



Operating Instructions

VLT® AutomationDrive FC 300





Safety

AWARNING

HIGH VOLTAGE!

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

High Voltage

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

AWARNING

UNINTENDED START!

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

Unintended Start

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

AWARNING

DISCHARGE TIME!

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

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

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

Discharge Time

Symbols

The following symbols are used in this manual.

AWARNING

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

ACAUTION

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

CAUTION

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

NOTE

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

Approvals



Table 1.2



Safety VLT AutomationDrive Operating Instructions



VLT Automation Drive Operating Instructions

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1 Introduction

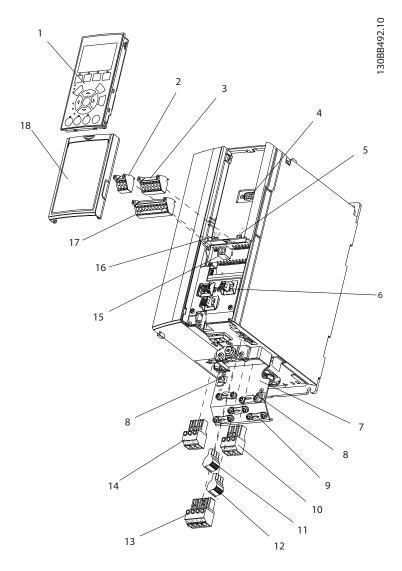


Illustration 1.1 Exploded View A1-A3, IP20

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

Table 1.1



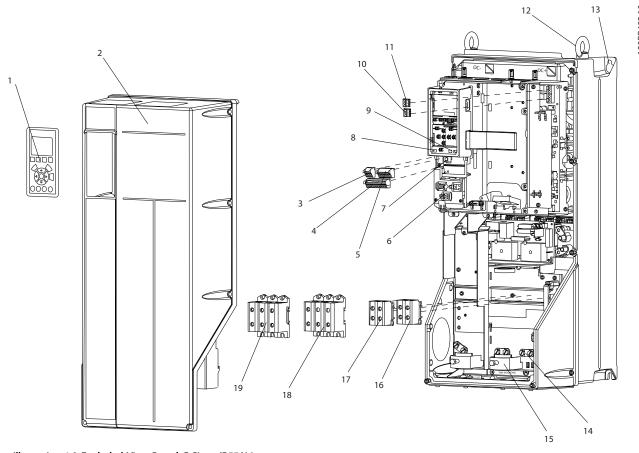


Illustration 1.2 Exploded View B and C Sizes, IP55/66

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

Table 1.2

1.1 Purpose of the Manual

This manual is intended to provide detailed information for the installation and start up of the frequency converter. provides requirements for mechanical and electrical installation, including input, motor, control and serial communications wiring, and control terminal functions. 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.



1.2 Additional Resources

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

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

1.3 Product Overview

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

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

1.4 Internal Controller Functions

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

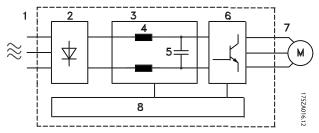


Illustration 1.3 Frequency Converter Block Diagram

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

Table 1.3 Frequency Converter Internal Components



1.5 Frame Sizes and Power Ratings

		Frame size [kW]											
[Volts]	A1	A2	A3	A4	A 5	B1	B2	В3	B4	C1	C2	СЗ	C4
200-240	0.25-1.5	0.25-2.2	3.0-3.7	0.25-2.2	0.25-3.7	5.5-7.5	11	5.5-7.5	11-15	15-22	30-37	18.5-22	30-37
380-480	0.37-1.5	0.37-4.0	5.5-7.5	0.37-4.0	0.37-7.5	11-15	18.5-22	11-15	18.5-30	30-45	55-75	37-45	55-75
525-600	N/A	N/A	0.75-7.5	N/A	0.75-7.5	11-15	18.5-22	11-15	18.5-30	30-45	55-90	37-45	55-90
525-690	N/A	N/A	1.1-7.5	N/A	N/A	N/A	11-22	11-15	20-30	N/A	30-75	37-45	55-75

Table 1.4 Frames Sizes and Power Ratings



2 Installation

2.1 Installation Site Check List

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

2.2 Frequency Converter and Motor Preinstallation Check List

- Compare the model number of unit on the nameplate to what was ordered to verify the proper equipment
- Ensure each of the following are rated for same voltage:

Mains (power)

Frequency converter

Motor

 Ensure that the frequency converter output current rating is equal to or greater than motor full load current for peak motor performance

Motor size and frequency converter power must match for proper overload protection

If frequency converter rating is less than motor, full motor output cannot be achieved

2.3 Mechanical Installation

2.3.1 Cooling

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

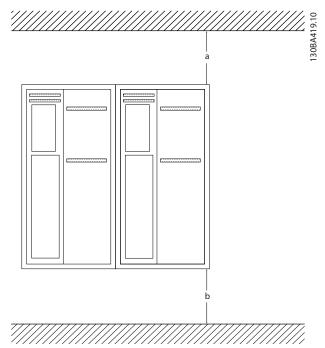


Illustration 2.1 Top and Bottom Cooling Clearance

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

Table 2.1 Minimum Airflow Clearance Requirements



2.3.2 Lifting

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

2.3.3 Mounting

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

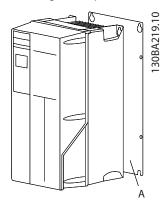


Illustration 2.2 Proper Mounting with Back Plate

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

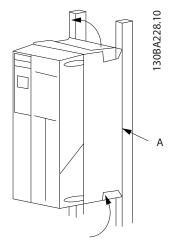


Illustration 2.3 Proper Mounting with Railings

NOTE

Back plate is needed when mounted on railings.

2.3.4 Tightening Torques

See 10.4 Connection Tightening Torques for proper tightening specifications.



2.4 Electrical Installation

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

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

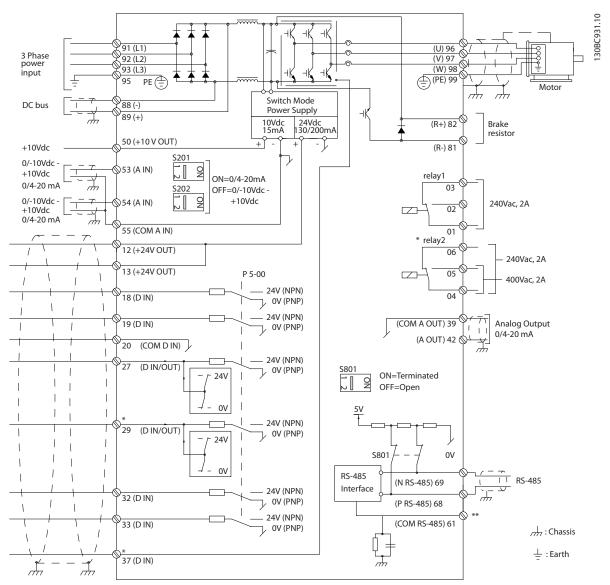


Illustration 2.4 Basic Wiring Schematic Drawing

A=Analog, D=Digital

Terminal 37 is used for Safe Stop. For Safe Stop installation instructions, refer to the Design Guide.

- * Terminal 37 is not included in FC 301 (except frame size
- A1). Relay 2 and terminal 29 have no function in FC 301.
- ** Do not connect cable screen.

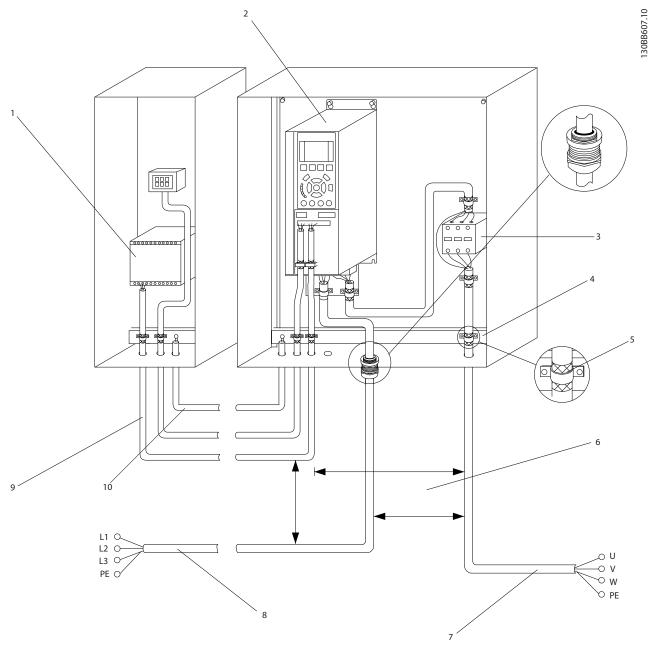


Illustration 2.5 Typical Electrical Connection

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

Table 2.2



2.4.1 Requirements

AWARNING

EQUIPMENT HAZARD!

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

CAUTION

WIRING ISOLATION!

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

For your safety, comply with the following requirements.

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

Overload and Equipment Protection

- An electronically activated function within the frequency converter provides overload protection for the motor. The overload calculates the level of increase to activate timing for the trip (controller output stop) function. The higher the current draw, the quicker the trip response. The overload provides Class 20 motor protection. See 8 Warnings and Alarms for details on the trip function.
- Because the motor wiring carries high frequency current, it is important that wiring for mains, motor power, and control are run separately. Use metallic conduit or separated shielded wire.
 Failure to isolate power, motor, and control wiring could result in less than optimum equipment performance.
- All frequency converters must be provided with short-circuit and over-current protection. Input fusing is required to provide this protection, see Illustration 2.6. If not factory supplied, fuses must be provided by the installer as part of installation.

See maximum fuse ratings in 10.3 Fuse Specifications.

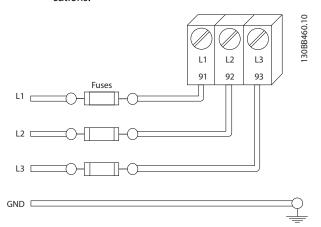


Illustration 2.6 Frequency Converter Fuses

Wire Type and Ratings

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

2.4.2 Earth (Grounding) Requirements

AWARNING

GROUNDING HAZARD!

For operator safety, it is important to ground the frequency converter properly in accordance with national and local electrical codes as well as instructions contained within these instructions. Ground currents are higher than 3,5 mA. Failure to ground the frequency converter properly could result in death or serious injury.

NOTE

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

- Follow all local and national electrical codes to ground electrical equipment properly
- Proper protective grounding for equipment with ground currents higher than 3,5 mA must be established, see *Leakage Current* (>3,5 mA)
- A dedicated ground wire is required for input power, motor power and control wiring



- Use the clamps provided with on the equipment for proper ground connections
- Do not ground one frequency converter to another in a "daisy chain" fashion
- Keep the ground wire connections as short as possible
- Use of high-strand wire to reduce electrical noise is recommended
- Follow motor manufacturer wiring requirements

2.4.2.1 Leakage Current (>3.5 mA)

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

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

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

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

Using RCDs

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

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

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

Dimension RCDs according to the system configuration and environmental considerations

2.4.2.2 Grounding Using Shielded Cable

Earthing (grounding) clamps are provided for motor wiring (see *Illustration 2.7*).

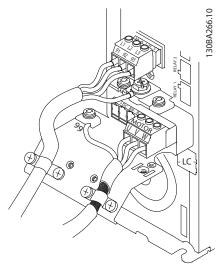


Illustration 2.7 Grounding with Shielded Cable

2.4.3 Motor Connection

▲WARNING

INDUCED VOLTAGE!

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

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

Illustration 2.8 represents mains input, motor, and earth grounding for basic frequency converters. Actual configurations vary with unit types and optional equipment.

30BB920.10



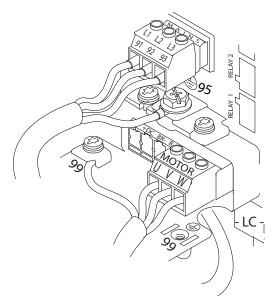


Illustration 2.8 Example of Motor, Mains and Earth Wiring

2.4.4 AC Mains Connection

- Size wiring based upon the input current of the frequency converter. For maximum wire sizes see 10.1 Power-dependent Specifications.
- Comply with local and national electrical codes for cable sizes.
- Connect 3-phase AC input power wiring to terminals L1, L2, and L3 (see *Illustration 2.8*).
- Depending on the configuration of the equipment, input power will be connected to the mains input terminals or the input disconnect.
- Ground the cable in accordance with grounding instructions provided in 2.4.2 Earth (Grounding) Requirements
- All frequency converters may be used with an isolated input source as well as with ground reference power lines. When supplied from an isolated mains source (IT mains or floating delta) or TT/TN-S mains with a grounded leg (grounded delta), set 14-50 RFI Filter to [0] Off. When off, the internal RFI filter capacitors between the chassis and the intermediate circuit are isolated to avoid damage to the intermediate circuit and to reduce earth capacity currents in accordance with IEC 61800-3.

2.4.5 Control Wiring

- Isolate control wiring from high power components in the frequency converter.
- If the frequency converter is connected to a thermistor, for PELV isolation, optional thermistor

control wiring must be reinforced/double insulated. A 24 V DC supply voltage is recommended.

2.4.5.1 Access

- Remove access cover plate with a screw driver.
 See Illustration 2.9.
- Or remove front cover by loosening attaching screws. See Illustration 2.10.

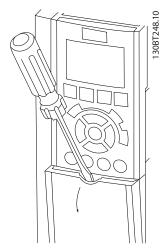


Illustration 2.9 Control Wiring Access for A2, A3, B3, B4, C3 and C4 Enclosures

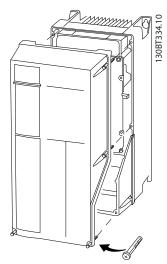


Illustration 2.10 Control Wiring Access for A4, A5, B1, B2, C1 and C2 Enclosures

See *Table 2.3* before tightening the covers.



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

^{*} No screws to tighten

Table 2.3 Tightening Torques for Covers (Nm)

2.4.5.2 Control Terminal Types

Illustration 2.11 and shows the removable frequency converter connectors. Terminal functions and default settings are summarized in *Table 2.5*.

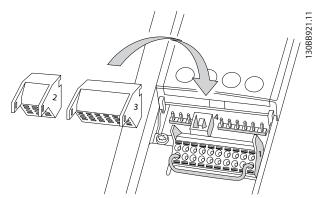


Illustration 2.11 Control Terminal Locations

1 12 13 18 19 0 0 0 0	27 29 32 33 20 37 m	
2 61 68 69 0 0 0	3 39 42 50 53 54 55	

Illustration 2.12 Terminal Numbers

- Connector 1 provides four programmable digital inputs terminals, two additional digital terminals programmable as either input or output, a 24 V DC terminal supply voltage, and a common for optional customer supplied 24 V DC voltage. FC 302 and FC 301 (optional in A1 enclosure) also provide a digital input for STO (Safe Torque Off) function.
- Connector 2 terminals (+)68 and (-)69 are for an RS-485 serial communications connection
- Connector 3 provides two analog inputs, one analog output, 10 V DC supply voltage, and commons for the inputs and output

- Connector 4 is a USB port available for use with the MCT 10 Set-up Software
- Also provided are two Form C relay outputs that are in various locations depending upon the frequency converter configuration and size
- Some options available for ordering with the unit may provide additional terminals. See the manual provided with the equipment option.

See 10.2 General Technical Data for terminal ratings details.

Terminal description						
Default						
Terminal	Parameter	setting	Description			
Digital inputs/outputs						
12, 13		+24 V DC	24 V DC supply			
1=, 15			voltage. Maximum			
			output current is 200			
			mA total (130 mA for			
			FC 301) for all 24 V			
			loads. Useable for			
			digital inputs and			
			external transducers.			
18	5-10	[8] Start				
19	5-11	[10] Reversing]			
32	5-14	[0] No	Dinital innuta			
		operation	Digital inputs.			
33	5-15	[0] No]			
		operation				
27	5-12	[2] Coast	Selectable for either			
		inverse	digital input or			
29	5-13	[14] JOG	output. Default setting			
			is input.			
20	-		Common for digital			
			inputs and 0 V			
			potential for 24 V			
			supply.			
37	-	Safe Torque	Safe input. Used for			
		Off (STO)	STO.			
	Ana	log inputs/outpu				
39	-		Common for analog			
			output			
42	6-50	[0] No	Programmable analog			
		operation	output. The analog			
			signal is 0-20 mA or			
			4-20 mA at a			
			maximum of 500 Ω			
50	-	+10 V DC	10 V DC analog			
			supply voltage. 15 mA			
			maximum commonly			
			used for potenti-			
			ometer or thermistor.			

⁻ Does not exist



Terminal description			
		Default	
Terminal	Parameter	setting	Description
53	6-1*	Reference	Analog input.
54	6-2*	Feedback	Selectable for voltage
			or current. Switches
			A53 and A54 select
			mA or V.
55	-		Common for analog
			input

Table 2.4

Terminal description				
		Default		
Terminal	Parameter	setting	Description	
	Seri	al communication	on	
61	-		Integrated RC-Filter for	
			cable screen. ONLY for	
			connecting the screen	
			when experiencing	
			EMC problems.	
68 (+)	8-3*		RS-485 Interface. A	
69 (-)	8-3*		control card switch is	
			provided for	
			termination resistance.	
	Relays			
		[0] No	Form C relay output.	
01, 02, 03	5-40 [0]	operation	Usable for AC or DC	
04, 05, 06	5-40 [1]	[0] No	voltage and resistive	
		operation	or inductive loads.	

Table 2.5 Terminal Description

2.4.5.3 Wiring to Control Terminals

Control terminal connectors can be unplugged from the frequency converter for ease of installation, as shown in *Illustration 2.11*.

- 1. Open the contact by inserting a small screwdriver into the slot above or below the contact, as shown in *Illustration 2.13*.
- 2. Insert the bared control wire into the contact.
- Remove the screwdriver to fasten the control wire into the contact.
- 4. Ensure the contact is firmly established and not loose. Loose control wiring can be the source of equipment faults or less than optimal operation.

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

See 6 Application Examples for typical control wiring connections.

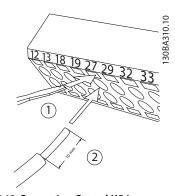


Illustration 2.13 Connecting Control Wiring

2.4.5.4 Using Screened Control Cables

Correct screening

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

If the earth potential between the frequency converter and the PLC is different, electric noise may occur that will disturb the entire system. Solve this problem by fitting an equalizing cable next to the control cable. Minimum cable cross section: 16 mm².

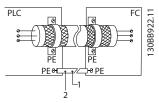


Illustration 2.14

1	Min. 16 mm ²
2	Equalizing cable

Table 2.6

50/60 Hz ground loops

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

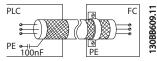


Illustration 2.15



Avoid EMC noise on serial communication

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

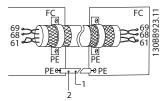


Illustration 2.16

1	Min. 16 mm ²
2	Equalizing cable

Table 2.7

Alternatively, the connection to terminal 61 can be omitted:

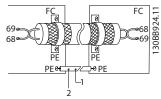


Illustration 2.17

1	Min. 16 mm ²
2	Equalizing cable

Table 2.8

2.4.5.5 Control Terminal Functions

Frequency converter functions are commanded by receiving control input signals.

- Each terminal must be programmed for the function it will be supporting in the parameters associated with that terminal. See *Table 2.5* for terminals and associated parameters.
- It is important to confirm that the control terminal is programmed for the correct function.
 See 4 User Interface for details on accessing parameters and 5 About Frequency Converter Programming for details on programming.
- The default terminal programming is intended to initiate frequency converter functioning in a typical operational mode.

2.4.5.6 Jumper Terminals 12 and 27

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

- Digital input terminal 27 is designed to receive an 24 V DC external interlock command. In many applications, the user wires an external interlock device to terminal 27
- When no interlock device is used, wire a jumper between control terminal 12 (recommended) or 13 to terminal 27. This provides in internal 24 V signal on terminal 27
- No signal present prevents the unit from operating
- When the status line at the bottom of the LCP reads AUTO REMOTE COAST, this indicates that the unit is ready to operate but is missing an input signal on terminal 27.
- When factory installed optional equipment is wired to terminal 27, do not remove that wiring

2.4.5.7 Terminal 53 and 54 Switches

- Analog input terminals 53 and 54 can select either voltage (-10 to 10 V) or current (0/4-20 mA) input signals
- Remove power to the frequency converter before changing switch positions
- Set switches A53 and A54 to select the signal type. U selects voltage, I selects current.
- The switches are accessible when the LCP has been removed (see *Illustration 2.18*). Note that some option cards available for the unit may cover these switches and must be removed to change switch settings. Always remove power to the unit before removing option cards.
- Terminal 53 default is for a speed reference signal in open loop set in 16-61 Terminal 53 Switch Setting
- Terminal 54 default is for a feedback signal in closed loop set in 16-63 Terminal 54 Switch Setting



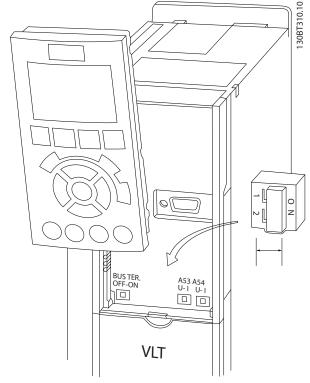


Illustration 2.18 Location of Terminals 53 and 54 Switches and Bus Termination Switch

2.4.5.8 Terminal 37

Terminal 37 Safe Stop Function

The FC 302 and FC 301 (optional for A1 enclosure) is available with safe stop functionality via control terminal 37. Safe stop disables the control voltage of the power semiconductors of the frequency converter output stage which in turn prevents generating the voltage required to rotate the motor. When the Safe Stop (T37) is activated, the frequency converter issues an alarm, trips the unit, and coasts the motor to a stop. Manual restart is required. The safe stop function can be used for stopping the frequency converter in emergency stop situations. In the normal operating mode when safe stop is not required, use the frequency converter's regular stop function instead. When automatic restart is used – the requirements according to ISO 12100-2 paragraph 5.3.2.5 must be fulfilled.

Liability Conditions

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

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

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

Standards

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

EN 954-1: 1996 Category 3

IEC 60204-1: 2005 category 0 - uncontrolled stop

IEC 61508: 1998 SIL2

IEC 61800-5-2: 2007 – safe torque off (STO)

function

IEC 62061: 2005 SIL CL2

ISO 13849-1: 2006 Category 3 PL d

ISO 14118: 2000 (EN 1037) - prevention of

unexpected start up

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

Protective Measures

- Safety engineering systems may only be installed and commissioned by qualified and skilled personnel
- The unit must be installed in an IP54 cabinet or in an equivalent environment
- The cable between terminal 37 and the external safety device must be short circuit protected according to ISO 13849-2 table D.4
- If any external forces influence the motor axis (e.g. suspended loads), additional measures (e.g., a safety holding brake) are required to eliminate hazards

Safe Stop Installation and Set-Up

AWARNING

SAFE STOP FUNCTION!

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

 It is not recommended to stop the frequency converter by using the Safe Torque Off function.
 If a running frequency converter is stopped by using the function, the unit will trip and stop by coasting. If this is not acceptable, e.g. causes danger, the frequency converter and machinery



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

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

- Remove the jumper wire between control terminals 37 and 12 or 13. Cutting or breaking the jumper is not sufficient to avoid shortcircuiting. (See jumper on *Illustration 2.19*.)
- Connect an external Safety monitoring relay via a NO safety function (the instruction for the safety device must be followed) to terminal 37 (safe stop) and either terminal 12 or 13 (24 V DC). The Safety monitoring relay must comply with Category 3 (EN 954-1) / PL "d" (ISO 13849-1).

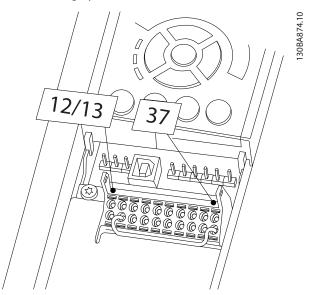


Illustration 2.19 Jumper between Terminal 12/13 (24 V) and 37

VLT*AutomationDrive Operating Instructions

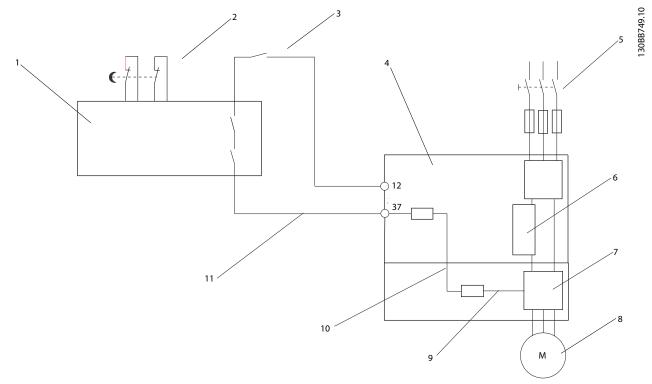


Illustration 2.20 Installation to Achieve a Stopping Category 0 (EN 60204-1) with Safety Cat. 3 (EN 954-1) / PL "d" (ISO 13849-1)

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

Table 2.9

Safe Stop Commissioning Test

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



2.4.5.9 Mechanical Brake Control

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

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

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

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

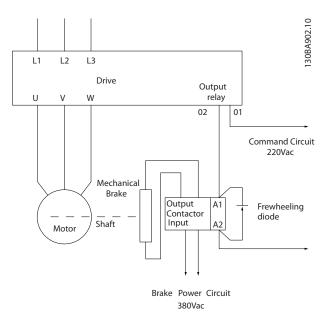


Illustration 2.21 Connecting the Mechanical Brake to the Frequency Converter

2.4.6 Serial Communication

Connect RS-485 serial communication wiring to terminals (+)68 and (-)69.

- Screened serial communication cable is recommended
- See 2.4.2 Earth (Grounding) Requirements for proper grounding

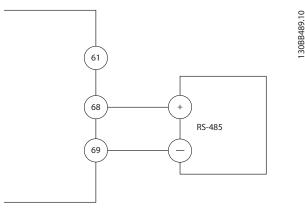


Illustration 2.22 Serial Communication Wiring Diagram

For basic serial communication set-up, select the following

- 1. Protocol type in 8-30 Protocol.
- 2. Frequency converter address in 8-31 Address.
- 3. Baud rate in 8-32 Baud Rate.

VLT Automation Drive Operating Instructions

Two communication protocols are internal to the frequency converter. Follow motor manufacturer wiring requirements.

Danfoss FC

Modbus RTU

- Functions can be programmed remotely using the protocol software and RS-485 connection or in parameter group 8-** Communications and Options
- Selecting a specific communication protocol changes various default parameter settings to match that protocol's specifications along with making additional protocol-specific parameters available
- Option cards which install into the frequency converter are available to provide additional communication protocols. See the option-card documentation for installation and operation instructions



3 Start Up and Functional Testing

3.1 Pre-start

3.1.1 Safety Inspection

AWARNING

HIGH VOLTAGE!

If input and output connections have been connected improperly, there is potential for high voltage on these terminals. If power leads for multiple motors are improperly run in same conduit, there is potential for leakage current to charge capacitors within the frequency converter, even when disconnected from mains input. For initial start up, make no assumptions about power components. Follow pre-start procedures. Failure to follow pre-start procedures could result in personal injury or damage to equipment.

- Input power to the unit must be OFF and locked out. Do not rely on the frequency converter disconnect switches for input power isolation.
- 2. Verify that there is no voltage on input terminals L1 (91), L2 (92), and L3 (93), phase-to-phase and phase-to-ground,
- 3. Verify that there is no voltage on output terminals 96 (U), 97 (V), and 98 (W), phase-to-phase and phase-to-ground.
- 4. Confirm continuity of the motor by measuring ohm values on U-V (96-97), V-W (97-98), and W-U (98-96).
- 5. Check for proper grounding of the frequency converter as well as the motor.
- 6. Inspect the frequency converter for loose connections on terminals.
- Record the following motor-nameplate data: power, voltage, frequency, full load current, and nominal speed. These values are needed to program motor nameplate data later.
- 8. Confirm that the supply voltage matches voltage of frequency converter and motor.



CAUTION

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

Inspect for	Description	Ø
Auxiliary equipment	Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers that may reside on the input power side of the frequency converter or output side to the motor. Ensure that they are ready for full speed operation.	
	Check function and installation of any sensors used for feedback to the frequency converter.	
	Remove power factor correction caps on motor(s), if present.	
Cable routing	Ensure that input power, motor wiring , and control wiring are separated or in three separate metallic conduits for high frequency noise isolation.	
Control wiring	Check for broken or damaged wires and loose connections.	
	Check that control wiring is isolated from power and motor wiring for noise immunity.	
	Check the voltage source of the signals, if necessary.	
	The use of shielded cable or twisted pair is recommended. Ensure that the shield is terminated correctly.	
Cooling clearance	Measure that top and bottom clearance is adequate to ensure proper air flow for cooling.	
EMC considerations	Check for proper installation regarding electromagnetic compatibility.	
Environmental consider-	See equipment label for the maximum ambient operating temperature limits.	
ations	Humidity levels must be 5-95% non-condensing.	
Fusing and circuit	Check for proper fusing or circuit breakers.	
breakers	Check that all fuses are inserted firmly and in operational condition and that all circuit breakers are in the open position.	
Earthing (Grounding)	The unit requires an earth wire(ground wire) from its chassis to the building earth (ground).	
	Check for good earth connections(ground connections) that are tight and free of oxidation.	
	Earthing (grounding) to conduit or mounting the back panel to a metal surface is not a suitable earth (ground).	
Input and output power	Check for loose connections.	
wiring	Check that motor and mains are in separate conduit or separated screened cables.	
Panel interior	Inspect that the unit interior is free of dirt, metal chips, moisture, and corrosion.	
Switches	Ensure that all switch and disconnect settings are in the proper positions.	
Vibration	Check that the unit is mounted solidly or that shock mounts are used, as necessary.	
	Check for an unusual amount of vibration.	

Table 3.1 Start Up Check List



3.2 Applying Power to the Frequency Converter

AWARNING

HIGH VOLTAGE!

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

AWARNING

UNINTENDED START!

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

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

NOTE

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

3.3 Basic Operational Programming

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

Enter data with power ON, but before operating the frequency converter. There are two ways of programming the frequency converter: either by using the Smart

Application Set-up (SAS) or by using the procedure described further down. The SAS is a quick wizard for setting up the most commonly used applications. At first power-up and after a reset the SAS appears on the LCP. Follow the instructions that appear on the successive screens for setting-up the applications listed. SAS can also be found under the Quick Menu. [Info] can be used throughout the Smart Set-up to see help information for various selections, settings, and messages.

NOTE

The start conditions will be ignored while in the wizard.

NOTE

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

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

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

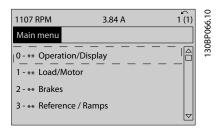


Illustration 3.1

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

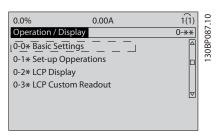


Illustration 3.2



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

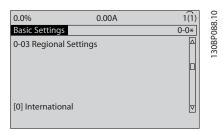


Illustration 3.3

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

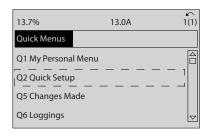


Illustration 3.4

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

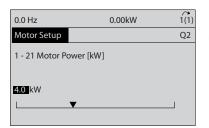


Illustration 3.5

- 9. A jumper wire should be in place between control terminals 12 and 27. If this is the case, leave 5-12 Terminal 27 Digital Input at factory default. Otherwise select No Operation. For frequency converters with an optional Danfoss bypass, no jumper wire is required.
- 10. 3-02 Minimum Reference
- 11. 3-03 Maximum Reference
- 12. 3-41 Ramp 1 Ramp Up Time
- 13. 3-42 Ramp 1 Ramp Down Time
- 14. *3-13 Reference Site*. Linked to Hand/Auto* Local Remote.

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

3.4 Automatic Motor Adaptation

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

- The frequency converter builds a mathematical model of the motor for regulating output motor current. The procedure also tests the input phase balance of electrical power. It compares the motor characteristics with the data entered in parameters 1-20 Motor Power [kW] to 1-25 Motor Nominal Speed.
- It does not cause the motor to run or harm to the motor
- Some motors may be unable to run the complete version of the test. In that case, select *Enable* reduced AMA
- If an output filter is connected to the motor, select Enable reduced AMA
- If warnings or alarms occur, see 8 Warnings and Alarms
- Run this procedure on a cold motor for best results

To run AMA

- 1. Press [Main Menu] to access parameters.
- 2. Scroll to parameter group 1-** Load and Motor.
- 3. Press [OK].
- 4. Scroll to parameter group 1-2* Motor Data.
- 5. Press [OK].
- 6. Scroll to 1-29 Automatic Motor Adaptation (AMA).
- 7. Press [OK].
- 8. Select Enable complete AMA.
- 9. Press [OK].



- 10. Follow on-screen instructions.
- 11. The test will run automatically and indicate when it is complete.

3.5 Check Motor Rotation

Before running the frequency converter, check the motor rotation.

- 1. Press [Hand On].
- 2. Press [▶] for positive speed reference.
- 3. Check that the speed displayed is positive.

When 1-06 Clockwise Direction is set to [0] Normal (default clockwise):

- 4a. Verify that the motor turns clockwise.
- 5a. Verify that the LCP direction arrow is clockwise.

When 1-06 Clockwise Direction is set to [1] Inverse (counter-clockwise):

- 4b. Verify that the motor turns counter-clockwise.
- 5b. Verify that the LCP direction arrow is counter-clockwise.

3.6 Check Encoder Rotation

Check encoder rotation only if encoder feedback is used. Check encoder rotation in default open loop control.

1. Verify that the encoder connection is according to the wiring diagram:

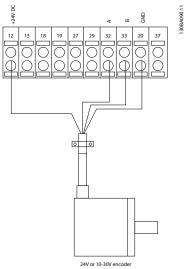


Illustration 3.6

NOTE

When using an encoder option, refer to the option manual

- 2. Enter the Speed PID feed-back source in 7-00 Speed PID Feedback Source.
- 3. Press [Hand On]
- Press [►] for positive speed reference (1-06 Clockwise Direction at [0] Normal).
- 5. Check in *16-57 Feedback [RPM]* that the feed-back is positive

NOTE

If the feedback is negative, the encoder connection is wrong!

3.7 Local-control Test

ACAUTION

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

NOTE

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

When operating in local mode, the up and down arrows on the LCP increase and decrease the speed output of the LCP. The left and right arrow keys move the display cursor in the numeric display.

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

If acceleration problems were encountered

- If warnings or alarms occur, see 8 Warnings and
 Alarms

 Alarms
- Check that motor data is entered correctly
- Increase the ramp-up time in 3-41 Ramp 1 Ramp
 Up Time
- Increase current limit in 4-18 Current Limit
- Increase torque limit in 4-16 Torque Limit Motor Mode

If deceleration problems were encountered



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

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

NOTE

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

3.8 System Start Up

The procedure in this section requires user-wiring and application programming to be completed. 6 Application Examples is intended to help with this task. Other aids to application set-up are listed in 1.2 Additional Resources. The following procedure is recommended after application set-up by the user is completed.

ACAUTION

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

- 1. Press [Auto On].
- Ensure that external control functions are properly wired to the frequency converter 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 frequency converter.

The LCP has several user functions.

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

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

NOTE

The display contrast can be adjusted by pressing [Status] and [A]/[V] key.

4.1.1 LCP Layout

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

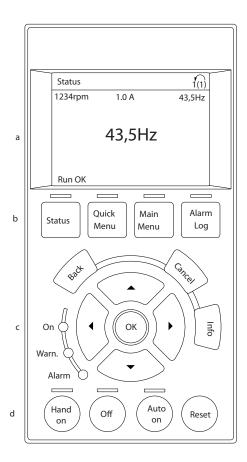


Illustration 4.1 LCP

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



4.1.2 Setting LCP Display Values

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

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

- Each display readout has a parameter associated with it.
- Options are selected in main menu 0-2*
- The frequency converter status at the bottom line of the display is generated automatically and is not selectable. See 7 Status Messages for definitions and details.

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

Table 4.1

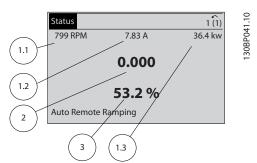


Illustration 4.2

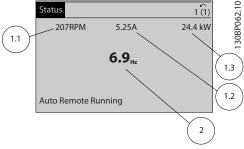


Illustration 4.3

4.1.3 Display Menu Keys

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

Status

Quick Menu Main Menu

Alarm Log 30BP045.10

Illustration 4.4

Key	Function
Status	Press to show operational information. In Auto mode, press and hold to toggle between status read-out displays Press repeatedly to scroll through each status display
	Press and hold [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. Press to access Q2 Quick Setup for sequenced instructions to program the basic frequency controller set up Follow the sequence of parameters as presented for the function set-up
Main Menu	Allows access to all programming parameters. Press twice to access top-level index Press once to return to the last location accessed Press and hold to enter a parameter number for direct access to that parameter
Alarm Log	Displays a list of current warnings, the last 5 alarms, and the maintenance log. • For details about the frequency converter before it entered the alarm mode, select the alarm number using the navigation keys and press [OK].

Table 4.2



4.1.4 Navigation Keys

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

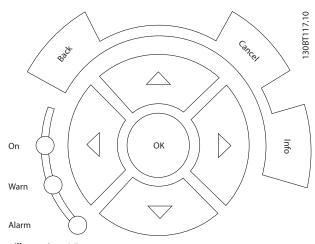


Illustration 4.5

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

Table 4.3

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

Table 4.4

4.1.5 Operation Keys

Operation keys are found at the bottom of the LCP.

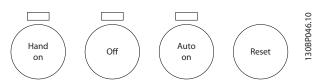


Illustration 4.6

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

Table 4.5

4.2 Back Up and Copying Parameter Settings

Programming data is stored internally in the frequency converter.

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



AWARNING

UNINTENDED START!

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

4.2.1 Uploading Data to the LCP

- 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

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

4.3 Restoring Default Settings

CAUTION

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

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

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

- personal menu settings, fault log, alarm log, and other monitoring functions
- Using 14-22 Operation Mode is generally recommended
- Manual initialisation erases all motor, programming, localization, and monitoring data and restores factory default settings

4.3.1 Recommended Initialisation

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

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

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

4.3.2 Manual Initialisation

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

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

Manual initialisation does not the following frequency converter information

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

130BT762.10



5 About Frequency Converter Programming

5.1 Introduction

The frequency converter is programmed for its application functions using parameters. Parameters are accessed by pressing either [Quick Menu] or [Main Menu] on the LCP. (See *4 User Interface* for details on using the LCP function keys.) Parameters may also be accessed through a PC using the MCT 10 Set-up Software (see *5.6.1 Remote Programming with*).

The quick menu is intended for initial start up (Q2-** Quick Set Up). Data entered in a parameter can change the options available in the parameters following that entry.

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

5.2 Programming Example

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

- This procedure programs the frequency converter to receive a 0-10 V DC analog control signal on input terminal 53
- The frequency converter will respond by providing 6-60 Hz output to the motor proportional to the input signal (0-10 V DC = 6-60 Hz)

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

1. 3-15 Reference Resource 1

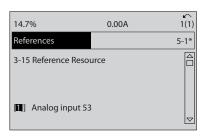


Illustration 5.1

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

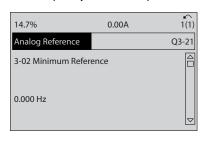


Illustration 5.2

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

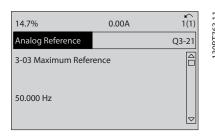


Illustration 5.3

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

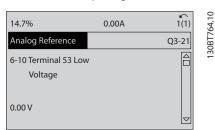


Illustration 5.4



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.)

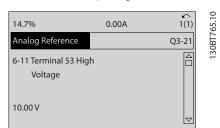


Illustration 5.5

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

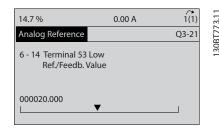


Illustration 5.6

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

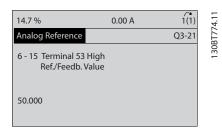


Illustration 5.7

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

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

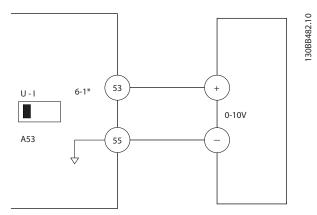


Illustration 5.8 Wiring Example for External Device Providing 0-10 V Control Signal (frequency converter left, external device right)

5.3 Control Terminal Programming Examples

Control terminals can be programmed.

- Each terminal has specified functions it is capable of performing
- Parameters associated with the terminal enable the function

See *Table 2.5* for control terminal parameter number and default setting. (Default setting can change based on the selection in *0-03 Regional Settings*.)

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

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

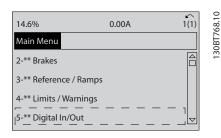


Illustration 5.9



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

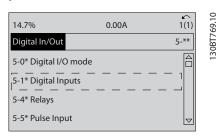


Illustration 5.10

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

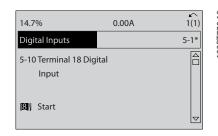


Illustration 5.11

5.4 International/North American Default Parameter Settings

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

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

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

Table 5.1 International/North American Default Parameter Settings

Note 1: 1-20 Motor Power [kW] is only visible when 0-03 Regional Settings is set to [0] International.

Note 2: 1-21 Motor Power [HP], is only visible when 0-03 Regional Settings is set to [1] North America.

Note 3: This parameter is only visible when 0-02 Motor Speed Unit is set to [0] RPM.

Note 4: This parameter is only visible when 0-02 Motor Speed Unit is set to [1] Hz.

Note 5: The default value depends on the number of motor poles. For a 4 poled motor the international default value is 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].

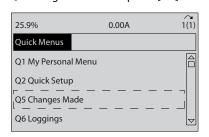


Illustration 5.12



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

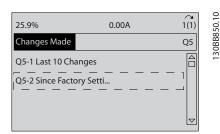


Illustration 5.13

5.5 Parameter Menu Structure

Establishing the correct programming for applications often requires setting functions in several related parameters. These parameter settings provide the frequency converter with system details for the frequency converter 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.

VLT Automation Drive Operating

About Frequency Converter P	Instructions
Current Limit Max Output Frequency Limit Factors Torque Limit Factor Source Speed Limit Factor Source Speed Limit Factor Source Motor Speed Mon. Motor Feedback Loss Function Motor Feedback Loss Timeout Tracking Error Function Tracking Error Ramping Timeout Tracking Error Ramping Timeout Tracking Error Ramping Timeout Marning Speed Low Warning Speed Low Warning Speed Low Warning Speed Low Warning Reference Low	Warning Reference High Warning Feedback Low Bypass Speed From [RPM] Bypass Speed From [RPM] Bypass Speed To [RPM] Bypass Speed From [RPM] Bypas Speed From [RPM] Bypa
4 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	
Reference Resource 1 Reference Resource 2 Reference Resource 3 Refative Scaling Reference Resource Jog Speed (RPM) Ramp 1 Type Ramp 1 Type Ramp 1 Framp Down Time Ramp 1 Framp Ratio at Accel. End Ramp 1 5-ramp Ratio at Accel. End Ramp 1 5-ramp Ratio at Decel. End Ramp 1 5-ramp Ratio at Decel. End Ramp 2 Ramp pup Time Ramp 2 Ramp down Time Ramp 2 Ramp down Time Ramp 2 Ramp down Time Ramp 2 S-ramp Ratio at Accel. Start Ramp 2 S-ramp Ratio at Decel. Start	Ramp 3 Ramp 3 Ramp 9 Ramp 3 Ramp ban Time Ramp 3 Ramp down Time Ramp 3 S-ramp Ratio at Accel. End Ramp 3 S-ramp Ratio at Decel. End Ramp 3 S-ramp Ratio at Decel. Start Ramp 4 S-ramp Ratio at Decel. End Ramp 4 Ramp buy Time Ramp 4 S-ramp Ratio at Accel. End Ramp 4 S-ramp Ratio at Accel. Start Ramp 4 S-ramp Ratio at Accel. Start Ramp 4 S-ramp Ratio at Decel. Start Quick Stop S-ramp Ratio at Decel. End Mour Speed Low Limit RPMI Motor Speed Low Limit [RPMI] Motor Speed Low Limit [RPMI] Motor Speed High Limit [RPMI] Motor Speed High Limit [RPMI] Torque Limit Generator Mode
	7. 6. 6. 6. 6. 6. 6. 6. 6
Min Speed for Function at Stop [RPM] Min Speed for Function at Stop [Hz] Precise Stop Function Precise Stop Function Precise Stop Function Precise Stop Speed Compensation Delay Motor Temperature Motor Thermal Protection Motor External Fan Thermistor Resource KTY Sensor Type KTY Thermistor Resource KTY Thermistor Resource ATEX ETR interpol, points freq. ATEX ETR interpol points current Brakes DC-Brake DC Hold Current DC Brake Current	DC Brake Cut In Speed [RPM] DC Brake Cut In Speed [Hz] Maximum Reference Parking Current Parking Time Brake Energy Funct. Brake Punction Brake Power Limit (kW) Brake Power Limit (kW) Brake Power Limit (kW) Brake Power Limit (kW) Brake Max. Current Act brake Max. Current Over-voltage Gain Mechanical Brake Release Brake Condition Over-voltage Gain Activate Brake Speed [Hz] Activate Brake Speed (Hz] Dosset Reference Reference Site Preset Relative Reference
1-81 1-82 1-83 1-84 1-85 1-90 1-97 1-97 1-97 1-98 1-99 1-96 1-97 1-97 1-97 1-97 1-97 1-97 1-97 1-97	2-03 2-04 2-04 2-04 2-05 2-06 2-07 2-11 2-11 2-12 2-13 2-13 2-22 2-23 2-23
Motor Construction Motor Model Damping Gain Low Speed Filter Time Const. High Speed Filter Time Const. Voltage filter time const. Motor Data Motor Power [kW] Motor Power [kW] Motor Power [kW] Motor Power [kW] Motor Current Motor Frequency Motor Current Motor Current Motor Cont. Rated Torque Automatic Motor Adaptation (AMA) Adv. Motor Data Stator Resistance (Rs) Rotor Leakage Reactance (X1) Stator Leakage Reactance (X2) Main Reactance (X2)	lron Loss Resistance (Rfe) d-axis Inductance (Ld) Motor Poles Back EMF at 1000 RPM Motor Angle Offset Position Detection Gain Load Indep. Setting Motor Magnetisation at Zero Speed Min Speed Normal Magnetising [RPM] Min Speed Normal Magnetising [Hz] Model Shiff Frequency Voltage reduction in fieldweakening U/f Characteristic - F Flystart Test Pulses Frequency Load Depen. Setting Low Speed Load Compensation High Speed Load Compensation High Speed Load Compensation Silp Compensation Time Constant Resonance Dampening Time Constant Min. Current at Low Speed Load Type Minimum Inertia Maximum Inertia Maximum Inertia Maximum Inertia Maximum Inertia Start Adjustments Start Adjustments Start Speed [RPM] Start Speed [Hz] Start Speed [Hz] Start Speed [Hz] Start Current Stop Adjustments
1-1-0 1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-	1.36 1.37 1.39 1.40 1.40 1.51 1.51 1.51 1.52 1.53 1.54 1.54 1.54 1.54 1.54 1.54 1.54 1.54
	0-22 Display Line 1.3 Small 0-23 Display Line 2 Large 0-24 My Personal Menu 0-34 LCP Custom Readout 0-37 Unit for User-defined Readout 0-37 Min Value of User-defined Readout 0-38 Max Value of User-defined Readout 0-39 Display Text 1 0-39 Display Text 3 0-44 LCP Keypad 0-40 Illand onl Key on LCP 0-41 IGHR Key on LCP 0-42 IReset] Key on LCP 0-43 Reset] Key on LCP 0-44 IOff Reset Key on LCP 0-45 Gopy/Save 0-65 LCP Copy 0-56 Main Menu Password 0-60 Main Menu Password 0-61 Access to Main Menu w/o Password 0-65 Quick Menu Password 0-66 Access to Main Menu Wo Password 0-67 Bus Password Access 1-04 General Settings 1-05 Configuration Motor 1-04 Configuration Mode 1-05 Local Mode Configuration 1-06 Clockwise Direction 1-07 Motor Angle Offset Adjust 1-1* Motor Selection 1-1* Motor Selection



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8-93 Slave Error Count 8-96 Bus Jog 8-90 Bus Jog 1 Speed 8-91 Bus Jog 2 Speed 9-18 Actual Value 9-15 PCD Write Configuration 9-16 PCD Write Configuration 9-16 PCD Write Configuration 9-17 PCD Write Configuration 9-18 PCD Write Configuration 9-19 PCD Write Configuration 9-10 PCD Write Configuration 9-11 PCD Write Configuration 9-12 Parameter Edit 9-27 Parameter Edit 9-28 Process Control 9-29 Pault Message Counter 9-45 Fault Number 9-45 Fault Situation Counter 9-5-52 Fault Situation Counter 9-6-53 Profibus Warning Word 9-6-64 Device Identification	* 0 - 0 10 10 0 7 * 0 - 0 10 10 1 * 0 - 0 10 10 1
Process PID I-part Reset Process PID Output Neg. Clamp Process PID Output Pos. Clamp Process PID Gain Scale at Min. Ref. Process PID Gain Scale at Min. Ref. Process PID Gain Scale at Max. Ref. Process PID Feed Fwd Normal/ Inv. Ctrl. Ctrl. PCD Feed Forward Process PID Output Normal/ Inv. Ctrl. Adv. Process PID II Process PID Extended PID Process PID Feed Fwd Ramp up Process PID Feed Fwd Ramp up Process PID Feed Fwd Ramp down Process PID Feed Fwd Ramp Gown Comm. and Options Gentrol Ster	tr Time tr Function ineout word STW word CTW son on tr
7.40 7.41 7.42 7.44 7.44 7.44 7.45 7.46 7.46 7.50 7.51 7.51 7.52 7.53 7.56 7.57 8.01	
Analog Input 4 Terminal X30/12 Low Voltage Terminal X30/12 Liow Noltage Term. X30/12 High Voltage Term. X30/12 Liow Ref./Feedb. Value Term. X30/12 Filter Time Constant Analog Output 1 Terminal 42 Output Min Scale Terminal 42 Output Min Scale Terminal 42 Output Timeout Preset Analog Output 2 Terminal 430/8 Output Timeout Preset Analog Output 3 Terminal X30/8 Min. Scale Terminal X40/7 Min. Scale	Terminal X45/1 Min. Scale Terminal X45/1 Max. Scale Terminal X45/1 Max. Scale Terminal X45/1 Bus Control Terminal X45/1 Bus Control Terminal X45/3 Output 4 Terminal X45/3 Min. Scale Terminal X45/3 Min. Scale Terminal X45/3 Min. Scale Terminal X45/3 Bus Control Terminal X45/3 Bus Control Terminal X45/3 Bus Control Speed PID Evedback Source Speed PID Evedback Source Speed PID Integral Time Speed PID Integral Time Speed PID Integral Time Speed PID Integral Time Speed PID Lowpass Filter Time Speed PID Evedback Gear Ratio Speed PID Lowpass Filter Time Speed PID Lowpass Filter Time Speed PID Lowpass Filter Time Speed PID Evedback I Resource Process Ctt. Feedback I Resource Process PID Anti Windup Process PID Start Speed Process PID Difficentiation Time
6-44 6-44 6-44 6-45 6-53 6-54 6-55 6-63 6-63 6-63 6-63 6-63 6-63 6-63	6-71 6-73 6-73 6-84 6-87 6-87 6-88 6-88 6-88 6-88 6-88 6-88
4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	5.58 5.74 5.75 6.85 6.75 6.

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About Frequency Converter P	Instructions
17-50 Poles 17-51 Input Voltage 17-52 Input Frequency 17-53 Transformation Ratio 17-56 Encoder Sim. Resolution 17-59 Resolver Interface 17-6* Monitoring and App. 17-60 Feedback Direction 17-61 Feedback Signal Monitoring 16-4* Data Readouts 18-3* Analog Readouts 18-3* Analog Input X48/2 [mA] 18-3* Temp. Input X48/1 18-3* Perpos SPID Clamped Output 18-90 Process PID Clamped Output	
16-37 Inv. Max. Current 16-38 S.L Controller State 16-39 Control Card Temp. 16-40 Logging Buffer Full 16-41 LCP Bottom Statusline 16-48 Speed Ref. After Ramp [RPM] 16-49 Current Fault Source 16-56 External Reference 16-51 Pulse Reference 16-52 Feedback (Unit) 16-53 Digi Pot Reference 16-53 Digi Pot Reference 16-54 Inputs & Outputs 16-66 Digital Input 16-67 Ireminal 53 Switch Setting 16-68 Analog Input 53 16-64 Analog Input 54 16-65 Analog Output 42 [mA] 16-66 Digital Output (16-61)	
15-47 Power Card Ordering No 15-48 LCP Id No 15-50 SW ID Control Card 15-51 Power Card Serial Number 15-53 Power Card Serial Number 15-58 Smart Setup Filename 15-59 CSIV Filename 15-60 Option Mounted 15-60 Option Mounted 15-60 Option Mounted 15-61 Option Serial No 15-62 Option Ordering No 15-63 Option Serial No 15-70 Option in Slot A 15-71 Slot A Option SW Version 15-72 Slot CO Option SW Version 15-75 Slot CO Option SW Version 15-76 Option in Slot C1 15-76 Option in Slot C1 15-76 Option in Slot C1 15-76 Option in Slot C1 15-76 Option in Slot C1	
14-30 Current Lim Ctrl, Proportional Gain 14-31 Current Lim Ctrl, Integration Time 14-32 Current Lim Ctrl, Filter Time 14-43 Stall Protection 14-44 Minimum AEO Frequency 14-40 Minimum AEO Frequency 14-41 AEO Minimum AEO Frequency 14-42 Minimum AEO Frequency 14-54 Minimum AEO Frequency 14-55 RFI Filter 14-56 RFI Filter 14-57 Ean Monitor 14-55 Output Filter 14-55 Output Filter 14-55 Capacitance Output Filter 14-56 Capacitance Output Filter 14-57 Legacy Alam Word 14-77 Legacy Marning Word	
12-9* Advanced Ethernet Services 12-90 Cable Diagnostic 12-91 Auto Cross Over 12-92 IGMP Snooping 12-94 IGMP Snooping 12-95 Broadcast Storm Protection 12-95 Broadcast Storm Filter 12-95 Port Config 12-95 Port Config 12-96 Port Config 12-96 Port Config 12-97 Idmension Filter 12-97 Media Counters 12-98 Interface Counters 12-99 Media Counters 13-08 Store Event 13-09 SLC Settings 13-08 LC ontroller Mode 13-07 Stop Event 13-07 Stop Event 13-08 Reset SLC 13-11 Comparator Operand 13-11 Comparator Operand 13-11 Comparator Operator 13-12 Comparator Value 13-11 Filt Filt Filt Filt Filt Filt Filt Filt	



Actual Velocity Actual Master Velocity Synchronizing Status Axis Status MCO 302 Status MCO 302 Control Diagnosis readouts MCO Alarm Word 1 MCO Alarm Word 2		
34-58 34-60 34-61 34-61 34-64 34-64 34-65 34-70 34-70	35-00 35-00 35-01 35-01 35-04 35-04 35-04 35-15 35-17 35-17 35-18	
62 Terminal X59/2 Digital Input 63 Terminal X59/1 Digital Output 64 Terminal X59/2 Digital Output 65 Terminal X59/3 Digital Output 66 Terminal X59/4 Digital Output 68 Terminal X59/5 Digital Output 69 Terminal X59/6 Digital Output 69 Terminal X59/8 Digital Output 70 Terminal X59/8 Digital Output 70 Terminal X59/8 Digital Output 71 Terminal X59/8 Digital Output 72 Terminal X59/8 Digital Output 73 Terminal X59/8 Digital Output		
33-62 33-64 33-64 33-65 33-69 33-69 33-69 33-69 33-70	33.88 33.88	
32-88 Dec. up for limited jerk 32-89 Dec. down for limited jerk 32-9* Development 32-9* MCO Adv. Settings 33-0* Home Motion 33-00 Force HOME 33-01 Zero Point Offset from Home Pos. 33-02 Ramp for Home Motion 33-03 Velocity of Home Motion		
32-01 Incremental Resolution 32-02 Absolute Protocol 32-03 Absolute Resolution 32-04 Absolute Encoder Baudrate X55 32-05 Absolute Encoder Clock Frequency 32-07 Absolute Encoder Clock Generation 32-08 Absolute Encoder Clock Generation 32-09 Encoder Monitoring 32-09 Encoder Monitoring	User Unit Numerator Enc.2 Control Enc.2 CaN guard Enc.2 CAN guard Enc.2 CAN guard Incremental Signal Type Incremental Resolution Absolute Protocol Absolute Encoder Data Length Absolute Encoder Clock Frequency Absolute Encoder Clock Generation Absolute Encoder Clock Generation Absolute Encoder Clock Generation Enc.1 Control Source Master PID Control Proportional factor Derivative factor Limit Value for Integral Sum PID Bandwidth Velocity Feed-Forward Acceleration Feed-Forward Max. Tolerated Position Error Reverse Behavior for Slave Sampling Time for Profile Generator Size of the Control Window (Activation) Shortest Ramp Ramp Type Welocity & Accel. Maximum Velocity (Encoder) Shortest Ramp Pace House of for limited jerk Acc. Hown for limited jerk Acc. Hown for limited jerk	



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

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

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

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



6 Application Examples

6.1 Introduction

NOTE

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

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

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

6.2 Application Examples

			Parameters	
FC		0.10	Function Setting	
+24 V	120	30BB929.10		
+24 V	130	30BI	1-29 Automatic	
DIN	180	_	Motor	[1] Enable
D IN	190		Adaptation	complete
СОМ	200		(AMA)	AMA
D IN	270		5-12 Terminal 27	[2]* Coast
D IN	290		Digital Input	inverse
D IN	320		* = Default Value	
D IN	330		Notes/comments: Parameter	
D IN	370		group 1-2* must be set	
+10 V	500		according to motor	
A IN	53			
A IN	540			
COM	550			
A OUT	420			
СОМ	390			

Table 6.1 AMA with T27 Connected

		Parameters	
FC	.10	Function	Setting
+24 V	120 66 68 68 69 69 69 69 69 69 69 69 69 69 69 69 69		
+24 V	130	1-29 Automatic	
DIN	180	Motor	[1] Enable
DIN	190	Adaptation	complete
сом	200	(AMA)	AMA
DIN	270	5-12 Terminal 27	[0] No
DIN	290	Digital Input	operation
DIN	320	* = Default Value	
DIN	330	Notes/comments: Parameter	
DIN	370	group 1-2* must be set	
		ļ* '	
+10 V	500	according to mot	OI .
A IN	530		
A IN	540		
сом	550		
A OUT	420		
сом	390		
	7		

Table 6.2 AMA without T27 Connected

FC
D IN
* = Default Value * = Default Value Notes/comments: * = Default Value Notes/comments:

Table 6.3 Analog Speed Reference (Voltage)

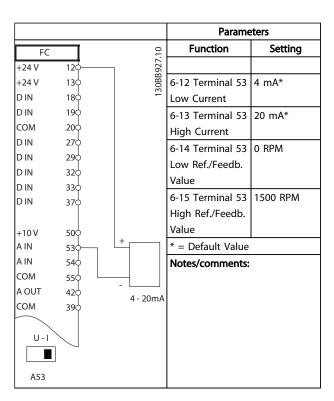


Table 6.4 Analog Speed Reference (Current)

				Parameters	
FC			10	Function	Setting
+24 V	120		30BB802.10		
+24 V	130		30BE	5-10 Terminal 18	[8] Start*
DIN	180		_	Digital Input	
D IN	190			5-12 Terminal 27	[0] No
СОМ	200			Digital Input	operation
DIN	270			5-19 Terminal 37	[1] Safe Stop
DIN	290			Safe Stop	Alarm
DIN	320			* = Default Value	
DIN	330			Notes/comments:	
DIN	37∳			If 5-12 Terminal 27 Digital Input	
+10	50Φ			is set to [0] No operation, a	
A IN	530			jumper wire to terminal 27 is	
A IN	540			not needed.	
сом	55 				
A OUT	420				
СОМ	390				

Table 6.5 Start/Stop Command with Safe Stop

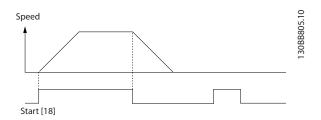


Illustration 6.1

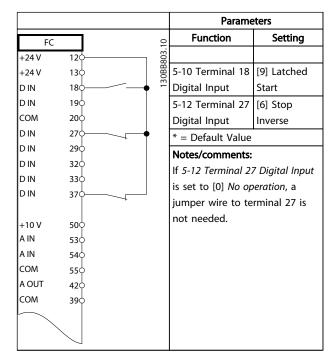


Table 6.6 Pulse Start/Stop

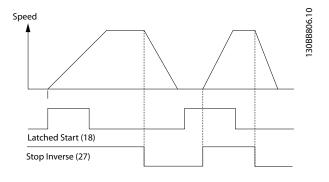


Illustration 6.2



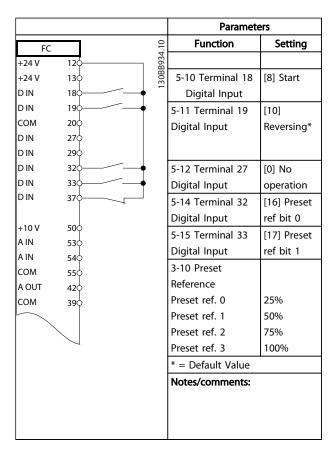


Table 6.7 Start/Stop with Reversing and 4 Preset Speeds

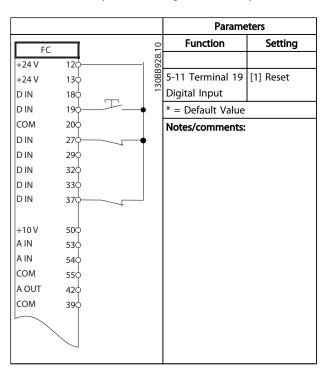


Table 6.8 External Alarm Reset

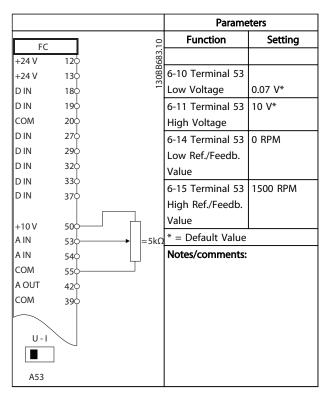


Table 6.9 Speed Reference (using a Manual Potentiometer)

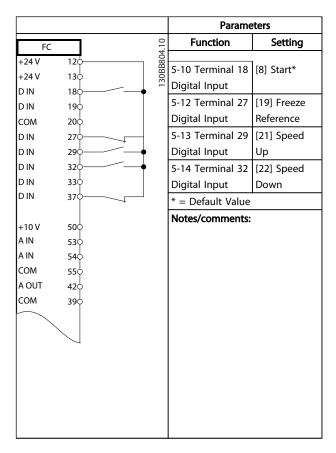
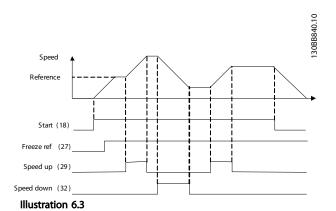


Table 6.10 Speed Up/Down





			Parameters		
FC	1	10	Function	Setting	
+24 V	120	130BB685.10			
+24 V	130	0.088	8-30 Protocol	FC*	
DIN	180	13	8-31 Address	1*	
D IN	190		8-32 Baud Rate	9600*	
СОМ	200		* = Default Value		
DIN	270		Notes/comments:		
DIN	290		Select protocol, a		
DIN	320				
DIN	330		baud rate in the above		
DIN	370		mentioned parameters.		
+10 V	500				
A IN	530				
COM	540				
A OUT	550				
	420				
СОМ	390				
	010				
	020				
	030				
	030				
	040				
₂	050				
	060	RS-485			
	610	+			
	68¢				
		-			

Table 6.11 RS-485 Network Connection

CAUTION

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

			Parameters	
FC	$\overline{}$	-	Function	Setting
+24 V	120	686	Function 1-90 Motor	
⊦24 V	130	30BE	1-90 Motor	[2]
) IN	180	(1)	Thermal	Thermistor
IN	190		Protection	trip
M	200		1-93 Thermistor	[1] Analog
N	270		Source	input 53
N	290		* = Default Value	
N	320		Delaut value	
١	330		Notes/comments:	
N	370		If only a warning	
) V			1-90 Motor Therm	
	500		should be set to [1] Thermistor	
	530— 540		warning.	
N M	550		warriing.	
OUT	420			
)M	390			
	390			
U-I \				
A53				

Table 6.12 Motor Thermistor



		Parameters	
		 	
FC +24 V	130	1 411041011	
+24 V +24 V	120	4-30 Motor	
D IN	180	Feedback Loss	
DIN	190	Function	[1] Warning
COM	200	4-31 Motor	100 RPM
DIN	270	Feedback Speed	
DIN	290	Error	
DIN	320	4-32 Motor	5 s
DIN	330	Feedback Loss	
DIN	370	Timeout	
		7-00 Speed PID	[2] MCB 102
+10 V	500	Feedback Source	[2] WICD 102
A IN	53	17-11 Resolution	1024*
A IN	540		1024"
СОМ	550	(PPR)	[1] 0
A OUT	420	13-00 SL	[1] On
СОМ	390	Controller Mode	
		13-01 Start	[19] Warning
L /	010	Event	
	020	13-02 Stop	[44] Reset
	030	Event	key
	040	13-10 Comparat	[21] Warning
[₂ ,/_	050	or Operand	no.
ľ Ľ	060	13-11 Comparat	[1] ≈*
		or Operator	
		13-12 Comparat	90
		or Value	
		13-51 SL	[22]
		Controller Event	Comparator 0
		13-52 SL	[32] Set
		Controller Action	digital out A
			low
		5-40 Function	[80] SL digital
		Relay	output A
		* = Default Value	
		Notes/comments:	
		If the limit in the	feedback
		monitor is exceed	led, Warning
		90 will be issued.	The SLC
		monitors Warning	90 and in the
		case that Warning	90 becomes
		TRUE then Relay	1 is triggered.
		External equipme	nt may then
		indicate that service may be	
		required. If the feedback error	
		goes below the limit again	
		within 5 s then the frequency	
		converter continues and the	
		warning disappears. But Relay 1	
		will still be triggered until	
		[Reset] on the LCP.	

Table 6.13 Using SLC to Set a Relay

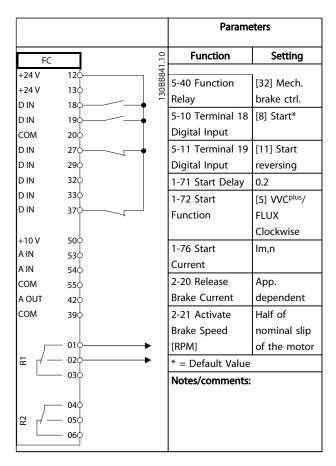


Table 6.14 Mechanical Brake Control

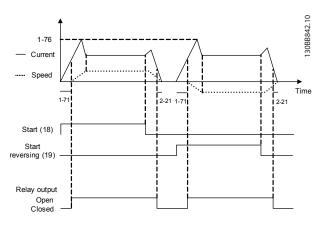


Illustration 6.4



7 Status Messages

7.1 Status Display

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

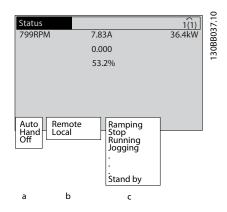


Illustration 7.1 Status Display

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

NOTE

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

7.2 Status Message Definitions Table

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

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

Table 7.1

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

Table 7.2

	Operation status		
AC Brake	AC Brake was selected in 2-10 Brake Function.		
	The AC brake over-magnetizes the motor to		
	achieve a controlled slow down.		
AMA finish OK	Automatic motor adaptation (AMA) was		
	carried out successfully.		
AMA ready	AMA is ready to start. Press [Hand On] to start.		
AMA running	AMA process is in progress.		
Braking	The brake chopper is in operation. Generative		
	energy is absorbed by the brake resistor.		
Braking max.	The brake chopper is in operation. The power		
	limit for the brake resistor defined in		
	2-12 Brake Power Limit (kW) is reached.		
Coast	Coast inverse was selected as a function		
	for a digital input (parameter group 5-1*).		
	The corresponding terminal is not		
	connected.		
	Coast activated by serial communication		

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	Operation status		
Ctrl. Ramp-down	Control Ramp-down was selected in		
Can. namp down	14-10 Mains Failure.		
	The mains voltage is below the value set		
	in 14-11 Mains Voltage at Mains Fault at		
	mains fault		
	T. 6		
	The frequency converter ramps down the motor using a controlled ramp down		
Current High	The frequency converter output current is		
	above the limit set in 4-51 Warning Current		
	High.		
Current Low	The frequency converter output current is		
	below the limit set in 4-52 Warning Speed Low		
DC Hold	DC hold is selected in 1-80 Function at Stop		
	and a stop command is active. The motor is		
	held by a DC current set in 2-00 DC Hold/		
	Preheat Current.		
DC Stop	The motor is held with a DC current (2-01 DC		
	Brake Current) for a specified time (2-02 DC		
	Braking Time).		
	DC Brake is activated in 2-03 DC Brake Cut		
	In Speed [RPM] and a Stop command is		
	active.		
	DC Brake (inverse) is selected as a function		
	for a digital input (parameter group 5-1*).		
	The corresponding terminal is not active.		
	The DC Brake is activated via serial		
	communication.		
Foodback bigh	The sum of all active feedbacks is above the		
Feedback high	feedback limit set in 4-57 Warning Feedback		
	High.		
Feedback low	The sum of all active feedbacks is below the		
l eedback low	feedback limit set in 4-56 Warning Feedback		
	Low.		
Freeze output	The remote reference is active, which holds		
Freeze output	the present speed.		
	Freeze output was selected as a function		
	for a digital input (parameter group 5-1*).		
	The corresponding terminal is active.		
	Speed control is only possible via the		
	terminal functions speed up and speed		
	down.		
	Hold romp is activated via social communi		
	Hold ramp is activated via serial communication.		
	Cation.		
Freeze output	A freeze output command has been given,		
request	but the motor will remain stopped until a run		
	permissive signal is received.		
Freeze ref.	Freeze Reference was chosen as a function for		
	a digital input (parameter group 5-1*). The		
	corresponding terminal is active. The		
	frequency converter saves the actual		
	reference. Changing the reference is now only		
	possible via terminal functions speed up and		
	speed down.		

	Operation status		
Jog request	A jog command has been given, but the		
Jog request	motor will be stopped until a run permissive		
	signal is received via a digital input.		
Jogging	The motor is running as programmed in		
Jogging	3-19 Jog Speed [RPM].		
	 Jog was selected as function for a digital 		
	input (parameter group 5-1*). The		
	corresponding terminal (e.g. Terminal 29) is		
	active.		
	The Jog function is activated via the serial		
	communication.		
	The Jog function was selected as a		
	reaction for a monitoring function (e.g. No		
	signal). The monitoring function is active.		
Motor check	In 1-80 Function at Stop, Motor Check was		
	selected. A stop command is active. To ensure		
	that a motor is connected to the frequency		
	converter, a permanent test current is applied		
	to the motor.		
OVC control	Overvoltage control was activated in 2-17 Over-		
	voltage Control. The connected motor is		
	supplying the frequency converter with		
	generative energy. The overvoltage control		
	adjusts the V/Hz ratio to run the motor in		
	controlled mode and to prevent the frequency		
	converter from tripping.		
PowerUnit Off	(For frequency converters with an external 24		
	V power supply installed only.) Mains supply		
	to the frequency converter is removed, but		
	the control card is supplied by the external 24 V.		
Protection md	Protection mode is active. The unit has		
riotection ind	detected a critical status (an overcurrent or		
	overvoltage).		
	To avoid tripping, switching frequency is		
	reduced to 4 kHz.		
	• If possible, protection mode ends after approximately 10 s.		
	Protection mode can be restricted in		
	14-26 Trip Delay at Inverter Fault		
QStop	The motor is decelerating using 3-81 Quick		
	Stop Ramp Time.		
	• Quick stop inverse was chosen as a function		
	for a digital input (parameter group 5-1*).		
	The corresponding terminal is not active.		
	The quick stop function was activated via		
	serial communication.		
Ramping	The motor is accelerating/decelerating using		
' '	the active Ramp Up/Down. The reference, a		
	limit value or a standstill is not yet reached.		
Ref. high	The sum of all active references is above the		
	reference limit set in 4-55 Warning Reference		
	High.		

7

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

Table 7.3



8 Warnings and Alarms

8.1 System Monitoring

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

8.2 Warning and Alarm Types

Warnings

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

Alarms

Trip

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

A trip can be reset in any of 4 ways:

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

Trip-lock

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

8.3 Warning and Alarm Displays

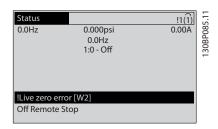


Illustration 8.1

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

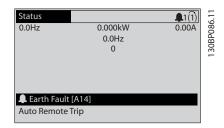


Illustration 8.2

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

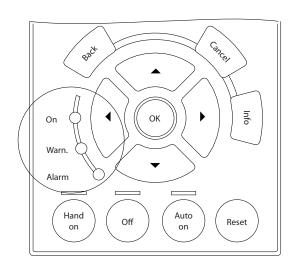


Illustration 8.3

130BB467.10



	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

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

WARNING 1, 10 Volts low

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

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

Troubleshooting

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

WARNING/ALARM 2, Live zero error

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

Troubleshooting

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

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

Perform Input Terminal Signal Test.

WARNING/ALARM 3, No motor

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

WARNING/ALARM 4, Mains phase loss

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

Troubleshooting

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

WARNING 5, DC link voltage high

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

WARNING 6, DC link voltage low

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

WARNING/ALARM 7, DC overvoltage

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

Troubleshooting

Connect a brake resistor

Extend the ramp time

Change the ramp type

Activate the functions in 2-10 Brake Function

Increase 14-26 Trip Delay at Inverter Fault

If the alarm/warning occurs during a power sag the solution is to use kinetic back-up (14-10 Mains Failure)

WARNING/ALARM 8, DC under voltage

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

Troubleshooting

Check that the supply voltage matches the frequency converter voltage.

Perform input voltage test.

Perform soft charge circuit test.

WARNING/ALARM 9, Inverter overload

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

The fault is that the frequency converter has run with more than 100% overload for too long.

Troubleshooting

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

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

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



WARNING/ALARM 10, Motor overload temperature

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

Troubleshooting

Check for motor overheating.

Check if the motor is mechanically overloaded

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

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

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

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

WARNING/ALARM 11, Motor thermistor over temp

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

Troubleshooting

Check for motor overheating.

Check if the motor is mechanically overloaded.

Check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply) and that the terminal switch for 53 or 54 is set for voltage. Check 1-93 Thermistor Source selects terminal 53 or 54.

When using digital inputs 18 or 19, check that the thermistor is connected correctly between either terminal 18 or 19 (digital input PNP only) and terminal 50.

If a KTY sensor is used, check for correct connection between terminals 54 and 55

If using a thermal switch or thermistor, check that the programming if 1-93 Thermistor Resource matches sensor wiring.

If using a KTY sensor, check the programming of 1-95 KTY Sensor Type, 1-96 KTY Thermistor Resource, and 1-97 KTY Threshold level match sensor wiring.

WARNING/ALARM 12, Torque limit

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

Troubleshooting

If the motor torque limit is exceeded during ramp up, extend the ramp up time.

If the generator torque limit is exceeded during ramp down, extend the ramp down time.

If torque limit occurs while running, possibly increase the torque limit. Be sure the system can operate safely at a higher torque.

Check the application for excessive current draw on the motor.

WARNING/ALARM 13, Over current

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 1.5 s, then the frequency converter trips and issues an alarm. This fault may be caused by shock loading or quick acceleration with high inertia loads. It may also appear after kinetic back-up if the acceleration during ramp up is quick. If extended mechanical brake control is selected, trip can be reset externally.

Troubleshooting

Remove power and check if the motor shaft can be turned.

Check that the motor size matches the frequency converter.

Check parameters 1-20 through 1-25 for correct motor data.

ALARM 14, Earth (ground) fault

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

Troubleshooting:

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

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

Perform current sensor test.

ALARM 15, Hardware mismatch

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

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

15-40 FC Type

15-41 Power Section

15-42 Voltage

15-43 Software Version

15-45 Actual Typecode String

15-49 SW ID Control Card

15-50 SW ID Power Card



15-60 Option Mounted

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

ALARM 16, Short circuit

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

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

WARNING/ALARM 17, Control word timeout

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

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

Troubleshooting:

Check connections on the serial communication cable.

Increase 8-03 Control Word Timeout Time

Check the operation of the communication equipment.

Verify a proper installation based on EMC requirements.

WARNING/ALARM 22, Hoist mechanical brake

Report value shows what kind it is.

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

1 = There was no brake feedback before timeout.

WARNING 23, Internal fan fault

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

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

Troubleshooting

Check fan resistance.

Check soft charge fuses.

WARNING 24, External fan fault

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

Troubleshooting

Check fan resistance.

Check soft charge fuses.

WARNING 25, Brake resistor short circuit

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

WARNING/ALARM 26, Brake resistor power limit

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

AWARNING

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

WARNING/ALARM 27, Brake chopper fault

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

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

This alarm/warning could also occur should the brake resistor overheat. Terminals 104 and 106 are available as brake resistors Klixon inuputs, see section *Brake Resistor Temperature Switch* in the Design Guide.

WARNING/ALARM 28, Brake check failed

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

ALARM 29, Heatsink temp

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

Troubleshooting

Check for the following conditions.

Ambient temperature too high.

Motor cable too long.

Incorrect airflow clearance above and below the frequency converter

Blocked airflow around the frequency converter.

Damaged heatsink fan.

Dirty heatsink.

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



Troubleshooting

Check fan resistance.

Check soft charge fuses.

IGBT thermal sensor.

ALARM 30, Motor phase U missing

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

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

ALARM 31, Motor phase V missing

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

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

ALARM 32, Motor phase W missing

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

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

ALARM 33, Inrush fault

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

WARNING/ALARM 34, Fieldbus communication fault

The fieldbus on the communication option card is not working.

WARNING/ALARM 36, Mains failure

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

ALARM 38, Internal fault

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

Troubleshooting

Cycle power

Check that the option is properly installed

Check for loose or missing wiring

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

No.	Text		
0	Serial port cannot be initialised. Contact your		
	Danfoss supplier or Danfoss Service Department.		
256-258	Power EEPROM data is defective or too old		
512	Control board EEPROM data is defective or too old.		
513	Communication time out reading EEPROM data		
514	Communication time out reading EEPROM data		
515	Application oriented control cannot recognize the		
	EEPROM data.		

No.	Text		
516	Cannot write to the EEPROM because a write		
	command is on progress.		
517	Write command is under time out		
518	Failure in the EEPROM		
519	Missing or invalid barcode data in EEPROM		
783	Parameter value outside of min/max limits		
1024-1279	A centelegram that has to be sent couldn't be		
	sent.		
1281	Digital signal processor flash timeout		
1282	Power micro software version mismatch		
1283	Power EEPROM data version mismatch		
1284	Cannot read digital signal processor software		
	version		
1299	Option SW in slot A is too old		
1300	Option SW in slot B is too old		
1301	Option SW in slot C0 is too old		
1302	Option SW in slot C1 is too old		
1315	Option SW in slot A is not supported (not allowed)		
1316	Option SW in slot B is not supported (not allowed)		
1317	Option SW in slot C0 is not supported (not		
	allowed)		
1318 Option SW in slot C1 is not supported (not			
allowed)			
1379	Option A did not respond when calculating		
	platform version		
1380	Option B did not respond when calculating		
	platform version		
1381	Option C0 did not respond when calculating		
	platform version.		
1382	Option C1 did not respond when calculating		
	platform version.		
1536	An exception in the application oriented control is		
	registered. Debug information written in LCP		
1792	DSP watchdog is active. Debugging of power part		
	data, motor oriented control data not transferred		
	correctly.		
2049	Power data restarted		
2064-2072	H081x: option in slot x has restarted		
2080-2088	H082x: option in slot x has issued a powerup-wait		
2096-2104	H983x: option in slot x has issued a legal		
	powerup-wait		
2304	Could not read any data from power EEPROM		
2305	Missing SW version from power unit		
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.		



	Γ		
No.	Text		
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 8.2

ALARM 39, Heatsink sensor

No feedback from the heatsink temperature sensor.

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

WARNING 40, Overload of digital output terminal 27

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

WARNING 41, Overload of digital output terminal 29

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

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

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

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

ALARM 46, Power card supply

The supply on the power card is out of range.

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

WARNING 47, 24 V supply low

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

WARNING 48, 1.8 V supply low

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

WARNING 49, Speed limit

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

ALARM 50, AMA calibration failed

Contact your Danfoss supplier or Danfoss Service Department.

ALARM 51, AMA check Unom and Inom

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

ALARM 52, AMA low Inom

The motor current is too low. Check the settings.

ALARM 53, AMA motor too big

The motor is too big for the AMA to operate.

ALARM 54, AMA motor too small

The motor is too small for the AMA to operate.

ALARM 55, AMA Parameter out of range

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

56 ALARM, AMA interrupted by user

The user has interrupted the AMA.

ALARM 57, AMA internal fault

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

ALARM 58, AMA internal fault

Contact your Danfoss supplier.

WARNING 59, Current limit

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



WARNING 60, External interlock

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

WARNING/ALARM 61, Tracking error

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

WARNING 62, Output frequency at maximum limit

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

ALARM 64, Voltage Limit

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

WARNING/ALARM 65, Control card over temperature

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

Troubleshooting

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

WARNING 66, Heatsink temperature low

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

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

Troubleshooting

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

ALARM 67, Option module configuration has changed

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

ALARM 68, Safe Stop activated

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

ALARM 69, Power card temperature

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

Troubleshooting

Check the operation of the door fans.

Check that the filters for the door fans are not blocked.

Check that the gland plate is properly installed on IP21/IP 54 (NEMA 1/12) frequency converters.

ALARM 70, Illegal frequency converter configuration

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

ALARM 71, PTC 1 safe stop

Safe Stop has been activated from the MCB 112 PTC Thermistor Card (motor too warm). Normal operation can be resumed when the MCB 112 applies 24 V DC to T-37 again (when the motor temperature reaches an acceptable level) and when the Digital Input from the MCB 112 is deactivated. When that happens, a reset signal must be is be sent (via Bus, Digital I/O, or by pressing [Reset]). Note that if automatic restart is enabled, the motor may start when the fault is cleared.

ALARM 72, Dangerous failure

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

WARNING 73, Safe stop auto restart

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

WARNING 76, Power unit setup

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

Troubleshooting:

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

77 WARNING, Reduced power mode

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

ALARM 79, Illegal power section configuration

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

ALARM 80, Drive initialised to default value

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



ALARM 81, CSIV corrupt

CSIV file has syntax errors.

ALARM 82, CSIV parameter error

CSIV failed to init a parameter.

ALARM 85, Dang fail PB:

Profibus/Profisafe Error.

WARNING/ALARM 104, Mixing fan fault

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

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

ALARM 243, Brake IGBT

This alarm is only for F Frame frequency converters. It is equivalent to Alarm 27. The report value in the alarm log indicates which power module generated the alarm:

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F3 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second frequency converter from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame sizes.
- 3 = third from the left intverter module in F14 frame size.
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

ALARM 244, Heatsink temperature

This alarm is only for F Frame frequency converters. It is equivalent to Alarm 29. The report value in the alarm log indicates which power module generated the alarm.

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F3 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second frequency converter from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame sizes.
- 3 = third from the left intverter module in F14 frame size.
- 4 = far right inverter module in F14 frame size.

- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

ALARM 245, Heatsink sensor

This alarm is only for F Frame frequency converters. It is equivalent to Alarm 39. The report value in the alarm log indicates which power module generated the alarm

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F3 frame
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second frequency converter from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame sizes.
- 3 = third from the left intverter module in F14 frame size.
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

ALARM 246, Power card supply

This alarm is only for F Frame frequency converter. It is equivalent to Alarm 46. The report value in the alarm log indicates which power module generated the alarm

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F3 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second frequency converter from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame sizes.
- 3 = third from the left intverter module in F14 frame size
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

ALARM 247, Power card temperature

This alarm is only for F Frame frequency converter. It is equivalent to Alarm 69. The report value in the alarm log indicates which power module generated the alarm

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F3 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.



- 2 = second frequency converter from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame sizes
- 3 = third from the left intverter module in F14 frame size
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

ALARM 248, Illegal power section configuration

This alarm is only for F Frame frequency converters. It is equivalent to Alarm 79. The report value in the alarm log indicates which power module generated the alarm:

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F3 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second frequency converter from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame sizes.
- 3 = third from the left intverter module in F14 frame size.
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

WARNING 250, New spare part

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

WARNING 251, New typecode

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



9 Basic Troubleshooting

9.1 Start Up and Operation

See Alarm Log in Table 4.2.

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

Danfoss VLT Automation Drive Operating Instructions

Symptom	Possible Cause	Test	Solution
	Service switch open or missing	Check if the motor is connected	Connect the motor and check the
	motor connection	and the connection is not	service switch.
		interrupted (by a service switch or	
		other devise).	
	No mains power with 24 V DC	If the display is functioning but no	Apply mains power to run the unit.
	option card	output, check that mains power is	
		applied to the frequency converter.	
	LCP Stop	Check if [Off] has been pressed.	Press [Auto On] or [Hand On]
			(depending on your operation
			mode) to run the motor.
Motor not running	Missing start signal (Standby)	Check 5-10 Terminal 18 Digital Input	Apply a valid start signal to start
Motor not running		for correct setting for terminal 18	the motor.
		(use default setting).	
	Motor coast signal active	Check 5-12 Terminal 27 Digital Input	Apply 24 V on terminal 27 or
	(Coasting)	for correct setting for terminal 27	programm this terminal to <i>No</i>
		(use default setting).	operation.
	Wrong reference signal source	Check reference signal: Local,	Program correct settings Check
		remote or bus reference? Preset	3-13 Reference Site Set preset
		reference active? Terminal	reference active in parameter
		connection correct? Scaling of	group 3-1* References. Check for
		terminals correct? Reference signal	correct wiring. Check scaling of
		available?	terminals. Check reference signal.
	Motor rotation limit	Check that 4-10 Motor Speed	Program correct settings.
		Direction is programmed correctly.	
Motor running in wrong	Active reversing signal	Check if a reversing command is	Deactivate reversing signal.
direction		programmed for the terminal in	
uncetton		parameter group 5-1* Digital inputs.	
	Wrong motor phase connection		See 3.5 Check Motor Rotation in this
			manual.
	Frequency limits set wrong	Check output limits in4-13 Motor	Program correct limits.
		Speed High Limit [RPM], 4-14 Motor	
		Speed High Limit [Hz], and 4-19 Max	
Motor is not reaching		Output Frequency	
maximum speed	Reference input signal not scaled	Check reference input signal	Program correct settings.
	correctly	scaling in parameter group 6-*	
		Analog I/O mode and parameter	
	<u> </u>	group 3-1* References.	
	Possible incorrect parameter	Check the settings of all motor	Check settings in parameter group
Motor speed unstable	settings	parameters, including all motor	1-6* Analog I/O mode. For closed
		compensation settings. For closed	loop operation check settings in
	Describle account of the	loop operation, check PID settings.	parameter group 20-0* Feedback.
	Possible over-magnetization	Check for incorrect motor settings	Check motor settings in parameter
Motor runs rough		in all motor parameters.	groups 1-2* Motor data 1-3* Adv
			motor data, and 1-5* Load indep. setting.
	Possible incorrect settings in the	Check brake parameters. Check	Check parameter group 2-0* DC
Motor will not brake	brake parameters. Possible too	ramp time settings.	brake and 3-0* Reference limits.
motor will flot brake	short ramp down times.	Tamp time settings.	orane and 50 hererence minus.
	Short ramp down times.		



Basic Troubleshooting

VLT Automation Drive Operating Instructions

Symptom	Possible Cause	Test	Solution
	Phase to phase short	Motor or panel has a short phase	Eliminate any shorts detected.
		to phase. Check motor and panel	
		phase to for shorts.	
	Motor overload	Motor is overloaded for the	Perform startup test and verify
		application.	motor current is within specifi-
Open power fuses or circuit			cations. If motor current is
breaker trip			exceeding nameplate full load
			current, motor may run only with
			reduced load. Review the specifi-
			cations for the application.
	Loose connections	Perform pre-startup check for loose	Tighten loose connections.
		connections.	
	Problem with mains power (See	Rotate input power leads into the	If imbalanced leg follows the wire,
	Alarm 4 Mains phase loss	drive one position: A to B, B to C, C	it is a power problem. Check mains
Mains current imbalance	description)	to A.	power supply.
greater than 3%	Problem with the frequency	Rotate input power leads into the	If imbalance leg stays on same
	converter unit	frequency converter one position: A	input terminal, it is a problem with
		to B, B to C, C to A.	the unit. Contact supplier.
	Problem with motor or motor	Rotate output motor leads one	If imbalanced leg follows the wire,
	wiring	position: U to V, V to W, W to U.	the problem is in the motor or
Motor current imbalance			motor wiring. Check motor and
			motor wiring.
greater than 3%	Problem with frequency converter	Rotate output motor leads one	If imbalance leg stays on same
	unit	position: U to V, V to W, W to U.	output terminal, it is a problem
			with the unit. Contact supplier.

Table 9.1



10 Specifications

10.1 Power-dependent Specifications

Mains Supply 3x200-240 V AC									
FC 301/FC 302	PK25	PK37	PK55	PK75	P1K1	P1K5	P2K2	РЗКО	P3K7
Typical Shaft Output [kW]	0.25	0.37	0.55	0.75	1.1	1.5	2.2	3	3.7
Enclosure IP20/IP21	A2	A2	A2	A2	A2	A2	A2	А3	А3
Enclosure IP20 (FC 301 only)	A1	A1	A1	A1	A1	A1	-	-	-
Enclosure IP55, 66	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A5	A5
Output current									
Continuous	1.8	2.4	3.5	4.6	6.6	7.5	10.6	12.5	16.7
(3x200-240 V) [A]	1.0	2.4	3.3	4.0	0.0	7.5	10.0	12.5	10.7
Intermittent	2.9	3.8	5.6	7.4	10.6	12.0	17.0	20.0	26.7
(3x200-240 V) [A]	2.9	3.0	5.0	7.4	10.0	12.0	17.0	20.0	20.7
Continuous	0.65	0.86	1.26	1.66	2.38	2.70	3.82	4.50	6.00
kVA (208 V AC) [kVA]	0.03	0.80	1.20	1.00	2.30	2.70	3.02	4.50	0.00
Max. input current									
Continuous	1.6	2.2	3.2	4.1	5.9	6.8	9.5	11.3	15.0
(3x200-240 V) [A]	1.0	2.2	3.2	7.1	3.7	0.0	J.5	11.5	15.0
Intermittent	2.6	3.5	5.1	6.6	9.4	10.9	15.2	18.1	24.0
(3x200-240 V) [A]	2.0	3.5	3.1	0.0	7.1	10.5	13.2	10.1	
Additional specifications									
IP20, 21 max. cable cross section ⁵⁾ (mains,				4.4	l,4 (12,12,12))			
motor, brake and load sharing) [mm²				,	nin. 0.2 (24)	•			
(AWG)] ²⁾				(11	IIII. U.Z (Z -1)	,			
IP55, 66 max. cable cross section ⁵⁾ (mains,									
motor, brake and load sharing) [mm ²				4,4	,4 (12,12,12	2)			
(AWG)]									
Max. cable cross section ⁵⁾ with disconnect				6,4	,4 (10,12,12	2)			
Estimated power loss	24	20	42				116	455	105
at rated max. load [W] 4)	21	29	42	54	63	82	116	155	185
Weight, enclosure IP20 [kg]	4.7	4.7	4.8	4.8	4.9	4.9	4.9	6.6	6.6
A1 (IP20)	2.7	2.7	2.7	2.7	2.7	2.7	-	-	-
A5 (IP55, 66)	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
Efficiency 4)	0.94	0.94	0.95	0.95	0.96	0.96	0.96	0.96	0.96
0.25-3.7 kW only available as 160% high ov	erload.								

Table 10.1



VLT Automation Drive Operating Instructions

Mains Supply 3x200-240 V AC						
FC 301/FC 302	P5	5K5	P	7K5	P.	I1K
High/ Normal Load ¹⁾	НО	NO	НО	NO	НО	NO
Typical Shaft Output [kW]	5.5	7.5	7.5	11	11	15
Enclosure IP20	E	33		B3		34
Enclosure IP21	E	31		B1		32
Enclosure IP55, 66	E	31		B1		32
Output current			•			
Continuous	24.2	20.0	20.0	46.2	46.2	50.4
(3x200-240 V) [A]	24.2	30.8	30.8	46.2	46.2	59.4
Intermittent						
(60 s overload)	38.7	33.9	49.3	50.8	73.9	65.3
(3x200-240 V) [A]						
Continuous	8.7	11.1	11.1	16.6	16.6	21.4
kVA (208 V AC) [kVA]	0.7	11.1	11.1	10.0	10.0	21.4
Max. input current						
Continuous	22	28	28	42	42	54
(3x200-240 V) [A]	22	26	20	42	42	54
Intermittent						
(60 s overload)	35.2	30.8	44.8	46.2	67.2	59.4
(3x200-240 V) [A]						
Additional specifications						
IP21 max. cable cross-section ⁵⁾ (mains, brake,	16 10 1	6 (6,8,6)	16 10	16 (6,8,6)	25	(2,-,-)
load sharing) [mm² (AWG)] ²⁾	10,10, 1	0 (0,8,0)	10,10,	10 (0,8,0)	35,-,-	(2,-,-)
IP21 max. cable cross-section ⁵⁾ (motor) [mm ²	10.10	(0.0.)	10.10	(0.0.)	25.25.2	F (2.4.4)
(AWG)] ²⁾	10,10,	- (8,8,-)	10,10	,- (8,8,-)	33,23,2	5 (2,4,4)
IP20 max. cable cross-section ⁵⁾ (mains, brake,	10.10	(0.0.)	10.10	(0.0.)	25	(2)
motor and load sharing)	10,10,	- (8,8,-)	10,10	,- (8,8,-)	35,-,-	(2,-,-)
Max. cable cross-section with Disconnect [mm ²				. ()		
(AWG)] ²⁾			16,10,1	0 (6,8,8)		
Estimated power loss						
at rated max. load [W] ⁴⁾	239	310	371	514	463	602
Weight,	_	23		23		27
enclosure IP21, IP55, 66 [kg]					•	<u>- /</u>
Efficiency ⁴⁾	0.9	964	0.	959	0.	964

Table 10.2

Specifications

Mains Supply 3x200-240 V AC										
FC 301/FC 302	P1	5K	P1	8K	P2	2K	P3	вок	P3	37K
High/Normal Load ¹⁾	НО	NO	НО	NO	НО	NO	НО	NO	НО	NO
Typical Shaft Output [kW]	15	18.5	18.5	22	22	30	30	37	37	45
Enclosure IP20	Е	34		3		3	(4		4
Enclosure IP21				1	C1		(1
Enclosure IP55, IP66		1		1	C1		C2			2
Output current										
Continuous	59.4	74.8	74.8	88	88	115	115	143	143	170
(3x200-240 V) [A]										
Intermittent (60 s overload)	89.1	82.3	112	96.8	132	127	173	157	215	187
(3x200-240 V) [A]	09.1	02.3	112	90.6	132	127	1/3	157	213	107
	-									
Continuous	21.4	26.9	26.9	31.7	31.7	41.4	41.4	51.5	51.5	61.2
kVA (208 V AC) [kVA] Max. input current										
Continuous										
(3x200-240 V) [A]	54	68	68	80	80	104	104	130	130	154
Intermittent	01	74.0	102	00	120	114	156	142	105	160
(60 s overload)	81	74.8	102	88	120	114	156	143	195	169
(3x200-240 V) [A] Additional specifications										
•			1							
IP20 max. cable cross-section ⁵⁾	25	(2)	50 (1)		50 (1)		150 (300MCM)		150 (300MCM)	
(mains, brake, motor and load sharing)	33	(2)] 30	(1)	30 (1)		130 (300IVICIVI)		130 (300IVICIVI)	
IP21, IP55, IP66 max. cable cross-										
		(1)		(1)		(1)	150 (2)	2014614)	150 (20	2014(214)
section ⁵⁾ (mains, motor) [mm ² (AWG)] ²⁾	50	(1)	50	(1)	50	(1)	150 (30	DOMCM)	150 (30	OMCM)
IP21, IP55, IP66 max. cable cross-		(4)		(4)		(4)	0.5	(2.(0)	05.	(2.(0)
section ⁵⁾ (brake, load sharing)	50	(1)	50	(1)	50	(1)	95	(3/0)	95 ((3/0)
[mm ² (AWG)] ²⁾										
Max cable size with mains							95, 7	70, 70		50, 120
disconnect [mm² (AWG)] ²⁾			50, 35, 35 (1, 2, 2)			(3/0, 2	/0, 2/0)	-	MCM, [M, 4/0)	
Estimated power loss	634	727	740	0.45	074	1140	1142	1252	1400	1636
at rated max. load [W] 4)	624	737	740	845	874	1140	1143	1353	1400	1636
Weight,					_					·
enclosure IP21, 55/66 [kg]		15	'	15	4	! 5	6	55	6	55
Efficiency ⁴⁾							+			
	0.	96	0.	97	0.	97	0.	97	0.	97

VLT Automation Drive Operating

Instructions

Table 10.3

For fuse ratings, see 10.3.1 Fuses

- 1) High overload = 160% torque during 60 s. Normal overload = 110% torque during 60 s.
- 2) American Wire Gauge.
- 3) Measured using 5 m screened motor cables at rated load and rated frequency.
- 4) The typical power loss is at nominal load conditions and expected to be within ▲/ ▼15% (tolerence relates to variety in voltage and cable conditions).

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

If the switching frequency is increased compared to the default setting, the power losses may rise significantly.

LCP and typical control card power consumptions are included. Further options and customer load may add up to 30 W to the losses. (Though typical only 4 W extra for a fully loaded control card, or options for slot A or slot B, each).

Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (▲/ ▼5%).

5) The three values for the max. cable cross section are for single core, flexible wire and flexible wire with sleeve, respectively.

Mains Supply 3x380-500 V AC (FC 302), 3x380-4	80 V AC (F	C 301)							
	PK 37	PK 55	PK75	P1K1	P1K5	P2K2	РЗКО	P4K0	P5K5	P7K5
FC 301/FC 302	0.27	0.55	0.75	1 1	1.5	2.2	2	4		7.5
Typical Shaft Output [kW]	0.37	0.55	0.75	1.1	1.5	2.2	3	4	5.5	7.5
Enclosure IP20/IP21	A2	A2	A2	A2	A2	A2	A2	A2	A3	A3
Enclosure IP20 (FC 301 only)	A1	A1	A1	A1	A1					
Enclosure IP55, 66	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A5	A5
Output current	•	•			•	•	•	•	•	•
High overload 160% for 1 min.										
Shaft output [kW]	0.37	0.55	0.75	1.1	1.5	2.2	3	4	5.5	7.5
Continuous	1.2	1.0	2.4	2	4.1	Г.	7.0	10	12	16
(3x380-440 V) [A]	1.3	1.8	2.4	3	4.1	5.6	7.2	10	13	16
Intermittent	2.1	2.0	2.0	4.0		0.0	11.5	16	20.0	25.6
(3x380-440 V) [A]	2.1	2.9	3.8	4.8	6.6	9.0	11.5	16	20.8	25.6
Continuous	1.2	1.6	2.1	2.7	2.4	4.0	6.3	0.2	11	145
(3x441-500 V) [A]	1.2	1.6	2.1	2.7	3.4	4.8	6.3	8.2	11	14.5
Intermittent	1.0	26	2.4	4.2	F 4	7.7	10.1	12.1	17.6	22.2
(3x441-500 V) [A]	1.9	2.6	3.4	4.3	5.4	7.7	10.1	13.1	17.6	23.2
Continuous kVA	0.9	1.2	1.7	2.1	2.0	2.0	F 0	6.0	0.0	110
(400 V AC) [kVA]	0.9	1.3	1.7	2.1	2.8	3.9	5.0	6.9	9.0	11.0
Continuous kVA	0.9	1.3	1.7	2.4	2.7	3.8	F 0	6.5	8.8	11.6
(460 V AC) [kVA]	0.9	1.5	1.7	2.4	2.7	3.0	5.0	6.5	0.0	11.0
Max. input current										
Continuous	1.2	1.6	2.2	2.7	3.7	5.0	6.5	9.0	11.7	14.4
(3x380-440 V) [A]	1.2	1.0	2.2	2.7	3.7	5.0	0.5	9.0	11.7	14.4
Intermittent	1.9	26	2.5	4.2	F 0	0.0	10.4	144	107	22.0
(3x380-440 V) [A]	1.9	2.6	3.5	4.3	5.9	8.0	10.4	14.4	18.7	23.0
Continuous	1.0	1.4	1.9	2.7	3.1	4.3	5.7	7.4	9.9	13.0
(3x441-500 V) [A]	1.0	1.4	1.9	2.7	3.1	4.5	3.7	7.4	9.9	13.0
Intermittent	1.6	2.2	3.0	4.3	5.0	6.9	9.1	11.8	15.8	20.8
(3x441-500 V) [A]	1.0	2.2	3.0	4.5	5.0	0.9	9.1	11.0	13.8	20.8
Additional specifications										
IP20, 21 max. cable cross section ⁵⁾					111	12,12,12)				
(mains, motor, brake and load					, , ,	0.2(24))				
sharing) [mm² (AWG)]²)					(111111.	0.2(24))				
IP55, 66 max. cable cross section ⁵⁾										
(mains, motor, brake and load					4,4,4 (12,12,12)				
sharing) [mm² (AWG)]										
Max. cable cross section ⁵⁾ with					C 4 4 ()	10 12 12)				
disconnect					6,4,4 (10,12,12)				
Estimated power loss	25	42	10	F0	(2)	00	116	124	107	255
at rated max. load [W] 4)	35	42	46	58	62	88	116	124	187	255
Weight,		4-	4.5	4.5	4.5	4.0	4.5	4.5		
enclosure IP20	4.7	4.7	4.8	4.8	4.9	4.9	4.9	4.9	6.6	6.6
Enclosure IP55, 66	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	14.2	14.2
Efficiency ⁴⁾	0.93	0.95	0.96	0.96	0.97	0.97	0.97	0.97	0.97	0.97
0.37-7.5 kW only available as 160% hi						1	I			1

Table 10.4

VLT Automation Drive Operating Instructions

Mains Supply 3x380-500 V AC (FC 302),	3x380-480 V /	AC (FC 301)							
FC 301/FC 302	P1	1K	P1	5K	P1	18K	P22K		
High/ Normal Load ¹⁾	НО	NO	НО	NO	НО	NO	НО	NO	
Typical Shaft output [kW]	11	15	15	18.5	18.5	22.0	22.0	30.0	
Enclosure IP20	Е	3	В	3	Е	34	В	34	
Enclosure IP21	В	31	В	1	Е	32	В	32	
Enclosure IP55, IP66	В	31	В	1	Е	32	В	32	
Output current	!		!		!				
Continuous	24	22	22	27.5	27.5	44	4.4		
(3x380-440 V) [A]	24	32	32	37.5	37.5	44	44	61	
Intermittent (60 s overload)	20.4	25.2	51.2	41.2		40.4	70.4	67.1	
(3x380-440 V) [A]	38.4	35.2	51.2	41.3	60	48.4	70.4	67.1	
Continuous	21	27	27	24	24	40	40		
(3x441-500 V) [A]	21	27	27	34	34	40	40	52	
Intermittent (60 s overload)	33.6	29.7	43.2	27.4	511	44	64	57.2	
(3x441-500 V) [A]	33.0	29.7	43.2	37.4	54.4	44	04	37.2	
Continuous kVA	16.6	22.2	22.2	26	26	30.5	30.5	42.3	
(400 V AC) [kVA]	10.0	22.2	22.2	20	20	30.3	30.5	42.3	
Continuous kVA		21.5		27.1		31.9		41.4	
(460 V AC) [kVA]		21.5		27.1		31.5		717	
Max. input current									
Continuous	22	29	29	34	34	40	40	55	
(3x380-440 V) [A]									
Intermittent (60 s overload)	35.2	31.9	46.4	37.4	54.4	44	64	60.5	
(3x380-440 V) [A]									
Continuous	19	25	25	31	31	36	36	47	
(3x441-500 V) [A]									
Intermittent (60 s overload)	30.4	27.5	40	34.1	49.6	39.6	57.6	51.7	
(3x441-500 V) [A]									
Additional specifications	1								
IP21, IP55, IP66 max. cable cross-		- ()		- ()		(2)		(0)	
section ⁵⁾ (mains, brake, load sharing)	16, 10, 1	6 (6, 8, 6)	16, 10, 16	6 (6, 8, 6)	35,-,	-(2,-,-)	35,-,-	(2,-,-)	
[mm² (AWG)] ²⁾									
IP21, IP55, IP66 max. cable cross-	10, 10,	- (8, 8,-)	10, 10,-	(8, 8,-)	35, 25, 2	5 (2, 4, 4)	35, 25, 2	5 (2, 4, 4)	
section ⁵⁾ (motor) [mm ² (AWG)] ²⁾									
IP20 max. cable cross-section ⁵⁾ (mains,	10, 10,	- (8, 8,-)	10, 10,-	(8, 8,-)	35,-,	-(2,-,-)	35,-,-	(2,-,-)	
brake, motor and load sharing)									
Max. cable cross-section with				16, 10, 10 (6, 8, 8)				
Disconnect [mm² (AWG)] 2)				1		1			
Estimated power loss	291	392	379	465	444	525	547	739	
at rated max. load [W] 4)								<u></u>	
Weight, enclosure IP20 [kg]	1 1	2	1	2	2:	3.5	23	3.5	
Weight,	2	23	2	23		27	27		
enclosure IP21. IP55, 66 [kg]		•							
Efficiency ⁴⁾	0.	98	0.9	98	0.	.98	0.	98	

Table 10.5

Mains Supply 3x380-500 V AC (FC	302), 3x380-	480 V AC (FC 301)							
FC 301/FC 302	P3	вок	P3	37K	P	45K	P5	5K	P7	75K
High/ Normal Load ¹⁾	НО	NO	НО	NO	НО	NO	НО	NO	НО	NO
Typical Shaft output [kW]	30	37	37	45	45	55	55	75	75	90
Enclosure IP20		34	C	3	(4	(4
Enclosure IP21	([1	(1	(<u> </u>	C	.2	C2	
Enclosure IP55, IP66		 [1		C1		 [1		.2		2
Output current										
Continuous										
(3x380-440 V) [A]	61	73	73	90	90	106	106	147	147	177
Intermittent (60 s overload) (3x380-440 V) [A]	91.5	80.3	110	99	135	117	159	162	221	195
Continuous	52	65	65	80	80	105	105	130	130	160
(3x441-500 V) [A]	32	0.5	03	00	80	103	103	130	130	100
Intermittent (60 s overload)	78	71.5	97.5	88	120	116	158	143	195	176
(3x441-500 V) [A]	/6	/1.5	97.5	00	120	110	130	143	195	176
Continuous kVA	42.2	F0.6	F0.6	62.4	62.4	72.4	72.4	102	102	122
(400 V AC) [kVA]	42.3	50.6	50.6	62.4	62.4	73.4	73.4	102	102	123
Continuous kVA		F1.0		62.7		02.7		104		120
(460 V AC) [kVA]		51.8		63.7		83.7		104		128
Max. input current	•									
Continuous				02	02	06	06	122	122	161
(3x380-440 V) [A]	55	66	66	82	82	96	96	133	133	161
Intermittent (60 s overload)	02.5	72.6	00	00.2	122	100	144	146	200	177
(3x380-440 V) [A]	82.5	72.6	99	90.2	123	106	144	146	200	177
Continuous	47	50				0.5	0.5	110	110	4.45
(3x441-500 V) [A]	47	59	59	73	73	95	95	118	118	145
Intermittent (60 s overload)						405		400		
(3x441-500 V) [A]	70.5	64.9	88.5	80.3	110	105	143	130	177	160
Additional specifications					!			!		!
IP20 max. cable cross-section ⁵⁾										
(mains and motor)	35	(2)	50	(1)	50	(1)	150 (30	00mcm)	150 (30	00mcm)
IP20 max. cable cross-section ⁵⁾										
(brake and load sharing)	35	(2)	50	(1)	50	(1)	95 ((4/0)	95	(4/0)
IP21, IP55, IP66 max. cable cross-										
section ⁵⁾ (mains, motor) [mm ²	50	(1)	50	(1)	50	(1)	150 (30	OMCM)	150 (30	OOMCM)
(AWG)] ²⁾		(1)	30	(1)		(1)	150 (50	olvicivi)	150 (50	JOINICIVI)
IP21, IP55, IP66 max. cable cross-										
section ⁵⁾ (brake, load sharing)	50	(1)	50	(1)	50	(1)	05 /	(3/0)	05	(3/0)
[mm ² (AWG)] ²⁾		(1)	30	(1)		(1)	95 ((3/0)	93	(3/0)
Max cable size with mains									105 1	FO 120
			50, 35	, 35			95, 7	0, 70		50, 120 CM, 300
disconnect [mm² (AWG)] ²⁾			(1, 2, 2)		(3/0, 2	/0, 2/0)	1	1, 4/0)		
Estimated power loss				1			1		IVICIV	1, 4,0)
at rated max. load [W] 4)	570	698	697	843	891	1083	1022	1384	1232	1474
			-				-		-	<u> </u>
Weight,	4	15	4	15	4	15	65		6	55
enclosure IP21, IP55, IP66 [kg]	+	00	_	00	<u> </u>	00	_	00		00
Efficiency ⁴⁾	1 0	.98	0.	98	1 0	.98	0.	98	0.	.99

Table 10.6



For fuse ratings, see 10.3.1 Fuses

1) High overload = 160% torque during 60 s. Normal overload = 110% torque during 60 s.

Instructions

- 2) American Wire Gauge.
- 3) Measured using 5 m screened motor cables at rated load and rated frequency.
- 4) The typical power loss is at nominal load conditions and expected to be within ▲/ ▼15% (tolerence relates to variety in voltage and cable conditions).

VLT Automation Drive Operating

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

If the switching frequency is increased compared to the default setting, the power losses may rise significantly.

LCP and typical control card power consumptions are included. Further options and customer load may add up to 30W to the losses. (Though typical only 4W extra for a fully loaded control card, or options for slot A or slot B, each).

Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (▲/▼5%).

5) The three values for the max. cable cross section are for single core, flexible wire and flexible wire with sleeve, respectively.

Mains Supply 3x525-600 V AC (FC 302 only) FC 302	PK75	P1K1	P1K5	P2K2	P3K0	P4K0	P5K5	P7K5
				1	-			
Typical Shaft Output [kW]	0.75	1.1	1.5	2.2	3	4	5.5	7.5
Enclosure IP20, 21	A3	A3	A3	A3	A3	A3	A3	A3
Enclosure IP55	A5	A5	A5	A5	A5	A5	A5	A5
Output current						1	1	
Continuous	1.8	2.6	2.9	4.1	5.2	6.4	9.5	11.5
(3x525-550 V) [A]								
Intermittent	2.9	4.2	4.6	6.6	8.3	10.2	15.2	18.4
(3x525-550 V) [A]								
Continuous	1.7	2.4	2.7	3.9	4.9	6.1	9.0	11.0
(3x551-600 V) [A]								
Intermittent	2.7	3.8	4.3	6.2	7.8	9.8	14.4	17.6
(3x551-600 V) [A]								
Continuous kVA (525 V AC) [kVA]	1.7	2.5	2.8	3.9	5.0	6.1	9.0	11.0
Continuous kVA (575 V AC) [kVA]	1.7	2.4	2.7	3.9	4.9	6.1	9.0	11.0
Max. input current								
Continuous	1.7	2.4	2.7	4.1	5.2	5.8	8.6	10.4
(3x525-600 V) [A]	1.7	2.4	2.7	4.1	5.2	5.0	0.0	10.4
Intermittent	2.7	3.8	4.3	6.6	8.3	9.3	12.0	16.6
(3x525-600 V) [A]	2.7	3.0	4.3	0.0	0.3	9.3	13.8	10.0
Additional specifications			•					
IP20, 21 max. cable cross section ⁵⁾ (mains,				4,4,4 (1	2,12,12)			
motor, brake and load sharing) [mm ² (AWG)] ²⁾				(min. 0).2 (24))			
IP55, 66 max. cable cross section ⁵⁾ (mains,								
motor, brake and load sharing) [mm ² (AWG)]				4,4,4 (1	2,12,12)			
Max. cable cross section ⁵⁾ with disconnect				6,4,4 (1	0,12,12)			
Estimated power loss					<u> </u>			
at rated max. load [W] ⁴⁾	35	50	65	92	122	145	195	261
Weight,								
Enclosure IP20 [kg]	6.5	6.5	6.5	6.5	6.5	6.5	6.6	6.6
Weight,								
enclosure IP55 [kg]	13.5	13.5	13.5	13.5	13.5	13.5	14.2	14.2
Efficiency 4)	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97

Table 10.7



g

Specifications	VLT Automation Drive Operating
Specifications	Instructions

Mains Supply 3x525-600 V AC										
FC 302	P1	1K	P1	5K	P18	ВК	P2	2K	P3	ок
High/ Normal Load ¹⁾	НО	NO	НО	NO	НО	NO	НО	NO	НО	NO
Typical Shaft Output [kW]	11	15	15	18.5	18.5	22	22	30	30	37
Enclosure IP21, IP55, IP66	E	31	E	31	B	2	В	32	C	1
Enclosure IP20	E	33	В3		B ₄	4	В	34	В	4
Output current										
Continuous										
(3x525-550 V) [A]	19	23	23	28	28	36	36	43	43	54
Intermittent										
(3x525-550 V) [A]	30	25	37	31	45	40	58	47	65	59
Continuous	10	22	22	27	27	2.4	2.4	4.1	44	
(3x525-600 V) [A]	18	22	22	27	27	34	34	41	41	52
Intermittent										
(3x525-600 V) [A]	29	24	35	30	43	37	54	45	62	57
Continuous kVA (550 V AC) [kVA]	18.1	21.9	21.9	26.7	26.7	34.3	34.3	41.0	41.0	51.4
Continuous kVA (575 V AC) [kVA]	17.9	21.9	21.9	26.9	26.9	33.9	33.9	40.8	40.8	51.8
Max. input current			ļ	Į.		!				
Continuous										
at 550 V [A]	17.2	20.9	20.9	25.4	25.4	32.7	32.7	39	39	49
Intermittent	20	22	22	20	44	26		42	50	
at 550 V [A]	28	23	33	28	41	36	52	43	59	54
Continuous	1.	20	20	2.4	2.4	24	24	27	27	4.7
at 575 V [A]	16	20	20	24	24	31	31	37	37	47
Intermittent	2.	22	22	27	20	2.4	50	4.1	F.6	
at 575 V [A]	26	22	32	27	39	34	50	41	56	52
Additional specifications	'				•					•
IP21, IP55, IP66 max. cable cross-										
section ⁵⁾ (mains, brake, load sharing)	16, 10, 1	0 (6, 8, 8)	16, 10, 1	0 (6, 8, 8)	35,-,-(2,-,-)		35,-,-(2,-,-)		50,-,-	(1,-,-)
[mm² (AWG)] ²⁾										
IP21, IP55, IP66 max. cable cross-										
section ⁵⁾ (motor) [mm ² (AWG)] ²⁾	10, 10,	- (8, 8,-)	10, 10,	- (8, 8,-)	35, 25, 25	(2, 4, 4)	35, 25, 2	5 (2, 4, 4)	50,-,-	(1,-,-)
IP20 max. cable cross-section ⁵⁾										
(mains, brake, motor and load										
sharing)	10, 10,	- (8, 8,-)	10, 10,	- (8, 8,-)	35,-,-((2,-,-)	35,-,-	(2,-,-)	35,-,-	(2,-,-)
3,										
Max. cable cross-section with				16,	10, 10				50, 3	5, 35
Disconnect [mm² (AWG)] 2)	(6,			8, 8)				(1,2	, 2)	
Estimated power loss		225		205		220		700		700
at rated max. load [W] 4)		225		285		329		700		700
Weight,		12				7	_	-		7
enclosure IP21, [kg]	2	23	2	23	27	′	2	.7	2	7
Weight,		2		2	22		23.5		33	
enclosure IP20 [kg]	'	2	'	2	23	.5	2:	5.5	23	3.5
Efficiency 4)	0.	98	0.	98	0.9	98	0.	98	0.9	98

Table 10.8

Continuous kVA (575 V AC) [kVA] 51.8 61.7 61.7 82.7 82.7 99.6 99.6 130.5	Mains Supply 3x525-600 V AC									
Typical Shaft Output [kW] 37	FC 302	P3	7K	P4	P45K		P55K		P75K	
Enclosure IP21, IP55, IP66	High/Normal Load*	НО	NO	НО	NO	НО	NO	НО	NO	
Enclosure P20	Typical Shaft Output [kW]	37	45	45	55	55	75	75	90	
Output current	Enclosure IP21, IP55, IP66	C1	C1	(1	C	2	C2		
Continuous (3x525-550 V) [A]	Enclosure IP20	C3	C3	(C	4	C	:4	
Sas 525 - 550 V [A]	Output current		•	•		•		•		
(3x525-550 V) [A] Intermittent (3x525-550 V) [A] Intermittent (3x525-550 V) [A] Continuous (3x525-500 V) [A] Intermittent (3x525-500 V) [A] Intermittent (3x525-500 V) [A] Intermittent (3x525-600 V) [A] Intermittent Continuous kVA (550 V AC) [kVA] 51.4 61.9 61.9 82.9 82.9 100.0 100.0 130.5 Max. Input current Continuous kVA (575 V AC) [kVA] S1.8 61.7 61.7 82.7 82.7 99.6 99.6 130.5 Max. Input current Continuous 49 59 59 78.9 78.9 95.3 95.3 124.3 Intermittent at 550 V [A] Continuous at 550 V [A] Continuous at 550 V [A] Additional specifications IP20 max. cable cross-section ⁵¹ (mains and motor) IP20 max. cable cross-section ⁵¹ (mains and motor) IP21 max. cable cross-section ⁵¹ (brake and load sharing) IP21, IP55, IP66 max. cable cross-section ⁵¹ (brake, load sharing) [max² (AWG)] ²¹ IP21, IP55, IP66 max. cable cross-section ⁵² (brake, load sharing) [max² (AWG)] ²³ Max cable size with mains disconnect Imax² (AWG)] ²³ IP21, IP55, IP66 max. cable cross-section ⁵² (brake, load sharing) [max² (AWG)] ²³ IP21, IP55, IP66 max. cable cross-section ⁵³ So (1) So (1) So (1) So (1) So (300MCM) IS0 (300MCM) I	Continuous	Γ.4	65	65	07	0.7	105	105	127	
Sas	(3x525-550 V) [A]	54	65	65	87	87	105	105	13/	
(3x525-560 V) [A] Continuous (3x525-600 V) [A] 1stermittent (3x525-600 V) [A] Continuous kVA (550 V AC) [kVA] 51.4 61.9 61.9 61.7 61.7 62.7 63.9 63.9 63.9 63.9 63.9 63.9 63.9 63.9 63.9 63.9 63.9 63.9 63.9 63.0 63.0 63.0 63.0 63.9 63.9 63.0 6	Intermittent	01	72	00	06	121	116	150	151	
Sx525-600 V) [A] 52 62 62 83 83 100 100 131 Intermittent (3x525-600 V) [A] 78 68 93 91 125 110 150 144 (3x525-600 V) [A] 51.4 61.9 61.9 82.9 82.9 100.0 100.0 130.5 Continuous kVA (550 V AC) [kVA] 51.8 61.7 61.7 82.7 82.7 99.6 99.6 130.5 Max. Input current	(3x525-550 V) [A]	81	/2	98	96	131	110	158	151	
(3x525-600 V) [A] Intermittent (3x525-600 V) [A] Continuous kVA (550 V AC) [kVA] Continuous kVA (550 V AC) [kVA] S1.4 61.9 61.9 61.9 82.9 82.9 82.9 100.0 100.0 100.0 130.5 Continuous kVA (575 V AC) [kVA] S1.8 61.7 61.7 82.7 82.7 99.6 99.6 130.5 Max. input current Continuous at 550 V [A] Intermittent at 575 V [A]	Continuous	50	62	62	02	02	100	100	121	
3x525-600 V) [A] 78	(3x525-600 V) [A]	52	02	02	03	03	100	100	131	
Continuous kVA (550 V AC) [kVA] 51.4 61.9 61.9 82.9 82.9 100.0 100.0 130.5	Intermittent	70	60	02	01	125	110	150	144	
Continuous kVA (575 V AC) [kVA] 51.8 61.7 61.7 82.7 82.7 99.6 99.6 130.5	(3x525-600 V) [A]	70	00	93	91	123	110	130	144	
Max. Input current	Continuous kVA (550 V AC) [kVA]	51.4	61.9	61.9	82.9	82.9	100.0	100.0	130.5	
Continuous at 550 V [A]	Continuous kVA (575 V AC) [kVA]	51.8	61.7	61.7	82.7	82.7	99.6	99.6	130.5	
at 550 V [A]	Max. input current									
at 550 V [A] Intermittent at 550 V [A] Intermittent at 550 V [A] Additional specifications IP20 max. cable cross-section ⁵⁾ (mains and motor) IP20 max. cable cross-section ⁵⁾ (brake and load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake and load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP20, IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP20, IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP20, IP21, IP55, IP66 max. cable cross-section ⁵⁾	Continuous	40	F0	50	70.0	70.0	05.2	05.3	1242	
at 550 V [A] 74 65 89 87 118 105 143 137 Continuous at 575 V [A] 47 56 56 56 75 75 91 91 119 Intermittent at 575 V [A] 70 62 85 83 113 100 137 131 Additional specifications IP20 max. cable cross-section ⁵⁾ (mains and motor) IP20 max. cable cross-section ⁵⁾ (brake and load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (mains, motor) [mm² (AWG)] ²⁾ IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake and load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) [mm² (AWG)] ²⁾ Max cable size with mains disconnect [mm² (AWG)] ²⁾ Max cable size with mains disconnect [mm² (AWG)] ²⁾ Estimated power loss at rated max. load [W] ⁴⁾ Weight, enclosure IP20 [kg] Weight.	at 550 V [A]	49	39	39	76.9	76.9	95.5	95.5	124.5	
at 550 V [A] Continuous at 575 V [A] Intermittent at 575 V [A] Additional specifications IP20 max. cable cross-section ⁵⁾ (mains and motor) IP20 max. cable cross-section ⁵⁾ (brake and load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (mains and motor) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake and load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake and load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) [mm² (AWG)] ²⁾ IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) [mm² (AWG)] ²⁾ Max cable size with mains disconnect [mm² (AWG)] ²⁾ Estimated power loss at rated max. load [W] ⁴⁾ Weight, enclosure IP20 [kg]	Intermittent	7.1	65	90	07	110	105	1/12	127	
at 575 V [A]	at 550 V [A]	74	03	09	67	110	103	143	137	
at 575 V [A] Intermittent at 575 V [A] Additional specifications IP20 max. cable cross-section ⁵⁾ (mains and motor) IP20 max. cable cross-section ⁵⁾ (brake and load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (mains, motor) [mm² (AWG)] 2) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) [mm² (AWG)] 2) Max cable size with mains disconnect [mm² (AWG)] 2) Estimated power loss at rated max. load [W] 4) Weight, enclosure IP20 [kg] Weight.	Continuous	47	56	56	75	75	01	01	110	
at 575 V [A] 70 62 85 83 113 100 137 131 Additional specifications IP20 max. cable cross-section ⁵⁾ (mains and motor) IP20 max. cable cross-section ⁵⁾ (brake and load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (mains, motor) [mm² (AWG)] ²⁾ IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) [mm² (AWG)] ²⁾ Max cable size with mains disconnect [mm² (AWG)] ²⁾ Estimated power loss at rated max. load [W] ⁴⁾ Weight, enclosure IP20 [kg] Additional specifications 50 (1) 150 (300MCM)	at 575 V [A]	47	30	30	/3	/3	91	91	119	
Additional specifications IP20 max. cable cross-section ⁵⁾ (mains and motor) IP20 max. cable cross-section ⁵⁾ (brake and load sharing) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (mains, motor) [mm² (AWG)] ²⁾ IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) [mm² (AWG)] ²⁾ Max cable size with mains disconnect [mm² (AWG)] ²⁾ Max cable size with mains disconnect [mm² (AWG)] ²⁾ Estimated power loss at rated max. load [W] ⁴⁾ Weight, enclosure IP20 [kg] Additional specifications 50 (1) 150 (300MCM) 95 (4/0) 150 (370, 2/0, 2/0) 185, 150, 120 (350MCM, 300MCM) 1500 1500	Intermittent	70	62	85	83	113	100	137	131	
P20 max. cable cross-section ⁵⁾ (mains and motor) 150 (300MCM) 160 (300MCM	at 575 V [A]	70	02	05	05	113	100	137	131	
Motor 150 (300MCM) 160 (300MCM	Additional specifications									
load sharing			50 (1)		150 (300MCM)				
IP21, IP55, IP66 max. cable cross-section ⁵⁾	IP20 max. cable cross-section ⁵⁾ (brake and		FO /1	`		05 (4/0)				
(mains, motor) [mm² (AWG)] ²) 50 (1) 150 (300MCM) IP21, IP55, IP66 max. cable cross-section ⁵⁾ (brake, load sharing) [mm² (AWG)] ²) 50 (1) 95 (4/0) Max cable size with mains disconnect [mm² (AWG)] ²) 50, 35, 35 (1, 2, 2) 95, 70, 70 (3/0, 2/0, 2/0) 185, 150, 120 (350MCM, 300MCM (3/0, 2/0, 2/0) Estimated power loss at rated max. load [W] ⁴) 850 1100 1400 1500 Weight, enclosure IP20 [kg] 35 35 50 50	load sharing)		50 (1)		95 (4/0)				
IP21, IP55, IP66 max. cable cross-section ⁵			50 (1)		150 (300MCM)				
Max cable size with mains disconnect [mm² (AWG)] 2) 50, 35, 35 (1, 2, 2) 95, 70, 70 (3/0, 2/0, 2/0) (350MCM, 300MCM 4/0) Estimated power loss at rated max. load [W] 4) 850 1100 1400 1500 Weight, enclosure IP20 [kg] 35 35 50 50	IP21, IP55, IP66 max. cable cross-section ⁵⁾	50 (1)			95 (4/0)					
[mm² (AWG)] ²)								185 1	50 120	
Estimated power loss at rated max. load [W] ⁴⁾ Weight, enclosure IP20 [kg] Weight.		I			1		(350MCM,	300MCM,		
at rated max. load [W] ⁴⁾ Weight, enclosure IP20 [kg] Weight.	Estimated power loss									
enclosure IP20 [kg] 35 35 50 50 Weight.	at rated max. load [W] ⁴⁾		850		1100		1400		1500	
Weight,	_	35 35			35	5	0	50		
45 45 65 65 enclosure IP21, IP55 [kg]	5 '	4	5	45		65		65		
Efficiency ⁴⁾ 0.98 0.98 0.98 0.98		0.0	98	0.98		0.98		0.	98	

Table 10.9



Specifications	VLT Automation Drive Operating
Specifications	Instructions

Mains Supply 3x525-690 V AC							
FC 301/FC 302	P1K1	P1K5	P2K2	P3K0	P4K0	P5K5	P7K5
Typical Shaft Output [kW]	1.1	1.5	2.2	3	4	5.5	7.5
Enclosure IP20 (only)	A3	A3	А3	А3	A3	A3	A3
Output current High overload 160% for 1 min	•	•	•	•	•	•	•
Continuous	2.1	2.7	2.0	4.0	6.1		11
(3x525-550 V) [A]	2.1	2.7	3.9	4.9	6.1	9	11
Intermittent	2.7	4.3	6.3	7.0	0.0	14.4	17.6
(3x525-550 V) [A]	3.7	4.3	6.2	7.8	9.8	14.4	17.6
Continuous kVA	1.6	2.2	3.2	4.5	5.5	7.5	10
(3x551-690 V) [A]	1.0	2.2	3.2	4.5	5.5	7.5	10
Intermittent kVA							
(3x551-690 V) [A]	2.6	3.5	5.1	7.2	8.8	12	16
Continuous kVA	1.9	2.5	3.5	4.5	5.5	8.2	10
525 V AC	1.9	2.3	3.3	4.5	ر. د	0.2	10
Continuous kVA	1.9	2.6	3.8	5.4	6.6	9	12
690 V AC	1.9	2.0	3.0	3.4	0.0	9	12
Max. input current							
Continuous	1.9	2.4	3.5	4.4	5.5	8	10
(3x525-550 V) [A]	1.5	2.7	3.5	7.7	5.5	Ů	10
Intermittent	3.0	3.9	5.6	7.1	8.8	13	16
(3x525-550 V) [A]	3.0	3.7	3.0	7.1	0.0	13	10
Continuous kVA	1.4	2.0	2.9	4.0	4.9	6.7	9
(3x551-690 V) [A]	1.4	2.0	2.7	4.0	٦.۶	0.7	
Intermittent kVA	2.3	3.2	4.6	6.5	7.9	10.8	14.4
(3x551-690 V) [A]	2.3	J.Z	-1.0	0.5	7.5	10.0	
Additional specifications							
IP20 max. cable cross section ⁵⁾ (mains, motor,				0.2-4 (24-10)			
brake and load sharing) [mm² (AWG)]				0.2-4 (24-10)			
Estimated power loss	4.4	- 60	00	120	160	220	300
at rated max. load [W] 4)	44	60	88	120	160	220	300
Weight, enclosure IP20 [kg]	6.6	6.6	6.6	6.6	6.6	6.6	6.6
Efficiency ⁴⁾	0.96	0.96	0.96	0.96	0.96	0.96	0.96

Table 10.10 A3 Frame

Mains Supply 3x525-690 V AC IP21/IP55	- NEMA 1/NI	MA 12						
FC 302	P	11K	P1	5K	P18K		P22K	
High/ Normal Load ¹⁾	НО	NO	НО	NO	НО	NO	НО	NO
Typical Shaft output at 550 V [kW]	7.5	11	11	15	15	18.5	18.5	22
Typical Shaft output at 575 V [HP]	11	15	15	20	20	25	25	30
Typical Shaft output at 690 V [kW]	11	15	15	18.5	18.5	22	22	30
Enclosure IP21, 55	1	B2	В	2	E	32	Е	32
Output current	•							
Continuous (3x525-550 V) [A]	14	19	19	23	23	28	28	36
Intermittent (60 s overload) (3x525-550 V) [A]	22.4	20.9	30.4	25.3	36.8	30.8	44.8	39.6
Continuous (3x551-690 V) [A]	13	18	18	22	22	27	27	34
Intermittent (60 s overload) (3x551-690 V) [A]	20.8	19.8	28.8	24.2	35.2	29.7	43.2	37.4
Continuous KVA (at 550 V) [KVA]	13.3	18.1	18.1	21.9	21.9	26.7	26.7	34.3
Continuous KVA (at 575 V) [KVA]	12.9	17.9	17.9	21.9	21.9	26.9	26.9	33.9
Continuous KVA (at 690 V) [KVA]	15.5	21.5	21.5	26.3	26.3	32.3	32.3	40.6
Max. input current								
Continuous (3x525-690 V) [A]	15	19.5	19.5	24	24	29	29	36
Intermittent (60 s overload) (3x525-690 V) [A]	23.2	21.5	31.2	26.4	38.4	31.9	46.4	39.6
Additional specifications	•							
Max. cable cross section (mains, load share and brake) [mm² (AWG)]	35,-,- (2,-,-)							
Max. cable cross section (motor) [mm² (AWG)]	35, 25, 25 (2, 4, 4)							
Max cable size with mains disconnect [mm² (AWG)] ²⁾	16,10,10 (6,8, 8)							
Estimated power loss at rated max. load [W] ⁴⁾	2	228		285		35	3	75
Weight, enclosure IP21, IP55 [kg]				27				
Efficiency ⁴⁾	0	.98	0.9	98	0.	.98	0.	98

Table 10.11 B2 Frame



VLT Automation Drive Operating

Specifications	VLI AutomationDrive Operating Instructions

Mains Supply 3x525-690 V AC IP2	0/protected	d chassis								
FC 302	P.	11K	P1.	5K	P1	18K	P2	2K	P3	OK .
High/Normal Load*	НО	NO	НО	NO	НО	NO	НО	NO	НО	NO
Typical Shaft output at 550 V [kW]	7.5	11	11	15	15	18.5	18.5	22	22	30
Typical Shaft output at 575 V [HP]	11	15	15	20	20	25	25	30	30	40
Typical Shaft output at 690 V [kW]	11	15	15	20	20	25	25	30	30	40
Enclosure IP20	[33	В	3	E	34	В	34	Е	34
Output current 160% for 1 min (H	HO), 110% f	or 1 min (N	O)							
Continuous (3x525-550 V) [A]	14	19	19	23	23	28	28	36	36	43
Intermittent (60 s overload) (3x525-550 V) [A]	22.4	20.9	30.4	25.3	36.8	30.8	44.8	39.6	54	47.3
Continuous (3x551-690 V) [A]	13	18	18	22	22	27	27	34	34	41
Intermittent (60 s overload) (3x551-690 V) [A]	20.8	19.8	28.8	24.2	35.2	29.7	43.2	37.4	51	45.1
Continuous KVA (at 550 V) [KVA]	13.3	18.1	18.1	21.9	21.9	26.7	26.7	34.3	34.3	41.0
Continuous KVA (at 575 V) [KVA]	12.9	17.9	17.9	21.9	21.9	26.9	26.9	33.9	33.9	40.8
Continuous KVA (at 690 V) [KVA]	15.5	21.5	21.5	26.3	26.3	32.3	32.3	40.6	40.6	49.0
Max. input current	1	1								
Continuous (at 550 V) [A]	15	19.5	19.5	24	24	29	29	36	36.7	43.9
Continuous (at 575 V) [A]	24	21.5	31.2	26.4	38.4	31.9	46.4	39.6	52	46
Additional specifications		1		!				!		!
Max. cable cross section (mains and motor) [mm² (AWG)]	35 (1/0)									
Max. cable cross section (load share and brake) [mm² (AWG)]	16 (6)				(2)					
Estimated power loss at rated max. load [W] 4)	2	28	28	35	3	35	3	75	4	80
Weight, enclosure IP20 [kg]		12	1.	2	23.5		23.5		23.5	
Efficiency ⁴⁾	0	.98	0.9	98	0.	.98	0.	98	0.	98

Table 10.12 B3/B4 Frames

Mains Supply 3x525-690 V AC IP2	1/IP55 - NE	MA 1/NEMA	\ 12							
FC 302	P3	ок	P3	7K	P4	15K	P5	5K	P7	′5K
High/Normal Load*	НО	NO	НО	NO	НО	NO	НО	NO	НО	NO
Typical Shaft output at 550 V [kW]	22	30	30	37	37	45	45	55	55	75
Typical Shaft output at 575 V [HP]	30	40	40	50	50	60	60	75	75	100
Typical Shaft output at 690 V [kW]	30	37	37	45	45	55	55	75	75	90
Enclosure IP21, 55	(2	С	2	(2	C		C	2
Output current	•		•				•		•	
Continuous (3x525-550 V) [A]	36	43	43	54	54	65	65	87	87	105
Intermittent (60 s overload) (3x525-550 V) [A]	54	47.3	64.5	59.4	81	71.5	97.5	95.7	130.5	115.5
Continuous (3x551-690 V) [A]	34	41	41	52	52	62	62	83	83	100
Intermittent (60 s overload) (3x551-690 V) [A]	51	45.1	61.5	57.2	78	68.2	93	91.3	124.5	110
Continuous KVA (at 550 V) [KVA]	34.3	41.0	41.0	51.4	51.4	61.9	61.9	82.9	82.9	100.0
Continuous KVA (at 575 V) [KVA]	33.9	40.8	40.8	51.8	51.8	61.7	61.7	82.7	82.7	99.6
Continuous KVA (at 690 V) [KVA]	40.6	49.0	49.0	62.1	62.1	74.1	74.1	99.2	99.2	119.5
Max. input current										
Continuous (at 550 V) [A]	36	49	49	59	59	71	71	87	87	99
Continuous (at 575 V) [A]	54	53.9	72	64.9	87	78.1	105	95.7	129	108.9
Additional specifications										
Max. cable cross section (mains and motor) [mm² (AWG)]		150 (300 MCM)								
Max. cable cross section (load share and brake) [mm² (AWG)]	95 (3/0)									
Max cable size with mains disconnect [mm² (AWG)] 2)	95, 70, 70 (3/0, 2/0, 2/0) 185, 150, 120 (350 MCM, 300 MCM, 4/0) -					-				
Estimated power loss at rated max. load [W] 4)	4	480 592 720				88	80	12	200	
Weight, enclosure IP21, IP55 [kg]					65					
Efficiency ⁴⁾	0.	98	0.9	98	0.	98	0.	98	0.	98

VLT Automation Drive Operating

Instructions

Table 10.13 C2 Frame

For fuse ratings, see 10.3.1 Fuses

- 1) High overload = 160% torque during 60 s. Normal overload = 110% torque during 60 s.
- 2) American Wire Gauge.
- 3) Measured using 5 m screened motor cables at rated load and rated frequency.
- 4) The typical power loss is at nominal load conditions and expected to be within △/ ▼ 15% (tolerence relates to variety in voltage and cable conditions).

10

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

If the switching frequency is increased compared to the default setting, the power losses may rise significantly.

LCP and typical control card power consumptions are included. Further options and customer load may add up to 30 W to the losses. (Though typical only 4 W extra for a fully loaded control card, or options for slot A or slot B, each).

Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (▲/▼ 5%).

5) The three values for the max. cable cross section are for single core, flexible wire and flexible wire with sleeve, respectively.

Mains Supply 3x525-690 V AC IP20/prot	ected chassis								
FC 302	P:	37K	P4	5K	P:	55K	P75K		
High/ Normal Load ¹⁾	НО	NO	НО	NO	НО	NO	НО	NO	
Typical Shaft output at 550 V [kW]	30	37	37	45	45	55	55	75	
Typical Shaft output at 575 V [HP]	40	50	50	60	60	75	75	100	
Typical Shaft output at 690 V [kW]	37	45	45	55	55	75	75	90	
Enclosure IP21, 55	(C3	C	:3	(<u></u>	(4	
Output current 150% for 1 min (HO), 11	0% for 1 min	(NO)							
Continuous (3x525-550 V) [A]	43	54	54	65	65	87	87	105	
Intermittent (60 s overload) (3x525-550 V) [A]	64.5	59.4	81	71.5	97.5	95.5	130.5	115.5	
Continuous (3x551-690 V) [A]	41	52	52	62	62	83	83	100	
Intermittent (60 s overload) (3x551-690 V) [A]	61.5	57.2	78	68.2	93	91.3	124.5	110	
Continuous KVA (at 550 V) [KVA]	41	51.4	51.4	62	62	82.9	82.9	100	
Continuous KVA (at 575 V) [KVA]	40.8	51.8	51.8	61.8	61.8	82.7	82.7	99.6	
Continuous KVA (at 690 V) [KVA]	49	62.2	62.2	74.1	74.1	99.2	99.2	119.5	
Max. input current									
Continuous (3x525-690 V) [A]	43.9	55.1	55.1	66.3	66.3	88.8	88.8	1087.1	
Intermittent (60 s overload) (3x525-690 V) [A]	62.8	58.4	79.6	69.6	64.9	93.2	127	112.2	
Additional specifications		•	•	•		•		•	
Max. cable cross section (mains, load share and brake) [mm² (AWG)]	95 (4/0)								
Max. cable cross section (motor) [mm² (AWG)]		50 (1)				95 (4/0) 150 (300 mcm)			
Max cable size with mains disconnect [mm² (AWG)] ²⁾		50 (1)				95	(4/0)		
Estimated power loss at rated max. load [W] 4)	5	92	720		880		1200		
Weight, enclosure IP20 [kg]	:	35	3	35 5		50		50	
Efficiency ⁴⁾	0	.98	0.	98	0	.98	0.	98	

Table 10.14 C3/C4 Frames



10.2 General Technical Data

Mains supply	
Supply Terminals (6-Pulse)	L1, L2, L3
Supply Terminals (12-Pulse)	L1-1, L2-1, L3-1, L1-2, L2-2, L3-2
Supply voltage	200-240 V ±10%
Supply voltage	FC 301: 380-480 V/FC 302: 380-500 V ±10%
	FC 302: 525-600 V ±10%
Supply voltage	FC 302: 525-690 V ±10%

Mains voltage low / mains drop-out:

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

Supply frequency	50/60 Hz ±5%
Max. imbalance temporary between mains phases	3.0 % of rated supply voltage
True Power Factor (λ)	≥ 0.9 nominal at rated load
Displacement Power Factor (cos φ)	near unity (> 0.98)
Switching on input supply L1, L2, L3 (power-ups) ≤ 7.5 kW	maximum 2 times/min.
Switching on input supply L1, L2, L3 (power-ups) 11-75 kW	maximum 1 time/min.
Switching on input supply L1, L2, L3 (power-ups) ≥ 90 kW	maximum 1 time/2 min.
Environment according to EN60664-1	overvoltage category III/pollution degree 2

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

Motor	output	(U,	٧,	W)
-------	--------	-----	----	----

Output voltage	0-100% of supply voltage
Output frequency (0.25-75 kW)	FC 301: 0.2-1000 Hz/FC 302: 0-1000 Hz
Output frequency (90-1000kW)	0-800 ¹⁾ Hz
Output frequency in Flux Mode (FC 302 only)	0-300 Hz
Switching on output	Unlimited
Ramp times	0.01-3600 s.

¹⁾ Voltage and power dependent

Torque characteristics

Starting torque (Constant torque)	maximum 160% for 60 s ¹⁾
Starting torque	maximum 180% up to 0.5 s ¹⁾
Overload torque (Constant torque)	maximum 160% for 60 s ¹⁾
Starting torque (Variable torque)	maximum 110% for 60 s ¹⁾
Overload torque (Variable torque)	maximum 110% for 60 s

Torque rise time in VVC^{plus} (independent of fsw) 10 ms
Torque rise time in FLUX (for 5 kHz fsw) 1 ms

Digital inputs

Programmable digital inputs	FC 301: 4 (5) ¹⁾ /FC 302: 4 (6) ¹⁾
Terminal number	18, 19, 27 ¹⁾ , 29 ¹⁾ , 32, 33,
Logic	PNP or NPN
Voltage level	0 - 24 V DC
Voltage level, logic'0' PNP	< 5 V DC
Voltage level, logic'1' PNP	> 10 V DC
Voltage level, logic '0' NPN ²⁾	> 19 V DC
Voltage level, logic '1' NPN ²⁾	< 14 V DC
Maximum voltage on input	28 V DC

¹⁾ Percentage relates to the nominal torque.

 $^{^{2)}}$ The torque response time depends on application and load but as a general rule, the torque step from 0 to reference is 4-5 x torque rise time.



60 mA rms

400 nF

VLT Automation Drive Operating **Specifications** Instructions Pulse frequency range 0-110 kHz (Duty cycle) Min. pulse width 4.5 ms approx. 4 kΩ Input resistance, Ri Safe stop Terminal 37^{3, 4)} (Terminal 37 is fixed PNP logic) 0-24 V DC Voltage level Voltage level, logic'0' PNP <4 V DC >20 V DC Voltage level, logic'1' PNP 28 V DC Maximum voltage on input Typical input current at 24 V 50 mA rms

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

Typical input current at 20 V

Input capacitance

Analog inputs

Allalog lilputs	
Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switch S201 and switch S202
Voltage mode	Switch S201/switch S202 = OFF (U)
Voltage level	FC 301: 0 to +10/FC 302: -10 to +10V (scaleable)
Input resistance, R _i	approx. 10 kΩ
Max. voltage	± 20 V
Current mode	Switch S201/switch S202 = ON (I)
Current level	0/4 to 20 mA (scaleable)
Input resistance, R _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	FC 301: 20 Hz/FC 302: 100 Hz

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

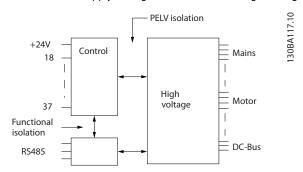


Illustration 10.1

DI	/ - - - -	
Puise/	'encoder	inputs

i disc/circodci iripats	
Programmable pulse/encoder inputs	2/1
Terminal number pulse/encoder	29 ¹⁾ , 33 ²⁾ / 32 ³⁾ , 33 ³⁾
Max. frequency at terminal 29, 32, 33	110 kHz (Push-pull driven)
Max. frequency at terminal 29, 32, 33	5 kHz (open collector)
Min. frequency at terminal 29, 32, 33	4 Hz

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

²⁾ Except safe stop input Terminal 37.

³⁾ See 2.4.5.8 Terminal 37 for further information about terminal 37 and Safe Stop.

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



VLT Automation Drive Operating
Instructions

Voltage level	see 10.2.1 Digital Inputs
Maximum voltage on input	28 V DC
Input resistance, R _i	approx. 4 kΩ
Pulse input accuracy (0.1-1 kHz)	Max. error: 0.1% of full scale
Encoder input accuracy (1-11 kHz)	Max. error: 0.05 % of full scale

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

Specifications

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.

Analog output

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

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

Control card, 24 V DC output

Terminal number	12, 13
Output voltage	24 V +1, -3 V
Max. load	FC 301: 130mA/FC 302: 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.

Control card, 10 V DC output

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

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

Control card, RS-485 serial communication

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

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

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.

¹⁾ FC 302 only

²⁾ Pulse inputs are 29 and 33

³⁾ Encoder inputs: 32 = A, and 33 = B



The USB ground connection is <u>not</u> galvanically isolated from protection earth. Use only an isolated laptop as PC connection to

the USB connector on the frequency converter.	
Relay outputs	

Specifications

nelay outputs	
Programmable relay outputs	FC 301all kW: 1/FC 302 all kW: 2
Relay 01 Terminal number	1-3 (break), 1-2 (make)
Max. terminal load (AC-1) ¹⁾ on 1-3 (NC), 1-2 (NO) (Resistive load)	240 V AC, 2A
Max. terminal load (AC-15) ¹⁾ (Inductive load @ cosφ 0.4)	240 V AC, 0.2A
Max. terminal load (DC-1) ¹⁾ on 1-2 (NO), 1-3 (NC) (Resistive load)	60 V DC, 1A
Max. terminal load (DC-13) ¹⁾ (Inductive load)	24 V DC, 0.1A
Relay 02 (FC 302 only) Terminal number	4-6 (break), 4-5 (make)
Max. terminal load (AC-1) ¹⁾ on 4-5 (NO) (Resistive load) ²⁾³⁾ Overvoltage cat. II	400 V AC, 2A
Max. terminal load (AC-15) ¹⁾ on 4-5 (NO) (Inductive load @ cosφ 0.4)	240 V AC, 0.2A
Max. terminal load (DC-1) ¹⁾ on 4-5 (NO) (Resistive load)	80 V DC, 2A
Max. terminal load (DC-13) ¹⁾ on 4-5 (NO) (Inductive load)	24 V DC, 0.1A
Max. terminal load (AC-1) ¹⁾ on 4-6 (NC) (Resistive load)	240 V AC, 2A
Max. terminal load (AC-15) ¹⁾ on 4-6 (NC) (Inductive load @ cosφ 0.4)	240 V AC, 0.2A
Max. terminal load (DC-1) ¹⁾ on 4-6 (NC) (Resistive load)	50 V DC, 2A
Max. terminal load (DC-13) ¹⁾ on 4-6 (NC) (Inductive load)	24 V DC, 0.1A
Min. terminal load on 1-3 (NC), 1-2 (NO), 4-6 (NC), 4-5 (NO)	24 V DC 10 mA, 24 V AC 20 mA
Environment according to EN 60664-1	overvoltage category III/pollution degree 2
0	

¹⁾ IEC 60947 part 4 and 5

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

Cable lengths and cross sections for control cables 1)

Max. motor cable length, screened	FC 301: 50 m/FC 301 (/	A1): 25 m/ FC 302: 150 m
Max. motor cable length, unscreened	FC 301: 75 m/FC 301 ((A1): 50 m/FC 302: 300 m
Maximum cross section to control terminals, flexible/ rigid wire without ca	ble end sleeves	1.5 mm ² /16 AWG
Maximum cross section to control terminals, flexible wire with cable end s	leeves	1 mm ² /18 AWG
Maximum cross section to control terminals, flexible wire with cable end s	leeves with collar	0.5 mm ² /20 AWG
Minimum cross section to control terminals		0.25 mm ² /24AWG

¹⁾For power cables, see 10.1 Power-dependent Specifications.

Control card performance

Scan interval	FC 301: 5 ms/FC 302: 1 ms
Control characteristics	
Resolution of output frequency at 0-1000 Hz	±0.003 Hz
Repeat accuracy of <i>Precise start/stop</i> (terminals 18, 19)	≤±0.1 ms
System response time (terminals 18, 19, 27, 29, 32, 33)	≤ 2 ms
Speed control range (open loop)	1:100 of synchronous speed
Speed control range (closed loop)	1:1000 of synchronous speed
Speed accuracy (open loop)	30-4000 rpm: error ±8 rpm
Speed accuracy (closed loop), depending on resolution of feedback device	0-6000 rpm: error ±0.15 rpm
Torque control accuracy (speed feedback)	max error ±5% of rated torque

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

Environment

Enclosure	IP20 ¹⁾ /Type 1, IP21 ²⁾ /Type 1, IP55/Type 12, IP66
Vibration test	1.0 g
Max. relative humidity	5% - 93% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H ₂ S test	class Kd
Ambient temperature ³⁾	Max. 50 °C (24-hour average maximum 45 °C)

¹⁾ Only for \leq 3.7 kW (200-240 V), \leq 7.5 kW (400-480/500V)

²⁾ Overvoltage Category II

³⁾ UL applications 300V AC2A

 $^{^{2)}}$ As enclosure kit for ≤ 3.7 kW (200-240 V), ≤ 7.5 kW (400-480/500V)





3) Derating for high ambient temperature, see spec	cial conditions in the Desian Guide
Minimum ambient temperature during full-scale	-
Minimum ambient temperature at reduced perfo	rmance - 10 °C
Temperature during storage/transport	-25 to +65/70 °C
Maximum altitude above sea level without derat	ing 1000 m
Derating for high altitude, see special conditions in	n the Design Guide
EMC standards, Emission	EN 61800-3, EN 61000-6-3/4, EN 55011
	EN 61800-3, EN 61000-6-1/2,
EMC standards, Immunity	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6

See section on special conditions in the Design Guide.

Specifications



10.3 Fuse Specifications

10.3.1 Fuses

It is recommended to use fuses and/ or circuit breakers on the supply side as protection in case of component breakdown inside the frequency converter (first fault).

NOTE

This is mandatory in order to ensure compliance with IEC 60364 for CE or NEC 2009 for UL.

AWARNING

Personnel and property must be protected against the consequence of component break-down internally in the frequency converter.

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 protected against short-circuit and over-current according to national/international regulations.

NOTE

The recommendations given do not cover Branch circuit protection for UL.

Short-circuit protection

Danfoss recommends using the fuses/Circuit Breakers mentioned below to protect service personnel and property in case of component break-down in the frequency converter.

10.3.2 Recommendations

AWARNING

In case of malfunction, not following the recommendation may result in personnel risk and damage to the frequency converter and other equipment.

The following tables list the recommended rated current. Recommended fuses are of the type gG for small to medium power sizes. For larger powers, aR fuses are recommended. For Circuit Breakers, Moeller types have been tested to have a recommendation. Other types of circuit breakers may be used provide they limit the energy into the frequency converter to a level equal to or lower than the Moeller types.

If fuses/Circuit Breakers according to recommendations are chosen, possible damages on the frequency converter will mainly be limited to damages inside the unit. For further information please see Application Note Fuses

and Circuit Breakers, MN90TXYY



10.3.3 CE Compliance

Fuses or Circuit Breakers are mandatory to comply with IEC 60364. Danfoss recommend using a selection of the following.

The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), 240 V, or 480 V, or 500 V, or 600 V depending on the frequency converter voltage rating. With the proper fusing the frequency converter short circuit current rating (SCCR) is 100,000 Arms.

Enclosure	FC 300 Power	Recommended	Recommended	Recommended circuit	Max trip level
		fuse size	Max. fuse	breaker	
Size	[kW]			Moeller	[A]
A1	0.25-1.5	gG-10	gG-25	PKZM0-16	16
A2	0.25-2.2	gG-10 (0.25-1.5)	gG-25	PKZM0-25	25
		gG-16 (2.2)			
А3	3.0-3.7	gG-16 (3)	gG-32	PKZM0-25	25
		gG-20 (3.7)			
В3	5.5	gG-25	gG-63	PKZM4-50	50
B4	7.5-15	gG-32 (7.5)	gG-125	NZMB1-A100	100
		gG-50 (11)			
		gG-63 (15)			
C3	18.5-22	gG-80 (18.5)	gG-150 (18.5)	NZMB2-A200	150
		aR-125 (22)	aR-160 (22)		
C4	30-37	aR-160 (30)	aR-200 (30)	NZMB2-A250	250
		aR-200 (37)	aR-250 (37)		
A4	0.25-2.2	gG-10 (0.25-1.5)	gG-32	PKZM0-25	25
		gG-16 (2.2)			
A5	0.25-3.7	gG-10 (0.25-1.5)	gG-32	PKZM0-25	25
		gG-16 (2.2-3)			
		gG-20 (3.7)			
B1	5.5-7.5	gG-25 (5.5)	gG-80	PKZM4-63	63
		gG-32 (7.5)			
B2	11	gG-50	gG-100	NZMB1-A100	100
C1	15-22	gG-63 (15)	gG-160 (15-18.5)	NZMB2-A200	160
		gG-80 (18.5)	aR-160 (22)		
		gG-100 (22)			
C2	30-37	aR-160 (30)	aR-200 (30)	NZMB2-A250	250
		aR-200 (37)	aR-250 (37)		

Table 10.15 200-240 V, Frame Sizes A, B, and C

Enclosure	FC 300 Power	Recommended	Recommended	Recommended circuit	Max trip level
		fuse size	Max. fuse	breaker	
Size	[kW]			Moeller	[A]
A1	0.37-1.5	gG-10	gG-25	PKZM0-16	16
A2	0.37-4.0	gG-10 (0.37-3)	gG-25	PKZM0-25	25
		gG-16 (4)			
А3	5.5-7.5	gG-16	gG-32	PKZM0-25	25
B3	11-15	gG-40	gG-63	PKZM4-50	50
B4	18.5-30	gG-50 (18.5)	gG-125	NZMB1-A100	100
		gG-63 (22)			
		gG-80 (30)			
C3	37-45	gG-100 (37)	gG-150 (37)	NZMB2-A200	150
		gG-160 (45)	gG-160 (45)		
C4	55-75	aR-200 (55)	aR-250	NZMB2-A250	250
		aR-250 (75)			
A4	0.37-4	gG-10 (0.37-3)	gG-32	PKZM0-25	25
		gG-16 (4)			
A5	0.37-7.5	gG-10 (0.37-3)	gG-32	PKZM0-25	25
		gG-16 (4-7.5)			
B1	11-15	gG-40	gG-80	PKZM4-63	63
B2	18.5-22	gG-50 (18.5)	gG-100	NZMB1-A100	100
		gG-63 (22)			
C1	30-45	gG-80 (30)	gG-160	NZMB2-A200	160
		gG-100 (37)			
		gG-160 (45)			
C2	55-75	aR-200 (55)	aR-250	NZMB2-A250	250
		aR-250 (75)			
		gG-300 (90)	gG-300 (90)		
		gG-350 (110)	gG-350 (110)		
D	90-200	gG-400 (132)	gG-400 (132)	-	-
		gG-500 (160)	gG-500 (160)		
		gG-630 (200)	gG-630 (200)		
_	250,400	aR-700 (250)	aR-700 (250)		
E	250-400	aR-900 (315-400)	aR-900 (315-400)	_	
		aR-1600 (450-500)	aR-1600 (450-500)		
F	450-800	aR-2000 (560-630)	aR-2000 (560-630)	-	-
		aR-2500 (710-800)	aR-2500 (710-800)		

Table 10.16 380-500 V, Frame Sizes A, B, C, D, E, and F

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Specifications

VLT Automation Drive Operating Instructions

Enclosure	FC 300 Power	Recommended	Recommended	Recommended circuit	Max trip level
		fuse size	Max. fuse	breaker	
Size	[kW]			Moeller	[A]
A2	0-75-4.0	gG-10	gG-25	PKZM0-25	25
А3	5.5-7.5	gG-10 (5.5)	gG-32	PKZM0-25	25
		gG-16 (7.5)			
B3	11-15	gG-25 (11)	gG-63	PKZM4-50	50
		gG-32 (15)			
B4	18.5-30	gG-40 (18.5)	gG-125	NZMB1-A100	100
		gG-50 (22)			
		gG-63 (30)			
C3	37-45	gG-63 (37)	gG-150	NZMB2-A200	150
		gG-100 (45)			
C4	55-75	aR-160 (55)	aR-250	NZMB2-A250	250
		aR-200 (75)			
A5	0.75-7.5	gG-10 (0.75-5.5)	gG-32	PKZM0-25	25
		gG-16 (7.5)			
B1	11-18	gG-25 (11)	gG-80	PKZM4-63	63
		gG-32 (15)			
		gG-40 (18.5)			
B2	22-30	gG-50 (22)	gG-100	NZMB1-A100	100
		gG-63 (30)			
C1	37-55	gG-63 (37)	gG-160 (37-45)	NZMB2-A200	160
		gG-100 (45)	aR-250 (55)		
		aR-160 (55)			
C2	75	aR-200 (75)	aR-250	NZMB2-A250	250

Table 10.17 525-600 V, Frame Sizes A, B, and C $\,$

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Enclosure	FC 300 Power	Recommended	Recommended	Recommended circuit	Max trip level
		fuse size	Max. fuse	breaker	
Size	[kW]			Moeller	[A]
А3	1.1	gG-6	gG-25	-	-
	1.5	gG-6	gG-25		
	2.2	gG-6	gG-25		
	3	gG-10	gG-25		
	4	gG-10	gG-25		
	5.5	gG-16	gG-25		
	7.5	gG-16	gG-25		
B2	11	gG-25 (11)	gG-63	-	-
	15	gG-32 (15)			
	18	gG-32 (18)			
	22	gG-40 (22)			
В3	11	gG-32	gG-63	-	-
	15	gG-32	gG-63		
B4	18.5	gG-40	gG-63	-	-
	22	gG-50	gG-63		
	30	gG-63	gG-80		
C2	30	gG-63 (30)	gG-80 (30)	-	-
	37	gG-63 (37)	gG-100 (37)		
	45	gG-80 (45)	gG-125 (45)		
	55	gG-100 (55)	gG-160 (55-75)		
	75	gG-125 (75)			
C3	37	gG-80	gG-100	-	-
	45	gG-100	gG-125		
C4	55	gG-125	gG-160	-	=
	75	gG-160	gG-200		
		gG-125 (37)	gG-125 (37)		
		gG-160 (45)	gG-160 (45)		
		gG-200 (55-75)	gG-200 (55-75)		
		aR-250 (90)	aR-250 (90)		
D	37-315	aR-315 (110)	aR-315 (110)	-	-
		aR-350 (132-160)	aR-350 (132-160)		
		aR-400 (200)	aR-400 (200)		
		aR-500 (250)	aR-500 (250)		
		aR-550 (315)	aR-550 (315)		
		aR-700 (355-400)	aR-700 (355-400)		
E	355-560	aR-900 (500-560)	aR-900 (500-560)	-	-
		aR-1600 (630-900)	aR-1600 (630-900)		
_		aR-2000 (1000)	aR-2000 (1000)		
F	630-1200	aR-2500 (1200)	aR-2500 (1200)	-	-
			(.200)		

Table 10.18 525-690 V, Frame Sizes A, B, C, D, E, and F



UL Compliance

Fuses or Circuit Breakers are mandatory to comply with NEC 2009. Danfoss recommends using a selection of the following

The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), 240 V, or 480 V, or

500 V, or 600 V depending on the frequency converter voltage rating. With the proper fusing the drive Short Circuit Current Rating (SCCR) is 100,000 Arms.

			Recommended max.	fuse		
FC 300 Power	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
[kW]	Type RK1 1)	Type J	Type T	Type CC	Type CC	Type CC
0.25-0.37	KTN-R-05	JKS-05	JJN-05	FNQ-R-5	KTK-R-5	LP-CC-5
0.55-1.1	KTN-R-10	JKS-10	JJN-10	FNQ-R-10	KTK-R-10	LP-CC-10
1.5	KTN-R-15	JKS-15	JJN-15	FNQ-R-15	KTK-R-15	LP-CC-15
2.2	KTN-R-20	JKS-20	JJN-20	FNQ-R-20	KTK-R-20	LP-CC-20
3.0	KTN-R-25	JKS-25	JJN-25	FNQ-R-25	KTK-R-25	LP-CC-25
3.7	KTN-R-30	JKS-30	JJN-30	FNQ-R-30	KTK-R-30	LP-CC-30
5.5	KTN-R-50	KS-50	JJN-50	-	-	-
7.5	KTN-R-60	JKS-60	JJN-60	-	-	-
11	KTN-R-80	JKS-80	JJN-80	-	-	-
15-18.5	KTN-R-125	JKS-125	JJN-125		-	-
22	KTN-R-150	JKS-150	JJN-150		-	-
30	KTN-R-200	JKS-200	JJN-200	-	-	-
37	KTN-R-250	JKS-250	JJN-250	-	-	-

Table 10.19 200-240 V, Frame Sizes A, B, and C

		Recommende	ed max. fuse	
FC 300 Power	SIBA	Littel fuse	Ferraz- Shawmut	Ferraz- Shawmut
[kW]	Type RK1	Type RK1	Type CC	Type RK1 ³⁾
0.25-0.37	5017906-005	KLN-R-05	ATM-R-05	A2K-05-R
0.55-1.1	5017906-010	KLN-R-10	ATM-R-10	A2K-10-R
1.5	5017906-016	KLN-R-15	ATM-R-15	A2K-15-R
2.2	5017906-020	KLN-R-20	ATM-R-20	A2K-20-R
3.0	5017906-025	KLN-R-25	ATM-R-25	A2K-25-R
3.7	5012406-032	KLN-R-30	ATM-R-30	A2K-30-R
5.5	5014006-050	KLN-R-50	-	A2K-50-R
7.5	5014006-063	KLN-R-60	-	A2K-60-R
11	5014006-080	KLN-R-80	-	A2K-80-R
15-18.5	2028220-125	KLN-R-125	-	A2K-125-R
22	2028220-150	KLN-R-150	-	A2K-150-R
30	2028220-200	KLN-R-200	-	A2K-200-R
37	2028220-250	KLN-R-250	-	A2K-250-R

Table 10.20 200-240 V, Frame Sizes A, B, and C



Specifications

		Recommended max. fuse		
FC 300 Power	Bussmann	Littel fuse	Ferraz- Shawmut	Ferraz- Shawmut
[kW]	Type JFHR2 ²⁾	JFHR2	JFHR2 ⁴⁾	J
0.25-0.37	FWX-5	-	-	HSJ-6
0.55-1.1	FWX-10	-	-	HSJ-10
1.5	FWX-15	-	-	HSJ-15
2.2	FWX-20	-	-	HSJ-20
3.0	FWX-25	-	-	HSJ-25
3.7	FWX-30	-	-	HSJ-30
5.5	FWX-50	-	-	HSJ-50
7.5	FWX-60	-	-	HSJ-60
11	FWX-80	-	-	HSJ-80
15-18.5	FWX-125	-	-	HSJ-125
22	FWX-150	L25S-150	A25X-150	HSJ-150
30	FWX-200	L25S-200	A25X-200	HSJ-200
37	FWX-250	L25S-250	A25X-250	HSJ-250

Table 10.21 200-240 V, Frame Sizes A, B, and C

- 1) KTS-fuses from Bussmann may substitute KTN for 240 V frequency converters.
- 2) FWH-fuses from Bussmann may substitute FWX for 240 V frequency converters.
- 3) A6KR fuses from FERRAZ SHAWMUT may substitute A2KR for 240 V frequency converters.
- 4) A50X fuses from FERRAZ SHAWMUT may substitute A25X for 240 V frequency converters.

			Recommended max.	fuse		
FC 300 Power	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
[kW]	Type RK1	Type J	Type T	Type CC	Type CC	Type CC
0.37-1.1	KTS-R-6	JKS-6	JJS-6	FNQ-R-6	KTK-R-6	LP-CC-6
1.5-2.2	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
3	KTS-R-15	JKS-15	JJS-15	FNQ-R-15	KTK-R-15	LP-CC-15
4	KTS-R-20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20
5.5	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25
7.5	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30
11	KTS-R-40	JKS-40	JJS-40	-	-	-
15	KTS-R-50	JKS-50	JJS-50	-	-	-
18	KTS-R-60	JKS-60	JJS-60	-	=	-
22	KTS-R-80	JKS-80	JJS-80	-	=	-
30	KTS-R-100	JKS-100	JJS-100	-	-	-
37	KTS-R-125	JKS-125	JJS-125	-	-	-
45	KTS-R-150	JKS-150	JJS-150	-	-	-
55	KTS-R-200	JKS-200	JJS-200	-	-	-
75	KTS-R-250	JKS-250	JJS-250	-	-	-

Table 10.22 380-500 V, Frame Sizes A, B, and C

Recommended max. fuse FC 302 Ferraz-Ferraz-SIBA Littel fuse Power Shawmut Shawmut [kW] Type RK1 Type RK1 Type CC Type RK1 0.37-1.1 5017906-006 KLS-R-6 ATM-R-6 A6K-6-R 1.5-2.2 5017906-010 KLS-R-10 ATM-R-10 A6K-10-R 3 5017906-016 KLS-R-15 ATM-R-15 A6K-15-R 4 5017906-020 KLS-R-20 ATM-R-20 A6K-20-R 5.5 5017906-025 KLS-R-25 ATM-R-25 A6K-25-R 7.5 5012406-032 KLS-R-30 ATM-R-30 A6K-30-R 11 5014006-040 KLS-R-40 A6K-40-R 15 5014006-050 KLS-R-50 A6K-50-R 18 5014006-063 KLS-R-60 A6K-60-R 22 2028220-100 KLS-R-80 A6K-80-R 2028220-125 KLS-R-100 -A6K-100-R 37 2028220-125 KLS-R-125 A6K-125-R 45 2028220-160 KLS-R-150 A6K-150-R 55 2028220-200 KLS-R-200 A6K-200-R 75 2028220-250 KLS-R-250 A6K-250-R

VLT Automation Drive Operating

Instructions

Table 10.23 380-500 V, Frame Sizes A, B, and C

		Recomm	ended max. fuse	
FC 302 Power	Bussmann	Ferraz- Shawmut	Ferraz- Shawmut	Littel fuse
[kW]	JFHR2	J	JFHR2 ¹⁾	JFHR2
0.37-1.1	FWH-6	HSJ-6	-	-
1.5-2.2	FWH-10	HSJ-10	-	-
3	FWH-15	HSJ-15	-	-
4	FWH-20	HSJ-20	-	-
5.5	FWH-25	HSJ-25	-	-
7.5	FWH-30	HSJ-30	-	-
11	FWH-40	HSJ-40	-	-
15	FWH-50	HSJ-50	-	-
18	FWH-60	HSJ-60	-	-
22	FWH-80	HSJ-80	-	-
30	FWH-100	HSJ-100	-	-
37	FWH-125	HSJ-125	-	-
45	FWH-150	HSJ-150	-	-
55	FWH-200	HSJ-200	A50-P-225	L50-S-225
75	FWH-250	HSJ-250	A50-P-250	L50-S-250

Table 10.24 380-500 V, Frame Sizes A, B, and C

1) Ferraz-Shawmut A50QS fuses may substitute for A50P fuses.



Specifications

			Recommended max.	fuse		
FC 302 Power	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
[kW]	Type RK1	Type J	Type T	Type CC	Type CC	Type CC
0.75-1.1	KTS-R-5	JKS-5	JJS-6	FNQ-R-5	KTK-R-5	LP-CC-5
1.5-2.2	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
3	KTS-R15	JKS-15	JJS-15	FNQ-R-15	KTK-R-15	LP-CC-15
4	KTS-R20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20
5.5	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25
7.5	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30
11	KTS-R-35	JKS-35	JJS-35	-	-	-
15	KTS-R-45	JKS-45	JJS-45	-	-	-
18	KTS-R-50	JKS-50	JJS-50	-	-	-
22	KTS-R-60	JKS-60	JJS-60	-	-	-
30	KTS-R-80	JKS-80	JJS-80	-	-	-
37	KTS-R-100	JKS-100	JJS-100	-	-	-
45	KTS-R-125	JKS-125	JJS-125	-	-	-
55	KTS-R-150	JKS-150	JJS-150	-	-	-
75	KTS-R-175	JKS-175	JJS-175	-	-	-

Table 10.25 525-600 V, Frame Sizes A, B, and C

		Recommended max. fuse		
FC 302	CIDA	I had for a	Ferraz-	Ferraz-
Power	SIBA	Littel fuse	Shawmut	Shawmut
[kW]	Type RK1	Type RK1	Type RK1	J
0.75-1.1	5017906-005	KLS-R-005	A6K-5-R	HSJ-6
1.5-2.2	5017906-010	KLS-R-010	A6K-10-R	HSJ-10
3	5017906-016	KLS-R-015	A6K-15-R	HSJ-15
4	5017906-020	KLS-R-020	A6K-20-R	HSJ-20
5.5	5017906-025	KLS-R-025	A6K-25-R	HSJ-25
7.5	5017906-030	KLS-R-030	A6K-30-R	HSJ-30
11	5014006-040	KLS-R-035	A6K-35-R	HSJ-35
15	5014006-050	KLS-R-045	A6K-45-R	HSJ-45
18	5014006-050	KLS-R-050	A6K-50-R	HSJ-50
22	5014006-063	KLS-R-060	A6K-60-R	HSJ-60
30	5014006-080	KLS-R-075	A6K-80-R	HSJ-80
37	5014006-100	KLS-R-100	A6K-100-R	HSJ-100
45	2028220-125	KLS-R-125	A6K-125-R	HSJ-125
55	2028220-150	KLS-R-150	A6K-150-R	HSJ-150
75	2028220-200	KLS-R-175	A6K-175-R	HSJ-175

Table 10.26 525-600 V, Frame Sizes A, B, and C

 $^{^{1)}}$ 170M fuses shown from Bussmann use the -/80 visual indicator. -TN/80 Type T, -/110 or TN/110 Type T indicator fuses of the same size and amperage may be substituted.



				Re	ecommended max.	fuse		
FC 302 [kW] Power	Max. prefuse	Bussmann E52273 RK1/JDDZ	Bussmann E4273 J/JDDZ	Bussmann E4273 T/JDDZ	SIBA E180276 RK1/JDDZ	LittelFuse E81895 RK1/JDDZ	Ferraz- Shawmut E163267/E2137 RK1/JDDZ	Ferraz- Shawmut E2137 J/HSJ
11	30 A	KTS-R-30	JKS-30	JKJS-30	5017906-030	KLS-R-030	A6K-30-R	HST-30
15-18.5	45 A	KTS-R-45	JKS-45	JJS-45	5014006-050	KLS-R-045	A6K-45-R	HST-45
22	60 A	KTS-R-60	JKS-60	JJS-60	5014006-063	KLS-R-060	A6K-60-R	HST-60
30	80 A	KTS-R-80	JKS-80	JJS-80	5014006-080	KLS-R-075	A6K-80-R	HST-80
37	90 A	KTS-R-90	JKS-90	JJS-90	5014006-100	KLS-R-090	A6K-90-R	HST-90
45	100 A	KTS-R-100	JKS-100	JJS-100	5014006-100	KLS-R-100	A6K-100-R	HST-100
55	125 A	KTS-R-125	JKS-125	JJS-125	2028220-125	KLS-150	A6K-125-R	HST-125
75	150 A	KTS-R-150	JKS-150	JJS-150	2028220-150	KLS-175	A6K-150-R	HST-150
* UL compli	ance only	525-600 V						

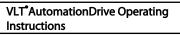
Table 10.27 525-690 V*, Frame Sizes B and C

10.4 Connection Tightening Torques

		Power (kV	N)			Torque	(Nm)			
Enclo- sure	200-240 V	380-480/500 V	525-600 V	525-690 V	Mains	Motor	DC connecti on	Brake	Earth	Relay
A2	0.25 - 2.2	0.37 - 4.0			1.8	1.8	1.8	1.8	3	0.6
A3	3.0 - 3.7	5.5 - 7.5	0.75 - 7.5	0.75 - 7.5	1.8	1.8	1.8	1.8	3	0.6
A4	0.25 - 2.2	0.37 - 4.0			1.8	1.8	1.8	1.8	3	0.6
A5	0.25 - 3.7	0.37 - 7.5	0.75 - 7.5		1.8	1.8	1.8	1.8	3	0.6
B1	5.5 - 7.5	11 - 15	11 - 15		1.8	1.8	1.5	1.5	3	0.6
B2	11	18	18	11	4.5	4.5	3.7	3.7	3	0.6
DZ	11	22	22	22	4.5	4.5	3.7	3.7	3	0.6
В3	5.5 - 7.5	11 - 15	11 - 15	11 - 15	1.8	1.8	1.8	1.8	3	0.6
B4	11 - 15	18 - 30	18 - 30	18 - 30	4.5	4.5	4.5	4.5	3	0.6
C1	15 - 22	30 - 45	30 - 45		10	10	10	10	3	0.6
C2	30 - 37	55 - 75	55 - 75	30 - 75	14/24 ¹⁾	14/24 ¹⁾	14	14	3	0.6
C3	18 - 22	37 - 45	37 - 45	37 - 45	10	10	10	10	3	0.6
C4	30 - 37	55 - 75	55 - 75	55 - 75	14/24 ¹⁾	14/24 ¹⁾	14	14	3	0.6

Table 10.28 Tightening of Terminals

¹⁾ For different cable dimensions x/y, where $x \le 95 \text{ mm}^2$ and $y \ge 95 \text{ mm}^2$.







Index	Control
	Cables
	Card
A	Card Performance
AC	Card, +10 V DC Output
Input	Card, RS-485 Serial Communication78
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