A2   | A3   | A3   | A3   | B3   | B3   | B3   | B4   | B4   | B4   | C3   | C3   | C4   | C4   |      |       |       |
| IP21/NEMA 1  | A3                                 | A3   | A3   | A3   | A2   | A3   | A3   | A3   | B1   | B1   | B1   | B2   | B2   | C1   | C1   | C1   | C2   | C2   |      |       |       |
| IP55/Type 12   | A5                                 | A5   | A5   | A5   | A5   | A5   | A5   | A5   | B1   | B1   | B1   | B2   | B2   | C1   | C1   | C1   | C2   | C2   |      |       |       |
| IP66/NEMA 4X   | A5                                 | A5   | A5   | A5   | A5   | A5   | A5   | A5   | B1   | B1   | B1   | B2   | B2   | C1   | C1   | C1   | C2   | C2   |      |       |       |
| <b>Output current</b>  |                                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |
|  | Continuous<br>(3 x 525-550V) [A]   |      | 2.6  | 2.9  | 4.1  | 5.2  | -    | 6.4  | 9.5  | 11.5 | 19   | 23   | 28   | 36   | 43   | 54   | 65   | 87   | 105  | 137   |       |
|  | Intermittent<br>(3 x 525-550V) [A] |      | 2.9  | 3.2  | 4.5  | 5.7  | -    | 7.0  | 10.5 | 12.7 | 21   | 25   | 31   | 40   | 47   | 59   | 72   | 96   | 116  | 151   | 151   |
|  | Continuous<br>(3 x 525-600V) [A]   |      | 2.4  | 2.7  | 3.9  | 4.9  | -    | 6.1  | 9.0  | 11.0 | 18   | 22   | 27   | 34   | 41   | 52   | 62   | 83   | 100  | 131   | 131   |
|  | Intermittent<br>(3 x 525-600V) [A] |      | 2.6  | 3.0  | 4.3  | 5.4  | -    | 6.7  | 9.9  | 12.1 | 20   | 24   | 30   | 37   | 45   | 57   | 68   | 91   | 110  | 144   | 144   |
|  | Continuous kVA<br>(525V AC) [kVA]  |      | 2.5  | 2.8  | 3.9  | 5.0  | -    | 6.1  | 9.0  | 11.0 | 18.1 | 21.9 | 26.7 | 34.3 | 41   | 51.4 | 61.9 | 82.9 | 100  | 130.5 | 130.5 |
|  | Continuous kVA<br>(575V AC) [kVA]  |      | 2.4  | 2.7  | 3.9  | 4.9  | -    | 6.1  | 9.0  | 11.0 | 17.9 | 21.9 | 26.9 | 33.9 | 40.8 | 51.8 | 61.7 | 82.7 | 99.6 | 130.5 | 130.5 |
| <b>Max. input current</b>  |                                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |
|  | Continuous<br>(3 x 525-600V) [A]   |      | 2.4  | 2.7  | 4.1  | 5.2  | -    | 5.8  | 8.6  | 10.4 | 17.2 | 20.9 | 25.4 | 32.7 | 39   | 49   | 59   | 78.9 | 95.3 | 124.3 |       |
|  | Intermittent<br>(3 x 525-600V) [A] |      | 2.7  | 3.0  | 4.5  | 5.7  | -    | 6.4  | 9.5  | 11.5 | 19   | 23   | 28   | 36   | 43   | 54   | 65   | 87   | 105  | 137   | 137   |
| <b>Additional specifications</b>   |                                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |
| Estim. power loss at rated max. load [W] <sup>4)</sup>                                   | 50                                 | 65   | 92   | 122  | -    | 145  | 195  | 261  | 300  | 400  | 475  | 525  | 700  | 750  | 850  | 1100 | 1400 | 1500 | 1500 | 1500  |       |
| Max. cable size, IP21/55/66 (mains, motor, brake) [mm <sup>2</sup> ]/[AWG] <sup>2)</sup> | 4/10                               |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |
| Max. cable size, IP 20 (mains, motor, brake) [mm <sup>2</sup> ]/[AWG] <sup>2)</sup>      | 4/10                               |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |
| Mains disconnect switch included:  | 4/10                               |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |
| Weight IP20 [kg]   | 6.5                                | 6.5  | 6.5  | 6.5  | -    | 6.5  | 6.6  | 6.6  | 12   | 12   | 12   | 23.5 | 23.5 | 23.5 | 35   | 35   | 35   | 35   | 50   | 50    |       |
| Weight IP21/55 [kg]  | 13.5                               | 13.5 | 13.5 | 13.5 | 13.5 | 13.5 | 14.2 | 14.2 | 23   | 23   | 23   | 27   | 27   | 27   | 45   | 45   | 45   | 45   | 65   | 65    |       |
| Efficiency <sup>4)</sup>   | 0.97                               | 0.97 | 0.97 | 0.97 | -    | 0.97 | 0.97 | 0.97 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98  |       |

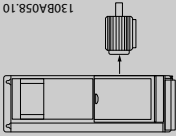
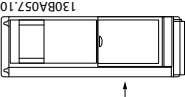
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Table 10.5 <sup>5)</sup> With brake and load sharing 95/ 4/0



10.1.1 Mains Supply 3 x 525 - 690V AC

10

| Size:   | Normal overload 110% for 1 minute  |      |      |      |      |      |      |      |      |       |  |
|---|--|------|------|------|------|------|------|------|------|-------|--|
|   | P11K   | P15K | P18K | P22K | P30K | P37K | P45K | P55K | P75K | P90K  |  |
| Typical Shaft Output [kW]   | 11   | 15   | 18.5 | 22   | 30   | 37   | 45   | 55   | 75   | 90    |  |
| Typical Shaft Output [HP] at 575V   | 10   | 16.4 | 20.1 | 24   | 33   | 40   | 50   | 60   | 75   | 100   |  |
| IP21 / NEMA 1   | B2   | B2   | B2   | B2   | B2   | C2   | C2   | C2   | C2   | C2    |  |
| IP55 / NEMA 12  | B2   | B2   | B2   | B2   | B2   | C2   | C2   | C2   | C2   | C2    |  |
| <b>Output current</b>   |  |      |      |      |      |      |      |      |      |       |  |
|  | Continuous<br>(3 x 525-550V) [A]   | 14   | 19   | 23   | 28   | 36   | 54   | 65   | 87   | 105   |  |
|   | Intermittent<br>(3 x 525-550V) [A]   | 15.4 | 20.9 | 25.3 | 30.8 | 39.6 | 59.4 | 71.5 | 95.7 | 115.5 |  |
|   | Continuous<br>(3 x 551-690V) [A]   | 13   | 18   | 22   | 27   | 34   | 41   | 52   | 62   | 83    |  |
|   | Intermittent<br>(3 x 551-690V) [A]   | 14.3 | 19.8 | 24.2 | 29.7 | 37.4 | 45.1 | 57.2 | 68.2 | 91.3  |  |
|   | Continuous kVA (550V AC) [kVA]   | 13.3 | 18.1 | 21.9 | 26.7 | 34.3 | 41   | 51.4 | 61.9 | 82.9  |  |
|   | Continuous kVA (575V AC) [kVA]   | 12.9 | 17.9 | 21.9 | 26.9 | 33.8 | 40.8 | 51.8 | 61.7 | 82.7  |  |
|   | Continuous kVA (690V AC) [kVA]   | 15.5 | 21.5 | 26.3 | 32.3 | 40.6 | 49   | 62.1 | 74.1 | 99.2  |  |
|   | Max. cable size<br>(mains, motor, brake)<br>[mm <sup>2</sup> ]/[AWG] <sup>2)</sup> |      |      | 35   |      |      |      |      | 95   |       |  |
|   |  |      |      | 1/0  |      |      |      |      | 4/0  |       |  |
|   | <b>Max. input current</b>  |      |      |      |      |      |      |      |      |       |  |
|  | Continuous<br>(3 x 525-690V) [A]   | 15   | 19.5 | 24   | 29   | 36   | 59   | 71   | 87   | 99    |  |
|   | Intermittent<br>(3 x 525-690V) [A]   | 16.5 | 21.5 | 26.4 | 31.9 | 39.6 | 64.9 | 78.1 | 95.7 | 108.9 |  |
|   | Max. pre-fuses <sup>1)</sup> [A]   | 63   | 63   | 63   | 63   | 80   | 100  | 125  | 160  | 160   |  |
|   | Environment:   |      |      |      |      |      |      |      |      |       |  |
|   | Estimated power loss<br>at rated max. load [W] <sup>4)</sup>                       | 201  | 285  | 335  | 375  | 430  | 592  | 720  | 880  | 1200  |  |
|   | Weight:  |      |      |      |      |      |      |      |      |       |  |
|   | IP21 [kg]  | 27   | 27   | 27   | 27   | 27   | 65   | 65   | 65   | 65    |  |
|   | IP55 [kg]  | 27   | 27   | 27   | 27   | 27   | 65   | 65   | 65   | 65    |  |
|   | Efficiency <sup>4)</sup>   | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98  |  |

1) For type of fuse see  
2) American Wire Gauge  
3) Measured using 5 m. screened motor cables at rated load and rated frequency  
4) The typical power loss is at normal load conditions and expected to be within +/- 15% (tolerance relates to variety in voltage and cable conditions).  
Values are based on a typical motor efficiency (eff2/eff3 border line). Lower efficiency motors will also add to the power loss in the frequency converter and vice versa.  
If the switching frequency is raised from nominal the power losses may rise significantly.  
LCP and typical control card power consumptions are included. Further options and customer load may add up to 30 Watts to the losses. (Though typically only 4 Watts extra for a fully loaded control card or options for slot A or slot B, each).  
Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (+/- 5%).  
5) Motor and mains cable: 300MCM/150mm<sup>2</sup>

Table 10.6 Mains Supply 3 x 525 - 690V AC

## 10.2 General Technical Data

### Mains supply

|                            |                           |
|----------------------------|---------------------------|
| Supply Terminals (6-Pulse) | L1, L2, L3                |
| Supply voltage             | 200-240 V ±10%            |
| Supply voltage             | 380-480 V/ 380-500 V ±10% |
|                            | : 525-600 V ±10%          |
| Supply voltage             | : 525-690 V ±10%          |

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

During low mains voltage or a mains drop-out, the FC continues until the intermediate circuit voltage drops below the minimum stop level, which corresponds typically to 15% below the 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 ( $\lambda$ )                           | ≥ 0.9 nominal at rated load                 |
| Displacement Power Factor ( $\cos \phi$ )                 | near unity (> 0.98)                         |
| Switching on input supply L1, L2, L3 (power-ups) ≤ 7.5kW  | maximum 2 times/min.                        |
| Switching on input supply L1, L2, L3 (power-ups) 11-75 kW | maximum 1 time/min.                         |
| Switching on input supply L1, L2, L3 (power-ups) ≥ 90kW   | maximum 1 time/2 min.                       |
| Environment according to EN60664-1                        | overvoltage category III/pollution degree 2 |

The unit is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes, 240/500/600/ 690 V maximum.

### Motor output (U, V, W)

|                                       |                              |
|---------------------------------------|------------------------------|
| Output voltage                        | 0 - 100% of supply voltage   |
| Output frequency (0.25-75 kW)         | : 0.2 - 1000 Hz/ 0 - 1000 Hz |
| Output frequency (90-1000 kW)         | 0 - 800 <sup>1)</sup> Hz     |
| Output frequency in Flux Mode ( only) | 0 - 300Hz                    |
| Switching on output                   | Unlimited                    |
| Ramp times                            | 0.01 - 3600 s                |

<sup>1)</sup> Voltage and power dependent

### Torque characteristics

|                                   |   |
|-----------------------------------|---|
| Starting torque (Constant torque) | maximum 160% for 60 s. <sup>1)</sup>      |
| Starting torque                   | maximum 180% up to 0.5 sec. <sup>1)</sup> |
| Overload torque (Constant torque) | maximum 160% for 60 s <sup>1)</sup>       |
| Starting torque (Variable torque) | maximum 110% for 60 s <sup>1)</sup>       |
| Overload torque (Variable torque) | maximum 110% for 60 s                     |

|  |       |
|--|-------|
| Torque rise time in (independent of fsw) | 10 ms |
| Torque rise time in FLUX (for 5 kHz fsw) | 1 ms  |

<sup>1)</sup> Percentage relates to the nominal torque.

<sup>2)</sup> The torque response time depends on application and load but as a general rule, the torque step from 0 to reference is 4-5 x torque rise time.

### Cable lengths and cross sections for control cables<sup>1)</sup>

|  |                              |
|--|------------------------------|
| Max. motor cable length, screened  | : 50 m/ (A1): 25 m/ : 150 m  |
| Max. motor cable length, unscreened  | : 75 m/ (A1): 50 m/ : 300 m  |
| Maximum cross section to control terminals, flexible/ rigid wire without cable end sleeves   | 1.5 mm <sup>2</sup> /16 AWG  |
| Maximum cross section to control terminals, flexible wire with cable end sleeves             | 1 mm <sup>2</sup> /18 AWG    |
| Maximum cross section to control terminals, flexible wire with cable end sleeves with collar | 0.5 mm <sup>2</sup> /20 AWG  |
| Minimum cross section to control terminals   | 0.25 mm <sup>2</sup> / 24AWG |

<sup>1)</sup>For power cables, see electrical data tables.

**Digital inputs**

|  |   |
|--|---|
| Programmable digital inputs                | : 4 (5) <sup>1)</sup> : 4 (6) <sup>1)</sup>           |
| Terminal number                            | 18, 19, 27 <sup>1)</sup> , 29 <sup>1)</sup> , 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 <sup>2)</sup> | > 19 V DC   |
| Voltage level, logic '1' NPN <sup>2)</sup> | < 14 V DC   |
| Maximum voltage on input                   | 28 V DC   |
| Pulse frequency range                      | 0 - 110 kHz   |
| (Duty cycle) Min. pulse width              | 4.5 ms  |
| Input resistance, R <sub>i</sub>           | approx. 4 kΩ  |

**Safe stop Terminal 37<sup>3, 4)</sup> (Terminal 37 is fixed PNP logic)**

|                               |             |
|-------------------------------|-------------|
| Voltage level                 | 0 - 24 V DC |
| Voltage level, logic '0' PNP  | < 4 V DC    |
| Voltage level, logic '1' PNP  | > 20 V DC   |
| Maximum voltage on input      | 28 V DC     |
| Typical input current at 24 V | 50 mA rms   |
| Typical input current at 20 V | 60 mA rms   |
| Input capacitance             | 400 nF      |

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

<sup>1)</sup> Terminals 27 and 29 can also be programmed as output.

<sup>2)</sup> Except safe stop input Terminal 37.

<sup>3)</sup> See for further information about terminal 37 and Safe Stop.

<sup>4)</sup> When using a contactor with a DC coil inside in combination with Safe Stop, it is important to make a return way for the current from the coil when turning it off. This can be done by using a freewheel diode (or, alternatively, a 30 or 50 V MOV for quicker response time) across the coil. Typical contactors can be bought with this diode.

**10**
**Analog inputs**

|                                  |   |
|----------------------------------|---|
| Number of analog inputs          | 2                                       |
| Terminal number                  | 53, 54                                  |
| Modes                            | Voltage or current                      |
| Mode select                      | Switch S201 and switch S202             |
| Voltage mode                     | Switch S201/switch S202 = OFF (U)       |
| Voltage level                    | : 0 to + 10/ : -10 to +10 V (scaleable) |
| Input resistance, R <sub>i</sub> | approx. 10 kΩ                           |
| Max. voltage                     | ± 20 V                                  |
| Current mode                     | Switch S201/switch S202 = ON (I)        |
| Current level                    | 0/4 to 20 mA (scaleable)                |
| Input resistance, R <sub>i</sub> | 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                        | : 20 Hz/ : 100 Hz                       |

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

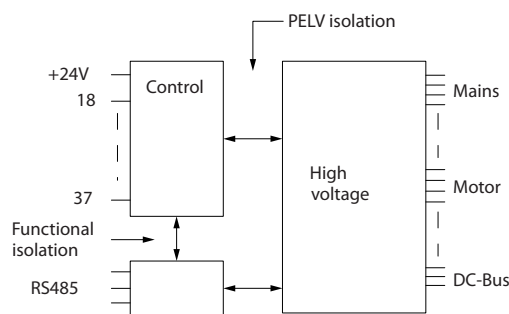


Illustration 10.1

Pulse/encoder inputs

|                                       |   |
|---------------------------------------|---|
| Programmable pulse/encoder inputs     | 2/1   |
| Terminal number pulse/encoder         | 29 <sup>1)</sup> , 33 <sup>2)</sup> / 32 <sup>3)</sup> , 33 <sup>3)</sup> |
| Max. frequency at terminal 29, 32, 33 | 110 kHz (Push-pull driven)  |
| Max. frequency at terminal 29, 32, 33 | 5 kHz (open collector)  |
| Min. frequency at terminal 29, 32, 33 | 4 Hz  |
| Voltage level                         | see   |
| Maximum voltage on input              | 28 V DC   |
| Input resistance, R <sub>i</sub>      | approx. 4 kΩ  |
| Pulse input accuracy (0.1 - 1 kHz)    | Max. error: 0.1% of full scale  |
| Encoder input accuracy (1 - 11 kHz)   | Max. error: 0.05 % of full scale  |

The pulse and encoder inputs (terminals 29, 32, 33) are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

<sup>1)</sup> only

<sup>2)</sup> Pulse inputs are 29 and 33

<sup>3)</sup> Encoder inputs: 32 = A, and 33 = B

Analog output

|                                       |                                |
|---------------------------------------|--------------------------------|
| Number of programmable analog outputs | 1                              |
| Terminal number                       | 42                             |
| Current range at analog output        | 0/4 - 20 mA                    |
| Max. load GND - analog output         | 500 Ω                          |
| Accuracy on analog output             | Max. error: 0.5% of full scale |
| Resolution on analog output           | 12 bit                         |

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

Control card, RS-485 serial communication:

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

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

Digital output

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

<sup>1)</sup> 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, 24V DC output**

|                 |                    |
|-----------------|--------------------|
| Terminal number | 12, 13             |
| Output voltage  | 24 V +1, -3 V      |
| Max. load       | : 130 mA/ : 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   | all kW: 1 / all kW: 2                       |
| Relay 01 Terminal number   | 1-3 (break), 1-2 (make)                     |
| Max. terminal load (AC-1) <sup>1)</sup> on 1-3 (NC), 1-2 (NO) (Resistive load)                           | 240 V AC, 2 A                               |
| Max. terminal load (AC-15) <sup>1)</sup> (Inductive load @ cosφ 0.4)                                     | 240 V AC, 0.2 A                             |
| Max. terminal load (DC-1) <sup>1)</sup> on 1-2 (NO), 1-3 (NC) (Resistive load)                           | 60 V DC, 1 A                                |
| Max. terminal load (DC-13) <sup>1)</sup> (Inductive load)  | 24 V DC, 0.1 A                              |
| Relay 02 ( only) Terminal number   | 4-6 (break), 4-5 (make)                     |
| Max. terminal load (AC-1) <sup>1)</sup> on 4-5 (NO) (Resistive load) <sup>2)3)</sup> Overvoltage cat. II | 400 V AC, 2A                                |
| Max. terminal load (AC-15) <sup>1)</sup> on 4-5 (NO) (Inductive load @ cosφ 0.4)                         | 240 V AC, 0.2A                              |
| Max. terminal load (DC-1) <sup>1)</sup> on 4-5 (NO) (Resistive load)                                     | 80 V DC, 2 A                                |
| Max. terminal load (DC-13) <sup>1)</sup> on 4-5 (NO) (Inductive load)                                    | 24 V DC, 0.1 A                              |
| Max. terminal load (AC-1) <sup>1)</sup> on 4-6 (NC) (Resistive load)                                     | 240 V AC, 2 A                               |
| Max. terminal load (AC-15) <sup>1)</sup> on 4-6 (NC) (Inductive load @ cosφ 0.4)                         | 240 V AC, 0.2 A                             |
| Max. terminal load (DC-1) <sup>1)</sup> on 4-6 (NC) (Resistive load)                                     | 50 V DC, 2 A                                |
| Max. terminal load (DC-13) <sup>1)</sup> on 4-6 (NC) (Inductive load)                                    | 24 V DC, 0.1 A                              |
| Min. terminal load on 1-3 (NC), 1-2 (NO), 4-6 (NC), 4-5 (NO)   | 24 V DC 10mA, 24 V AC 20 mA                 |
| Environment according to EN 60664-1  | overvoltage category III/pollution degree 2 |

<sup>1)</sup> IEC 60947 part 4 and 5

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

<sup>2)</sup> Overvoltage Category II

<sup>3)</sup> UL applications 300V AC2A

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**Control card, 10V DC output**

|                 |               |
|-----------------|---------------|
| Terminal number | 50            |
| Output voltage  | 10.5 V ±0.5 V |
| Max. load       | 15 mA         |

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

**Control characteristics**

|  |                               |
|--|-------------------------------|
| Resolution of output frequency at 0 - 1000 Hz                            | ± 0.003 Hz                    |
| Repeat accuracy of <i>Precise start/stop</i> (terminals 18, 19)          | ±0.1 ms                       |
| System response time (terminals 18, 19, 27, 29, 32, 33)                  | ≤ 2 ms                        |
| Speed control range (open loop)  | 1:100 of synchronous speed    |
| Speed control range (closed loop)  | 1:1000 of synchronous speed   |
| Speed accuracy (open loop)   | 30 - 4000 rpm: error ±8rpm    |
| Speed accuracy (closed loop), depending on resolution of feedback device | 0 - 6000 rpm: error ±0.15 rpm |
| Torque control accuracy (speed feedback)                                 | max error±5% of rated torque  |

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

**Environment**

|   |  |
|---|--|
| Enclosure   | IP20 <sup>1)</sup> / Type 1, IP21 <sup>2)</sup> / Type 1, IP55/ Type 12, IP 66 |
| Vibration test  | 1.0g   |
| Max. relative humidity  | 5% - 93%(IEC 721-3-3; Class 3K3 (non-condensing) during operation              |
| Aggressive environment (IEC 60068-2-43) H <sub>2</sub> S test | class Kd   |
| Ambient temperature <sup>3)</sup>                             | Max. 50°C (24-hour average maximum 45°C)                                       |

<sup>1)</sup> Only for ≤ 3.7 kW (200 - 240 V), ≤ 7.5 kW (400 - 480/ 500 V)

<sup>2)</sup> As enclosure kit for ≤ 3.7 kW (200 - 240 V), ≤ 7.5 kW (400 - 480/ 500 V)

<sup>3)</sup> Derating for high ambient temperature, see special conditions in the Design Guide

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

*Derating for high altitude, see special conditions in the Design Guide*

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

*See section on special conditions in the Design Guide.*

#### Control card performance

|  |                          |
|--|--------------------------|
| Scan interval                          | : 5 ms / : 1ms           |
| Control card, USB serial communication |                          |
| USB standard                           | 1.1 (Full speed)         |
| USB plug                               | USB type B "device" plug |

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

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

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

#### Protection and Features

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the frequency converter trips if the temperature reaches a predefined level. An overload temperature cannot be reset until the temperature of the heatsink is below the values stated in the tables on the following pages (Guideline - these temperatures may vary for different power sizes, frame sizes, enclosure ratings etc.).
- 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 constantly checks for critical levels of internal temperature, load current, high voltage on the intermediate circuit and low motor speeds. As a response to a critical level, the frequency converter can adjust the switching frequency and/ or change the switching pattern in order to ensure the performance of the frequency converter.

### 10.3 Fuse Tables

#### 10.3.1 Branch Circuit Protection Fuses

For compliance with IEC/EN 61800-5-1 electrical standards the following fuses are recommended.

| Frequency converter   | Maximum fuse size | Voltage | Type    |
|---|-------------------|---------|---------|
| <b>200-240 V - T2</b>   |                   |         |         |
| 1K1-1K5   | 16A <sup>1</sup>  | 200-240 | type gG |
| 2K2   | 25A <sup>1</sup>  | 200-240 | type gG |
| 3K0   | 25A <sup>1</sup>  | 200-240 | type gG |
| 3K7   | 35A <sup>1</sup>  | 200-240 | type gG |
| 5K5   | 50A <sup>1</sup>  | 200-240 | type gG |
| 7K5   | 63A <sup>1</sup>  | 200-240 | type gG |
| 11K   | 63A <sup>1</sup>  | 200-240 | type gG |
| 15K   | 80A <sup>1</sup>  | 200-240 | type gG |
| 18K5  | 125A <sup>1</sup> | 200-240 | type gG |
| 22K   | 125A <sup>1</sup> | 200-240 | type gG |
| 30K   | 160A <sup>1</sup> | 200-240 | type gG |
| 37K   | 200A <sup>1</sup> | 200-240 | type aR |
| 45K   | 250A <sup>1</sup> | 200-240 | type aR |
| <b>380-480 V - T4</b>   |                   |         |         |
| 1K1-1K5   | 10A <sup>1</sup>  | 380-500 | type gG |
| 2K2-3K0   | 16A <sup>1</sup>  | 380-500 | type gG |
| 4K0-5K5   | 25A <sup>1</sup>  | 380-500 | type gG |
| 7K5   | 35A <sup>1</sup>  | 380-500 | type gG |
| 11K-15K   | 63A <sup>1</sup>  | 380-500 | type gG |
| 18K   | 63A <sup>1</sup>  | 380-500 | type gG |
| 22K   | 63A <sup>1</sup>  | 380-500 | type gG |
| 30K   | 80A <sup>1</sup>  | 380-500 | type gG |
| 37K   | 100A <sup>1</sup> | 380-500 | type gG |
| 45K   | 125A <sup>1</sup> | 380-500 | type gG |
| 55K   | 160A <sup>1</sup> | 380-500 | type gG |
| 75K   | 250A <sup>1</sup> | 380-500 | type aR |
| 90K   | 250A <sup>1</sup> | 380-500 | type aR |
| 1) Max. fuses - see national/international regulations for selecting an applicable fuse size. |                   |         |         |

Table 10.7 EN50178 fuses 200 V to 480 V

### 10.3.2 UL and cUL Branch Circuit Protection Fuses

For compliance with UL and cUL electrical standards the following fuses or UL/cUL approved substitutions are required. Maximum fuse ratings are listed.

| Frequency converter         | Bussmann | Bussmann | Bussmann | SIBA        | Littel fuse | Ferraz-Shawmut | Ferraz-Shawmut |
|-----------------------------|----------|----------|----------|-------------|-------------|----------------|----------------|
| <b>200-240 V</b>            |          |          |          |             |             |                |                |
| kW                          | Type RK1 | Type J   | Type T   | Type RK1    | Type RK1    | Type CC        | Type RK1       |
| K25-K37                     | KTN-R05  | JKS-05   | JJN-05   | 5017906-005 | KLN-R005    | ATM-R05        | A2K-05R        |
| K55-1K1                     | KTN-R10  | JKS-10   | JJN-10   | 5017906-010 | KLN-R10     | ATM-R10        | A2K-10R        |
| 1K5                         | KTN-R15  | JKS-15   | JJN-15   | 5017906-015 | KLN-R15     | ATM-R15        | A2K-15R        |
| 2K2                         | KTN-R20  | JKS-20   | JJN-20   | 5012406-020 | KLN-R20     | ATM-R20        | A2K-20R        |
| 3K0                         | KTN-R25  | JKS-25   | JJN-25   | 5012406-025 | KLN-R25     | ATM-R25        | A2K-25R        |
| 3K7                         | KTN-R30  | JKS-30   | JJN-30   | 5012406-030 | KLN-R30     | ATM-R30        | A2K-30R        |
| 5K5                         | KTN-R50  | JKS-50   | JJN-50   | 5012406-050 | KLN-R50     | -              | A2K-50R        |
| 7K5                         | KTN-R50  | JKS-60   | JJN-60   | 5012406-050 | KLN-R60     | -              | A2K-50R        |
| 11K                         | KTN-R60  | JKS-60   | JJN-60   | 5014006-063 | KLN-R60     | A2K-60R        | A2K-60R        |
| 15K                         | KTN-R80  | JKS-80   | JJN-80   | 5014006-080 | KLN-R80     | A2K-80R        | A2K-80R        |
| 18K5                        | KTN-R125 | JKS-150  | JJN-125  | 2028220-125 | KLN-R125    | A2K-125R       | A2K-125R       |
| 22K                         | KTN-R125 | JKS-150  | JJN-125  | 2028220-125 | KLN-R125    | A2K-125R       | A2K-125R       |
| 30K                         | FWX-150  | -        | -        | 2028220-150 | L25S-150    | A25X-150       | A25X-150       |
| 37K                         | FWX-200  | -        | -        | 2028220-200 | L25S-200    | A25X-200       | A25X-200       |
| 45K                         | FWX-250  | -        | -        | 2028220-250 | L25S-250    | A25X-250       | A25X-250       |
| <b>380-480 V, 525-600 V</b> |          |          |          |             |             |                |                |
| kW                          | Type RK1 | Type J   | Type T   | Type RK1    | Type RK1    | Type CC        | Type RK1       |
| K37-1K1                     | KTS-R6   | JKS-6    | JJS-6    | 5017906-006 | KLS-R6      | ATM-R6         | A6K-6R         |
| 1K5-2K2                     | KTS-R10  | JKS-10   | JJS-10   | 5017906-010 | KLS-R10     | ATM-R10        | A6K-10R        |
| 3K0                         | KTS-R15  | JKS-15   | JJS-15   | 5017906-016 | KLS-R16     | ATM-R16        | A6K-16R        |
| 4K0                         | KTS-R20  | JKS-20   | JJS-20   | 5017906-020 | KLS-R20     | ATM-R20        | A6K-20R        |
| 5K5                         | KTS-R25  | JKS-25   | JJS-25   | 5017906-025 | KLS-R25     | ATM-R25        | A6K-25R        |
| 7K5                         | KTS-R30  | JKS-30   | JJS-30   | 5012406-032 | KLS-R30     | ATM-R30        | A6K-30R        |
| 11K                         | KTS-R40  | JKS-40   | JJS-40   | 5014006-040 | KLS-R40     | -              | A6K-40R        |
| 15K                         | KTS-R40  | JKS-40   | JJS-40   | 5014006-040 | KLS-R40     | -              | A6K-40R        |
| 18K                         | KTS-R50  | JKS-50   | JJS-50   | 5014006-050 | KLS-R50     | -              | A6K-50R        |
| 22K                         | KTS-R60  | JKS-60   | JJS-60   | 5014006-063 | KLS-R60     | -              | A6K-60R        |
| 30K                         | KTS-R80  | JKS-80   | JJS-80   | 2028220-100 | KLS-R80     | -              | A6K-80R        |
| 37K                         | KTS-R100 | JKS-100  | JJS-100  | 2028220-125 | KLS-R100    |                | A6K-100R       |
| 45K                         | KTS-R125 | JKS-150  | JJS-150  | 2028220-125 | KLS-R125    |                | A6K-125R       |
| 55K                         | KTS-R150 | JKS-150  | JJS-150  | 2028220-160 | KLS-R150    |                | A6K-150R       |
| 75K                         | FWH-220  | -        | -        | 2028220-200 | L50S-225    |                | A50-P225       |
| 90K                         | FWH-250  | -        | -        | 2028220-250 | L50S-250    |                | A50-P250       |

Table 10.8 UL fuses, 200 - 240 V and 380 - 600 V



### 10.3.3 Substitute Fuses for 240 V

| Original fuse | Manufacturer   | Substitute fuses |
|---------------|----------------|------------------|
| KTN           | Bussmann       | KTS              |
| FWX           | Bussmann       | FWH              |
| KLNR          | LITTEL FUSE    | KLSR             |
| L50S          | LITTEL FUSE    | L50S             |
| A2KR          | FERRAZ SHAWMUT | A6KR             |
| A25X          | FERRAZ SHAWMUT | A50X             |

Table 10.9

### 10.4 Connection Tightening Torques

| Enclosure | Power (kW) |               |            | Torque (Nm) |                     |                     |               |       |       |       |
|-----------|------------|---------------|------------|-------------|---------------------|---------------------|---------------|-------|-------|-------|
|           | 200-240V   | 380-480/500 V | 525-600V   | 525-690V    | Mains               | Motor               | DC connection | Brake | Earth | Relay |
| A2        | 0.25 - 2.2 | 0.37 - 4.0    |            |             | 1.8                 | 1.8                 | 1.8           | 1.8   | 3     | 0.6   |
| A3        | 3.0 - 3.7  | 5.5 - 7.5     | 0.75 - 7.5 |             | 1.8                 | 1.8                 | 1.8           | 1.8   | 3     | 0.6   |
| A4        | 0.25 - 2.2 | 0.37 - 4.0    |            |             | 1.8                 | 1.8                 | 1.8           | 1.8   | 3     | 0.6   |
| A5        | 0.25 - 3.7 | 0.37 - 7.5    | 0.75 - 7.5 |             | 1.8                 | 1.8                 | 1.8           | 1.8   | 3     | 0.6   |
| B1        | 5.5 - 7.5  | 11 - 15       | 11 - 15    |             | 1.8                 | 1.8                 | 1.5           | 1.5   | 3     | 0.6   |
| B2        | 11         | 18            | 18         | 11          | 4.5                 | 4.5                 | 3.7           | 3.7   | 3     | 0.6   |
|           |            | 22            | 22         | 22          | 4.5                 | 4.5                 | 3.7           | 3.7   | 3     | 0.6   |
| B3        | 5.5 - 7.5  | 11 - 15       | 11 - 15    |             | 1.8                 | 1.8                 | 1.8           | 1.8   | 3     | 0.6   |
| B4        | 11 - 15    | 18 - 30       | 18 - 30    |             | 4.5                 | 4.5                 | 4.5           | 4.5   | 3     | 0.6   |
| C1        | 15 - 22    | 30 - 45       | 30 - 45    |             | 10                  | 10                  | 10            | 10    | 3     | 0.6   |
| C2        | 30 - 37    | 55 - 75       | 55 - 75    | 30 - 75     | 14/24 <sup>1)</sup> | 14/24 <sup>1)</sup> | 14            | 14    | 3     | 0.6   |
| C3        | 18 - 22    | 37 - 45       | 37 - 45    |             | 10                  | 10                  | 10            | 10    | 3     | 0.6   |
| C4        | 30 - 37    | 55 - 75       | 55 - 75    |             | 14/24 <sup>1)</sup> | 14/24 <sup>1)</sup> | 14            | 14    | 3     | 0.6   |

Table 10.10 Tightening of Terminals

<sup>1)</sup> For different cable dimensions x/y, where  $x \leq 95\text{mm}^2$  and  $y \geq 95\text{mm}^2$ .

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