



Instruction Manual

VLT[®] Refrigeration Drive FC 103, 75–400 kW

Safety

⚠ WARNING

HIGH VOLTAGE!

Adjustable frequency drives contain high voltage when connected to AC line power. Installation, startup, and maintenance should be performed by qualified personnel only. Failure to perform installation, startup, and maintenance by qualified personnel could result in death or serious injury.

High Voltage

Adjustable frequency drives are connected to hazardous AC line voltage. 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 adjustable frequency drive is connected to AC line power, the motor may start at any time. The adjustable frequency drive, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the adjustable frequency drive is connected to AC line power could result in death, serious injury, equipment, or property damage.

Unintended Start

When the adjustable frequency drive is connected to AC line power, the motor may be started with an external switch, a serial bus command, an input reference signal, or a cleared fault condition. Use appropriate caution to guard against an unintended start.

⚠ WARNING

DISCHARGE TIME!

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

Voltage [V]	Power range hp [kW]	Minimum waiting time [min]
3 x 400	125–350 [90–250]	20
3 x 400	150–450 [110–315]	20
3 x 480	150–450 [110–315]	20
3 x 480	175–475 [132–355]	20
3 x 550	75–450 [55–315]	20
3 x 690	100–550 [75–400]	20

Discharge Time

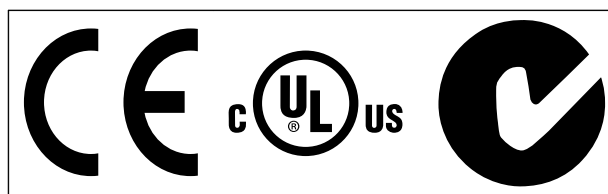


Table 1.2

NOTE!

Imposed limitations on the output frequency (due to export control regulations):

From software version 6.72, the output frequency of the adjustable frequency drive is limited to 590 Hz. Software versions 6x.xx also limit the maximum output frequency to 590 Hz, but these versions cannot be flashed, i.e., neither downgraded nor upgraded.

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1 Introduction

1.1 Product Overview

1.1.1 Interior Views

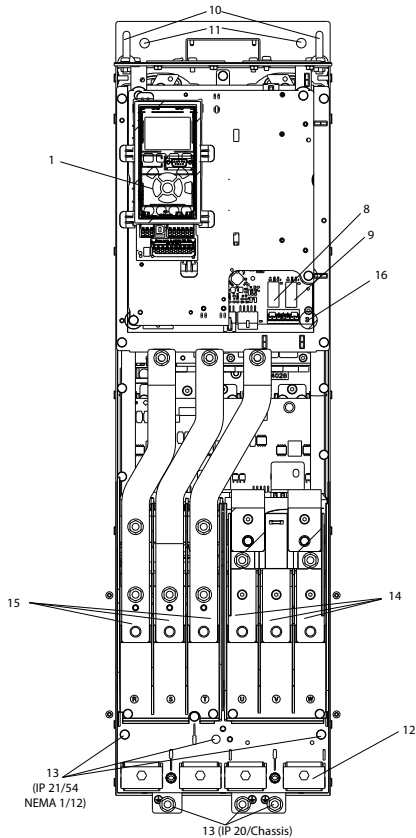


Figure 1.1 D1 Interior Components

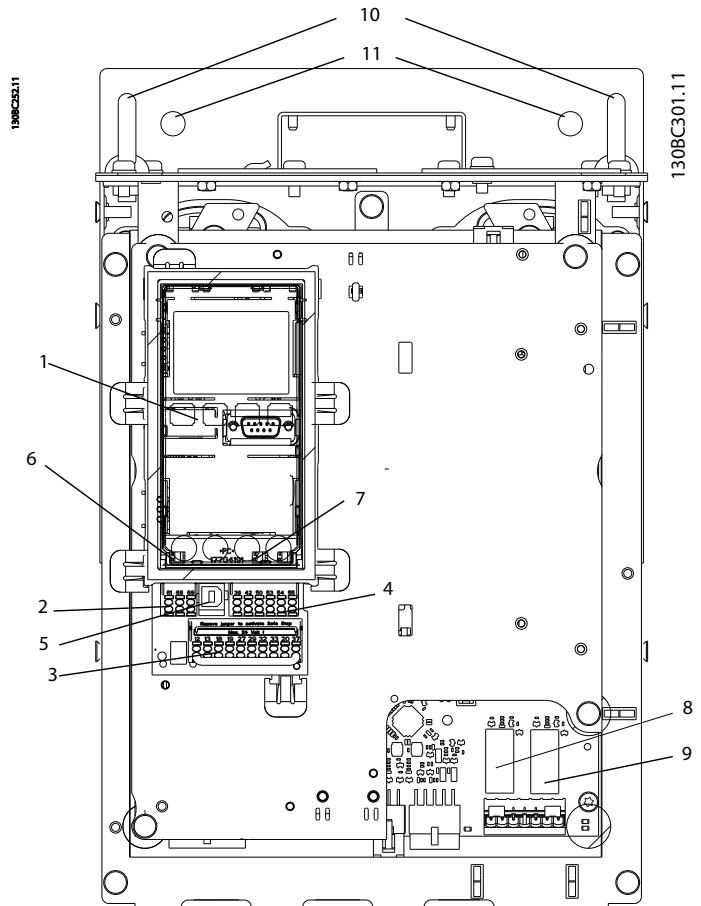


Figure 1.2 Close-up View: LCP and Control Functions

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

Table 1.1

1.2 Purpose of the Manual

This manual is intended to provide detailed information for the installation and start up of the adjustable frequency drive. 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 details include user interface, detailed programming, application examples, start-up troubleshooting, and specifications.

1.3 Additional Resources

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

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

1.4 Product Overview

An adjustable frequency drive is an electronic motor controller that converts AC line power input into a variable AC waveform output. The frequency and voltage of the output are regulated to control the motor speed or torque. The adjustable frequency drive can vary the speed of the motor in response to system feedback, such as position sensors on a conveyor belt. The adjustable frequency drive can also regulate the motor by responding to remote commands from external controllers.

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

1.5 Internal Controller Functions

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

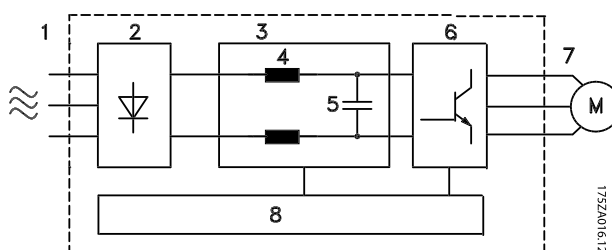


Figure 1.3 Adjustable Frequency Drive Block Diagram

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

Table 1.2 Legend to Figure 1.3

1.6 Frame Sizes and Power Ratings

Normal Overload [kW]	90	110	132	160	200	250	315	355	400
400 V		D3h	D3h	D3h	D4h	D4h	D4h		
480 V			D3h	D3h	D3h	D4h	D4h	D4h	
525 V	D3h	D3h	D3h	D4h	D4h	D4h	D4h		
690 V		D3h	D3h	D3h	D4h	D4h	D4h		D4h

Table 1.3 kW Rated Adjustable Frequency Drives

Normal Overload [HP]	125	150	200	250	300	350	400	450
460 V		D3h	D3h	D3h	D4h	D4h		D4h
575 V	D3h	D3h	D3h	D4h	D4h	D4h	D4h	

Table 1.4 HP Rated Adjustable Frequency Drives

2 Installation

2.1 Planning the Installation Site

NOTE!

Before performing the installation, it is important to plan the installation of the adjustable frequency drive.

Neglecting this may result in extra work during and after installation.

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

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

Voltage [V]	Altitude restrictions
380–500	At altitudes above 10,000 ft [3 km], contact Danfoss regarding PELV
525–690	At altitudes above 6,600 ft [2 km], contact Danfoss regarding PELV

Table 2.1 Installation in High Altitudes

2.1.2 Planning the Installation Site

NOTE!

Before performing the installation, it is important to plan the installation of the adjustable frequency drive.

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380–480	At altitudes above 10,000 ft [3 km], contact Danfoss regarding PELV
525–690	At altitudes above 6,600 ft [2 km], contact Danfoss regarding PELV

Table 2.2 Installation in High Altitudes

2.2 Pre-Installation Check List

- Before unpacking the adjustable frequency drive, ensure the packaging is intact. If any damage has occurred, immediately contact the shipping company to claim the damage.
- Before unpacking the adjustable frequency drive, locate it as close as possible to the final installation site
- Compare the model number on the nameplate to what was ordered to verify the proper equipment
- Ensure each of the following are rated for the same voltage:
 - Line power
 - Adjustable frequency drive
 - Motor
- Ensure that adjustable frequency drive output current rating is equal to or greater than motor full load current for peak motor performance
 - Motor size and adjustable frequency drive power must match for proper overload protection
 - If adjustable frequency drive rating is less than motor, full motor output cannot be achieved

2.3 Mechanical Installation

2.3.1 Cooling

- Top and bottom clearance for air cooling must be provided. Generally, 9 in [225 mm] is required.
- Improper mounting can result in overheating and reduced performance.
- Derating for temperatures starting between 113°F [45°C] and 122°F [50°C] and elevation 3,300 ft [1,000 m] above sea level must be considered. See VLT® *Design Guide* for detailed information.

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

Duct cooling

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

Cooling out the back (top and bottom covers)

The backchannel cooling air can be ventilated out of the room so that the heat from the backchannel is not dissipated into the control room.

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

Airflow

The necessary airflow over the heatsink must be ensured. The flow rate is shown in *Table 2.3*.

The fan runs for the following reasons:

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

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

Table 2.3 Airflow

2.3.2 Lifting

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

CAUTION

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

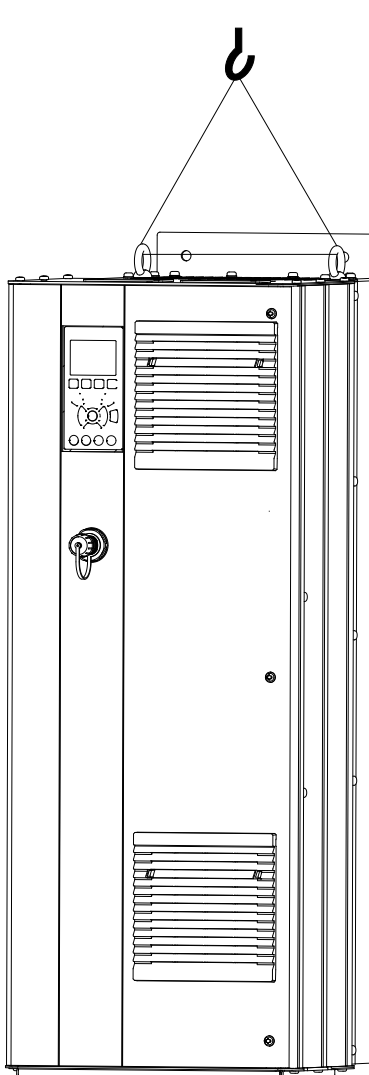


Figure 2.1 Recommended Lifting Method

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

Consider the following before selecting the final installation site:

- Clearance space for cooling
- Clearance for opening the door
- Cable entry clearance from the bottom

2.4 Electrical Installation

2.4.1 General Requirements

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

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

WARNING

EQUIPMENT HAZARD!

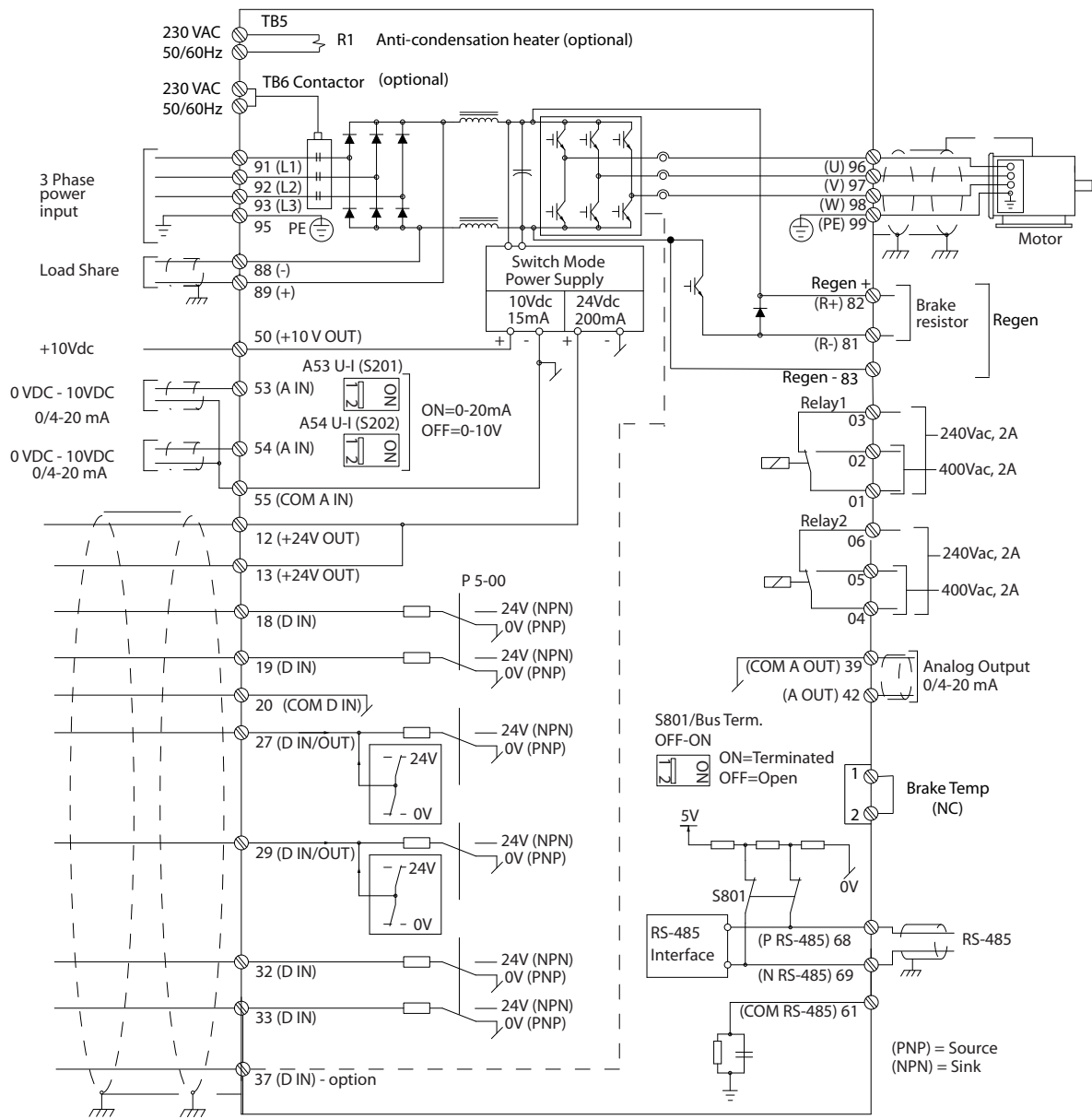
Rotating shafts and electrical equipment can be hazardous. All electrical work must conform to national and local electrical codes. It is strongly recommended that installation, start-up, and maintenance be performed only by trained and qualified personnel. Failure to follow these guidelines could result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

CAUTION

WIRING ISOLATION!

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

2



130RC54R.11

Figure 2.2 Interconnect Diagram

For your safety, comply with the following requirements

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

Overload and Equipment Protection

- An electronically activated function within the adjustable frequency drive 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 line power, motor power, and control is run separately. Use metallic conduit or separated shielded wire. See *Figure 2.3*. Failure to isolate power, motor, and control wiring could result in less than optimum equipment performance.
- All adjustable frequency drives must be provided with short-circuit and overcurrent protection. Input fusing is required to provide this protection, see *Figure 2.4*. If not factory supplied, fuses must be provided by the installer as part of the installation. See maximum fuse ratings in *10.3.1 Protection*.

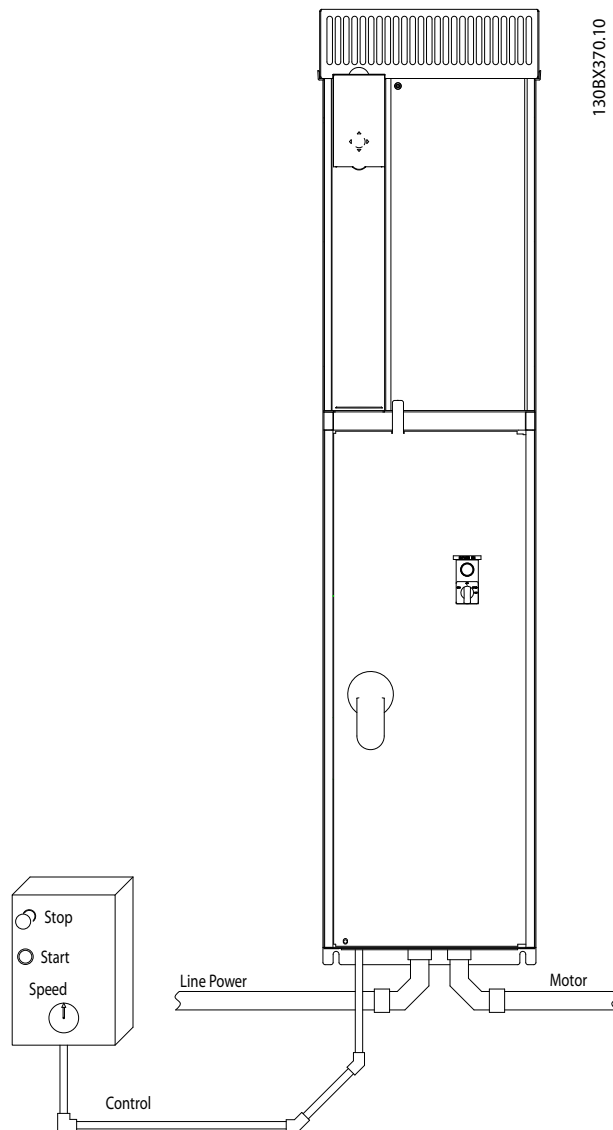


Figure 2.3 Example of Proper Electrical Installation Using Conduit

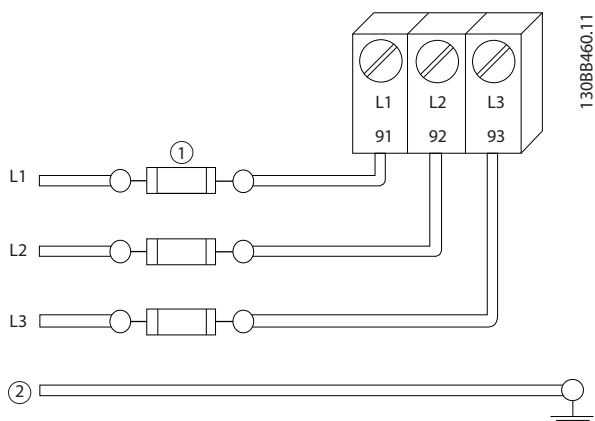


Figure 2.4 Adjustable Frequency Drive Fuses

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 167°F [75°C] rated copper wire.

2.4.2 Grounding Requirements

⚠ WARNING

GROUNDING HAZARD!

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

NOTE!

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

- Follow all local and national electrical codes to ground electrical equipment properly
- Proper protective grounding for equipment with ground currents higher than 3.5 mA must be established, see 2.4.2.1 Leakage Current (>3.5 mA)

- A dedicated ground wire is required for input power, motor power and control wiring
- Use the clamps provided with the equipment for proper ground connections
- Do not ground one adjustable frequency drive 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 the motor manufacturer wiring requirements

2.4.2.1 Leakage Current (>3.5 mA)

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

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

- Ground wire of at least 0.016 in² [10 mm²]
- Two separate 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 ground leakage circuit breakers (ELCBs) – are used, comply with the following: residual current devices (RCDs)

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

2.4.2.2 Grounding IP20 Enclosures

The adjustable frequency drive can be grounded using conduit or shielded cable. For grounding of the power connections, use the dedicated grounding points as shown in *Figure 2.5*.

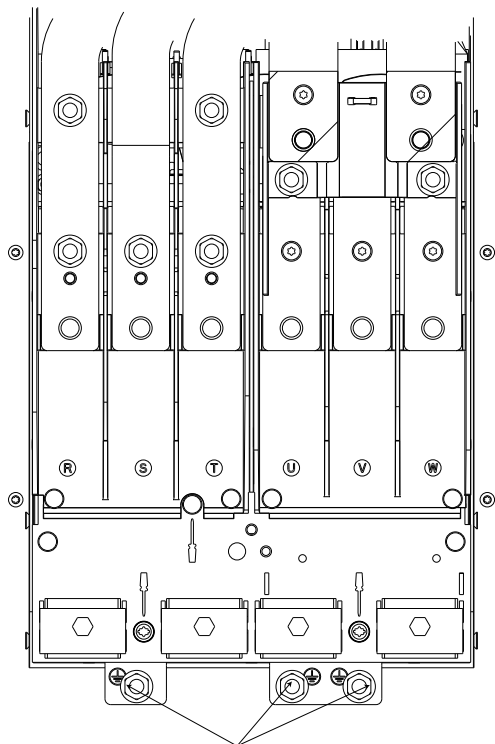


Figure 2.5 Grounding Points for IP20 (Chassis) Enclosures

2.4.2.3 Grounding IP21/54 Enclosures

The adjustable frequency drive can be grounded using conduit or shielded cable. For grounding of the power connections, use the dedicated grounding points as shown in *Figure 2.6*.

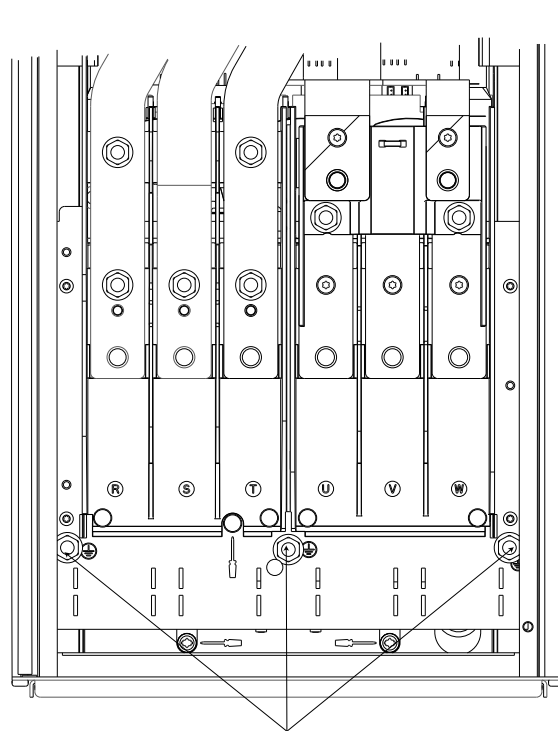


Figure 2.6 Grounding for IP21/54 Enclosures.

2.4.3 Motor Connection

2

⚠ WARNING

INDUCED VOLTAGE!

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

- For maximum cable sizes, see 10.1 Power-dependent Specifications
- Comply with local and national electrical codes for cable sizes
- Connector plates are provided at the base of IP21/54 and higher (NEMA1/12) units

- Do not install power factor correction capacitors between the adjustable frequency drive and the motor
- Do not wire a starting or pole-changing device between the adjustable frequency drive and the motor.
- Connect the 3-phase motor wiring to terminals 96 (U), 97 (V), and 98 (W)
- Ground the cable in accordance with the instructions provided
- Torque terminals in accordance with the information provided in 10.3.4 Connection Tightening Torques
- Follow the motor manufacturer wiring requirements

2.4.3.1 Terminal Locations: D1h-D4h

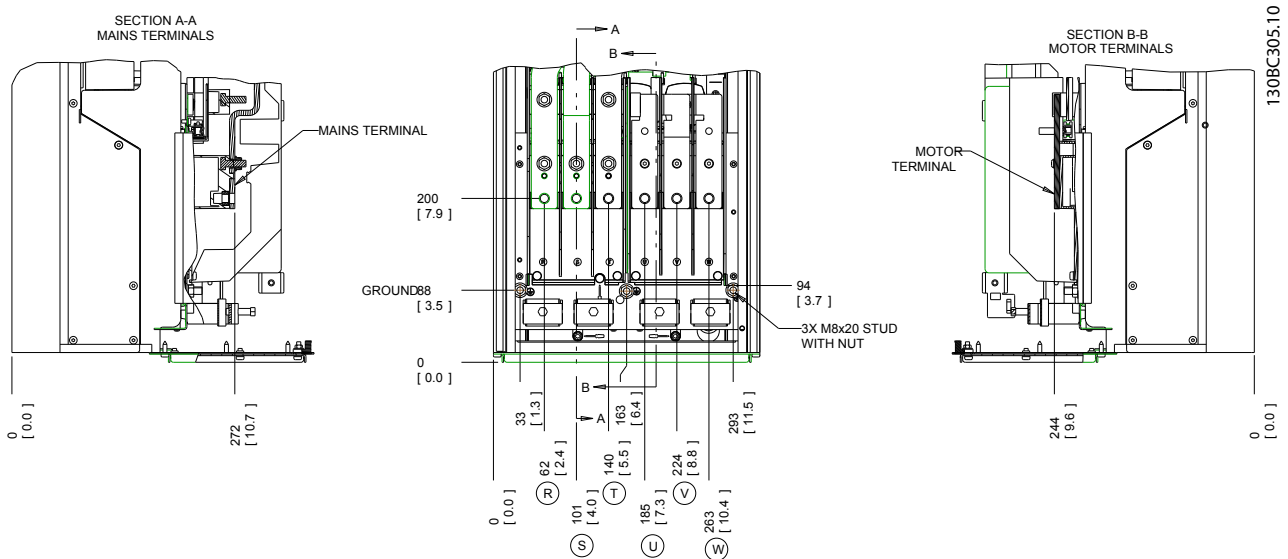


Figure 2.7 Terminal Locations D1h

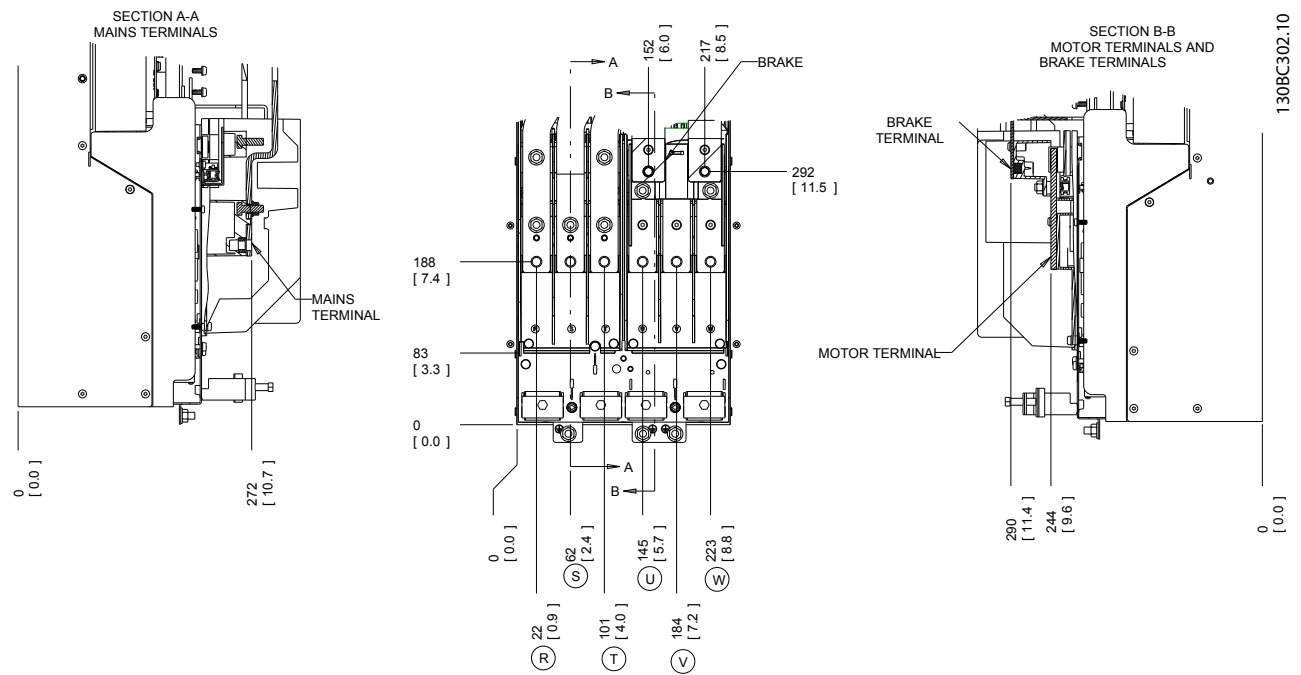


Figure 2.8 Terminal Locations D3h

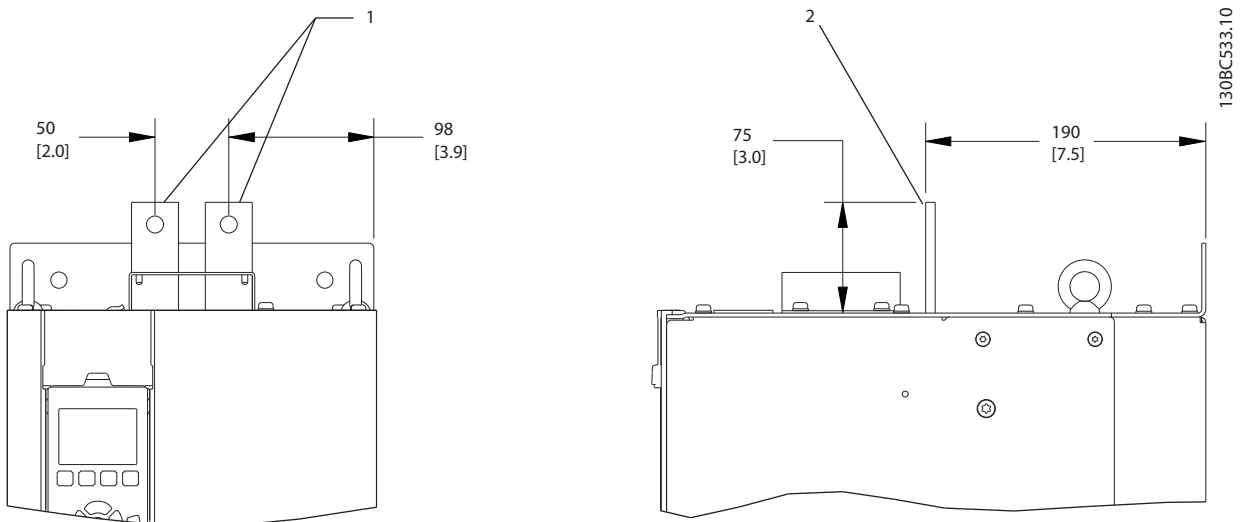


Figure 2.9 Load share or Regeneration Terminals, D3h

1	Front view
2	Side view

Table 2.4

2

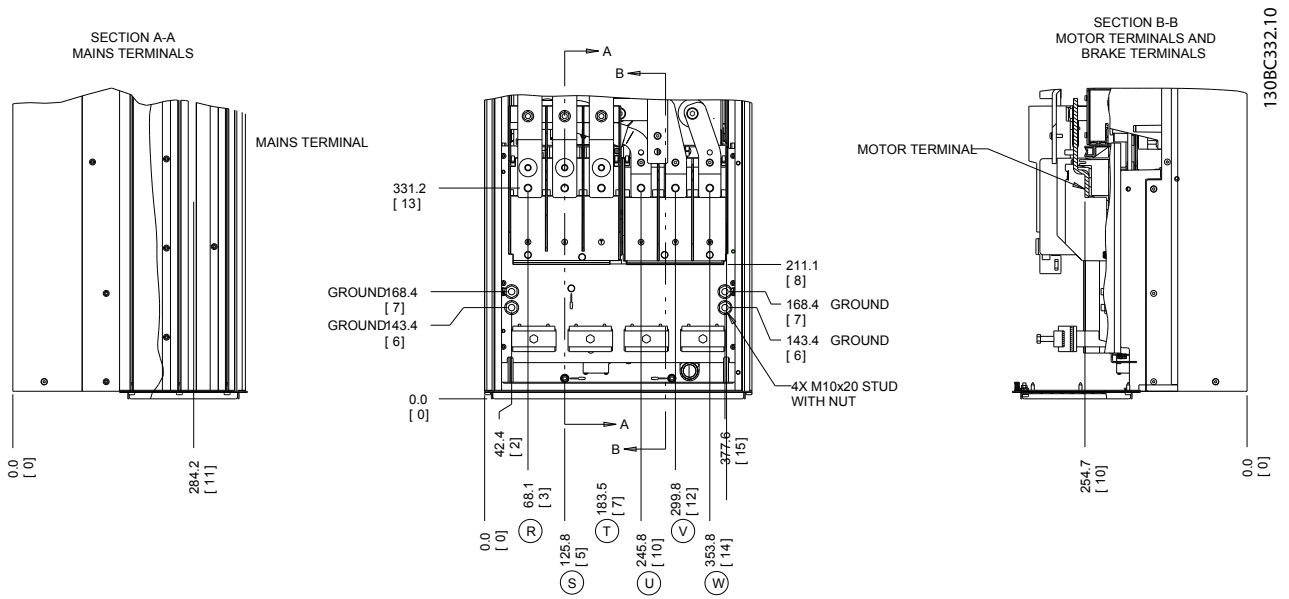


Figure 2.10 Terminal Locations D2h

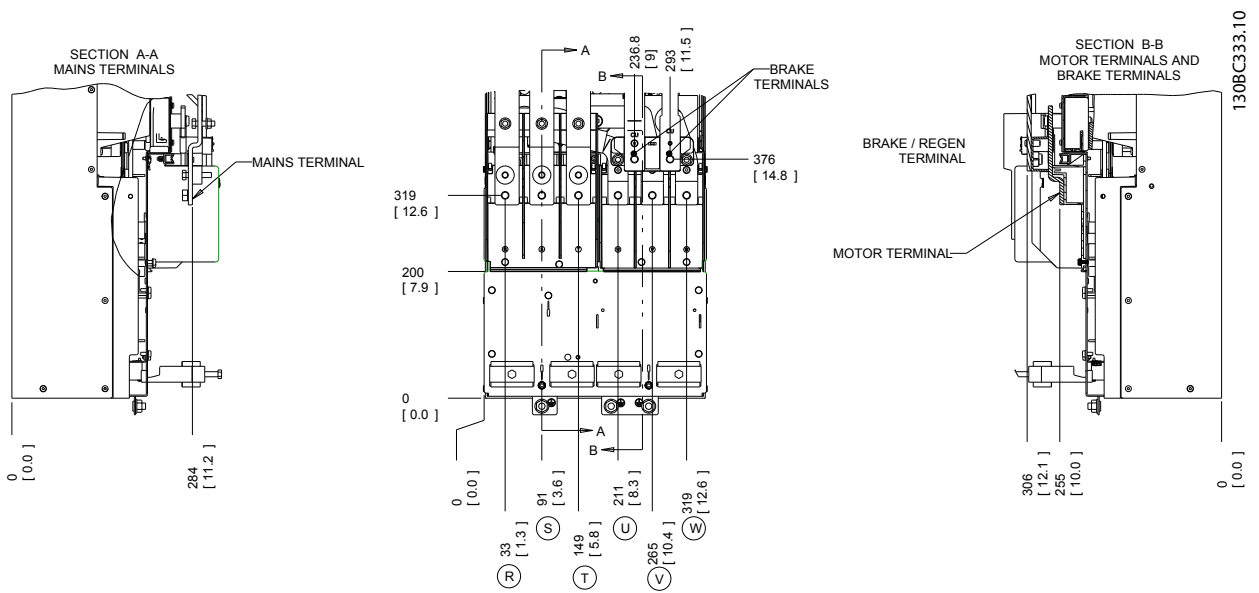


Figure 2.11 Terminal Locations D4h

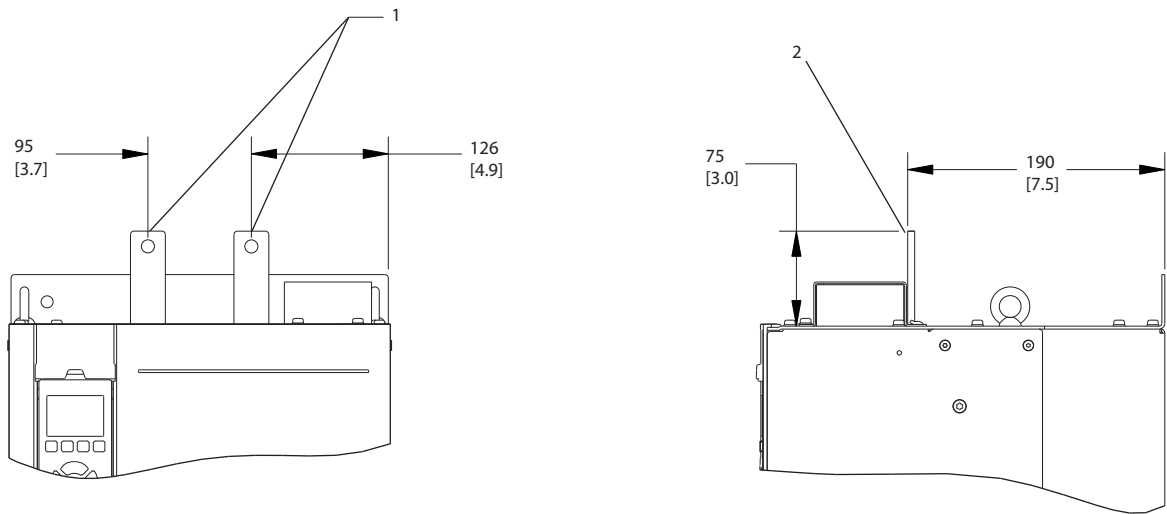


Figure 2.12 Load share and Regeneration Terminals, D4h

1	Front view
2	Side view

Table 2.5

2.4.4 Motor Cable

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

Terminal no.	Function
96, 97, 98, 99	Line power U/T1, V/T2, W/T3 Ground

Table 2.6

2.4.5 Motor Rotation Check

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

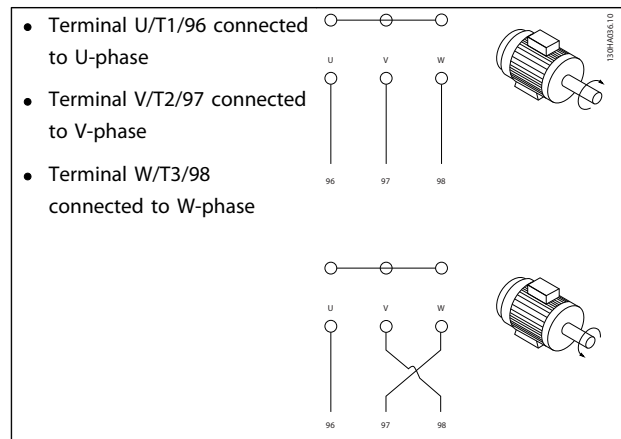


Table 2.7

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

2.4.6 AC Line Input Connections

- Size wiring is based upon the input current of the adjustable frequency drive
- Comply with local and national electrical codes for cable sizes
- Connect 3-phase AC input power wiring to terminals L1, L2, and L3 (see Figure 2.13)

- Ground the cable in accordance with the instructions provided
- All adjustable frequency drives may be used with an isolated input source as well as with ground reference power lines. When supplied from an isolated line power source (IT line power or floating delta) or TT/TN-S line power with a grounded leg (grounded delta), set 14-50 RFI 1 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 ground capacity currents in accordance with IEC 61800-3.

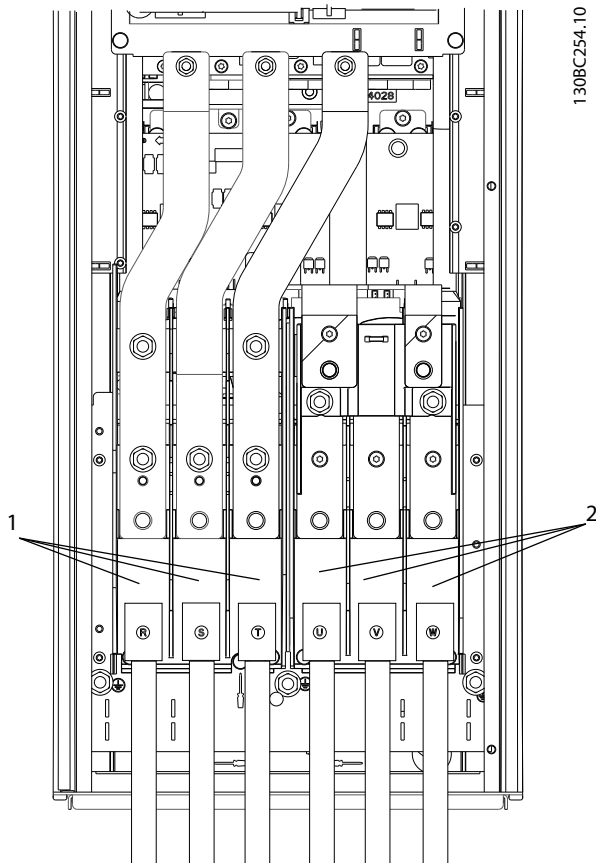


Figure 2.13 Connecting to AC Line Power

1	AC line input connections
2	Motor connection

Table 2.8

2.5 Control Wiring Connection

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

2.5.1 Access

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

2.5.2 Using Shielded Control Cables

Danfoss recommends braided shielded/armored cables to optimize EMC immunity of the control cables and the EMC emission from the motor cables.

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

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

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

- The conductivity of the shield material
 - The contact resistance between the individual shield conductors
 - The shield coverage, i.e., the physical area of the cable covered by the shield - often stated as a percentage value
 - Shield type, i.e., braided or twisted pattern
- a. Aluminum-clad with copper wire
 - b. Twisted copper wire or armored steel wire cable
 - c. Single-layer braided copper wire with varying percentage shield coverage. This is the typical Danfoss reference cable.
 - d. Double-layer braided copper wire
 - e. Twin layer of braided copper wire with a magnetic, shielded/armored intermediate layer
 - f. Cable that runs in copper tube or steel tube
 - g. Lead cable with 0.043 in [1.1 mm] wall thickness

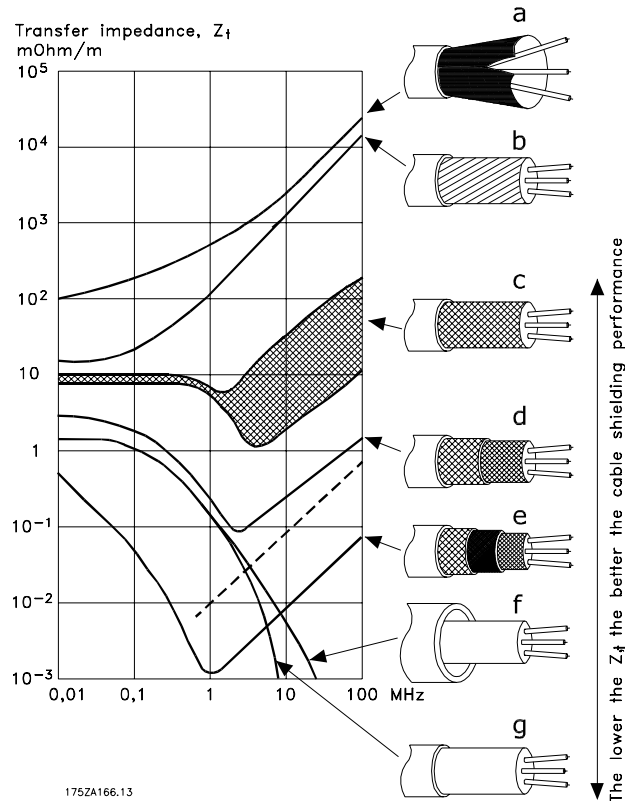


Figure 2.14

2.5.3 Grounding of Shielded Control Cables

Correct shielding

The preferred method in most cases is to secure control and serial communication cables with shielding clamps provided at both ends to ensure best possible high frequency cable contact. If the ground potential between the adjustable frequency drive 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: 0.025 in² [16 mm²].

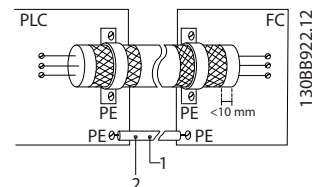


Figure 2.15

1	Min. 0.025 in ² [16 mm ²]
2	Equalizing cable

Table 2.9

50/60 Hz ground loops

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

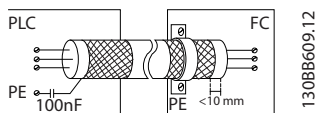


Figure 2.16

Avoid EMC noise on serial communication

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

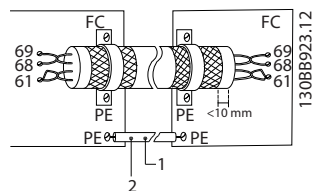


Figure 2.17

1	Min. 0.025 in ² [16 mm ²]
2	Equalizing cable

Table 2.10

Alternatively, the connection to terminal 61 can be omitted:

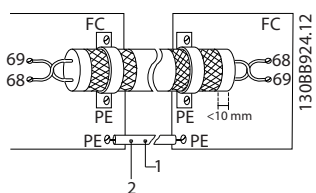


Figure 2.18

1	Min. 0.025 in ² [16 mm ²]
2	Equalizing cable

Table 2.11

2.5.4 Control Terminal Types

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

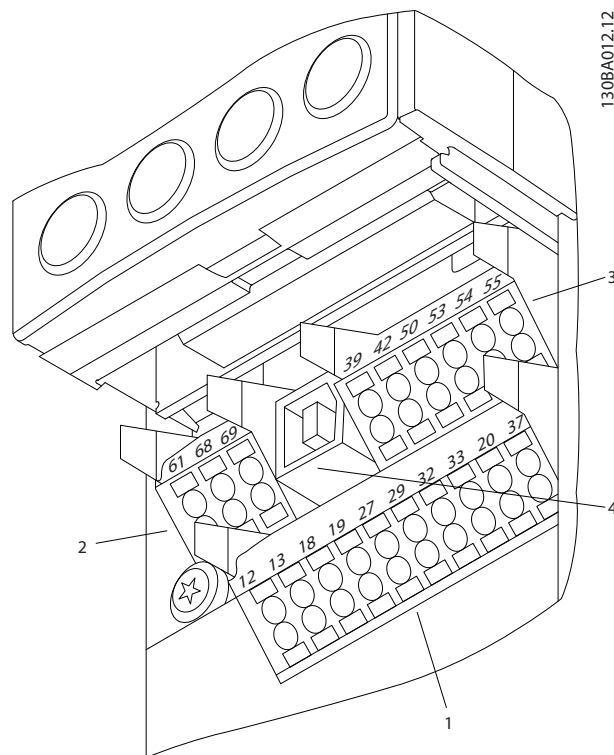


Figure 2.19 Control Terminal Locations

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

2.5.5 Wiring to Control Terminals

Terminal plugs can be removed for easy access.

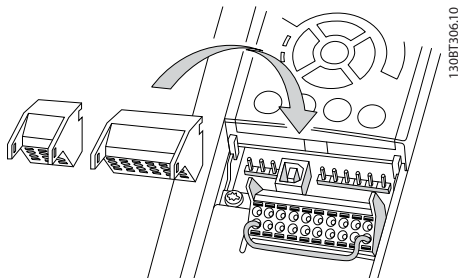


Figure 2.20 Removal of Control Terminals

2.5.6 Control Terminal Functions

Adjustable frequency drive functions are commanded by receiving control input signals.

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

2.5.6.1 Terminal 53 and 54 Switches

- Analog input terminals 53 and 54 can select either voltage (0–10 V) or current (0/4–20 mA) input signals
- Remove power to the adjustable frequency drive 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 *Figure 2.21*).

NOTE!

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

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

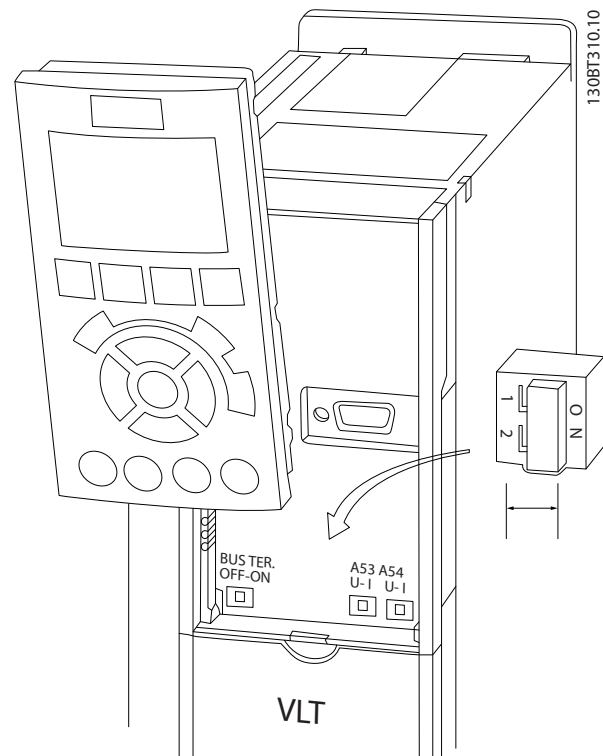


Figure 2.21 Location of Terminals 53 and 54 Switches and Bus Termination Switch

2

2.6 Serial Communication

RS-485 is a two-wire bus interface compatible with multi-drop network topology, i.e., nodes can be connected as a bus, or via drop cables from a common trunk line. A total of 32 nodes can be connected to one network segment. Repeaters divide network segments. Each repeater functions as a node within the segment in which it is installed. Each node connected within a given network must have a unique node address across all segments. Terminate each segment at both ends, using either the termination switch (S801) of the adjustable frequency drive or a biased termination resistor network. Always use shielded twisted pair (STP) cable for bus cabling, and always follow good common installation practice. Low-impedance ground connection of the shield at every node is important, including at high frequencies. Thus, connect a large surface of the shield to ground, for example with a cable clamp or a conductive cable connector. It may be necessary to apply potential-equalizing cables to maintain the same ground potential throughout the network, particularly in installations with long cables. To prevent impedance mismatch, always use the same type of cable throughout the entire network. When connecting a motor to the adjustable frequency drive, always use shielded motor cable.

Cable	Shielded twisted pair (STP)
Impedance	120 Ω
Max. cable length	4,000 ft [1,200 m] (including drop lines) 1,650 ft [500 m] station-to-station

Table 2.12

2.7 Optional Equipment

2.7.1 Load Share Terminals

Load share terminals enable the connection of the DC circuits of several adjustable frequency drives. Load share terminals are available in IP20 adjustable frequency drives and extend out the top of the adjustable frequency drive. A terminal cover, supplied with the adjustable frequency drive, must be installed to maintain the IP20 rating of the enclosure. Figure 2.22 shows both the covered and uncovered terminals.

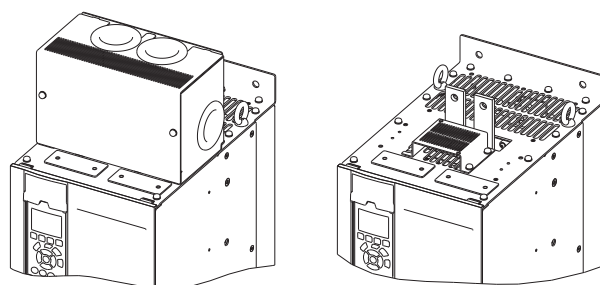


Figure 2.22 Load Share or Regeneration Terminal with Cover (L) and without Cover (R)

2.7.2 Regeneration Terminals

Regen (regeneration) terminals can be supplied for applications that have a regenerative load. A regenerative unit, supplied by a third party, connects to the regen terminals so that power can be regenerated back onto line power, resulting in energy savings. Regen terminals are available in IP20 adjustable frequency drives and extend out the top of the adjustable frequency drive. A terminal cover, supplied with the adjustable frequency drive, must be installed to maintain the IP20 rating of the enclosure. Figure 2.22 shows both the covered and uncovered terminals.

2.7.3 Anti-condensation Heater

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

2.7.4 Brake Chopper

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

2.7.5 line Power Shield

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

3 Start-up and Functional Testing

3.1 Pre-start

3.1.1 Safety Inspection

⚠ WARNING

HIGH VOLTAGE!

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

3

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

Table 3.1 Start-up Check List

3.2 Applying Power

⚠ WARNING

HIGH VOLTAGE!

Adjustable frequency drives contain high voltage when connected to AC line power. 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 adjustable frequency drive is connected to AC line power, the motor may start at any time. The adjustable frequency drive, 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 that the input voltage is balanced within 3%. If not, correct input voltage imbalance before proceeding. Repeat this procedure after the voltage correction.
2. Ensure that optional equipment wiring (if present) matches the installation application.
3. Ensure that all operator devices are in the OFF position. Panel doors should be closed or cover mounted.
4. Apply power to the unit. DO NOT start the adjustable frequency drive at this time. For units with a disconnect switch, turn to the ON position to apply power to the adjustable frequency drive.

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.

3.3 Basic Operational Programming

3.3.1 Set-up Wizard

The built-in “wizard” menu guides the installer through the set-up of the adjustable frequency drive in a clear and structured manner. The wizard has been designed with industry refrigeration engineers in mind in order to ensure that the text and language used make complete sense to the installer.

At start-up, the FC 103 asks the user to run the VLT Drive Application Guide or to skip it (until it has been run, the FC 103 will ask every time at start-up). Once this has been done, the application guide can be accessed through the Quick Menu screen, for example, after a power failure. If [Cancel] is pressed, the FC 103 will return to the status screen. An automatic timer will cancel the wizard after five minutes of inactivity (no keys pressed). The wizard must be re-entered through the Quick Menu after it has been run once.

Answering the questions on the screens takes the user through the complete FC 103 set-up. Most standard refrigeration applications can be set up by using this Application Guide. Advanced features must be accessed through the menu structure (Quick Menu or Main Menu) in the adjustable frequency drive.

The FC 103 Wizard covers all standard settings for:

- Compressors
- Single fan and pump
- Condenser fans

These applications then allow the adjustable frequency drive to be further controlled via the adjustable frequency drive's own internal PID controllers or from an external control signal.

After completing the set-up, you can choose to re-run the wizard or start the application.

The Application Guide can be cancelled at any time by pressing [Back]. The Application Guide can be re-entered through the Quick Menu. When re-entering the Application Guide, the user will be asked to keep previous changes to the factory set-up or to restore default values.

The first time the FC 103 is started up, the Application guide is opened. After this, the Application Guide can be accessed through the Quick Menu screen, for example, after a power failure.

The following screen will be presented:

3

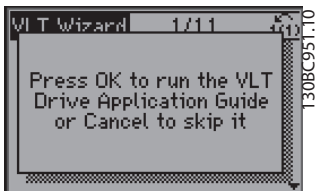


Figure 3.1

If [Cancel] is pressed, the FC 103 will return to the status screen. An automatic timer will cancel the wizard after five minutes of inactivity (no keys pressed). The wizard must be re-entered through the Quick Menu as described below. If [OK] is pressed, the Application Guide will start with the following screen:

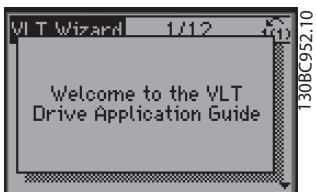


Figure 3.2

NOTE!

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

This screen will automatically change to the first input screen of the Application Guide:



Figure 3.3



Figure 3.4

Compressor pack set-up

The following example shows screens for a compressor pack set-up:

Voltage and frequency set-up

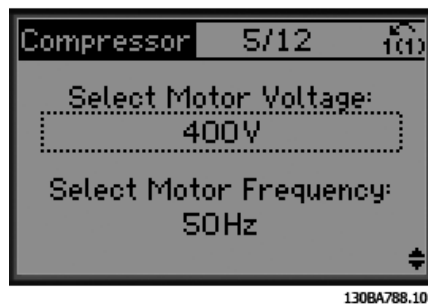


Figure 3.5

Current and nominal speed set-up

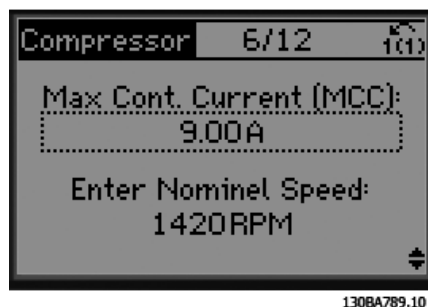


Figure 3.6

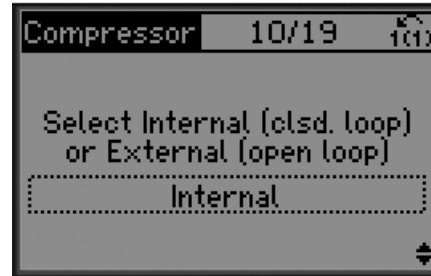
Min. and max. frequency set-up



130BA790.10

Figure 3.7

Select open-loop or closed-loop



130BA793.10

Figure 3.10

Min. time between two starts



130BA791.10

Figure 3.8

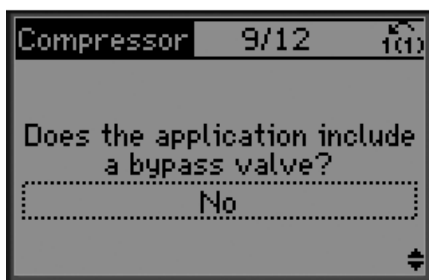
NOTE!

Internal/Closed-loop: The FC 103 will control the application directly using the internal PID control within the adjustable frequency drive and needs an input from an external input such as a temperature or other sensor which is wired directly into the adjustable frequency drive and controls from the sensor signal.

External/Open-loop: The FC 103 takes its control signal from another controller (such as a pack controller) which gives the adjustable frequency drive, e.g., 0–10 V, 4–20 mA or FC 103 Lon. The adjustable frequency drive will change its speed depending upon this reference signal.

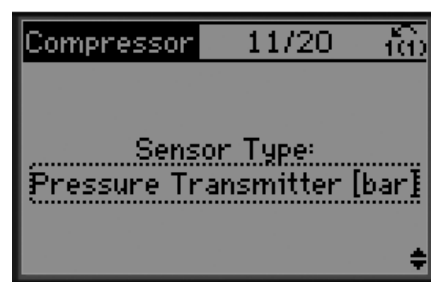
Select sensor type

Choose with/without bypass valve



130BA792.10

Figure 3.9

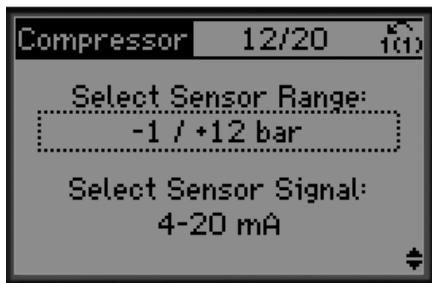


130BA794.10

Figure 3.11

3

Settings for sensor



130BA795.10

Figure 3.12

Select unit and conversion from pressure



130BA798.10

Figure 3.15

Info: 4–20 mA feedback chosen - connect accordingly



130BA796.10

Figure 3.13

Select fixed or floating setpoint



130BA799.10

Figure 3.16

Info: Set switch accordingly



130BA797.10

Figure 3.14

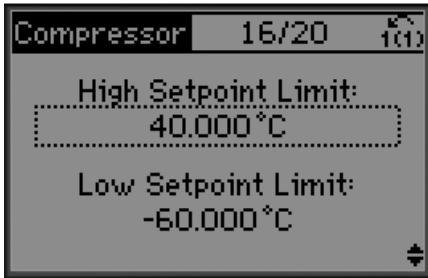
Set setpoint



130BA800.10

Figure 3.17

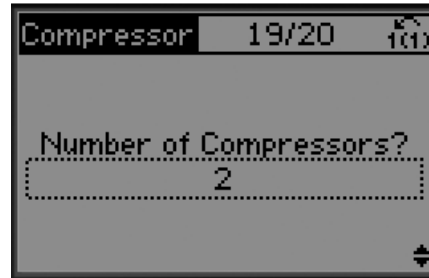
Set high/low limit for setpoint



130BA801.10

Figure 3.18

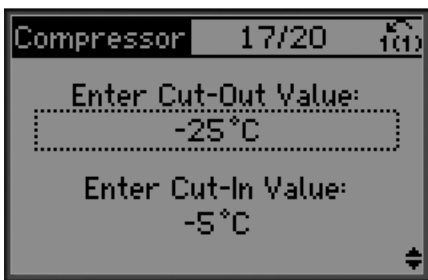
Set number of compressors in pack



130BA804.10

Figure 3.21

Set cut-out/in value



130BA802.10

Figure 3.19

Info: Connect accordingly

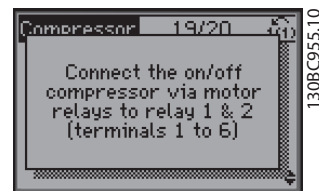
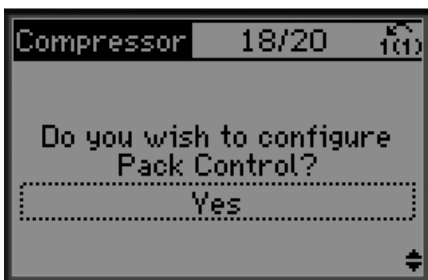


Figure 3.22

Info: Set-up completed

Choose pack control set-up



130BA803.10

Figure 3.20



130BA806.10

Figure 3.23

After completing the set-up, you can choose to re-run the wizard or start the application. Select between the following options:

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

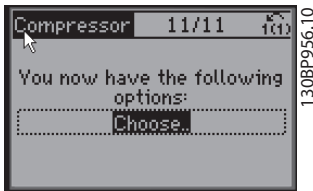


Figure 3.24

The Application Guide can be cancelled at any time by pressing [Back]. The Application Guide can be re-entered through the Quick Menu:



Figure 3.25

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

NOTE!

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

The bypass valve must be programmed to operate from one of the extra relay outputs on the MCB 105 board. This is needed because the standard relay outputs in the FC 103 are used to control the compressors in the pack.

3.3.2 Required Initial Adjustable Frequency Drive Programming

NOTE!

If the wizard is run, ignore the following.

Adjustable frequency drives 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. The recommended parameter settings 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 adjustable frequency drive.

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

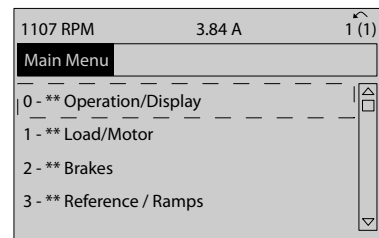


Figure 3.26 Main Menu

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

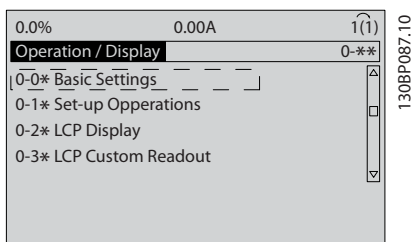


Figure 3.27 Operation/Display

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

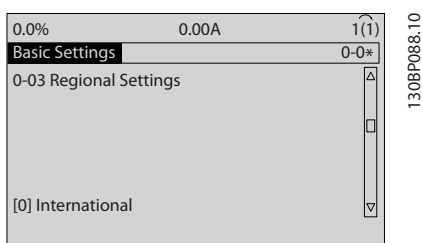


Figure 3.28 Basic Settings

- 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.)
- Press [Quick Menu] on the LCP.
- Use the navigation keys to scroll to parameter group Q2 Quick set-up and press [OK].

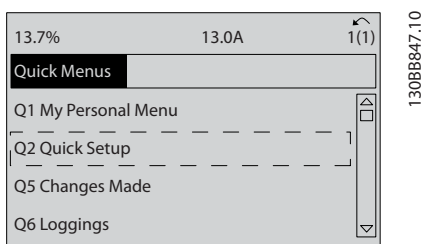


Figure 3.29 Quick Menus

- Select language and press [OK].
- 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 adjustable frequency drives 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.

3.4 Automatic Motor Adaptation

Automatic motor adaptation (AMA) is a test procedure that measures the electrical characteristics of the motor to optimize compatibility between the adjustable frequency drive and the motor.

- The adjustable frequency drive builds a mathematical model of the motor for regulating output motor current. The procedure also tests the input phase balance of electrical power. It compares the motor characteristics with the data entered in parameters 1-20 to 1-25.
- 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 [2] 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 [1] *Enable complete AMA*.
9. Press [OK].
10. Follow on-screen instructions.
11. The test will run automatically and indicate when it is complete.

3.5 Check Motor Rotation

Before running the adjustable frequency drive, check the motor rotation. The motor will run briefly at 5 Hz or the minimum frequency set in 4-12 *Motor Speed Low Limit [Hz]*.

1. Press [Quick Menu].
2. Scroll to Q2 *Quick Set-up*.
3. Press [OK].
4. Scroll to 1-28 *Motor Rotation Check*.
5. Press [OK].
6. Scroll to [1] *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 adjustable frequency drive and wait for power to discharge. Reverse the connection of any two of the three motor cables on the motor or adjustable frequency drive side of the connection.

3.6 Local Control Test

CAUTION

MOTOR START!

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

NOTE!

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

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

1. Press [Hand On].
2. Accelerate the adjustable frequency drive 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 accel time in 3-41 *Ramp 1 Ramp-up Time*
- Increase current limit in 4-18 *Current Limit*
- Increase torque limit in 4-16 *Torque Limit Motor Mode*

If deceleration problems were encountered

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

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

NOTE!

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

3.7 System Start-up

The procedure in this section requires user-wiring and application programming to be completed. *6 Application Examples* is intended to help with this task. Other aids to application set-up are listed in *1.3 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 adjustable frequency drive and all programming completed.
3. Apply an external run command.
4. Adjust the speed reference throughout the speed range.
5. Remove the external run command.
6. Note any problems.

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

4 User Interface

4.1 Local Control Panel

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

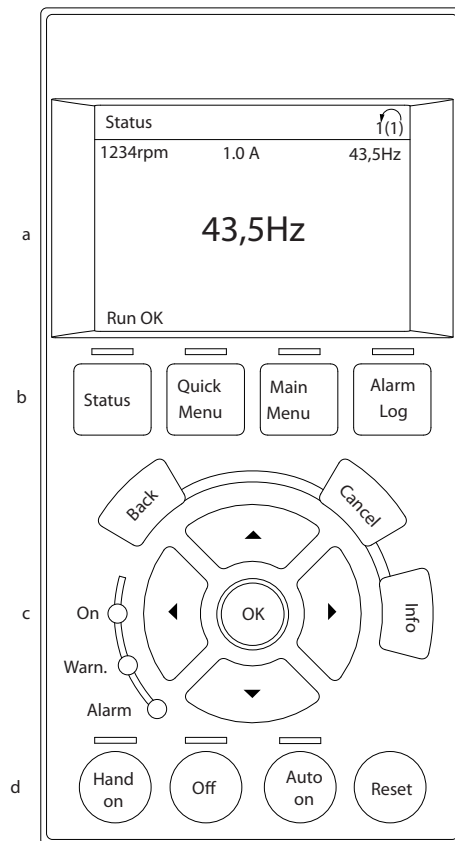
The LCP has several user functions.

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

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

4.1.1 LCP Layout

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



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Figure 4.1 LCP

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

4.1.2 Setting LCP Display Values

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

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

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

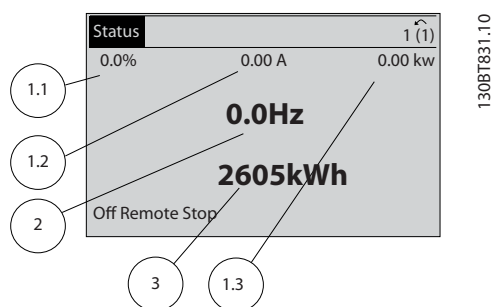


Figure 4.2 Display Readouts

Display	Parameter number	Default setting
1.1	0-20	Reference %
1.2	0-21	Motor current
1.3	0-22	Power [kW]
2	0-23	Frequency
3	0-24	kWh counter

Table 4.1 Legend to Figure 4.2

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.



Figure 4.3 Menu Keys

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

Table 4.2 Function Description Menu Keys

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 adjustable frequency drive status indicators are also located in this area.

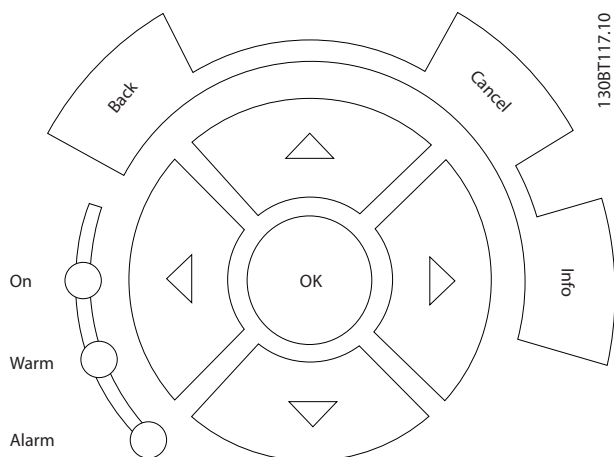


Figure 4.4 Navigation Keys

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

Table 4.3 Navigation Keys Functions

Light	Indicator	Function
Green	ON	The ON light activates when the adjustable frequency drive receives power from AC line voltage, a DC bus terminal, or an external 24 V supply.
Yellow	WARNING	When warning conditions are met, the yellow WARNING 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 Indicator Lights Functions

4.1.5 Operation Keys

Operation keys are found at the bottom of the LCP.

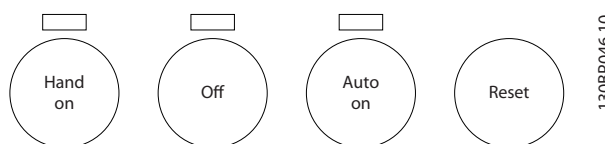


Figure 4.5 Operation Keys

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

Table 4.5 Operation Keys Functions

4.2 Backup and Copying Parameter Settings

Programming data is stored internally in the adjustable frequency drive.

- The data can be uploaded into the LCP memory as a storage backup.
- Once stored in the LCP, the data can be downloaded back into the adjustable frequency drive.
- Data can also be downloaded into other adjustable frequency drives 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).
- Initialization of the adjustable frequency drive to restore factory default settings does not change data stored in the LCP memory.

⚠ WARNING**UNINTENDED START!**

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

4

4.2.1 Uploading Data to the LCP

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

4.2.2 Downloading Data from the LCP

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

4.3 Restoring Default Settings

CAUTION

Initialization 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 initialization.

Restoring the adjustable frequency drive parameter settings back to default values is done by initialization of the adjustable frequency drive. Initialization can be through *14-22 Operation Mode* or manually.

- Initialization using *14-22 Operation Mode* does not change adjustable frequency drive 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 initialization erases all motor, programming, localization, and monitoring data and restores factory default settings.

4.3.1 Recommended Initialization

1. Press [Main Menu] twice to access parameters.
2. Scroll to *14-22 Operation Mode*.
3. Press [OK].
4. Scroll to *Initialization*.
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 Initialization

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 initialization does reset not the following adjustable frequency drive information

- *15-00 Operating hours*
- *15-03 Power-ups*
- *15-04 Over Temps*
- *15-05 Over Volts*

5 Programming

5.1 Introduction

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

The quick menu is intended for initial startup (*Q2-** Quick Set-up*) and detailed instructions for common adjustable frequency drive 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 adjustable frequency drive applications.

5.2 Programming Example

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

- This procedure programs the adjustable frequency drive to receive a 0–10 V DC analog control signal on input terminal 53
- The adjustable frequency drive 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*

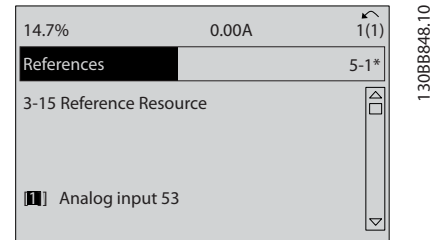


Figure 5.1

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

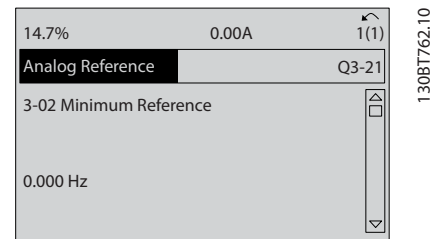


Figure 5.2

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

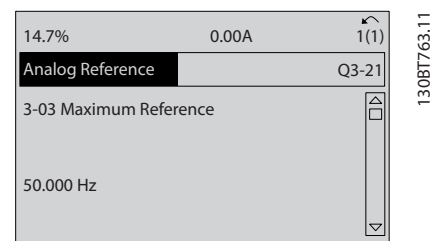


Figure 5.3

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.)

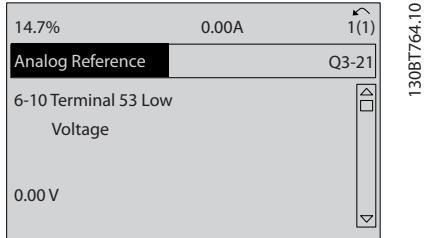


Figure 5.4

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

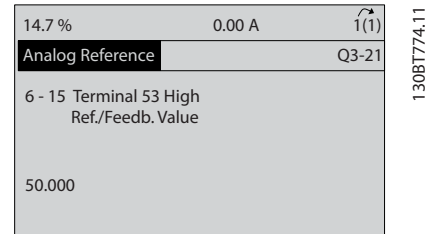


Figure 5.7

5

5. **6-11 Terminal 53 High Voltage.** Set maximum external voltage reference on Terminal 53 at 10 V. (This sets the maximum input signal at 10 V.)

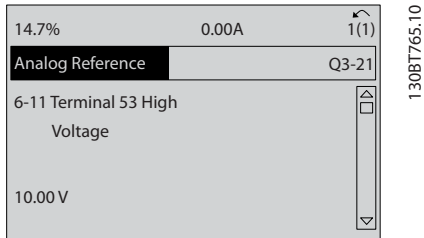


Figure 5.5

With an external device providing a 0–10 V control signal connected to adjustable frequency drive terminal 53, the system is now ready for operation. Note that the scroll bar on the right in the last figure of the display is at the bottom, indicating the procedure is complete.

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

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

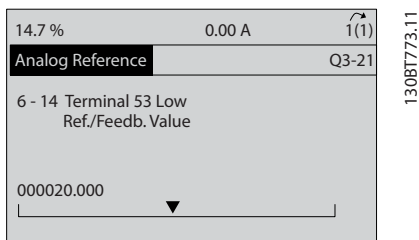


Figure 5.6

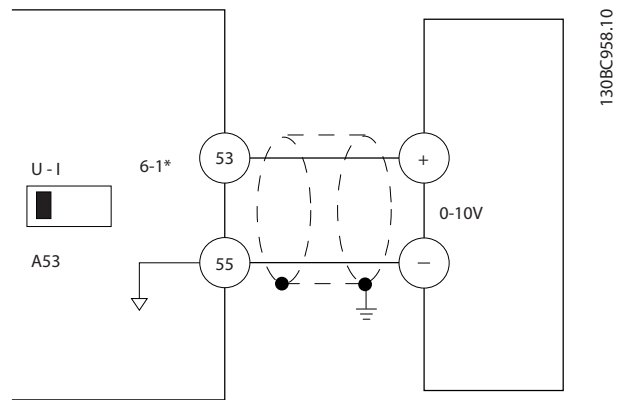


Figure 5.8 Wiring Example for External Device Providing 0–10 V Control Signal (Adjustable Frequency Drive Left, External Device Right)

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 adjustable frequency drive functioning, the control terminals must be wired properly programmed for the intended function receiving a signal

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

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

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

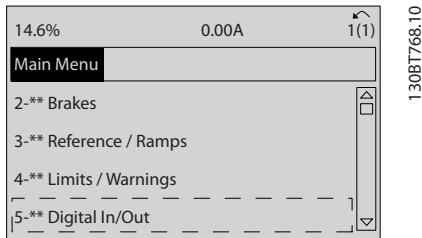


Figure 5.9

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

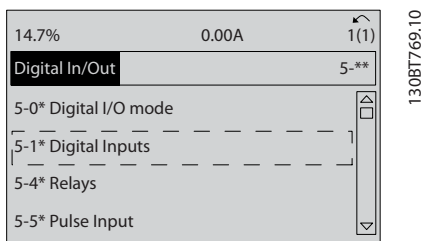


Figure 5.10

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

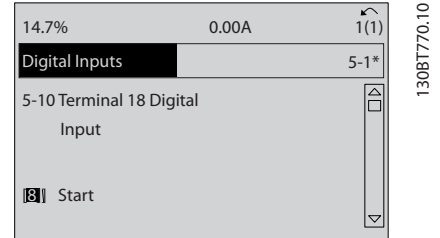


Figure 5.11

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
0-71 Date Format	DD-MM-YYYY	MM/DD/YYYY
0-72 Time Format	24 h	12 h
1-20 Motor Power [kW]	See Note 1	See Note 1
1-21 Motor Power [HP]	See Note 2	See Note 2
1-22 Motor Voltage	230 V/400 V/575 V	208 V/460 V/575 V
1-23 Motor Frequency	50 Hz	60 Hz
3-03 Maximum Reference	50 Hz	60 Hz
3-04 Reference Function	Sum	External/Preset
4-13 Motor Speed High Limit [RPM] See Note 3	1500 RPM	1800 RPM
4-14 Motor Speed High Limit [Hz] See Note 4	50 Hz	60 Hz
4-19 Max Output Frequency	100 Hz	120 Hz
4-53 Warning Speed High	1500 RPM	1800 RPM
5-12 Terminal 27 Digital Input	Coast inverse	External interlock

Parameter	International default parameter value	North American default parameter value
5-40 Function Relay	[2] Drive ready	No alarm
6-15 Terminal 53 High Ref./Feedb. Value	50	60
6-50 Terminal 42 Output	Output frequency	Speed 4–20mA
14-20 Reset Mode	Manual reset	Infinite auto reset
22-85 Speed at Design Point [RPM] See Note 3	1500 RPM	1800 RPM
22-86 Speed at Design Point [Hz]	50 Hz	60 Hz

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 1500 RPM, and for a 2-poled motor, 3000 RPM. The corresponding values for North America is 1800 and 3600 RPM, 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].
3. Select Q5-2 Since Factory Setting to view all programming changes or Q5-1 Last 10 Changes for the most recent.

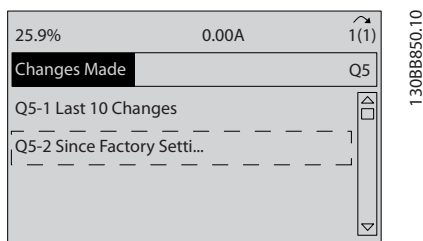


Figure 5.12 Changes Made

5.4.1 Parameter Data Check

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

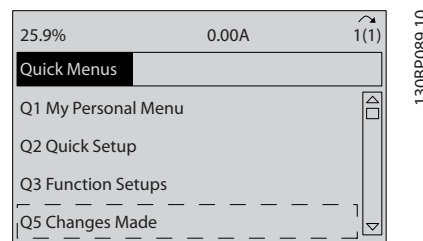


Figure 5.13 Q5 Changes Made

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 adjustable frequency drive with system details it needs to operate properly. System details may include such things as input and output signal types, programming terminals, minimum and maximum signal ranges, custom displays, automatic restart, and other features.

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

Code	Operation / Display	Code	Parameter Description	Code	Parameter Description	Code	Parameter Description
1-0*	General Settings	1-82	Min Speed for Function at Stop [Hz]	4-16	Torque Limit Motor Mode	5-63	Terminal 29 Pulse Output Variable
1-00	Configuration Mode	1-86	Compressor Min. Speed for Trip [RPM]	4-17	Torque Limit Generator Mode	5-65	Pulse Output Max Freq #29
1-03	Torque Characteristics	1-87	Compressor Min. Speed for Trip [Hz]	4-18	Current Limit	5-66	Terminal X30/6 Pulse Output Variable
1-1*	Motor Selection	1-87	Compressor Min. Speed for Trip [Hz]	4-19	Max Output Frequency	5-68	Pulse Output Max Freq #X30/6
1-10	Motor Construction	1-9*	Motor Temperature	4-5*	Adj. Warnings	5-9*	Bus Controlled
1-1*	WC+ PM	1-90	Motor Thermal Protection	4-50	Warning Current Low	5-90	Digital & Relay Bus Control
0-01	Language	1-91	Motor External Fan	4-51	Warning Current High	5-93	Pulse Out #27 Bus Control
0-02	Motor Speed Unit	1-93	Thermistor Source	4-52	Warning Speed Low	5-94	Pulse Out #27 Timeout Preset
0-03	Regional Settings	2-*	Brakes	4-53	Warning Speed High	5-95	Pulse Out #29 Bus Control
0-04	Operating State at Power-up	2-0*	DC-Brake	4-54	Warning Reference Low	5-96	Pulse Out #29 Timeout Preset
0-05	Local Mode Unit	2-00	DC Hold/Preheat Current	4-55	Warning Reference High	5-97	Pulse Out #X30/6 Bus Control
0-1*	Set-up Operations	2-01	DC Brake Current	4-56	Warning Feedback Low	5-98	Pulse Out #X30/6 Timeout Preset
0-10	Active Set-up	2-02	DC Braking Time	4-57	Warning Feedback High	6-*	Analog I/O/Out
0-11	Programming Set-up	2-03	DC Brake Cut In Speed [RPM]	4-58	Missing Motor Phase Function	6-0*	Analog I/O Mode
0-12	This Set-up Linked to	2-04	DC Brake Cut In Speed [Hz]	4-6*	Speed Bypass	6-00	Live Zero Timeout Time
0-13	Readout: Linked Set-ups	2-06	Parking Current	4-61	Bypass Speed From [RPM]	6-01	Live Zero Timeout Function
0-14	Readout: Prog. Set-ups / Channel	2-07	Parking Time	4-62	Bypass Speed To [RPM]	6-02	Fire Mode Live Zero Timeout Function
0-2*	LCP Display	2-1*	Brake Energy Funct.	4-62	Bypass Speed To [Hz]	6-1*	Analog Input 53
0-20	Display Line 1.1 Small	2-10	Brake Function	4-64	Semi-Auto Bypass Set-up	6-10	Terminal 53 Low Voltage
0-21	Display Line 1.2 Small	2-16	AC brake Max. Current	5-*	Digital In/Out	6-11	Terminal 53 High Voltage
0-22	Display Line 1.3 Small	2-17	Over-voltage Control	5-0*	Digital I/O Mode	6-12	Terminal 53 Low Current
0-23	Display Line 2 Large	3-0*	Reference / Ramps	5-00	Digital I/O Mode	6-13	Terminal 53 High Current
0-24	Display Line 3 Large	3-02	Minimum Reference	5-01	Terminal 27 Mode	6-14	Terminal 53 Low Ref./Feedb. Value
0-25	My Personal Menu	3-03	Maximum Reference	5-02	Terminal 29 Mode	6-15	Terminal 53 High Ref./Feedb. Value
0-3*	LCP Custom Readout	3-04	Reference Function	5-1*	Digital Inputs	6-16	Terminal 53 Filter Time Constant
0-30	Custom Readout Unit	3-1*	References	5-10	Terminal 18 Digital Input	6-17	Terminal 53 Live Zero
0-31	Custom Readout Min Value	3-10	Preset Reference	5-11	Terminal 19 Digital Input	6-2*	Analog Input 54
0-32	Custom Readout Max Value	3-11	Jog Speed [Hz]	5-12	Terminal 27 Digital Input	6-20	Terminal 54 Low Voltage
0-37	Display Text 1	3-13	Reference Site	5-13	Terminal 29 Digital Input	6-21	Terminal 54 High Voltage
0-38	Display Text 2	3-14	Preset Relative Reference	5-14	Terminal 32 Digital Input	6-22	Terminal 54 Low Current
0-39	Display Text 3	3-15	Reference 1 Source	5-15	Terminal 33 Digital Input	6-23	Terminal 54 High Current
0-4*	LCP Keypad	3-16	Reference 2 Source	5-16	Terminal X30/2 Digital Input	6-24	Terminal 54 Low Ref./Feedb. Value
0-40	[Hand on] Key on LCP	3-17	Reference 3 Source	5-17	Terminal X30/3 Digital Input	6-25	Terminal 54 High Ref./Feedb. Value
0-41	[Off] Key on LCP	3-19	Jog Speed [RPM]	5-18	Terminal X30/4 Digital Input	6-26	Terminal 54 Filter Time Constant
0-42	[Auto on] Key on LCP	3-4*	Ramp 1	5-19	Terminal 37 Safe Stop	6-27	Terminal 54 Live Zero
0-43	[Reset] Key on LCP	3-41	Ramp 1 Ramp Up Time	5-3*	Digital Outputs	6-3*	Analog Input X30/11
0-5*	Copy/Save	3-42	Ramp 1 Ramp Down Time	5-30	Terminal 27 Digital Output	6-30	Terminal X30/11 Low Voltage
0-50	LCP Copy	3-5*	Ramp 2	5-31	Terminal 29 Digital Output	6-31	Terminal X30/11 High Voltage
0-51	Set-up Copy	3-51	Ramp 2 Ramp Up Time	5-32	Term X30/6 Digi Out (MCB 101)	6-34	Term. X30/11 Low Ref./Feedb. Value
0-6*	Password	3-52	Ramp 2 Ramp Down Time	5-33	Term X30/7 Digi Out (MCB 101)	6-35	Term. X30/11 High Ref./Feedb. Value
0-60	Main Menu Password	3-8*	Other Ramps	5-4*	Relays	6-36	Term. X30/11 Filter Time Constant
0-61	Access to Main Menu w/o Password	3-80	Jog Ramp Time	5-40	Function Relay	6-37	Term. X30/11 Live Zero
0-65	Personal Menu Password	3-81	Quick Stop Ramp Time	5-41	On Delay, Relay	6-4*	Analog Input X30/12
0-66	Access to Personal Menu w/o Password	3-82	Starting Ramp Up Time	5-42	Off Delay, Relay	6-40	Terminal X30/12 Low Voltage
0-67	Bus Password Access	3-9*	Digital Pot.Meter	5-5*	Pulse Input	6-41	Terminal X30/12 High Voltage
0-7*	Clock Settings	3-90	Step Size	5-50	Term. 29 Low Frequency	6-44	Term. X30/12 Low Ref./Feedb. Value
0-70	Set Date and Time	3-91	Ramp Time	5-51	Term. 29 High Frequency	6-45	Term. X30/12 High Ref./Feedb. Value
0-71	Date Format	3-92	Power Restore	5-52	Term. 29 Low Ref./Feedb. Value	6-46	Term. X30/12 Filter Time Constant
0-72	Time Format	3-93	Maximum Limit	5-53	Term. 29 High Ref./Feedb. Value	6-47	Term. X30/12 Live Zero
0-74	DST/Summertime	3-94	Minimum Limit	5-54	Pulse Filter Time Constant #29	6-5*	Analog Output 42
0-76	DST/Summertime Start	3-95	Ramp Delay	5-55	Term. 33 Low Frequency	6-50	Terminal 42 Output
0-77	DST/Summertime End	4-*	Limits / Warnings	5-56	Term. 33 High Frequency	6-51	Terminal 42 Output Min Scale
0-79	Clock Fault	4-1*	Motor Limits	5-57	Term. 33 Low Ref./Feedb. Value	6-52	Terminal 42 Output Max Scale
0-81	Working Days	4-10	Motor Speed Direction	5-58	Term. 33 High Ref./Feedb. Value	6-53	Terminal 42 Output Bus Control
0-82	Additional Working Days	4-11	Motor Speed Low Limit [RPM]	5-59	Pulse Filter Time Constant #33	6-54	Terminal 42 Output Timeout Preset
0-83	Additional Non-Working Days	4-12	Motor Speed Low Limit [Hz]	5-6*	Pulse Output	6-5*	Analog Output X30/8
0-89	Date and Time Readout	4-13	Motor Speed High Limit [RPM]	5-60	Terminal 27 Pulse Output Variable	6-60	Terminal X30/8 Output
1-*	Load and Motor	4-14	Motor Speed High Limit [Hz]	5-62	Pulse Output Max Freq #27	6-61	Terminal X30/8 Min. Scale

5.5.1 Main Menu Structure

6-62	Terminal X30/8 Max. Scale	15-07	Reset Running Hours Counter	16-15	Frequency [%]	18-01	Maintenance Log: Action
6-63	Terminal X30/8 Output Bus Control	15-08	Number of Starts	16-16	Torque [Nm]	18-02	Maintenance Log: Time
6-64	Terminal X30/8 Output Timeout	15-1*	Data Log Settings	16-17	Speed [RPM]	18-03	Maintenance Log: Date and Time
	Presets	15-10	Logging Source	16-18	Motor Thermal	18-1*	Fire Mode Log
8-*	Comm. and Options	15-11	Logging Interval	16-22	Torque [%]	18-10	Fire Mode Log: Event
8-0*	General Settings	15-12	Trigger Event	16-3*	Drive Status	18-11	Fire Mode Log: Time
8-01	Control Site	15-13	Logging Mode	16-30	DC Link Voltage	18-12	Fire Mode Log: Date and Time
8-02	Control Source	15-14	Samples Before Trigger	16-32	Brake Energy /s	18-3*	Inputs & Outputs
8-03	Control Timeout Time	15-2*	Historic Log	16-33	Brake Energy /2 min	18-30	Analog Input X42/1
8-04	Control Timeout Function	15-20	Historic Log: Event	16-34	Heatsink Temp.	18-31	Analog Input X42/3
8-05	End-of-Timeout Function	15-21	Historic Log: Value	16-35	Inverter Thermal	18-32	Analog Input X42/5
8-06	Reset Control Timeout	15-22	Historic Log: Time	16-36	Inv. Nom. Current	18-33	Analog Out X42/7 [V]
8-07	Diagnosis Trigger	15-23	Historic log: Date and Time	16-37	Inv. Max. Current	18-34	Analog Out X42/9 [V]
8-1*	Control Settings	15-3*	Alarm Log	16-38	SL Controller State	18-35	Analog Out X42/11 [V]
8-10	Control Profile	15-30	Alarm Log: Error Code	16-39	Control Card Temp.	20-*	Drive Closed Loop
8-13	Configurable Status Word STW	15-31	Alarm Log: Value	16-40	Logging Buffer Full	20-0*	Feedback
8-3*	FC Port Settings	15-32	Alarm Log: Time	16-41	LCP Bottom Statusline	20-00	Feedback 1 Source
8-30	Protocol	15-33	Alarm Log: Date and Time	16-5*	Ref. & Feeds.	20-01	Feedback 1 Conversion
8-31	Address	15-34	Alarm Log: Status	16-50	External Reference	20-02	Feedback 1 Source Unit
8-32	Baud Rate	15-35	Alarm Log: Alarm Text	16-52	Feedback[Unit]	20-03	Feedback 2 Source
8-33	Parity / Stop Bits	15-4*	Drive Identification	16-53	Digi Pot Reference	20-04	Feedback 2 Conversion
8-35	Minimum Response Delay	15-40	FC Type	16-54	Feedback 1 [Unit]	20-05	Feedback 2 Source Unit
8-36	Maximum Response Delay	15-41	Power Section	16-55	Feedback 2 [Unit]	20-06	Feedback 3 Source
8-37	Maximum Inter-Char Delay	15-42	Voltage	16-56	Feedback 3 [Unit]	20-07	Feedback 3 Conversion
8-4*	Adv. Protocol Set.	15-43	Software Version	16-6*	Inputs & Outputs	20-08	Feedback 3 Source Unit
8-40	Telegram Selection	15-44	Ordered Typecode String	16-60	Digital Input	20-12	Reference/Feedback Unit
8-45	BTM Transaction Command	15-45	Actual Typecode String	16-61	Terminal 53 Switch Setting	20-2*	Feedback/Setpoint
8-46	BTM Transaction Status	15-46	Frequency Converter Ordering No	16-62	Analog Input 53	20-20	Feedback Function
8-47	BTM Timeout	15-47	Power Card Ordering No	16-63	Terminal 54 Switch Setting	20-21	Setpoint 1
8-5*	Digital/Bus	15-48	LCP Id No	16-64	Analog Input 54	20-22	Setpoint 2
8-50	Coasting Select	15-49	SW ID Control Card	16-65	Analog Output 42 [mA]	20-23	Setpoint 3
8-52	DC Brake Select	15-50	SW ID Power Card	16-66	Digital Output [bin]	20-3*	Feedback Adv. Conv
8-53	Start Select	15-51	Frequency Converter Serial Number	16-67	Pulse Input #29 [Hz]	20-30	Refrigerant
8-54	Reversing Select	15-6*	Option Ident	16-68	Pulse Input #33 [Hz]	20-31	User Defined Refrigerant A1
8-55	Set-up Select	15-60	Option Mounted	16-69	Pulse Output #27 [Hz]	20-32	User Defined Refrigerant A2
8-56	Preset Reference Select	15-61	Option SW Version	16-70	Pulse Output #29 [Hz]	20-33	User Defined Refrigerant A3
8-8*	FC Port Diagnostics	15-62	Option Ordering No	16-71	Relay Output [bin]	20-4*	Thermostat/Pressostat
8-80	Bus Message Count	15-63	Option Serial No	16-72	Counter A	20-40	Thermostat/Pressostat Function
8-81	Bus Error Count	15-8*	Operating Data II	16-73	Counter B	20-41	Cut-out Value
8-82	Slave Message Count	15-80	Fan Running Hours	16-75	Analog In X30/11	20-42	Cut-in Value
8-83	Slave Error Count	15-92	Defined Parameters	16-76	Analog In X30/12	20-7*	PID Autotuning
8-9*	Bus Jog / Feedback	15-93	Modified Parameters	16-77	Analog Out X30/8 [mA]	20-70	Closed Loop Type
8-94	Bus Feedback 1	15-99	Parameter Metadata	16-8*	Fieldbus & FC Port	20-71	PID Performance
8-95	Bus Feedback 2	16-*	Data Readouts	16-80	Fieldbus CTW 1	20-72	PID Output Change
8-96	Bus Feedback 3	16-0*	General Status	16-82	Fieldbus REF 1	20-73	Minimum Feedback Level
11-*	LonWorks	16-00	Control Word	16-84	Comm. Option STW	20-74	Maximum Feedback Level
11-2*	Lon Param. Access	16-01	Reference [Unit]	16-85	FC Port CTW 1	20-8*	PID Basic Settings
11-21	Store Data Values	16-02	Reference [%]	16-86	FC Port REF 1	20-81	PID Normal/ Inverse Control
11-9*	AK LonWorks	16-05	Main Actual Value [%]	16-9*	Diagnosis Readouts	20-82	PID Start Speed [RPM]
11-90	VLT Network Address	16-09	Custom Readout	16-90	Alarm Word	20-83	PID Start Speed [Hz]
11-91	AK Service Pin	16-1*	Motor Status	16-91	Alarm Word 2	20-84	On Reference Bandwidth
11-98	Alarm Text	16-10	Power [kW]	16-92	Warning Word	20-9*	PID Controller
11-99	Alarm Status	16-11	Power [hp]	16-93	Warning Word 2	20-91	PID Anti Windup
13-*	Smart Logic	16-12	Motor Voltage	16-94	Ext. Status Word	20-93	PID Proportional Gain
13-0*	SLC Settings	16-13	Frequency	18-*	Info & Readouts	20-94	PID Integral Time
13-00	SL Controller Mode	16-14	Motor current	18-0*	Maintenance Log	20-95	PID Differentiation Time
13-01	Start Event			18-00	Maintenance Log: Item	20-96	PID Diff. Gain Limit
13-02	Stop Event						
13-03	Reset SLC						

21-1* Ext. Closed Loop	22-2* No-Flow Detection	23-1* Maintenance	25-82 Lead Compressor	28-25 Warning Action
21-0* Ext. CL Autotuning	22-20 Low Power Auto Set-up	23-10 Maintenance Item	25-83 Relay Status	28-26 Emergency Level
21-00 Closed Loop Type	22-21 Low Power Detection	23-11 Maintenance Action	25-84 Compressor ON Time	28-27 Discharge Temperature
21-01 PID Performance	22-22 Low Speed Detection	23-12 Maintenance Time Base	25-85 Relay ON Time	28-7* Day/Night Settings
21-02 PID Output Change	22-23 No-Flow Function	23-13 Maintenance Time Interval	25-86 Reset Relay Counters	28-71 Day/Night Bus Indicator
21-03 Minimum Feedback Level	22-24 No-Flow Delay	23-14 Maintenance Date and Time	25-87 Inverse Interlock	28-72 Enable Day/Night Via Bus
21-04 Maximum Feedback Level	22-25 Dry Pump Function	23-1* Maintenance Reset	25-88 Pack capacity [%]	28-73 Night Setback
21-09 PID Autotuning	22-27 Dry Pump Delay	23-15 Reset Maintenance Word	25-9* Service	28-74 Night Speed Drop [RPM]
21-1* Ext. CL 1 Ref/Fb.	22-3* No-Flow Power Tuning	23-16 Maintenance Text	25-90 Compressor Interlock	28-75 Night Speed Drop Override
21-10 Ext. 1 Ref./Feedback Unit	22-30 No-Flow Power	23-5* Energy Log	25-91 Manual Alternation	28-8* PO Optimization
21-11 Ext. 1 Minimum Reference	22-31 Power Correction Factor	23-50 Energy Log Resolution	26-5* Analog I/O Mode	28-81 dPO Offset
21-12 Ext. 1 Maximum Reference	22-32 Low Speed [RPM]	23-51 Period Start	26-00 Terminal X42/3 Mode	28-82 PO
21-13 Ext. 1 Reference Source	22-33 Low Speed [Hz]	23-53 Energy Log	26-01 Terminal X42/3 Mode	28-83 PO Setpoint
21-14 Ext. 1 Feedback Source	22-34 Low Speed Power [kW]	23-54 Reset Energy Log	26-02 Terminal X42/5 Mode	28-84 PO Reference
21-15 Ext. 1 Setpoint	22-35 Low Speed Power [HP]	23-6* Trending	26-1* Analog Input X42/1	28-85 PO Minimum Reference
21-17 Ext. 1 Reference [Unit]	22-36 High Speed [RPM]	23-60 Trend Variable	26-10 Terminal X42/1 Low Voltage	28-86 PO Maximum Reference
21-18 Ext. 1 Feedback [Unit]	22-37 High Speed [Hz]	23-61 Continuous Bin Data	26-11 Terminal X42/1 High Voltage	28-87 Most Loaded Controller
21-19 Ext. 1 Output [%]	22-38 High Speed Power [kW]	23-62 Timed Bin Data	26-14 Term. X42/1 Low Ref./Feedb. Value	28-9* Injection Control
21-2* Ext. CL 1 PID	22-39 High Speed Power [HP]	23-63 Timed Period Start	26-15 Term. X42/1 High Ref./Feedb. Value	28-90 Injection On
21-20 Ext. 1 Normal/Inverse Control	22-4* Sleep Mode	23-64 Timed Period Stop	26-16 Term. X42/1 Filter Time Constant	28-91 Delayed Compressor Start
21-21 Ext. 1 Proportional Gain	22-40 Minimum Run Time	23-65 Minimum Bin Value	26-17 Term. X42/1 Live Zero	
21-22 Ext. 1 Integral Time	22-41 Minimum Sleep Time	23-66 Reset Continuous Bin Data	26-2* Analog Input X42/3	
21-23 Ext. 1 Differentiation Time	22-42 Wake-up Speed [RPM]	23-67 Reset Timed Bin Data	26-20 Terminal X42/3 Low Voltage	
21-24 Ext. 1 Dif. Gain Limit	22-43 Wake-up Speed [Hz]	23-8* Payback Counter	26-21 Terminal X42/3 High Voltage	
21-3* Ext. CL 2 Ref/Fb.	22-44 Wake-up Ref/FB Difference	23-80 Power Reference Factor	26-24 Term. X42/3 Low Ref./Feedb. Value	
21-30 Ext. 2 Ref./Feedback Unit	22-45 Setpoint Boost	23-81 Energy Cost	26-25 Term. X42/3 High Ref./Feedb. Value	
21-31 Ext. 2 Minimum Reference	22-46 Maximum Boost Time	23-82 Investment	26-26 Term. X42/3 Filter Time Constant	
21-32 Ext. 2 Maximum Reference	22-5* End of Curve	23-83 Energy Savings	26-27 Term. X42/3 Live Zero	
21-33 Ext. 2 Reference Source	22-50 End of Curve Function	23-84 Cost Savings	26-3* Analog Input X42/5	
21-34 Ext. 2 Feedback Source	22-51 End of Curve Delay	25-5* Pack Controller	26-30 Terminal X42/5 Low Voltage	
21-35 Ext. 2 Setpoint	22-6* Broken Belt Detection	25-00 Pack Controller	26-31 Terminal X42/5 High Voltage	
21-37 Ext. 2 Reference [Unit]	22-60 Broken Belt Function	25-04 Compressor Cycling	26-34 Term. X42/5 Low Ref./Feedb. Value	
21-38 Ext. 2 Feedback [Unit]	22-61 Broken Belt Torque	25-06 Number of Compressors	26-35 Term. X42/5 High Ref./Feedb. Value	
21-39 Ext. 2 Output [%]	22-62 Broken Belt Delay	25-2* Zone Settings	26-36 Term. X42/5 Filter Time Constant	
21-4* Ext. CL 2 PID	22-7* Short Cycle Protection	25-20 Neutral Zone [unit]	26-37 Term. X42/5 Live Zero	
21-40 Ext. 2 Normal/Inverse Control	22-75 Short Cycle Protection	25-21 + Zone [unit]	26-4* Analog Out X42/7	
21-41 Ext. 2 Proportional Gain	22-76 Interval between Starts	25-22 - Zone [unit]	26-40 Terminal X42/7 Output	
21-42 Ext. 2 Integral Time	22-77 Minimum Run Time	25-23 Fixed Speed neutral Zone [unit]	26-41 Terminal X42/7 Min. Scale	
21-43 Ext. 2 Differentiation Time	22-78 Minimum Run Time Override	25-24 + Zone Delay	26-42 Terminal X42/7 Max. Scale	
21-44 Ext. 2 Dif. Gain Limit	22-79 Minimum Run Time Override Value	25-25 - Zone Delay	26-43 Terminal X42/7 Bus Control	
21-5* Ext. CL 3 Ref/Fb.	22-8* Flow Compensation	25-26 ++ Zone Delay	26-5* Analog Out X42/9	
21-50 Ext. 3 Ref./Feedback Unit	22-80 Flow Compensation	25-27 -- Zone Delay	26-50 Terminal X42/9 Output	
21-51 Ext. 3 Minimum Reference	22-81 Square-linear Curve Approximation	25-3* Staging Functions	26-51 Terminal X42/9 Min. Scale	
21-52 Ext. 3 Maximum Reference	22-82 Work Point Calculation	25-30 Destage At No-Flow	26-52 Terminal X42/9 Max. Scale	
21-53 Ext. 3 Reference Source	22-83 Speed at No-Flow [RPM]	25-31 Stage Function	26-53 Terminal X42/9 Bus Control	
21-54 Ext. 3 Feedback Source	22-84 Speed at No-Flow [Hz]	25-32 Stage Function Time	26-54 Terminal X42/9 Timeout Preset	
21-55 Ext. 3 Setpoint	22-85 Speed at Design Point [RPM]	25-33 Stage Function	26-6* Analog Out X42/11	
21-57 Ext. 3 Reference [Unit]	22-86 Speed at Design Point [Hz]	25-34 Destage-Function Time	26-60 Terminal X42/11 Output	
21-58 Ext. 3 Feedback [Unit]	22-87 Pressure at No-Flow Speed	25-4* Staging Settings	26-61 Terminal X42/11 Min. Scale	
21-59 Ext. 3 Output [%]	22-88 Pressure at Rated Speed	25-43 Destaging Threshold	26-62 Terminal X42/11 Max. Scale	
21-6* Ext. CL 3 PID	22-89 Flow at Design Point	25-44 Staging Speed [RPM]	26-63 Terminal X42/11 Bus Control	
21-60 Ext. 3 Normal/Inverse Control	22-90 Flow at Rated Speed	25-46 Destaging Speed [RPM]	26-64 Terminal X42/11 Timeout Preset	
21-61 Ext. 3 Proportional Gain	23-0* Time-based Functions	25-8* Status	28-2* Compressor Functions	
21-62 Ext. 3 Integral Time	23-0* Time-based Functions	25-80 Pack Status	28-20 Temperature Source	
21-63 Ext. 3 Differentiation Time	23-00 ON Time	25-81 Compressor Status	28-21 Temperature Unit	
21-64 Ext. 3 Dif. Gain Limit	23-01 ON Action		28-24 Warning Level	
22-0* Miscellaneous	23-02 OFF Time			
22-00 External Interlock Delay	23-03 OFF Action			
	23-04 Occurrence			

5.6 Remote Programming with MCT 10 Set-up Software

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

5

The USB connector or RS-485 terminal is available for connecting to the adjustable frequency drive.

6 Application Examples

6.1 Introduction

NOTE!

When the optional safe stop feature is used, a jumper wire may be required between terminal 12 (or 13) and terminal 37 for the adjustable frequency drive 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.

FC		Parameters	
		Function	Setting
+24 V	12	130BB930.10	1-29 Automatic Motor Adaptation (AMA)
+24 V	13		
D IN	18		
D IN	19		
COM	20		
D IN	27		
D IN	29		
D IN	32		
D IN	33		
D IN	37		
+10 V	50	5-12 Terminal 27 Digital Input	[0] No operation
A IN	53	* = Default Value	
A IN	54	Notes/comments: Parameter group 1-2* must be set according to motor	
COM	55		
A OUT	42		
COM	39		

6.2 Application Examples

FC		Parameters	
		Function	Setting
+24 V	12	130BB929.10	1-29 Automatic Motor Adaptation (AMA)
+24 V	13		
D IN	18		
D IN	19		
COM	20		
D IN	27		
D IN	29		
D IN	32		
D IN	33		
D IN	37		
+10 V	50	5-12 Terminal 27 Digital Input	[2]* Coast inverse
A IN	53	* = Default Value	
A IN	54	Notes/comments: Parameter group 1-2* must be set according to motor	
COM	55		
A OUT	42		
COM	39		

Table 6.1 AMA with T27 Connected

Table 6.2 AMA without T27 Connected

FC		Parameters	
		Function	Setting
+24 V	12	130BB926.10	6-10 Terminal 53 Low Voltage
+24 V	13		
D IN	18		
D IN	19		
COM	20		
D IN	27		
D IN	29		
D IN	32		
D IN	33		
D IN	37		
+10 V	50	6-11 Terminal 53 High Voltage	10 V*
A IN	53	6-14 Terminal 53 Low Ref./Feedb. Value	0 Hz
A IN	54	6-15 Terminal 53 High Ref./Feedb. Value	50 Hz
COM	55	* = Default Value	
A OUT	42	Notes/comments:	
COM	39		

Table 6.3 Analog Speed Reference (Voltage)

		Parameters	
FC		Function	Setting
+24 V	12	6-12 Terminal 53	4 mA*
+24 V	13	Low Current	
D IN	18	6-13 Terminal 53	20 mA*
D IN	19	High Current	
COM	20	6-14 Terminal 53	0 Hz
D IN	27	Low Ref./Feedb. Value	
D IN	29	6-15 Terminal 53	50 Hz
D IN	32	High Ref./Feedb. Value	
D IN	33		
D IN	37		
+10 V	50	* = Default Value	
A IN	53	Notes/comments:	
A IN	54		
COM	55		
A OUT	42		
COM	39		

Table 6.4 Analog Speed Reference (Current)

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

Table 6.5 Start/Stop Command with Safe Stop

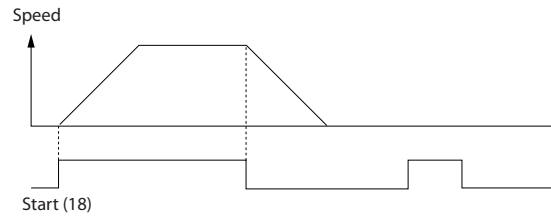


Figure 6.1 Start/Stop Command with Safe Stop

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

Table 6.6 Pulse Start/Stop

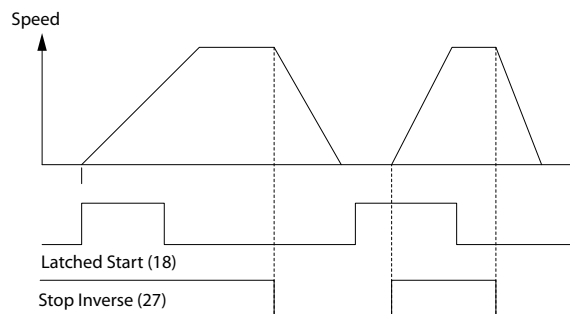


Figure 6.2 Latched Start/Stop Inverse

FC		Parameters	
		Function	Setting
+24 V	12	5-10 Terminal 18 <i>Digital Input</i>	[8] Start
+24 V	13		
D IN	18	5-11 Terminal 19 <i>Digital Input</i>	[10] Reverse*
D IN	19		
COM	20		
D IN	27		
D IN	29		
D IN	32	5-12 Terminal 27 <i>Digital Input</i>	[0] No operation
D IN	33		
D IN	37	5-14 Terminal 32 <i>Digital Input</i>	[16] Preset ref bit 0
+10 V	50	5-15 Terminal 33 <i>Digital Input</i>	[17] Preset ref bit 1
A IN	53	3-10 Preset <i>Reference</i>	
A IN	54	Preset ref. 0	25%
COM	55	Preset ref. 1	50%
A OUT	42	Preset ref. 2	75%
COM	39	Preset ref. 3	100%
		* = Default Value	
		Notes/comments:	

Table 6.7 Start/Stop with Reversing and Four Preset Speeds

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

Table 6.8 External Alarm Reset

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

Table 6.9 Speed Reference (using a Manual Potentiometer)

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

Table 6.10 Speed Up/Down

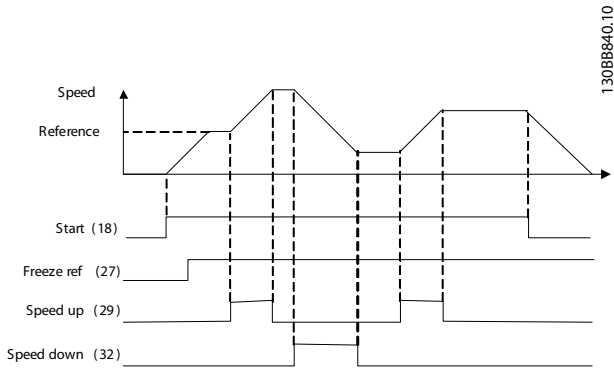


Figure 6.3 Speed Up/Down

6

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

Table 6.11 RS-485 Network Connection

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

Table 6.12 Motor Thermistor

CAUTION

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

7 Status Messages

7.1 Status Messages

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

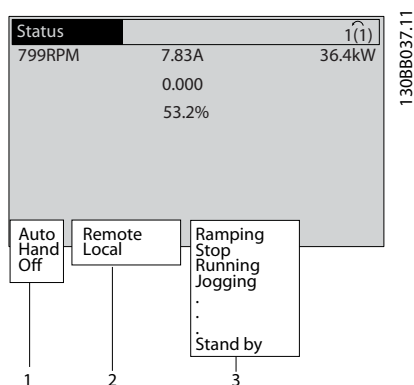


Figure 7.1 Status Display

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

NOTE!

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

7.2 Status Message Definitions

Table 7.1, Table 7.2 and Table 7.3 define the meaning of the status message display words.

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

Table 7.1 Operation Mode

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

Table 7.2 Reference Site

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

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

Freeze ref.	<i>Freeze Reference</i> was chosen as a function for a digital input (parameter group <i>5-1* Digital Inputs</i>). The corresponding terminal is active. The adjustable frequency drive saves the actual reference. Changing the reference is now only possible via terminal functions speed up and slow.
Jog request	A jog command has been given, but the motor will be stopped until a run permissive signal is received via a digital input.
Jogging	The motor is running as programmed in <i>3-19 Jog Speed [RPM]</i> . <ul style="list-style-type: none"> <i>Jog</i> was selected as function for a digital input (parameter group <i>5-1* Digital Inputs</i>). The corresponding terminal (e.g., Terminal 29) is active. The Jog function is activated via the serial communication. The Jog function was selected as a reaction for a monitoring function (e.g., No signal). The monitoring function is active.
Motor check	In <i>1-80 Function at Stop, Motor Check</i> was selected. A stop command is active. To ensure that a motor is connected to the adjustable frequency drive, a permanent test current is applied to the motor.
OVC control	<i>Overvoltage control</i> was activated in <i>2-17 Overvoltage Control</i> . The connected motor is supplying the adjustable frequency drive with generative energy. Overvoltage control adjusts the V/Hz ratio to run the motor in controlled mode and to prevent the adjustable frequency drive from tripping.
PowerUnit Off	(For adjustable frequency drives with an external 24 V power supply installed only). Line power supply to the adjustable frequency drive is removed, but the control card is supplied by the external 24 V.
Protection md	Protection mode is active. The unit has detected a critical status (an overcurrent or overvoltage). <ul style="list-style-type: none"> To avoid tripping, switching frequency is reduced to 4 kHz If possible, Protection mode ends after approximately 10 s Protection mode can be restricted in <i>14-26 Trip Delay at Inverter Fault</i>
Ramping	The motor is accelerating/decelerating using the active ramp-up/down. The reference, a limit value or a standstill is not yet reached.

Ref. high	The sum of all active references is above the reference limit set in <i>4-55 Warning Reference High</i> .
Ref. low	The sum of all active references is below the reference limit set in <i>4-54 Warning Reference Low</i> .
Run on ref.	The adjustable frequency drive is running in the reference range. The feedback value matches the setpoint value.
Run request	A start command has been given, but the motor is stopped until a run permissive signal is received via digital input.
Running	The motor is driven by the adjustable frequency drive.
Speed high	Motor speed is above the value set in <i>4-53 Warning Speed High</i> .
Speed low	Motor speed is below the value set in <i>4-52 Warning Speed Low</i> .
Standby	In Auto On Auto mode, the adjustable frequency drive will start the motor with a start signal from a digital input or serial communication.
Start delay	In <i>1-71 Start Delay</i> , a delay starting time was set. A start command is activated and the motor will start after the start delay time expires.
Start fwd/rev	Start forward and start reverse were selected as functions for two different digital inputs (parameter group <i>5-1* Digital Inputs</i>). The motor will start in forward or reverse depending on which corresponding terminal is activated.
Stop	The adjustable frequency drive 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 adjustable frequency drive 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 adjustable frequency drive. The adjustable frequency drive can then be reset manually by pressing [Reset] or remotely by control terminals or serial communication.

Table 7.3 Operation Status

8 Warnings and Alarms

8.1 System Monitoring

The adjustable frequency drive 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 adjustable frequency drive itself. In many cases, it indicates failure conditions from input voltage, motor load or temperature, external signals, or other areas monitored by the adjustable frequency drive's internal logic. Be sure to investigate those areas exterior to the adjustable frequency drive as indicated in the alarm or warning.

8.2 Warning and Alarm Types

8.2.1 Warnings

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

8.2.2 Alarm Trip

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

A trip can be reset in any of four ways:

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

8.2.3 Alarm Trip Lock

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

8.3 Warning and Alarm Displays

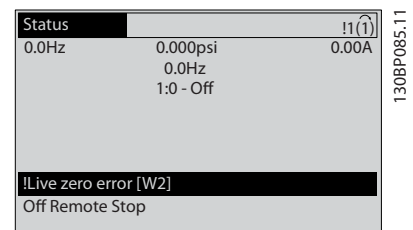


Figure 8.1

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

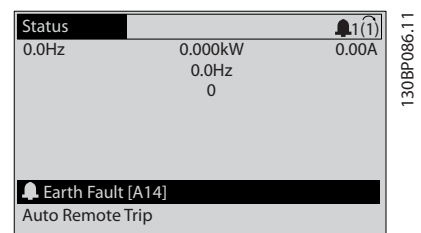


Figure 8.2

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

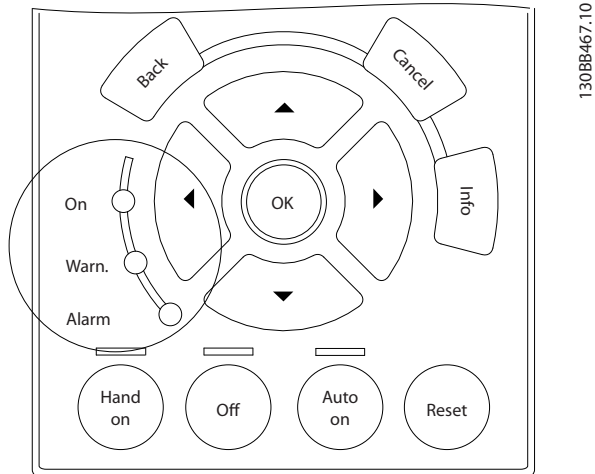


Figure 8.3

8

	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 overvoltage	X	X		
8	DC under voltage	X	X		
9	Inverter overloaded	X	X		
10	Motor ETR overtemperature	(X)	(X)		1-90 Motor Thermal Protection
11	Motor thermistor overtemperature	(X)	(X)		1-90 Motor Thermal Protection
12	Torque limit	X	X		
13	Overcurrent	X	X	X	
14	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 overtemperature	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	4-58 Missing Motor Phase Function
31	Motor phase V missing	(X)	(X)	(X)	4-58 Missing Motor Phase Function
32	Motor phase W missing	(X)	(X)	(X)	4-58 Missing Motor Phase Function
33	Inrush fault		X	X	
34	Fieldbus communication fault	X	X		
35	Out of frequency range	X	X		
36	Mains Failure	X	X		
37	Phase Imbalance	X	X		
38	Internal fault		X	X	
39	Heatsink sensor		X	X	
40	Overload of Digital Output Terminal 27	(X)			5-00 Digital I/O Mode, 5-01 Terminal 27 Mode
41	Overload of Digital Output Terminal 29	(X)			5-00 Digital I/O Mode, 5-02 Terminal 29 Mode
42	Overload of Digital Output On X30/6	(X)			5-32 Term X30/6 Digi Out (MCB 101)
42	Overload of Digital Output On X30/7	(X)			5-33 Term X30/7 Digi Out (MCB 101)

No.	Description	Warning	Alarm/Trip	Alarm/Trip lock	Parameter reference
46	Pwr. card supply		X	X	
47	24 V supply low	X	X	X	
48	1.8 V supply low		X	X	
49	Speed limit	X	(X)		1-86 Trip Speed Low [RPM]
50	AMA calibration failed		X		
51	AMA check U_{nom} and I_{nom}		X		
52	AMA low I_{nom}		X		
53	AMA motor too big		X		
54	AMA motor too small		X		
55	AMA Parameter out of range		X		
56	AMA interrupted by user		X		
57	AMA timeout		X		
58	AMA internal fault	X	X		
59	Current limit	X			
60	External Interlock	X			
62	Output Frequency at Maximum Limit	X			
64	Voltage Limit	X			
65	Control board overtemperature	X	X	X	
66	Heatsink Temperature Low	X			
67	Option Configuration has Changed		X		
70	Illegal FC configuration			X	
71	PTC 1 Safe Stop	X	X ⁽¹⁾		
72	Dangerous Failure			X ⁽¹⁾	
73	Safe Stop Auto Restart				
76	Power Unit Set-up	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	No-Flow	X	X		22-2* No-Flow Detection

Table 8.2 Alarm/Warning Code List

No.	Description	Warning	Alarm/Trip	Alarm/Trip lock	Parameter reference
93	Dry Pump	X	X		22-2* No-Flow Detection
94	End of Curve	X	X		22-5* End of Curve
95	Broken Belt	X	X		22-6* Broken Belt Detection
96	Start Delayed	X			22-7* Short Cycle Protection
97	Stop Delayed	X			22-7* Short Cycle Protection
98	Clock Fault	X			0-7* Clock Settings
104	Mixing Fan Fault	X	X		14-53 Fan Monitor
203	Missing Motor				
204	Locked Rotor				
243	Brake IGBT	X	X		
244	Heatsink temp	X	X	X	
245	Heatsink sensor		X	X	
246	Pwr.card supply		X	X	
247	Pwr.card temp		X	X	
248	Illegal PS config		X	X	
250	New spare parts			X	
251	New Type Code		X	X	

Table 8.3 Alarm/Warning Code List

(X) Dependent on parameter

¹⁾ Cannot be Auto reset via 14-20 Reset Mode

8.5 Fault Messages

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

WARNING 1, 10 Volts low

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

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

Troubleshooting

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

WARNING/ALARM 2, Live zero error

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

Troubleshooting

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

WARNING/ALARM 3, No motor

No motor has been connected to the output of the adjustable frequency drive.

WARNING/ALARM 4, Mains phase loss

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

Troubleshooting

Check the supply voltage and supply currents to the adjustable frequency drive.

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 adjustable frequency drive 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 adjustable frequency drive voltage rating. The unit is still active.

WARNING/ALARM 7, DC overvoltage

If the intermediate circuit voltage exceeds the limit, the adjustable frequency drive 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 undervoltage

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

Troubleshooting

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

WARNING/ALARM 9, Inverter overload

The adjustable frequency drive 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 adjustable frequency drive *cannot* be reset until the counter is below 90%.

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

Troubleshooting

- Compare the output current shown on the LCP with the adjustable frequency drive 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 adjustable frequency drive continuous current rating, the counter should increase. When running below the adjustable frequency drive 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 adjustable frequency drive gives a warning or an alarm when the counter reaches 100% in *1-90 Motor Thermal Protection*. The fault occurs when the motor is overloaded by more than 100% for too long.

Troubleshooting

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

WARNING/ALARM 11, Motor thermistor overtemp

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

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply) and that the terminal switch for 53 or 54 is set for voltage. Check that *1-93 Thermistor Source* selects terminal 53 or 54.
- When using digital inputs 18 or 19, check that the thermistor is connected correctly between either terminal 18 or 19 (digital input PNP only) and terminal 50.
- If using a thermal switch or thermistor, check that the programming of *1-93 Thermistor Resource* matches sensor wiring.

WARNING/ALARM 12, Torque limit

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

Troubleshooting

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

WARNING/ALARM 13, Overcurrent

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 1.5 s, then the adjustable frequency drive 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 adjustable frequency drive
- Check parameters 1-20 to 1-25 for correct motor data

ALARM 14, Ground fault

There is current from the output phases to ground, either in the cable between the adjustable frequency drive and the motor or in the motor itself.

Troubleshooting:

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

ALARM 15, Hardware mismatch

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

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

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

ALARM 16, Short-circuit

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

Remove power to the adjustable frequency drive and repair the short circuit.

WARNING/ALARM 17, Control word timeout

There is no communication to the adjustable frequency drive.

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 adjustable frequency drive ramps down until it trips then displays an alarm.

Troubleshooting:

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

WARNING 23, Internal fan fault

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

Troubleshooting

- Check fan resistance
- Check soft charge fuses

WARNING 24, External fan fault

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

Troubleshooting

- Check fan resistance.
- Check soft charge fuses.

WARNING 25, Brake resistor short-circuit

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

WARNING/ALARM 26, Brake resistor power limit

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



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

WARNING/ALARM 27, Brake chopper fault

The brake transistor is monitored during operation and if a short circuit occurs, the brake function is disabled and a warning is issued. The adjustable frequency drive 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 adjustable frequency drive and remove the brake resistor.

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

WARNING/ALARM 28, Brake check failed

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

ALARM 29, Heatsink temp

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

Troubleshooting

Check for the following conditions

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

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

Troubleshooting

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

ALARM 30, Motor phase U missing

Motor phase U between the adjustable frequency drive and the motor is missing.

Remove power from the adjustable frequency drive and check motor phase U.

ALARM 31, Motor phase V missing

Motor phase V between the adjustable frequency drive and the motor is missing.

Remove power from the adjustable frequency drive and check motor phase V.

ALARM 32, Motor phase W missing

Motor phase W between the adjustable frequency drive and the motor is missing.

Remove power from the adjustable frequency drive and check motor phase W.

ALARM 33, Inrush fault

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

WARNING/ALARM 34, Fieldbus communication fault

The serial communication bus 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 adjustable frequency drive is lost and *14-10 Mains Failure* is NOT set to [0] *No Function*. Check the fuses to the adjustable frequency drive and line power supply to the unit.

ALARM 38, Internal fault

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

Troubleshooting

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

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

No.	Text
0	Serial port cannot be initialized. Contact the Danfoss supplier or Danfoss Service Department.
256-258	Power EEPROM data is defective or too old.
512	Control board EEPROM data is defective or too old.
513	Communication time out reading EEPROM data
514	Communication time out reading EEPROM data
515	Application oriented control cannot recognize the EEPROM data.
516	Cannot write to the EEPROM because a write command is on progress.
517	Write command is under timeout
518	Failure in the EEPROM
519	Missing or invalid barcode data in EEPROM
783	Parameter value outside of min/max limits
1024-1279	A CAN message that has to be sent cannot be sent.
1281	Digital signal processor flash timeout
1282	Power micro software version mismatch
1283	Power EEPROM data version mismatch
1284	Cannot read digital signal processor software version
1299	Option SW in slot A is too old
1300	Option SW in slot B is too old
1301	Option SW in slot C0 is too old
1302	Option SW in slot C1 is too old
1315	Option SW in slot A is not supported (not allowed)
1316	Option SW in slot B is not supported (not allowed)
1317	Option SW in slot C0 is not supported (not allowed)
1318	Option SW in slot C1 is not supported (not allowed)
1379	Option A did not respond when calculating platform version
1380	Option B did not respond when calculating platform version
1381	Option C0 did not respond when calculating platform version.
1382	Option C1 did not respond when calculating platform version.
1536	An exception in the application oriented control is registered. Debug information written in LCP

No.	Text
1792	DSP watchdog is active. Debugging of power part data, motor oriented control data not transferred correctly.
2049	Power data restarted
2064-2072	H081x: option in slot x has restarted
2080-2088	H082x: option in slot x has issued a power-up wait
2096-2104	H983x: option in slot x has issued a legal power-up wait
2304	Could not read any data from power EEPROM
2305	Missing SW version from power unit
2314	Missing power unit data from power unit
2315	Missing SW version from power unit
2316	Missint lo_statepage from power unit
2324	Power card configuration is determined to be incorrect at power-up
2325	A power card has stopped communicating while main power is applied
2326	Power card configuration is determined to be incorrect after the delay for power cards to register.
2327	Too many power card locations have been registered as present.
2330	Power size information between the power cards does not match.
2561	No communication from DSP to ATACD
2562	No communication from ATACD to DSP (state running)
2816	Stack overflow control board module
2817	Scheduler slow tasks
2818	Fast tasks
2819	Parameter thread
2820	LCP stack overflow
2821	Serial port overflow
2822	USB port overflow
2836	cflistMempool too small
3072-5122	Parameter value is outside its limits
5123	Option in slot A: Hardware incompatible with control board hardware
5124	Option in slot B: Hardware incompatible with control board hardware.
5125	Option in slot C0: Hardware incompatible with control board hardware.
5126	Option in slot C1: Hardware incompatible with control board hardware.
5376-6231	Out of memory

Table 8.4
ALARM 39, Heatsink sensor

No feedback from the heatsink temperature sensor.

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

WARNING 40, Overload of digital output terminal 27

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

WARNING 41, Overload of digital output terminal 29

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

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

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

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

ALARM 46, Power card supply

The supply on the power card is out of range.

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

WARNING 47, 24 V supply low

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

WARNING 48, 1.8 V supply low

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

WARNING 49, Speed limit

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

ALARM 50, AMA calibration failed

Contact the Danfoss supplier or Danfoss Service Department.

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

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

ALARM 52, AMA low I_{nom}

The motor current is too low. Check the settings.

ALARM 53, AMA motor too big

The motor is too big for the AMA to operate.

ALARM 54, AMA motor too small

The motor is too small for the AMA to operate.

ALARM 55, AMA Parameter out of range

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

ALARM 56, AMA interrupted by user

The user has interrupted the AMA.

ALARM 57, AMA internal fault

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

ALARM 58, AMA internal fault

Contact the Danfoss supplier.

WARNING 59, Current limit

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

WARNING 60, External interlock

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

WARNING 62, Output frequency at maximum limit

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

ALARM 64, Voltage Limit

The load and speed combination demands a motor voltage higher than the actual DC link voltage.

WARNING/ALARM 65, Control card over temperature

The control card has reached its trip temperature of 167° F [75°C].

WARNING 66, Heatsink temperature low

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

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

Troubleshooting

The heatsink temperature measured as 32° F [0°C] could indicate that the temperature sensor is defective, causing the fan speed to increase to the maximum. If the sensor wire between the IGBT and the gate drive card is disconnected, this warning would result. Also, check the IGBT thermal sensor.

ALARM 67, Option module configuration has changed

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

ALARM 68, Safe Stop activated

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

ALARM 69, Power card temperature

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

Troubleshooting

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

ALARM 70, Illegal FC configuration

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

WARNING 73, Safe stop auto restart

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

WARNING 76, Power unit set-up

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

Troubleshooting:

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

WARNING 77, Reduced power mode

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

ALARM 79, Illegal power section configuration

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

ALARM 80, Drive initialized to default value

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

ALARM 81, CSIV corrupt

CSIV file has syntax errors.

ALARM 82, CSIV parameter error

CSIV failed to init a parameter.

ALARM 85, Dang fail PB

Profibus/Profisafe Error.

WARNING/ALARM 104, Mixing fan fault

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

Troubleshooting

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

WARNING 250, New spare part

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

WARNING 251, New type code

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

9 Basic Troubleshooting

9.1 Start-up and Operation

Symptom	Possible cause	Test	Solution
Display dark/No function	Missing input power	See <i>Table 3.1</i>	Check the input power source
	Missing or open fuses or circuit breaker tripped	See open fuses and tripped circuit breaker in this table for possible causes.	Follow the recommendations provided
	No power to the LCP	Check the LCP cable for proper connection or damage.	Replace the faulty LCP or connection cable.
	Shortcut on control voltage (terminal 12 or 50) or at control terminals	Check the 24 V control voltage supply for terminals 12/13 to 20-39 or 10 V supply for terminals 50 to 55.	Wire the terminals properly.
	Wrong LCP (LCP from VLT® 2800 or 5000/6000/8000/ FCD or FCM)		Use only LCP 101 (P/N 130B1124) or LCP 102 (P/N 130B1107).
	Wrong contrast setting		Press [Status] + [▲]/[▼] to adjust the contrast.
	Display (LCP) is defective.	Test using a different LCP.	Replace the faulty LCP or connection cable.
	Internal voltage supply fault or SMPS is defective.		Contact supplier
Intermittent display	Overloaded power supply (SMPS) due to improper control wiring or a fault within the adjustable frequency drive.	To rule out a problem in the control wiring, disconnect all control wiring by removing the terminal blocks.	If the display stays lit, then the problem is in the control wiring. Check the wiring for shorts or incorrect connections. If the display continues to cut out, follow the procedure for display dark.

Symptom	Possible cause	Test	Solution
Motor not running	Service switch open or missing motor connection	Check if the motor is connected and the connection is not interrupted (by a service switch or other device).	Connect the motor and check the service switch.
	No line power with 24 V DC option card	If the display is functioning but no output, check that line power is applied to the adjustable frequency drive.	Apply line power to run the unit.
	LCP Stop	Check if [Off] has been pressed.	Press [Auto On] or [Hand On] (depending on operation mode) to run the motor.
	Missing start signal (Standby)	Check 5-10 <i>Terminal 18 Digital Input</i> for correct setting for terminal 18 (use default setting).	Apply a valid start signal to start the motor.
	Motor coast signal active (Coasting)	Check 5-12 <i>Coast inv.</i> for correct setting for terminal 27 (use default setting).	Apply 24 V on terminal 27 or program this terminal to <i>No operation</i> .
	Wrong reference signal source	Check reference signal: Local, remote or bus reference? Preset reference active? Terminal connection correct? Scaling of terminals correct? Reference signal available?	Program correct settings. Check 3-13 <i>Reference Site</i> . Set preset reference active in parameter group 3-1* <i>References</i> . Check for correct wiring. Check scaling of terminals. Check reference signal.
Motor running in wrong direction	Motor rotation limit	Check that 4-10 <i>Motor Speed Direction</i> is programmed correctly.	Program correct settings.
	Active reversing signal	Check if a reversing command is programmed for the terminal in parameter group 5-1* <i>Digital inputs</i> .	Deactivate reversing signal.
	Wrong motor phase connection		See 2.4.5 <i>Motor Rotation Check</i> in this manual.
Motor is not reaching maximum speed.	Frequency limits set wrong.	Check output limits in 4-13 <i>Motor Speed High Limit [RPM]</i> , 4-14 <i>Motor Speed High Limit [Hz]</i> and 4-19 <i>Max Output Frequency</i> .	Program correct limits.
	Reference input signal not scaled correctly	Check reference input signal scaling in 6-0* <i>Analog I/O Mode</i> and parameter group 3-1* <i>References</i> . Reference limits in parameter group 3-0* <i>Reference Limit</i> .	Program correct settings.
Motor speed unstable	Possible incorrect parameter settings	Check the settings of all motor parameters, including all motor compensation settings. For closed-loop operation, check PID settings.	Check settings in parameter group 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 overmagnetization	Check for incorrect motor settings in all motor parameters.	Check motor settings in parameter groups 1-2* <i>Motor Data</i> , 1-3* <i>Adv Motor Data</i> , and 1-5* <i>Load Indep. Setting</i> .
Motor will not brake.	Possible incorrect settings in the brake parameters. Possible too short ramp down times.	Check brake parameters. Check ramp time settings.	Check parameter group 2-0* <i>DC Brake</i> and 3-0* <i>Reference Limits</i> .

Symptom	Possible cause	Test	Solution
Open power fuses or circuit breaker trip.	Phase-to-phase short	Motor or panel has a short phase-to-phase. Check motor and panel phase for shorts.	Eliminate any shorts detected.
	Motor overload	Motor is overloaded for the application.	Perform start-up 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.
Line power current imbalance greater than 3%	Problem with line power (See <i>Alarm 4 Mains phase loss</i> description).	Rotate input power leads into the adjustable frequency drive one position: A to B, B to C, C to A.	If imbalanced leg follows the wire, it is a power problem. Check line power supply.
	Problem with the adjustable frequency drive	Rotate input power leads into the adjustable frequency drive 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 adjustable frequency drives	Rotate output motor leads one position: U to V, V to W, W to U.	If imbalance leg stays on same output terminal, it is a problem with the unit. Contact the supplier.
Acoustic noise or vibration (e.g., a fan blade is making noise or vibrations at certain frequencies)	Resonances, e.g., in the motor/fan system	Bypass critical frequencies by using parameters in parameter group 4-6* <i>Speed Bypass</i> .	Check if noise and/or vibration have been reduced to an acceptable limit.
		Turn off overmodulation in 14-03 <i>Overmodulation</i>	
		Change switching pattern and frequency in parameter group 14-0* <i>Inverter Switching</i> .	
		Increase Resonance Dampening in 1-64 <i>Resonance Dampening</i>	

Table 9.1 Troubleshooting

10 Specifications

10.1 Power-dependent Specifications

	N110	N132	N160	N200	N250	N315
Normal Load*	NO	NO	NO	NO	NO	NO
Typical Shaft output at 400 V [kW]	110	132	160	200	250	315
Typical Shaft output at 460 V [hp]	150	200	250	300	350	450
Typical Shaft output at 480 V [kW]	132	160	200	250	315	355
Enclosure IP21	D1h	D1h	D1h	D2h	D2h	D2h
Enclosure IP54	D1h	D1h	D1h	D2h	D2h	D2h
Enclosure IP20	D3h	D3h	D3h	D4h	D4h	D4h
Output current						
Continuous (at 400 V) [A]	212	260	315	395	480	588
Intermittent (60 s overload) (at 400 V) [A]	233	286	347	435	528	647
Continuous (at 460/480 V) [A]	190	240	302	361	443	535
Intermittent (60 s overload) (at 460/480 V) [kVA]	209	264	332	397	487	588
Continuous kVA (at 400 V) [kVA]	147	180	218	274	333	407
Continuous kVA (at 460 V) [kVA]	151	191	241	288	353	426
Max. input current						
Continuous (at 400 V) [A]	204	251	304	381	463	567
Continuous (at 460/480 V) [A]	183	231	291	348	427	516
Max. cable size: line power, motor, brake and load share mm (AWG)]	2x95 (2x3/0)			2x185 (2x350)		
Max. external electrical fuses [A]	315	350	400	550	630	800
Estimated power loss at 400 V [W]	2555	2949	3764	4109	5129	6663
Estimated power loss at 460 V [W]	2257	2719	3622	3561	4558	5703
Weight, enclosure IP21, IP54 lbs [kg]	135 [62]			275 [125]		
Weight, enclosure IP20 lbs [kg]	135 [62]			275 [125]		
Efficiency	0.98					
Output frequency	0–590 Hz					
*Normal overload=110% current for 60 s						

Table 10.1 Line Power Supply 3 x 380–480 V AC

	N75K	N90K	N110	N132	N160	N200
Normal Load*	NO	NO	NO	NO	NO	NO
Typical Shaft output at 550 V [kW]	55	75	90	110	132	160
Typical Shaft output at 575 V [hp]	75	100	125	150	200	250
Typical Shaft output at 690 V [kW]	75	90	110	132	160	200
Enclosure IP21	D1h	D1h	D1h	D1h	D1h	D2h
Enclosure IP54	D1h	D1h	D1h	D1h	D1h	D2h
Enclosure IP20	D3h	D3h	D3h	D3h	D3h	D4h
Output current						
Continuous (at 550 V) [A]	90	113	137	162	201	253
Intermittent (60 s overload) (at 550 V) [A]	99	124	151	178	221	278
Continuous (at 575/690 V) [A]	86	108	131	155	192	242
Intermittent (60 s overload) (at 575/690 V) [kVA]	95	119	144	171	211	266
Continuous kVA (at 550 V) [kVA]	86	108	131	154	191	241
Continuous kVA (at 575 V) [kVA]	86	108	130	154	191	241
Continuous kVA (at 690 V) [kVA]	103	129	157	185	229	289
Max. input current						
Continuous (at 550 V) [A]	89	110	130	158	198	245
Continuous (at 575 V) [A]	85	106	124	151	189	234
Continuous (at 690 V) [A]	87	109	128	155	197	240
Max. cable size: line power, motor, brake and load share [mm (AWG)]	2x95 (2x3/0)					2x185 (2x350 mcm)
Max. external electrical fuses [A]	160	315	315	315	350	350
Estimated power loss at 575 V [W]	1161	1426	1739	2099	2646	3071
Estimated power loss at 690 V [W]	1203	1476	1796	2165	2738	3172
Weight, enclosure IP21, IP54 lbs [kg]	135 [62]					275 [125]
Weight, enclosure IP20 lbs [kg]	135 [62]					275 [125]
Efficiency	0.98					
Output frequency	0–590 Hz					
Heatsink overtemp. trip	230°F [110°C]					
Power card ambient trip	167°F [75°C]					
*Normal overload=110% current for 60 s						

Table 10.2 Line Power Supply 3 x 525–690 V AC

	N250	N315	N400
Normal Load*	NO	NO	NO
Typical Shaft output at 550 V [kW]	200	250	315
Typical Shaft output at 575 V [hp]	300	350	400
Typical Shaft output at 690 V [kW]	250	315	400
Enclosure IP21	D2h	D2h	D2h
Enclosure IP54	D2h	D2h	D2h
Enclosure IP20	D4h	D4h	D4h
Output current			
Continuous (at 550 V) [A]	303	360	418
Intermittent (60 s overload) (at 550 V) [A]	333	396	460
Continuous (at 575/690 V) [A]	290	344	400
Intermittent (60 s overload) (at 575/690 V) [kVA]	319	378	440
Continuous kVA (at 550 V) [kVA]	289	343	398
Continuous kVA (at 575 V) [kVA]	289	343	398
Continuous kVA (at 690 V) [kVA]	347	411	478
Max. input current			
Continuous (at 550 V) [A]	299	355	408
Continuous (at 575 V) [A]	286	339	390
Continuous (at 690 V) [A]	296	352	400
Max. cable size: line power, motor, brake and load share, mm (AWG)	2x185 (2x350 mcm)		
Max. external electrical fuses [A]	400	500	550
Estimated power loss at 575 V [W]	3719	4460	5023
Estimated power loss at 690 V [W]	3848	4610	5150
Weight, enclosure IP21, IP54 lbs [kg]	275 [125]		
Weight, enclosure IP20 lbs [kg]	275 [125]		
Efficiency	0.98		
Output frequency	0–590 Hz		
Heatsink overtemp. trip	230°F [110°C]		
Power card ambient trip	167°F [75°C]		

*Normal overload=110% current for 60 s

Table 10.3 Line Power Supply 3 x 525–690 V AC

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

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

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

Frame size	Description	Maximum weight, lbs [kg]
D5h	D1h ratings+disconnect and/or brake chopper	255 [116]
D6h	D1h ratings+contactor and/or circuit breaker	285 [129]
D7h	D2h ratings+disconnect and/or brake chopper	440 [200]
D8h	D2h ratings+contactor and/or circuit breaker	496 [225]

Table 10.4 D5h–D8h Weights

10.2 General Technical Data

Line power supply (L1, L2, L3)

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

AC line voltage low/line voltage drop-out:

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

Supply frequency 50/60 Hz ±5%

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

True Power Factor (λ) ≥0.9 nominal at rated load

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

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

Environment according to EN60664-1 overvoltage category III/pollution degree 2

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

Motor Output (U, V, W)

Output voltage 0–100% of supply voltage

Output frequency 0–590 Hz*

Switching on output Unlimited

Ramp times 0.01–3,600 s

* *Dependent on voltage and power*

Torque Characteristics

Starting torque (Constant torque) maximum 110% for 60 s*

Starting torque maximum 135% up to 0.5 s*

Overload torque (Constant torque) maximum 110% for 60 s*

*¹⁾ *Percentage relates to the adjustable frequency drive's nominal torque*

Cable lengths and cross-sections

Max. motor cable length, shielded/armored 500 ft [150 m]

Max. motor cable length, unshielded/unarmored 1,000 ft [300 m]

Max. cross-section to motor, line power, load sharing and brake *

Maximum cross-section to control terminals, rigid wire 0.0023 in² [1.5 mm²]/16 AWG (2x0.75 mm²)

Maximum cross-section to control terminals, flexible cable 0.0016 in² [1 mm²]/18 AWG

Maximum cross-section to control terminals, cable with enclosed core 0.0008 in² [0.5 mm²]/20 AWG

Minimum cross-section to control terminals 0.00039 in² [0.25 mm²]

*¹⁾ *Depending on voltage and power.*

Digital inputs

Programmable digital inputs 4 (6)

Terminal number 18, 19, 27¹⁾, 29¹⁾, 32, 33

Logic PNP or NPN

Voltage level 0–24 V DC

Voltage level, logic '0' PNP <5 V DC

Voltage level, logic '1' PNP >10 V DC

Voltage level, logic '0' NPN >19 V DC

Voltage level, logic '1' NPN <14 V DC

Maximum voltage on input 28 V DC

Input resistance, R_i approx. 4 kΩ

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

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

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

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

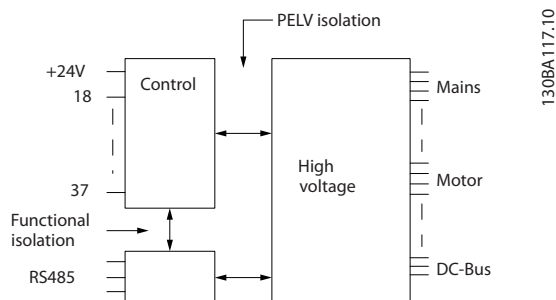


Figure 10.1

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

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

Control card, RS-485 serial communication

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

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

Digital output

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

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

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

Control card, 24 V DC output

Terminal number	12, 13
Max. load	200 mA

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

Relay outputs

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

¹⁾ IEC 60947 t 4 and 5

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

²⁾ Overvoltage Category II

³⁾ UL applications 300 V AC 2 A

Control card, 10 V DC output

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

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

Control characteristics

Resolution of output frequency at 0–590 Hz	± 0.003 Hz
System response time (terminals 18, 19, 27, 29, 32, 33)	≤2 ms
Speed control range (open-loop)	1:100 of synchronous speed
Speed accuracy (open-loop)	30–4000 rpm: Maximum error of ±8 rpm

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

Surroundings

Enclosure type D1h/D2h/D5h/D6h/D7h/D8h	IP21/Type 1, IP54/Type12
Enclosure type D3h/D4h	IP20/Chassis
Vibration test all enclosure types	1.0 g
Relative humidity	5%–95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H ₂ S test	class Kd
Test method according to IEC 60068-2-43 H ₂ S (10 days)	
Ambient temperature (at 60 AVM switching mode)	
- with derating	max. 131° F [55°C] ¹⁾
- with full output power of typical EFF2 motors (up to 90% output current)	max. 122° F [50°C] ¹⁾
- at full continuous FC output current	max. 113° F [45°C] ¹⁾

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

Minimum ambient temperature during full-scale operation	32° F [0°C]
Minimum ambient temperature at reduced performance	14° F [-10°C]
Temperature during storage/transport	-13°–149°/158° F [-25 to +65°/70°C]
Maximum altitude above sea level without derating	3,300 ft [1,000 m]
Maximum altitude above sea level with derating	10,000 ft [3,000 m]

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

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

See the Design Guide, section on Special Conditions.

Control card performance

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

Control card, USB Serial Communication

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

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

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

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

Protection and Features

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the adjustable frequency drive trips if the temperature reaches $203^{\circ}\text{F} \pm 10^{\circ}\text{F}$ [$95^{\circ}\text{C} \pm 5^{\circ}\text{C}$]. An overload temperature cannot be reset until the temperature of the heatsink is below $158^{\circ}\text{F} \pm 9^{\circ}\text{F}$ [$70^{\circ}\text{C} \pm 5^{\circ}\text{C}$] (Guideline - these temperatures may vary for different power sizes, enclosures, etc.). The adjustable frequency drive has an auto derating function to avoid its heatsink reaching 203°F [95°C].
- The adjustable frequency drive is protected against short-circuits on motor terminals U, V, W.
- If a line phase is missing, the adjustable frequency drive trips or issues a warning (depending on the load).
- Monitoring of the intermediate circuit voltage ensures that the adjustable frequency drive trips if the intermediate circuit voltage is too low or too high.
- The adjustable frequency drive is protected against ground faults on motor terminals U, V, W.

10.3 Fuse Tables

10.3.1 Protection

Branch Circuit Protection

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

Short-circuit Protection

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

Overcurrent Protection:

Provide overload protection to avoid fire hazard due to overheating of the cables in the installation. The adjustable frequency drive is equipped with internal overcurrent protection that can be used for upstream overload

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

10.3.2 Fuse Selection

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

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

N110-N315	380–480 V	type aR
N75K-N400	525–690 V	type aR

Table 10.5

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

Table 10.6 Fuse Options for 380–480 V Adjustable Frequency Drives

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

Table 10.7 Fuse Options for 525–690 V Adjustable Frequency Drives

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

10.3.3 Short Circuit Current Rating (SCCR)

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

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

10.3.4 Connection Tightening Torques

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

10

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

Table 10.8 Torque for Terminals

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