ENGINEERING TOMORROW

Quick Guide
VLT® AutomationDrive FC 360

vlt-drives.danfoss.com

Contents

1 Introduction

1.1 Purpose of the Manual

The quick guide provides information for safe installation and commissioning of the frequency converter.

The quick guide is intended for use by qualified personnel.

To use the frequency converter safely and professionally, read and follow the quick guide. Pay particular attention to the safety instructions and general warnings. Always keep this quick guide with the frequency converter.

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1.2 Additional Resources

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

- The *programming guide* provides greater detail on working with parameters.
- The *design guide* provides detailed information about the design and applications of the frequency converter.
- Optional equipment is available that may change some of the procedures described. Be sure to see the instructions supplied with those options for specific requirements.

Contact the local Danfoss supplier for technical documentation.

1.3 Document and Software Version

The quick guide is regularly reviewed and updated. All suggestions for improvement are welcome.

Edition	Remarks	Software version
MG06A8	Update due to new hardware and software release.	1.8x

1.4 Approvals and Certifications

CE

1.5 Disposal

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

1.6 Product Overview

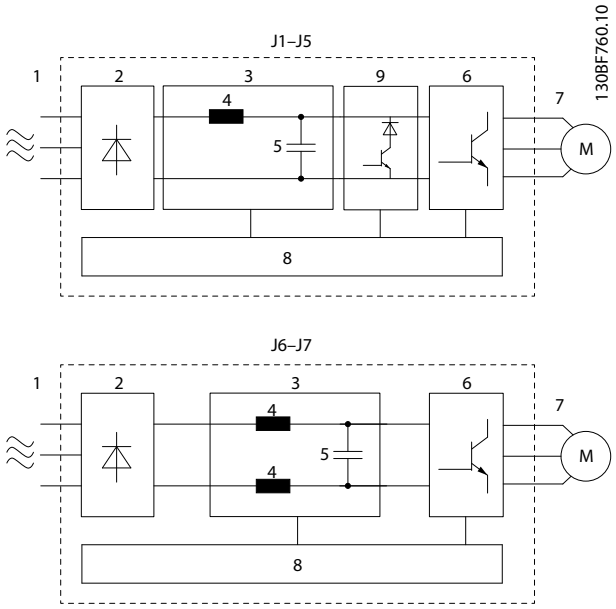
A frequency converter is an electronic motor controller that converts AC mains input into a variable AC waveform output. The frequency and voltage of the output are regulated to control the motor speed or torque. The frequency converter can vary the speed of the motor in response to system feedback,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

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

1

1.6.1 Block Diagram of the Frequency Converter

Illustration 1.1 is a block diagram of the internal components of the frequency converter.



Area	Component	Functions
1	Mains input	• AC mains 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 reactor	• Filters the intermediate DC circuit current. • Provides mains transient protection. • Reduces the root mean square (RMS) current. • Raises the power factor reflected back to the line. • Reduces 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 3-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.
9	Brake chopper	• Brake chopper is used in the DC intermediate circuit to control DC voltage when the load feeds energy back.

Illustration 1.1 Example of Block Diagram for a Frequency Converter

1

1.6.2 Enclosure Sizes and Power Ratings

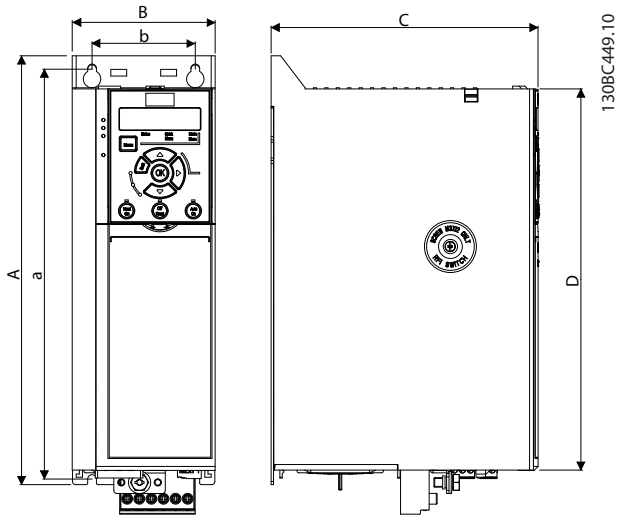
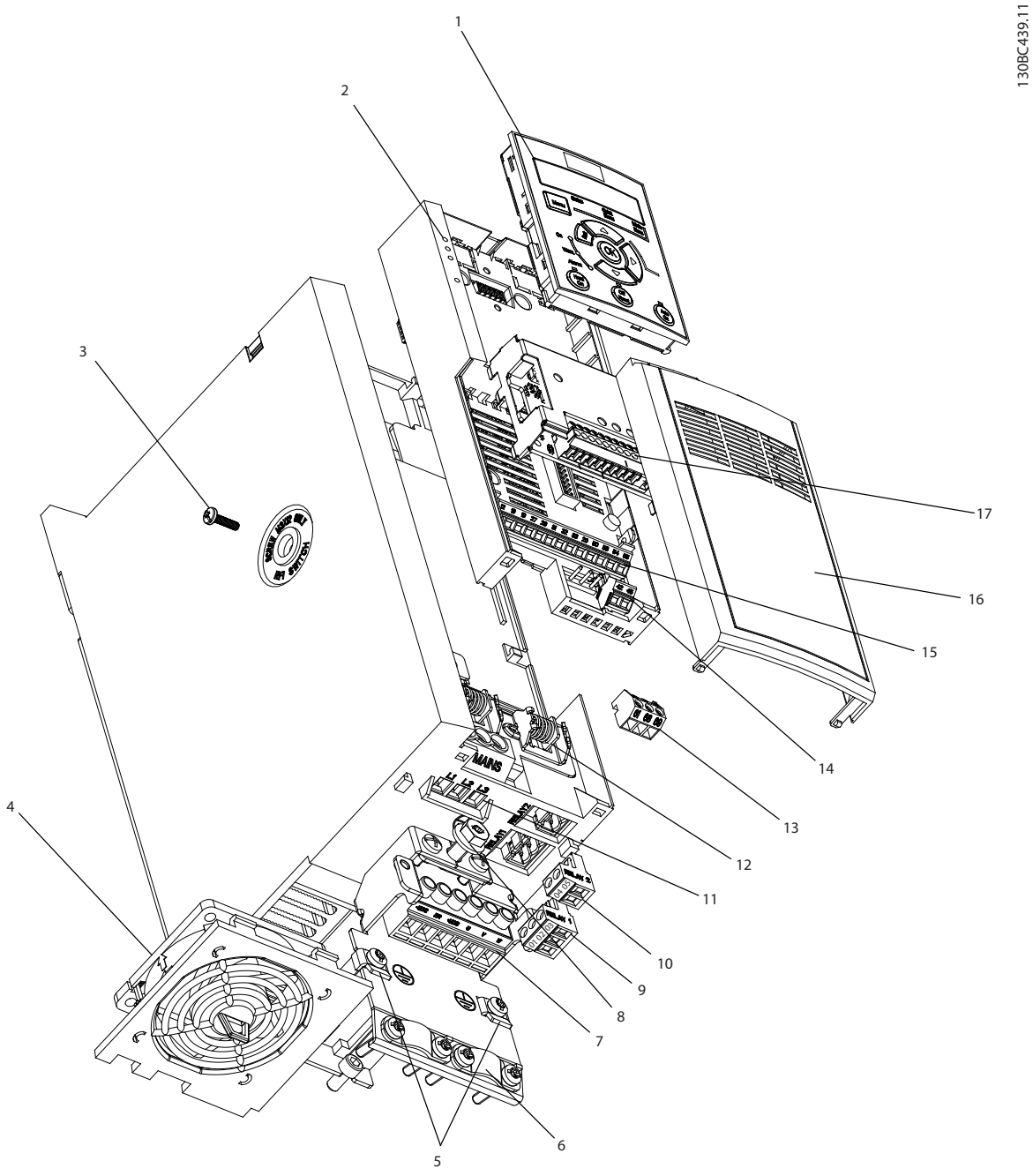
Enclosure size 380–480 V	J1	J2	J3	J4	J5	J6	J7
Power size [kW (hp)]	0.37–2.2 (0.5–3)	3.0–5.5 (4.0–7.5)	7.5 (10)	11–15 (15–20)	18.5–22 (25–30)	30–45 (40–60)	55–75 (75–100)
Dimensions [mm (in)]							
Height A	210 (8.3)	272.5 (10.7)	272.5 (10.7)	317.5 (12.5)	410 (16.1)	515 (20.3)	550 (21.7)
Width B	75 (3.0)	90 (3.5)	115 (4.5)	133 (5.2)	150 (5.9)	233 (9.2)	308 (12.1)
Depth C	168 (6.6)	168 (6.6)	168 (6.6)	245 (9.6)	245 (9.6)	241 (9.5)	323 (12.7)
Depth C with option B	173 (6.8)	173 (6.8)	173 (6.8)	250 (9.8)	250 (9.8)	241 (9.5)	323 (12.7)
D	180 (7.1)	240 (9.4)	240 (9.4)	270 (10.6)	364.7 (14.4)	452 (17.8)	484.5 (19.0)
Mounting holes							
a	198 (7.8)	260 (10.2)	260 (10.2)	297.5 (11.7)	390 (15.4)	495 (19.5)	521 (20.5)
b	60 (2.4)	70 (2.8)	90 (3.5)	105 (4.1)	120 (4.7)	200 (7.9)	270 (10.6)
Mounting screw	M4	M5	M5	M6	M6	M8	M8

Table 1.1 Enclosure Sizes, Power Ratings, and Dimensions

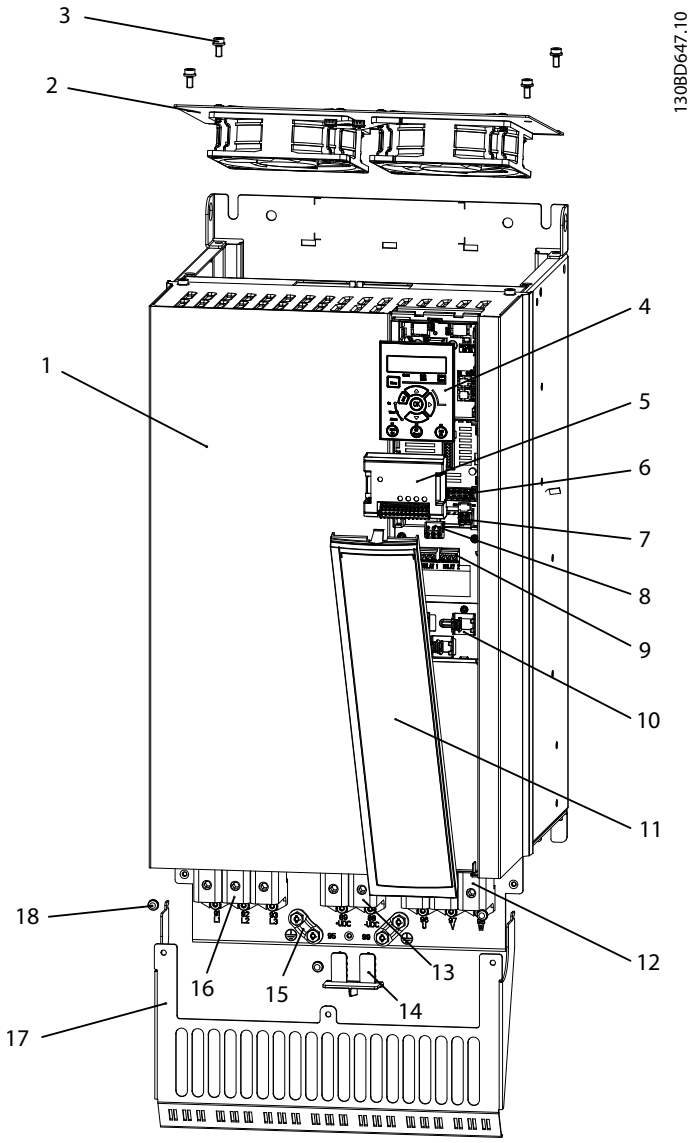
1

1.6.3 Exploded Views



1	NLCP (accessory)	10	2-pole relay 2 (0.37–7.5 kW/0.5–10 hp), pluggable 3-pole relay 2 (11–22 kW/15–30 hp), pluggable
2	Control cassette	11	Mains terminals
3	RFI switch (screw M3x12 only)	12	Cable strain relief (accessory for 0.37–2.2 kW units)
4	Removable fan assembly	13	Pluggable RS485 terminal
5	Grounding clamp (accessory)	14	Fixed I/O terminals
6	Shielded cable grounding clamp and strain relief (accessory)	15	Fixed I/O terminals
7	Motor terminals (U, V, W), and brake and load sharing terminals	16	Terminal cover
8	PE ground	17	B options (MCB 102/MCB 103 accessories)
9	3-pole relay 1		

Illustration 1.2 Exploded View, J1–J5 (0.37–22 kW/0.5–30 hp), IP20 (Taking J2 as an Example)



1	J7 frequency converter	10	I/O cable clamps
2	Removable fan assembly	11	Terminal cover
3	M5 screw X4 (for fan assembly)	12	Motor terminals
4	NLCP (accessory)	13	Load sharing terminals
5	B options (MCB 102/MCB 103 accessories)	14	Removable plugger (for load sharing terminal)
6	I/O terminals	15	Shielded cable grounding clamps
7	I/O terminals	16	Mains terminals
8	Pluggable RS485 terminals	17	Decoupling plate (accessory)
9	Relay terminal 1&2, fixed	18	M4 screw X3 (for decoupling plate)

Illustration 1.3 Exploded View, J6–J7 (30–75 kW/40–100 hp), IP20 (Taking J7 as an Example)

2 Safety

2

2.1 Safety Symbols

The following symbols are used in this document:

⚠WARNING

Indicates a potentially hazardous situation that could result in death or serious injury.

⚠CAUTION

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

NOTICE

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

2.2 Qualified Personnel

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

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

2.3 Safety Precautions

⚠WARNING

HIGH VOLTAGE

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

- **Only qualified personnel must perform installation, start-up, and maintenance.**
- **Before performing any service or repair work, use an appropriate voltage measuring device to make sure that there is no remaining voltage on the drive.**

⚠WARNING

UNINTENDED START

When the frequency converter is connected to AC mains, DC supply, or load sharing, the motor may start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. Start the motor with an external switch, a fieldbus command, an input reference signal from the local control panel (LCP), via remote operation using MCT 10 software, or after a cleared fault condition.

To prevent unintended motor start:

- **Disconnect the frequency converter from the mains.**
- **Press [Off/Reset] on the LCP before programming parameters.**
- **Ensure that the frequency converter is fully wired and assembled when it is connected to AC mains, DC supply, or load sharing.**

⚠WARNING

DISCHARGE TIME

The frequency converter contains DC-link capacitors, which can remain charged even when the frequency converter is not powered. High voltage can be present even when the warning LED indicator lights are off. Failure to wait the specified time after power has been removed before performing service or repair work can result in death or serious injury.

- **Stop the motor.**
- **Disconnect AC mains and remote DC-link power supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters.**
- **Disconnect or lock PM motor.**
- **Wait for the capacitors to discharge fully. The minimum waiting time is specified in *Table 2.1* and is also visible on the product label on top of the frequency converter.**
- **Before performing any service or repair work, use an appropriate voltage measuring device to make sure that the capacitors are fully discharged.**

Voltage [V]	Power range [kW (hp)]	Minimum waiting time (minutes)
380–480	0.37–7.5 kW (0.5–10 hp)	4
380–480	11–75 kW (15–100 hp)	15

Table 2.1 Discharge Time

⚠WARNING

LEAKAGE CURRENT HAZARD

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

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

⚠WARNING

EQUIPMENT HAZARD

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

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

NOTICE

HIGH ALTITUDES

For installation at altitudes above 2000 m (6562 ft), contact Danfoss regarding PELV.

⚠CAUTION

INTERNAL FAILURE HAZARD

An internal failure in the frequency converter can result in serious injury when the frequency converter is not properly closed.

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

NOTICE

USE ON ISOLATED MAINS

For details about the use of the frequency converter on isolated mains, refer to the section *RFI Switch* in the *design guide*.

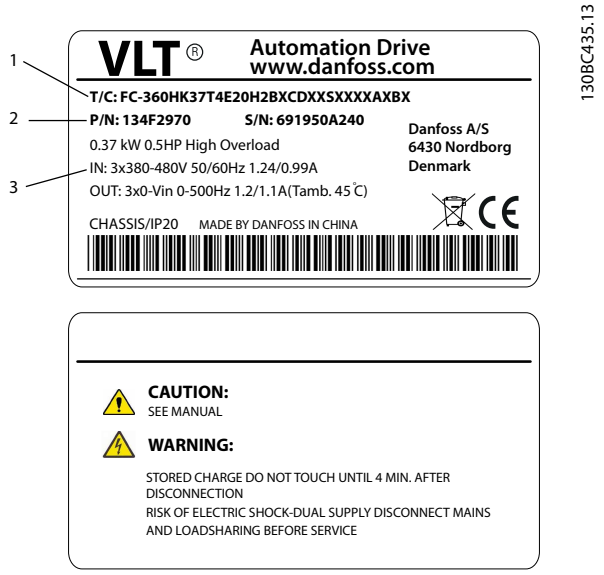
Follow the recommendations regarding the installation on IT mains. Use relevant monitoring devices for IT mains to avoid damage.

3 Mechanical Installation

3.1 Identification and Variants

3

Confirm that the equipment matches the requirements and ordering information by checking power size, voltage data, and overload data on the nameplate of the frequency converter.



1	Type code
2	Ordering number
3	Specifications

Illustration 3.1 Nameplates 1 and 2

1–6: Product Name	
7: Overload	H: Heavy duty Q: Normal duty[1)]
8–10: Power size	0.37–75 kW (0.5–100 hp). For example: K37: 0.37 kW[2)] (0.5 hp) 1K1: 1.1 kW (1.5 hp) 11 K: 11 kW (15 hp)
11–12: Voltage class	T4: 380–480 V 3 phases
13–15: IP class	E20: IP20
16–17: RFI	H1: C2 Class[3)] H2: C3 Class
18: Brake chopper	X: No B: Built-in[4)]
19: LCP	X: No
20: PCB coating	C: 3C3
21: Mains terminals	D: Load sharing
29–30: Embedded fieldbus	AX: No A0: PROFIBUS AL: PROFINET
31–32: Option B	BX: No option

Table 3.1 Type Code: Selection of Different Features and Options

For options and accessories, refer to the section Options and Accessories in the VLT® AutomationDrive FC 360 Design Guide.

1) Only 11–75 kW (15–100 hp) for normal duty variants. PROFIBUS and PROFINET are unavailable for normal duty.

2) For all power sizes, see chapter 8.1.1 Mains Supply 3x380–480 V AC.

3) H1 RFI filter is available for 0.37–22 kW (0.5–30 hp).

4) 0.37–22 kW (0.5–30 hp) with built-in brake chopper. 30–75 kW (40–100 hp) with external brake chopper only.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
F	C	-	3	6	0	H				T	4	E	2	0	H	1	X	X	C	D	X	X	S	X	X	X	X	A	X	B	X
						Q									H	2	B											A	0		
																												A	L		

130BC437.11

Illustration 3.2 Type Code String

3.2 Installation Environment

NOTICE

REDUCED LIFETIME

In environments with airborne liquids, particles, or corrosive gases, ensure that the IP/Type rating of the equipment matches the installation environment. Failure to meet requirements for ambient conditions can reduce lifetime of the frequency converter.

- **Ensure that requirements for air humidity, temperature, and altitude are met.**

Vibration and shock

The frequency converter complies with requirements for units mounted on the walls and floors of production premises, and in panels bolted to walls or floors.

For detailed ambient conditions specifications, refer to *chapter 8.2 General Technical Data*.

3.3 Mounting

Select the best possible operation site by considering:

- Ambient operating temperature.
- Installation method.
- Cooling.
- Position of the frequency converter.
- Cable routing.
- Power source supplying correct voltage and necessary current.
- Motor current rating within the maximum current from the frequency converter.
- Correct rating of external fuses and circuit breakers.

Cooling and mounting:

- Provide top and bottom clearance for air cooling, see *Table 3.2* for clearance requirements.
- Consider derating for temperatures starting from 45 °C (113 °F) and elevation 1000 m (3281 ft) above sea level. See the *design guide* for details on derating.

Enclosure size	J1–J5	J6 and J7
Clearance above and below the unit [mm (in)]	100 (3.94)	200 (7.87)

Table 3.2 Minimum Airflow Clearance Requirements

- Mount the unit vertically.
- IP20 units allow side-by-side installation.
- Improper mounting can result in overheating and reduced performance.
- Use the slotted mounting holes on the unit for wall mount, when provided.
- See *chapter 8.4 Connection Tightening Torques* for proper tightening specifications.

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3.3.1 Side-by-side Installation

All VLT® AutomationDrive FC 360 units can be installed side by side in vertical position. The units do not require extra ventilation on the side.

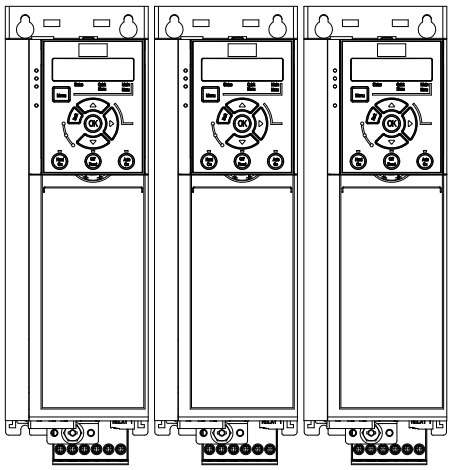


Illustration 3.3 Side-by-side Installation

3.3.2 Horizontal Mounting

Enclosure size J1–J5 of VLT® AutomationDrive FC 360 units can be installed in horizontal position.

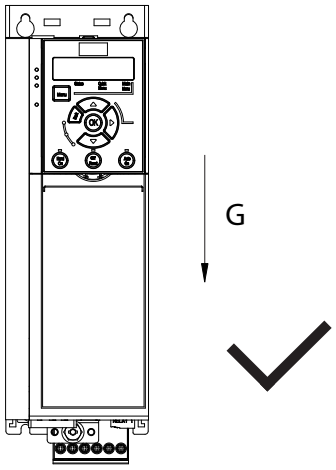


Illustration 3.4 Normal Mounting

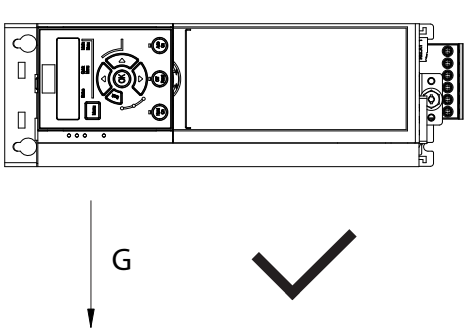


Illustration 3.5 Correct Horizontal Mounting (Left Side Downwards)

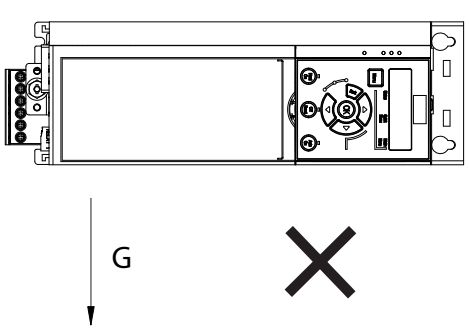


Illustration 3.6 Incorrect Horizontal Mounting (Right Side Downwards)

4 Electrical Installation

4.1 General Requirements

⚠WARNING

EQUIPMENT HAZARD

Rotating shafts and electrical equipment can be hazardous. It is important to protect against electrical hazards when applying power to the unit. All electrical work must conform to national and local electrical codes. Installation, start up, and maintenance must be performed only by trained and qualified personnel. Failure to follow these guidelines could result in death or serious injury.

⚠WARNING

WIRING ISOLATION

Run input power, motor wiring, and control wiring in 3 separate metallic conduits, or use separated shielded cables 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.

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

- Run output motor cables separately.
- Use shielded cables.
- Lock out all frequency converters simultaneously.

Wire type and ratings

- All wiring must comply with local and national regulations regarding cross-section and ambient temperature requirements.
- Danfoss recommends that all power connections are made with a minimum 75 °C (167 °F) rated copper wire.
- See *chapter 8 Specifications* for recommended wire sizes.

⚠WARNING

SHOCK HAZARD

The frequency converter can cause a DC current in the PE conductor and hence result in death or serious injury.

- **When a residual current-operated protective device (RCD) is used for protection against electrical shock, only an RCD of Type B is allowed on the supply side.**

Failure to follow the recommendation means that the RCD cannot provide the intended protection.

Overcurrent protection

- Extra protective equipment such as short-circuit protection or motor thermal protection between frequency converter and motor is required for applications with multiple motors.
- Input fusing is required to provide protection against short circuit and overcurrent. If fuses are not factory-supplied, the installer must provide them. See maximum fuse ratings in *chapter 8.3 Fuses*.

4.2 EMC-compliant Installation

To obtain an EMC-compliant installation, follow the instructions provided in *chapter 4.3 Grounding Requirements*, *chapter 4.4 Wiring Schematic*, *chapter 4.5 Mains, Motor, and Ground Connections*, and *chapter 4.6 Control Wiring*.

4.3 Grounding Requirements

⚠WARNING

GROUNDING HAZARD

For operator safety, a certified electrical installer should ground the frequency converter in accordance with national and local electrical codes and instructions contained within this manual. Ground currents are higher than 3.5 mA. Failure to ground the frequency converter properly could result in death or serious injury.

4

- Proper protective grounding for equipment with ground currents higher than 3.5 mA must be established.
- A dedicated ground wire is required for input power, motor power, and control wiring.
- Use the clamps provided with the equipment for proper ground connections.
- Do not ground 1 frequency converter to another in a daisy chain fashion (see *Illustration 4.1*).
- Keep the ground wire connections as short as possible.
- Use high-strand wire to reduce electrical noise.
- Follow motor manufacturer wiring requirements.

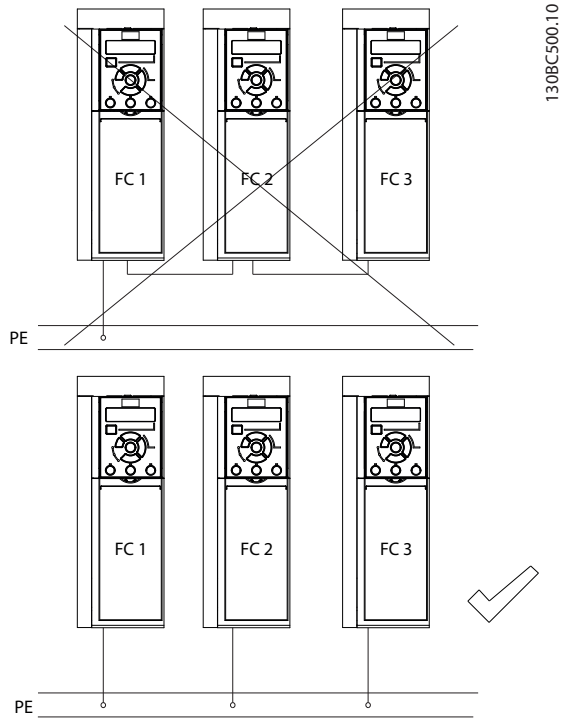


Illustration 4.1 Grounding Principle

4.4 Wiring Schematic

This section describes how to wire the frequency converter.

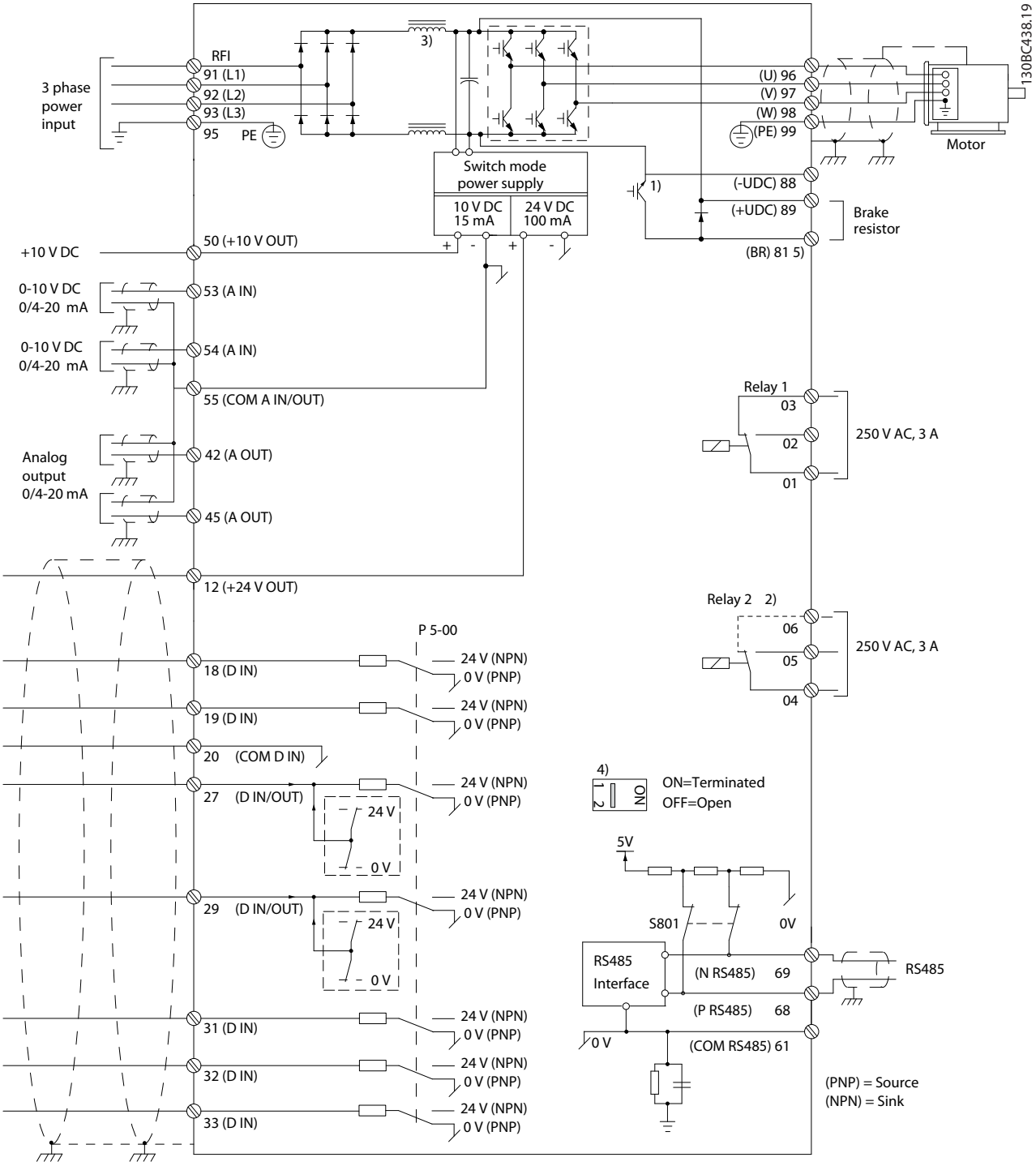


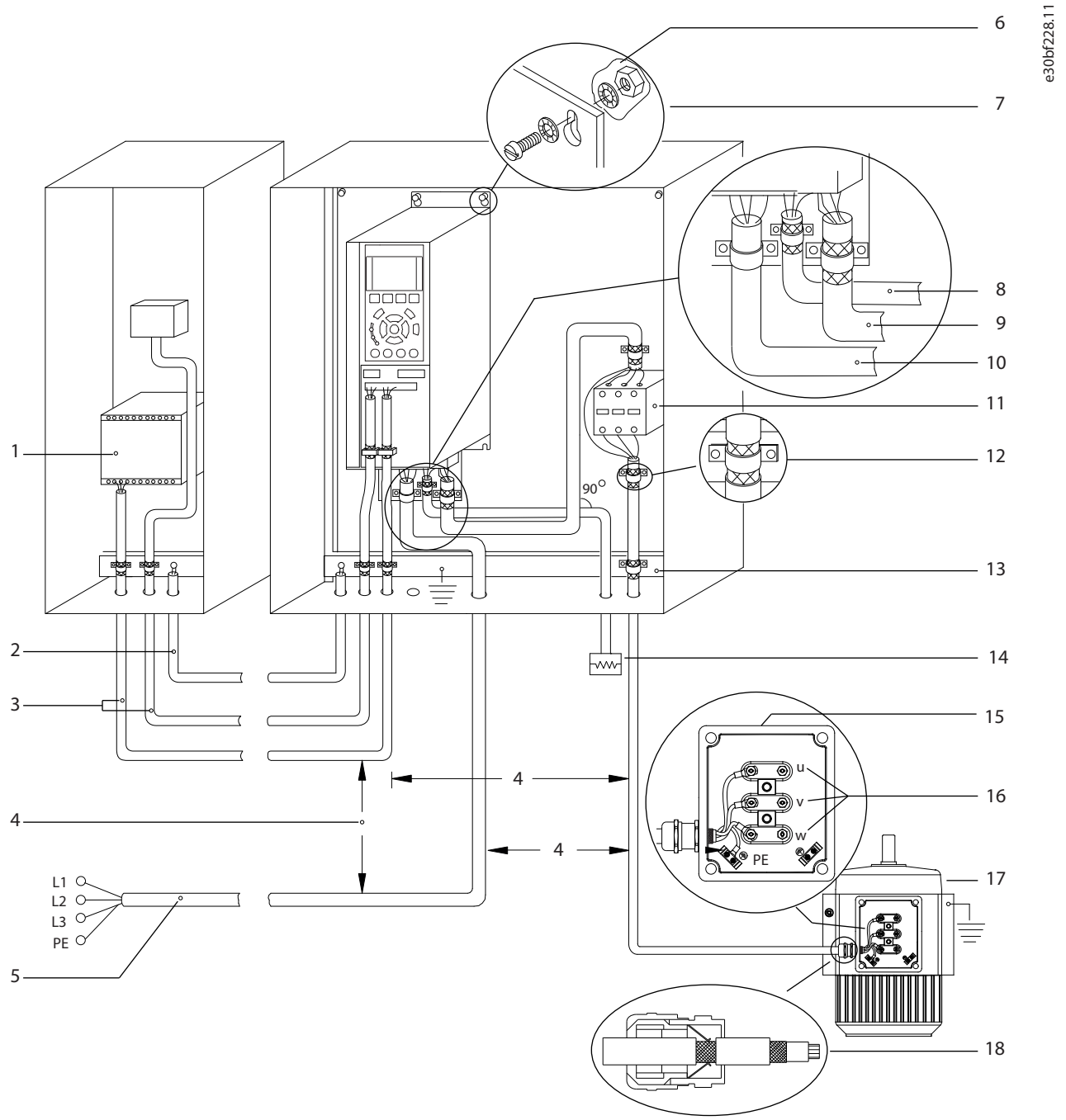
Illustration 4.2 Basic Wiring Schematic Drawing

A=Analog, D=Digital

1) Built-in brake chopper available from J1–J5.

2) Relay 2 is 2-pole for J1–J3 and 3-pole for J4–J7. Relay 2 of J4–J7 with terminals 4, 5, and 6 has same NO/NC logic as relay 1. Relays are pluggable in J1–J5 and fixed in J6–J7.

3) Single DC choke in J1–J5; dual DC choke in J6–J7.
4) Switch S801 (bus terminal) can be used to enable termination on the RS485 port (terminals 68 and 69).
5) No BR for J6–J7.



1	PLC	10	Mains cable (unshielded)
2	Minimum 16 mm^2 (6 AWG) equalizing cable	11	Output contactor, and more.
3	Control cables	12	Cable insulation stripped
4	Minimum 200 mm (7.87 in) between control cables, motor cables, and mains cables.	13	Common ground busbar. Follow local and national requirements for cabinet grounding.
5	Mains supply	14	Brake resistor
6	Bare (unpainted) surface	15	Metal box
7	Star washers	16	Connection to motor
8	Brake cable (shielded)	17	Motor
9	Motor cable (shielded)	18	EMC cable gland

Illustration 4.3 Typical Electrical Connection

4.5 Mains, Motor, and Ground Connections

⚠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 when the equipment is turned off and locked out. Failure to run output motor cables separately could result in death or serious injury.

4

Grounding clamps are provided for motor wiring (see *Illustration 4.4*).

- 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.
- Follow motor manufacturer wiring requirements.
- All frequency converters must be used with an isolated input source and 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 *parameter 14-50 RFI Filter* to OFF (enclosure sizes J6–J7) or remove the RFI screw (enclosure sizes J1–J5). When off, the internal RFI filter capacitors between the chassis and the intermediate circuit are isolated to avoid damage to the intermediate circuit and reduce ground capacity currents in accordance with IEC 61800-3.
- Do not install a switch between the frequency converter and the motor in IT mains.

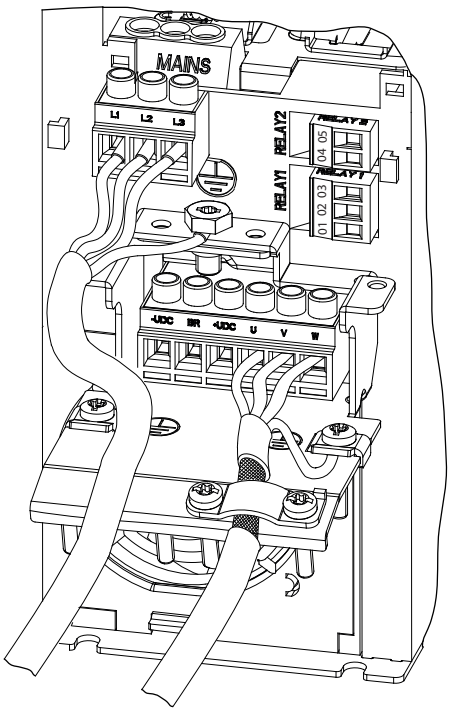


Illustration 4.4 Mains, Motor, and Ground Connections for Enclosure Sizes J1–J5 (Taking J2 as an Example)

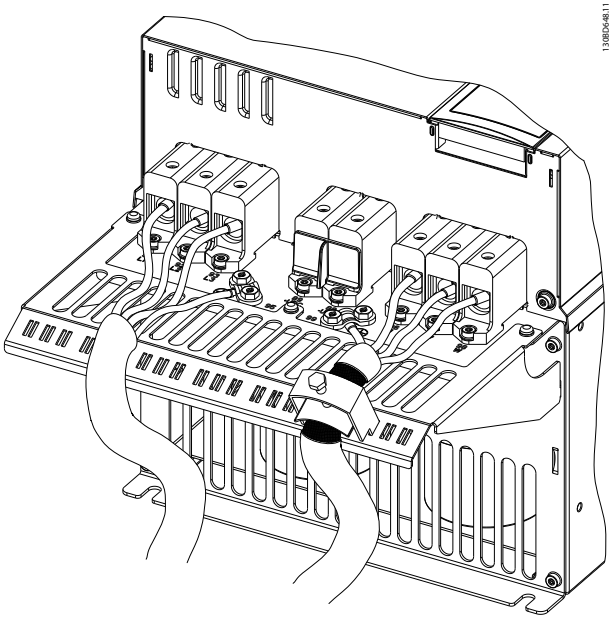


Illustration 4.5 Mains, Motor, and Ground Connections for Enclosure Sizes J6–J7 (Taking J7 as an Example)

Illustration 4.4 shows mains input, motor, and grounding for enclosure sizes J1–J5. *Illustration 4.5* shows mains input, motor, and grounding for enclosure sizes J6–J7. Actual configurations vary with unit types and optional equipment.

4.6 Control Wiring

Access

- Remove the cover plate with a screwdriver. See *Illustration 4.6*.

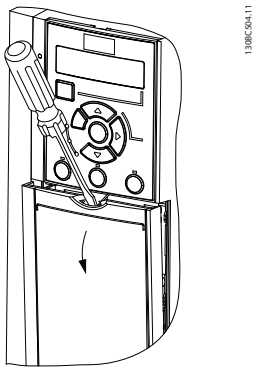


Illustration 4.6 Control Wiring Access for Enclosure Sizes J1–J7

Control terminal types

Illustration 4.7 shows the frequency converter control terminals. Terminal functions and default settings are summarized in *Table 4.1*.

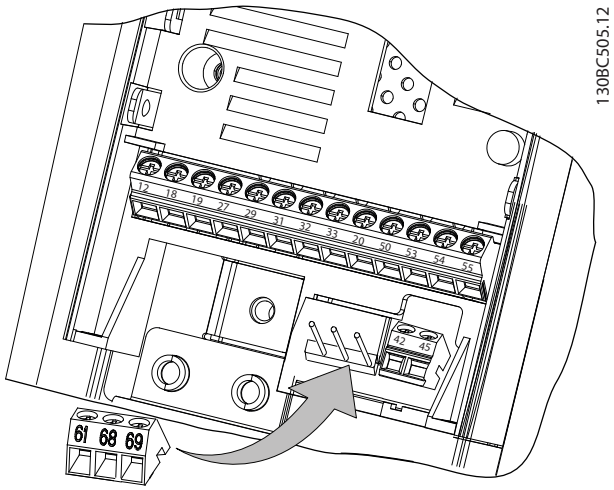


Illustration 4.7 Control Terminal Locations

See *chapter 8.2 General Technical Data* for terminal ratings details.

Terminal	Parameter	Default setting	Description
Digital I/O, pulse I/O, encoder			
12	–	+24 V DC	24 V DC supply voltage. Maximum output current is 100 mA for all 24 V loads.
18	*Parameter 5-10 Terminal 18 Digital Input*	*[8] Start*	Digital inputs.
19	*Parameter 5-11 Terminal 19 Digital Input*	*[10] Reversing*	
31	*Parameter 5-16 Terminal 31 Digital Input*	*[0] No operation*	Digital input.
32	*Parameter 5-14 Terminal 32 Digital Input*	*[0] No operation*	Digital input, 24 V encoder. Terminal 33 can be used for pulse input.
33	*Parameter 5-15 Terminal 33 Digital Input*	*[16] Preset ref bit 0*	
27	*Parameter 5-12 Terminal 27 Digital Input* *Parameter 5-30 Terminal 27 Digital Output*	DI *[2] Coast inverse* DO *[0] No operation*	Selectable for either digital input, digital output, or pulse output. Default setting is digital input. Terminal 29 can be used for pulse input.
29	*Parameter 5-13 Terminal 29 Digital Input* *Parameter 5-31 Terminal 29 Digital Output*	DI *[14] Jog* DO *[0] No operation*	
20	–	–	Common for digital inputs and 0 V potential for 24 V supply.
Analog inputs/outputs			
42	*Parameter 6-91 Terminal 42 Analog Output*	*[0] No operation*	Programmable analog output. The analog signal is 0–20 mA or 4–20 mA at a maximum of 500 Ω. Can also be configured as digital outputs.
45	*Parameter 6-71 Terminal 45 Analog Output*	*[0] No operation*	

4

Terminal	Parameter	Default setting	Description
50	–	+10 V DC	10 V DC analog supply voltage. 15 mA maximum commonly used for potentiometer or thermistor.
53	*Parameter group 6-1* Analog Input 53*	–	Analog input. Selectable for voltage or current.
54	*Parameter group 6-2* Analog Input 54*	–	
55	–	–	Common for analog input
Serial communication			
61	–	–	Integrated RC-filter for cable shield. ONLY for connecting the shield when experiencing EMC problems.
68 (+)	*Parameter group 8-3* FC Port Settings*	–	RS485 interface. A control card switch is provided for termination resistance.
69 (-)	*Parameter group 8-3* FC Port Settings*	–	
Relays			
01, 02, 03	5-40 [0]	*[9] Alarm*	Form C relay output. These relays are in various locations depending on the frequency converter configuration and size. Usable for AC or DC voltage and resistive or inductive loads. RO2 in J1–J3 enclosure is 2-pole, only terminals 04 and 05 are available
04, 05, 06	5–40 [1]	*[5] Running*	

Table 4.1 Terminal Descriptions

Control terminal functions

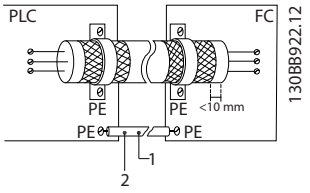
Frequency converter functions are commanded by receiving control input signals.

- Program each terminal for the function it supports in the parameters associated with that terminal.
- Confirm that the control terminal is programmed for the correct function. See *chapter 5 Commissioning* for details on accessing parameters and programming.
- The default terminal programming initiates frequency converter functioning in a typical operational mode.

Using shielded control cables

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

If the ground potential between the frequency converter and the PLC is different, electric noise could disturb the entire system. Solve this problem by fitting an equalizing cable as close as possible to the control cable. Minimum cable cross-section: 16 mm^2 (6 AWG).



1	Minimum 16 mm^2 (6 AWG)
2	Equalizing cable

Illustration 4.8 Shielding Clamps at Both Ends

50/60 Hz ground loops

With long control cables, ground loops could occur. To eliminate ground loops, connect 1 end of the shield to the ground with a 100 nF capacitor (keeping leads short).

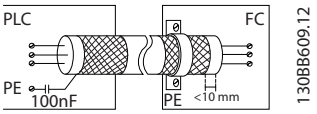
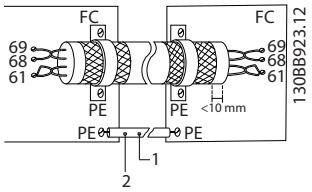


Illustration 4.9 Connection with a 100 nF Capacitor

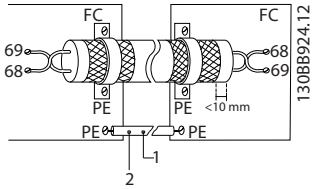
Avoid EMC noise on serial communication
This terminal is connected to ground via an internal RC link. Use twisted-pair cables to reduce interference between conductors. The recommended method is shown in *Illustration 4.10*.



1	Minimum 16 mm² (6 AWG)
2	Equalizing cable

Illustration 4.10 Twisted-pair Cables

Alternatively, the connection to terminal 61 can be omitted.



1	Minimum 16 mm² (6 AWG)
2	Equalizing cable

Illustration 4.11 Twisted-pair Cables without Terminal 61

4.7 Jumper Terminals 12 and 27

When the factory default programming values are used, connect a jumper wire between terminal 12 and terminal 27 for the frequency converter to operate.

- Digital input terminal 27 is designed to receive a 24 V DC coast command. In many applications, wire a coast device to terminal 27.
- When no interlock device is used, wire a jumper between control terminal 12 and terminal 27. This provides an internal 24 V signal on terminal 27.
- No signal present prevents the unit from operating.
- Only for GLCP: When the status line at the bottom of the LCP reads *AUTO REMOTE COAST*, it indicates that the unit is ready to operate but is missing an input signal on terminal 27.

4.8 Serial Communication

Connect RS485 serial communication wiring to terminals (+) 68 and (-) 69.

- Shielded serial communication cable is recommended.
- See *chapter 4.3.1 Grounding Requirements* for proper grounding.

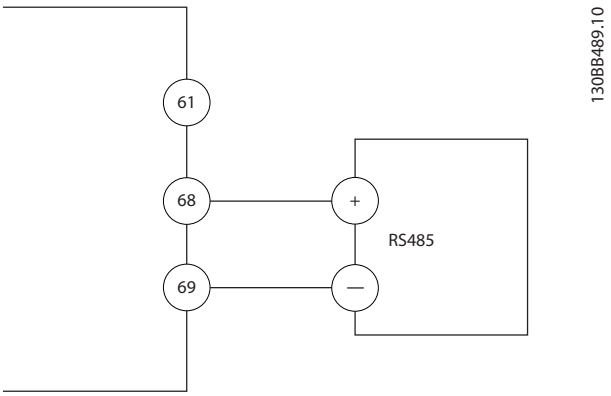


Illustration 4.12 Serial Communication Wiring Diagram

For basic serial communication set-up, select the following:

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

Two communication protocols are internal to the frequency converter.

- Danfoss FC.
- Modbus RTU.

Follow motor manufacturer wiring requirements.

Functions can be programmed remotely using the protocol software and RS485 connection, or in *parameter group 8-** Communications and Options*.

Selecting a specific communication protocol changes various default parameter settings to match the specifications of the protocol and makes extra protocol-specific parameters available.

5 Commissioning

5.1 Safety Instructions

See *chapter 2 Safety* for general safety instructions.

⚠WARNING

HIGH VOLTAGE

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

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

Before applying power:

1. Close the cover properly.
2. Check that all cable glands are firmly tightened.
3. Ensure that input power to the unit is off and locked out. Do not rely on the frequency converter disconnect switches for input power isolation.
4. Verify that there is no voltage on input terminals L1 (91), L2 (92), and L3 (93), phase-to-phase, and phase-to-ground.
5. Verify that there is no voltage on output terminals 96 (U), 97 (V), and 98 (W), phase-to-phase, and phase-to-ground.
6. Confirm continuity of the motor by measuring Ω values on U–V (96–97), V–W (97–98), and W–U (98–96).
7. Check for proper grounding of the frequency converter and the motor.
8. Inspect the frequency converter for loose connections on the terminals.
9. Confirm that the supply voltage matches the voltage of the frequency converter and the motor.

5.2 Applying Power

Apply power to the frequency converter using the following steps:

1. Confirm that the input voltage is balanced within 3%. If not, correct the input voltage imbalance before proceeding. Repeat this procedure after the voltage correction.
2. Ensure that any optional equipment wiring matches the installation application.
3. Ensure that all operator devices are in the OFF position. Panel doors must be closed and covers securely fastened.
4. Apply power to the unit. Do not start the frequency converter now. For units with a disconnect switch, turn it to the ON position to apply power to the frequency converter.

5.3 Hand On/Auto On Mode

After installation, there are 2 simple ways to start up the frequency converter:

- Hand-on mode.
- Auto-on mode.

At the first power-up, it is in auto-on mode.

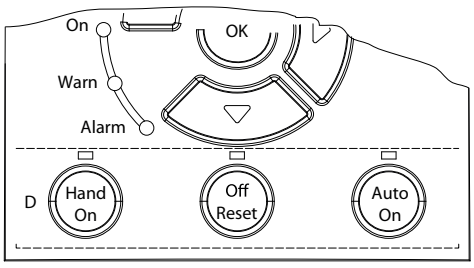


Illustration 5.1 Location of Hand On, Off/Reset, and Auto On Keys on the NLCP

- Press [Hand On] to provide a local start command to the frequency converter. Press [▲] and [▼] to increase and decrease speed.
- Press [Off/Reset] to stop the frequency converter.
- Press [Auto On] to control the frequency converter either via control terminals or bus communication.

⚠CAUTION

Since the frequency converter is in auto-on mode at the first power-up, the frequency converter may start the motor directly when the start command is valid via terminals or bus.

NOTICE

***Parameter 5-12 Terminal 27 Digital Input* has coast inverse as default setting. Connect terminals 12 and 27 to test Hand On/Auto On running.**

5.4 Local Control Panel (LCP) Operations

VLT® AutomationDrive FC 360 supports numerical local control panel (NLCP) LCP 21, graphic local control panel (GLCP) LCP 102, and blind cover. This chapter describes the operations with LCP 21 and LCP 102.

NOTICE

The frequency converter can also be programmed from the MCT-10 Set-up Software on PC via RS485 com-port. This software can be ordered using code number 130B1000 or downloaded from the Danfoss website: *drives.danfoss.com/downloads/pctools/#/*.

5.4.1 Numerical Local Control Panel

The numerical local control panel LCP 21 is divided into 4 functional sections.

A. Numeric display.

B. Menu key.

C. Navigation keys and indicator lights (LEDs).

D. Operation keys and indicator lights (LEDs).

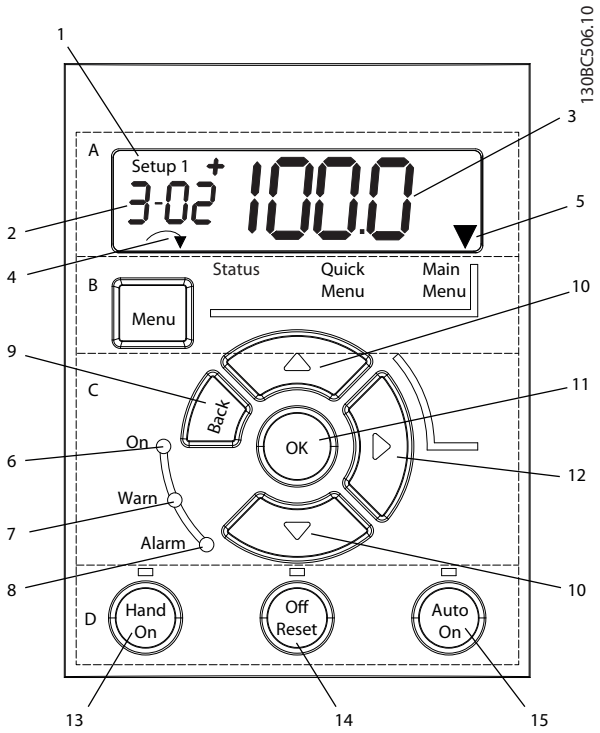


Illustration 5.2 View of the LCP 21

5

A. Numeric display

The LCD display is backlit with 1 numeric line. All data is shown in the LCP.

1	The set-up number shows the active set-up and the edit set-up. If the same set-up acts as both active and edit set-up, only that set-up number is shown (factory setting). When active and edit set-ups differ, both numbers are shown in the display (set-up 12). The number flashing indicates the edit set-up.
2	Parameter number.
3	Parameter value.
4	Motor direction is shown at the bottom left of the display. A small arrow indicates the direction.
5	The triangle indicates whether the LCP is in Status, Quick Menu, or Main Menu.

Table 5.1 Legend to *Illustration 5.2*, Section A

Illustration 5.3 Display Information

B. Menu key

To select between Status, Quick Menu, or Main Menu, press [Menu].

C. Indicator lights (LEDs) and navigation keys

	Indicator	Light	Function
6	On	Green	ON turns on when the frequency converter receives power from the mains voltage, a DC bus terminal, or a 24 V external supply.
7	Warn	Yellow	When warning conditions are met, the yellow WARN LED turns on, and text appears in the display area identifying the problem.
8	Alarm	Red	A fault condition causes the red alarm LED to flash and an alarm text is shown.

Table 5.2 Legend to *Illustration 5.2*, Indicator Lights (LEDs)

	Key	Function
9	[Back]	For moving to the previous step or layer in the navigation structure.
10	[▲] [▼]	For switching between parameter groups, parameters, and within parameters, or increasing/decreasing parameter values. Arrows can also be used for setting local reference.
11	[OK]	Press to access parameter groups or to enable a selection.
12	[►]	Press to move from left to right within the parameter value to change each digit individually.

Table 5.3 Legend to *Illustration 5.2*, Navigation Keys

D. Operation keys and indicator lights (LEDs)

	Key	Function
13	Hand On	Starts the frequency converter in local control. • An external stop signal by control input or serial communication overrides the local hand on.
14	Off/Reset	Stops the motor but does not remove power to the frequency converter, or resets the frequency converter manually after a fault has been cleared. If in alarm mode, the alarm is reset if the alarm condition is removed.
15	Auto On	Puts the system in remote operational mode. • Responds to an external start command by control terminals or bus communication.

Table 5.4 Legend to *Illustration 5.2*, Section D

⚠WARNING

HIGH VOLTAGE

Touching the frequency converter after pressing the [Off/Reset] key is still dangerous, because the key does not disconnect the frequency converter from the mains.

- Disconnect the frequency converter from the mains and wait for the frequency converter to fully discharge. See the discharge time in *Table 2.1*.

5.4.2 The Right-key Function on NLCP

Press [►] to edit any of the 4 digits on the display individually. When pressing [►] once, the cursor moves to the first digit and the digit starts flashing as shown in *Illustration 5.4*. Press the [▲] [▼] to change the value. Pressing [►] does not change the value of the digits or move the decimal point.

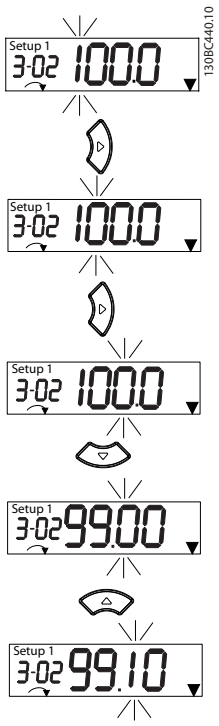


Illustration 5.4 Right-key Function

[►] can also be used for moving between parameter groups. When in *Main Menu*, press [►] to move to the first parameter in the next parameter group (for example, move from *parameter 0-03 Regional Settings [0] International* to *parameter 1-00 Configuration Mode [0] Open loop*).

5.4.3 Quick Menu on NLCP

The *Quick Menu* gives easy access to the most frequently used parameters.

1. To enter *Quick Menu*, press [Menu] until the indicator in the display is placed above *Quick Menu*.
2. Press [▲] [▼] to select either QM1 or QM2, then press [OK].
3. Press [▲] [▼] to browse through the parameters in *Quick Menu*.
4. Press [OK] to select a parameter.
5. Press [▲] [▼] to change the value of a parameter setting.
6. Press [OK] to accept the change.
7. To exit, press either [Back] twice (or 3 times if in QM2 and QM3) to enter *Status*, or press [Menu] once to enter *Main Menu*.

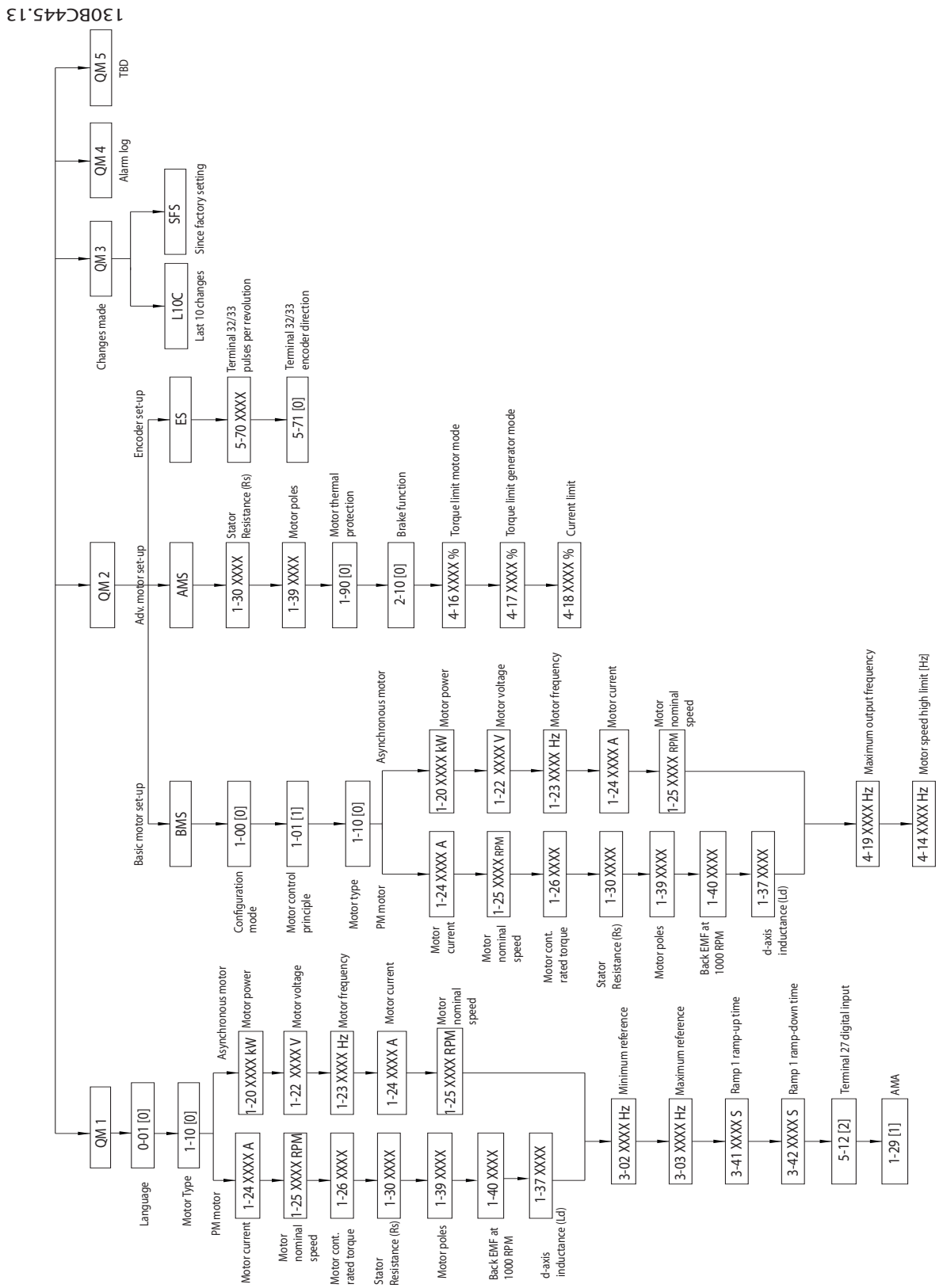


Illustration 5.5 Quick Menu Structure

5.4.4 Status Menu on NLCP

After power-up, Status Menu is active. Press [Menu] to toggle between *Status*, *Quick Menu*, and *Main Menu*.

[▲] and [▼] toggle between the options in each menu.

The display indicates the status mode with a small arrow above *Status*.

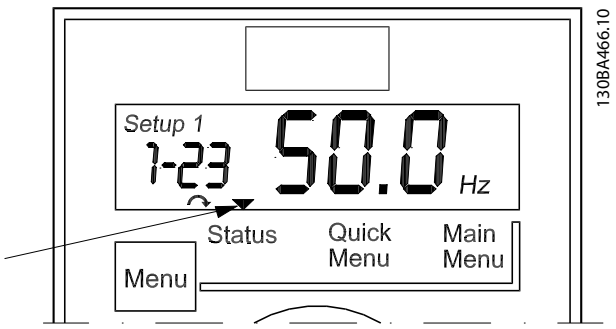


Illustration 5.6 Indicating Status Mode

The following 8 parameters can be accessed from the NLCP status menu in auto-on mode:

- *Parameter 16-02 Reference [%]*.
- *Parameter 16-09 Custom Readout*.
- *Parameter 16-10 Power [kW]*.
- *Parameter 16-13 Frequency*.
- *Parameter 16-14 Motor current*.
- *Parameter 16-16 Torque [Nm]*.
- *Parameter 16-30 DC Link Voltage*.
- *Parameter 16-52 Feedback[Unit]*.

The following 6 parameters can be accessed from the NLCP status menu in [Hand On] mode:

- *Parameter 16-09 Custom Readout*.
- *Parameter 16-10 Power [kW]*.
- *Parameter 16-13 Frequency*.
- *Parameter 16-14 Motor current*.
- *Parameter 16-16 Torque [Nm]*.
- *Parameter 16-30 DC Link Voltage*.

5.4.5 Main Menu on NLCP

The *Main Menu* gives access to all parameters.

1. To enter *Main Menu*, press [Menu] until the indicator in the display is placed above *Main Menu*.
2. [▲] [▼]: Browse through the parameter groups.
3. Press [OK] to select a parameter group.
4. [▲] [▼]: Browse through the parameters in the specific group.
5. Press [OK] to select the parameter.
6. [►] and [▲] [▼]: Set/change the parameter value.
7. Press [OK] to accept the value.
8. To exit, press either [Back] twice (or 3 times for array parameters) to enter *Main Menu*, or press [Menu] once to enter *Status*.

See *Illustration 5.7*, *Illustration 5.8*, and *Illustration 5.9* for the principles of changing the value of continuous, enumerated, and array parameters, respectively. The actions in the illustrations are described in *Table 5.5*, *Table 5.6*, and *Table 5.7*.

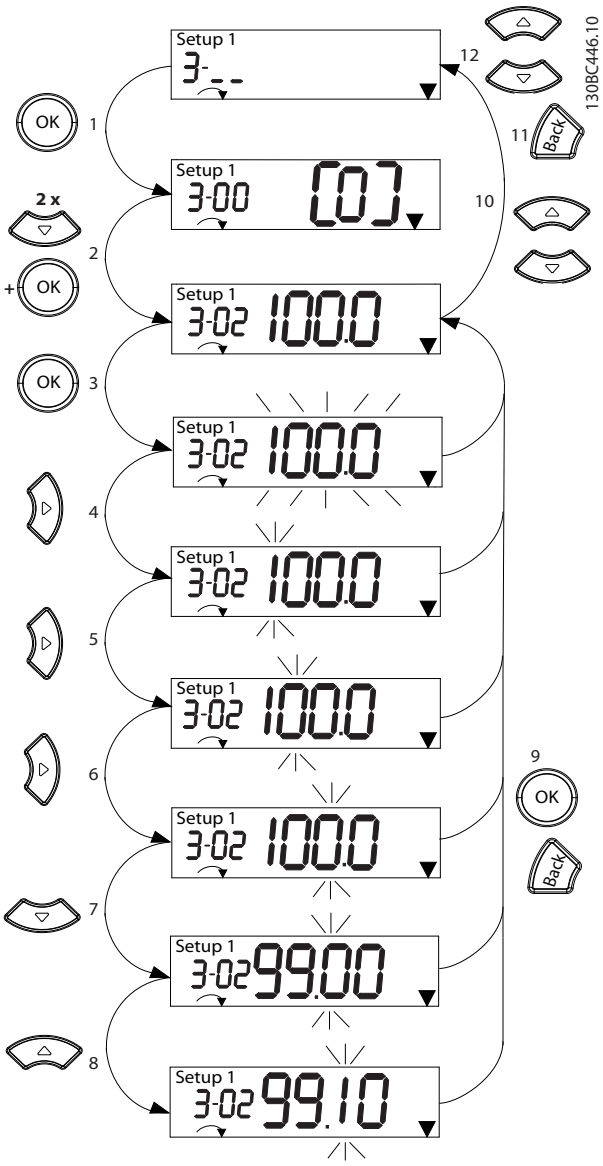


Illustration 5.7 Main Menu Interactions - Continuous Parameters

1	[OK]: The first parameter in the group is shown.
2	Press [▼] repeatedly to move down to the parameter.
3	Press [OK] to start editing.
4	[►]: First digit flashing (can be edited).
5	[►]: Second digit flashing (can be edited).
6	[►]: Third digit flashing (can be edited).
7	[▼]: Decreases the parameter value, the decimal point changes automatically.
8	[▲]: Increases the parameter value.
9	[Back]: Cancel changes, return to 2. [OK]: Accept changes, return to 2.
10	[▲][▼]: Select parameter within the group.
11	[Back]: Removes the value and shows the parameter group.
12	[▲][▼]: Select group.

Table 5.5 Changing Values in Continuous Parameters

For enumerated parameters, the interaction is similar, but the parameter value is shown in brackets because of the LCP 21 digits limitation (4 large digits), and the enum can be greater than 99. When the enum value is greater than 99, the LCP 21 can only show the first part of the bracket.

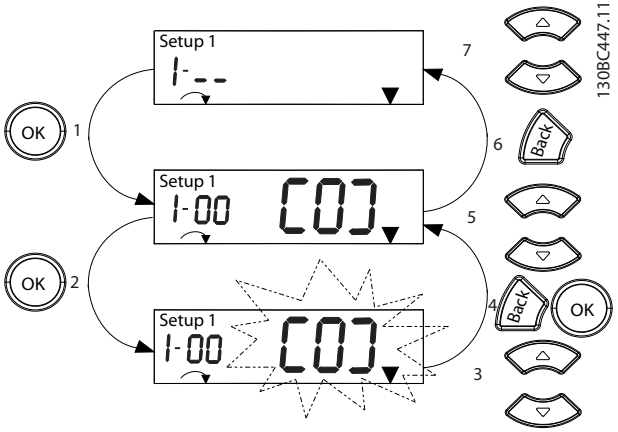
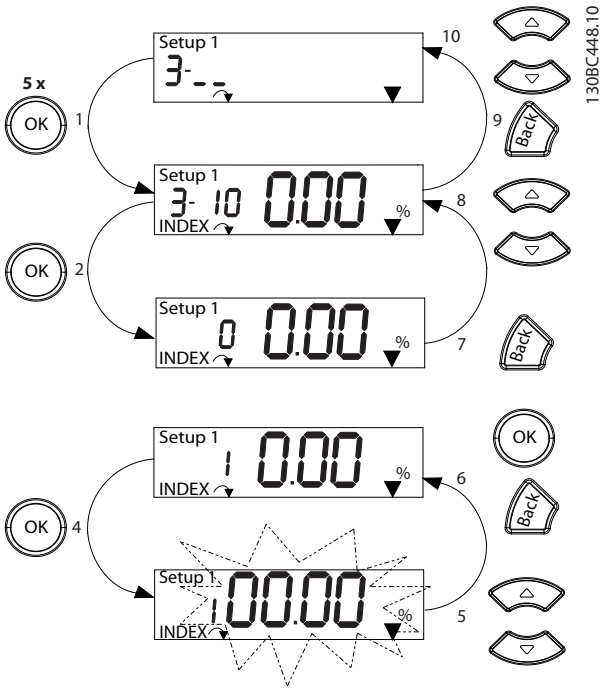


Illustration 5.8 Main Menu Interactions - Enumerated Parameters

1	[OK]: The first parameter in the group is shown.
2	Press [OK] to start editing.
3	[▲][▼]: Change parameter value (flashing).
4	Press [Back] to cancel changes or [OK] to accept changes (return to screen 2).
5	[▲][▼]: Select a parameter within the group.
6	[Back]: Removes the value and shows the parameter group.
7	[▲][▼]: Select a group.

Table 5.6 Changing Values in Enumerated Parameters

Array parameters function as follows:



1	[OK]: Shows parameter numbers and the value in the first index.
2	[OK]: Index can be selected.
3	[▲][▼]: Select index.
4	[OK]: Value can be edited.
5	[▲][▼]: Change parameter value (flashing).
6	[Back]: Cancels changes. [OK]: Accepts changes.
7	[Back]: Cancels editing index, a new parameter can be selected.
8	[▲][▼]: Select parameter within the group.
9	[Back]: Removes parameter index value and shows the parameter group.
10	[▲][▼]: Select group.

Table 5.7 Changing Values in Array Parameters

Illustration 5.9 Main Menu Interactions - Array Parameters

5.4.6 Graphical Local Control Panel

The graphical local control panel LCP 102 has a larger display area, which shows more information than LCP 21. LCP 102 supports English, Chinese, and Portuguese displays.

The GLCP is divided into 4 functional groups (see *Illustration 5.10*).

A. Display area.

B. Display menu keys.

C. Navigation keys and indicator lights (LEDs).

D. Operation keys and reset.

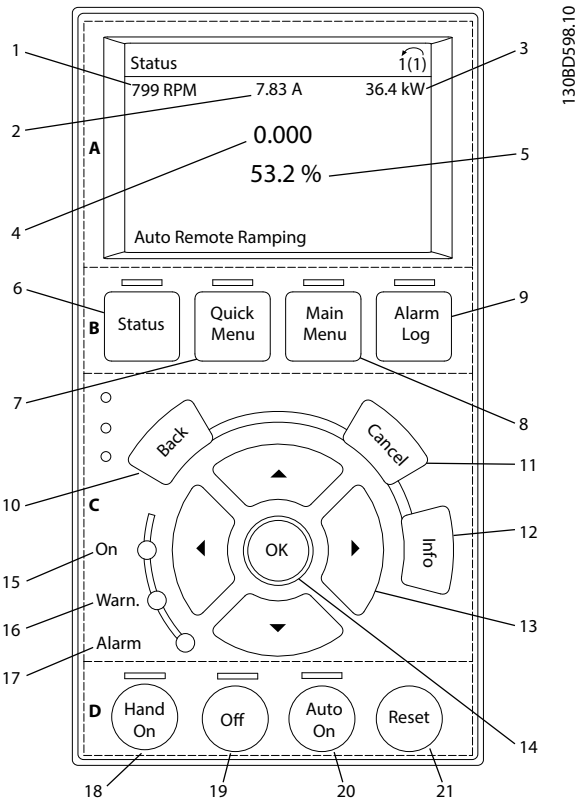


Illustration 5.10 Graphic Local Control Panel (GLCP)

5

A. Display area
The display area is activated when the frequency converter receives power from the mains voltage or a DC bus terminal.

The information shown on the LCP can be customized for user applications. Select options in the *Quick Menu Q3-13 Display Settings*.

Display	Parameter number	Default setting
1	0-20	*[1602] Reference [%]*
2	0-21	*[1614] Motor Current*
3	0-22	*[1610] Power [kW]*
4	0-23	*[1613] Frequency*
5	0-24	*[1502] kWh Counter*

Table 5.8 Legend to *Illustration 5.10*, Display Area

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

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

Table 5.9 Legend to *Illustration 5.10*, Display Menu Keys

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

	Key	Function
10	Back	Reverts to the previous step or list in the menu structure.
11	Cancel	Cancels the last change or command as long as the display mode has not changed.
12	Info	Press for a definition of the function being shown.
13	Navigation keys	To move between items in the menu, use the 4 navigation keys.
14	OK	Press to access parameter groups or to enable a selection.

Table 5.10 Legend to *Illustration 5.10*, Navigation Keys

	Indicator	Light	Function
15	On	Green	ON turns on when the frequency converter receives power from the mains voltage or a DC bus terminal.
16	Warn	Yellow	When warning conditions are met, the yellow WARN LED turns on, and text appears in the display area identifying the problem.
17	Alarm	Red	A fault condition causes the red alarm LED to flash, and an alarm text is shown.

Table 5.11 Legend to *Illustration 5.10*, Indicator Lights (LEDs)

D. Operation keys and reset
Operation keys are at the bottom of the LCP.

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

Table 5.12 Legend to *Illustration 5.10*, Operation Keys and Reset

NOTICE

To adjust the display contrast, press [Status] and the [▲]/[▼] keys.

5.4.7 Changing Parameter Settings with GLCP

Access and change parameter settings from the *Quick Menu* or from the *Main Menu*. The *Quick Menu* only gives access to a limited number of parameters.

1. Press [Quick Menu] or [Main Menu] on the LCP.
2. Press [▲] [▼] to browse through the parameter groups, press [OK] to select a parameter group.
3. Press [▲] [▼] to browse through the parameters, press [OK] to select a parameter.
4. Press [▲] [▼] to change the value of a parameter setting.
5. Press [◄] [►] to shift digit when a decimal parameter is in the editing state.
6. Press [OK] to accept the change.
7. Press either [Back] twice to enter Status, or press [Main Menu] once to enter the Main Menu.

View changes
Quick Menu Q5 - Changes Made lists all parameters changed from default settings.

- The list only shows parameters which have been changed in the current edit set-up.
- Parameters which have been reset to default values are not listed.
- The message *Empty* indicates that no parameters have been changed.

5.4.8 Mounting the GLCP

Use the GLCP adapter (ordering number: 132B0281) and a cable to connect the LCP 102 to the frequency converter, as shown in *Illustration 5.11*.

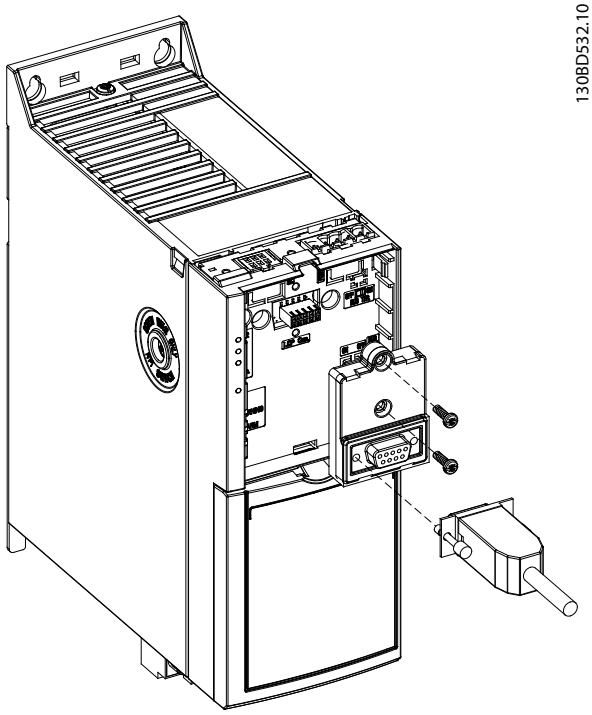


Illustration 5.11 GLCP Adapter and Connecting Cable

5

5.4.9 Backing Up/Downloading Parameters with LCP

Establishing the correct programming for applications often requires setting functions in several related parameters. Parameter details are provided in *chapter 9.2 Parameter Menu Structure*.

Programming data is stored internally in the frequency converter.

- For back-up, upload data into the LCP memory.
- To download data to another frequency converter, connect the LCP to that unit and download the stored settings.
- Restoring factory default settings does not change data stored in the LCP memory.

Back-up/download process

1. Press [Off] on the GLCP or [Off Reset] on the NLCP to stop the motor before uploading or downloading data.
2. Press [Main Menu] *parameter 0-50 LCP Copy* and press [OK].
3. Select *[1] All to LCP* to upload data to the LCP, or select *[2] All from LCP* to download data from the LCP, or select *[3] Size indep. from LCP* to download motor size independent parameters from LCP.
4. Press [OK]. A progress bar shows the uploading or downloading progress.
5. Press [Hand On] or [Auto On] to return to normal operation.

5.4.10 Restoring Default Settings with LCP

NOTICE

Risk of losing programming, motor data, localization, and monitoring records by restoration of default settings. To provide a back-up, upload data to the LCP before initialization.

Restoring the default parameter settings is done by initialization of the frequency converter. Initialization is carried out through *parameter 14-22 Operation Mode* (recommended) or manually. Initialization does not reset the settings for *parameter 1-06 Clockwise Direction* and *parameter 0-03 Regional Settings*.

- Initialization using *parameter 14-22 Operation Mode* does not reset frequency converter settings, such as operating hours, serial communication selections, fault log, alarm log, and other monitoring functions.
- Manual initialization erases all motor, programming, localization, and monitoring data, and restores factory default settings.

Recommended initialization procedure, via *parameter 14-22 Operation Mode*

1. Select *parameter 14-22 Operation Mode* and press [OK].
2. Select *[2] Initialisation* and press [OK].
3. Remove power to the unit and wait until the display turns off.
4. Apply power to the unit.

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

5. *Alarm 80, Drive initialized to default value* is shown.
6. Press [Reset] to return to operating mode.

Manual initialization procedure

1. Remove power to the unit and wait until the display turns off.
2. Press and hold [Status], [Main Menu], and [OK] at the same time on the GLCP, or press [Menu] and [OK] at the same time on the NLCP while applying power to the unit (approximately 5 s or until a click is heard and the fan starts).

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

Manual initialization does not reset the following frequency converter information:

- *Parameter 0-03 Regional Settings*
- *Parameter 1-06 Clockwise Direction*
- *Parameter 15-00 Operating hours*
- *Parameter 15-03 Power Up's*
- *Parameter 15-04 Over Temp's*
- *Parameter 15-05 Over Volt's*
- *Parameter 15-30 Alarm Log: Error Code*

5.5 Basic Programming

5.5.1 Asynchronous Motor Set-up

Enter the following motor data in the listed order. Find the information on the motor nameplate.

1. *Parameter 1-20 Motor Power*.
2. *Parameter 1-22 Motor Voltage*.
3. *Parameter 1-23 Motor Frequency*.
4. *Parameter 1-24 Motor Current*.
5. *Parameter 1-25 Motor Nominal Speed*.

For optimum performance in VVC+ mode, extra motor data is required to set up the following parameters.

6. *Parameter 1-30 Stator Resistance (Rs)*.
7. *Parameter 1-31 Rotor Resistance (Rr)*.
8. *Parameter 1-33 Stator Leakage Reactance (X1)*.
9. *Parameter 1-35 Main Reactance (Xh)*.

The data is found in the motor datasheet (this data is typically not available on the motor nameplate). Run a complete AMA using *parameter 1-29 Automatic Motor Adaption (AMA) [1] Enable Complete AMA* or enter the parameters manually.

Application-specific adjustment when running VVC+

VVC+ is the most robust control mode. In most situations, it provides optimum performance without further adjustments. Run a complete AMA for best performance.

5.5.2 PM Motor Set-up in VVC+

Initial programming steps

1. Set *parameter 1-10 Motor Construction* to the following options to activate PM motor operation:
   - 1a *[1] PM, non salient SPM*
   - 1b *[3] PM, salient IPM*
2. Select *[0] Open Loop* in *parameter 1-00 Configuration Mode*.

NOTICE

Encoder feedback is not supported for PM motors.

Programming motor data

When the initial programming steps are completed, the PM motor-related parameters in *parameter groups 1-2* Motor Data*, *1-3* Adv. Motor Data*, and *1-4* Adv. Motor Data II* are active.

The information is on the motor nameplate and in the motor datasheet.

Program the following parameters in the listed order:

1. *Parameter 1-24 Motor Current*.
2. *Parameter 1-26 Motor Cont. Rated Torque*.
3. *Parameter 1-25 Motor Nominal Speed*.
4. *Parameter 1-39 Motor Poles*.
5. *Parameter 1-40 Back EMF at 1000 RPM*.
6. *Parameter 1-42 Motor Cable Length*.

Run a complete AMA using *parameter 1-29 Automatic Motor Adaption (AMA)* and select *[1] Enable Complete AMA*. If a complete AMA is not performed successfully, configure the following parameters manually.

1. *Parameter 1-30 Stator Resistance (Rs)*.
   Enter phase common stator winding resistance (Rs). If only phase-to-phase data is available, divide the phase-to-phase value by 2 to achieve the phase value.
   It is also possible to measure the value with an ohmmeter, which also takes the resistance of the cable into account. Divide the measured value by 2 and enter the result.
2. *Parameter 1-37 d-axis Inductance (Ld)*.
   Enter direct axis inductance of the PM motor.
   If only phase-to-phase data is available, divide the phase-to-phase value by 2 to achieve the phase value.
   It is also possible to measure the value with an inductance meter, which also takes the inductance of the cable into account. Divide the measured value by 2 and enter the result.
3. *Parameter 1-38 q-axis Inductance (Lq)*.
   This parameter is active only when *parameter 1-10 Motor Construction* is set to *[3] PM, salient IPM*.
   Enter the quadrature axis inductance of the PM motor. If only phase-to-phase data is available, divide the phase-to-phase value by 2 to achieve the phase value.
   It is also possible to measure the value with an inductance meter, which also takes the inductance of the cable into account. Make 1 rotation of the motor's rotor and find the maximum phase-to-phase inductance value. Divide the value by 2 and enter the result.
4. *Parameter 1-44 d-axis Inductance Sat. (LdSat)*.
   This parameter is active only when *parameter 1-10 Motor Construction* is set to *[3] PM, salient IPM*.
   This parameter corresponds to the saturation inductance of d-axis. The default value is the value set in *parameter 1-37 d-axis Inductance (Ld)*. Do not change the default value in most cases. If the motor supplier provides the saturation curve,

enter the d-axis inductance value, which is 100% of the nominal current.

5. *Parameter 1-45 q-axis Inductance Sat. (LqSat)*.
This parameter is active only when *parameter 1-10 Motor Construction* is set to *[3] PM, salient IPM*.
This parameter corresponds to the saturation inductance of q-axis. The default value is the value set in *parameter 1-38 q-axis Inductance (Lq)*. In most cases, do not change the default. If the motor supplier provides the saturation curve, enter the q-axis inductance value, which is 100% of the nominal current.

Test motor operation

1. Start the motor at low speed (100–200 RPM). If the motor does not run, check installation, general programming, and motor data.
2. Check if the start function in *parameter 1-70 Start Mode* fits the application requirements.

Rotor detection
This function is the recommended selection for applications where the motor starts from standstill, for example pumps or conveyors. For some motors, a sound is heard when the frequency converter performs the rotor detection. This sound does not harm the motor. Adjust the value in *parameter 1-46 Position Detection Gain* for different motors. If the frequency converter fails to start, or an overcurrent alarm occurs when the frequency converter starts, check if the rotor is blocked or not. If the rotor is not blocked, set *parameter 1-70 Start Mode* to *[1] Parking* and try again.

Parking
This function is the recommended option for applications where the motor is rotating at low speed, for example windmilling in fan applications. *Parameter 2-06 Parking Current* and *parameter 2-07 Parking Time* are adjustable. Increase the factory setting of these parameters for applications with high inertia.

Start the motor at nominal speed. If the application does not run well, check the VVC+ PM settings. *Table 5.13* shows recommendations in different applications.

Application	Settings
Low inertia applications I_{Load}[1)]/I_{Motor}[2)] <5	• Increase the value for *parameter 1-17 Voltage filter time const.* by factor 5 to 10. • Reduce the value for *parameter 1-14 Damping Gain*. • Reduce the value (<100%) for *parameter 1-66 Min. Current at Low Speed*.
Medium inertia applications 50>I_{Load}/I_{Motor} >5	Keep calculated values.
High inertia applications I_{Load}/I_{Motor} > 50	Increase the values for *parameter 1-14 Damping Gain*, *parameter 1-15 Low Speed Filter Time Const.*, and *parameter 1-16 High Speed Filter Time Const.*
High load at low speed <30% (rated speed)	Decrease *parameter 1-17 Voltage filter time const.* Decrease *parameter 1-66 Min. Current at Low Speed* (>100% for longer time can overheat the motor).

Table 5.13 Recommendations in Different Applications

1) I_{Load} = The inertia of load.
2) I_{Motor} = The inertia of motor.

If the motor starts oscillating at a certain speed, increase *parameter 1-14 Damping Gain*. Increase the value in small steps.

Adjust the starting torque in *parameter 1-66 Min. Current at Low Speed*. 100% provides nominal torque as starting torque.

5.5.3 Automatic Motor Adaptation (AMA)

It is highly recommended to run AMA because it measures the electrical characteristics of the motor to optimize compatibility between the frequency converter and the motor in VVC+ mode.

- The frequency converter builds a mathematical model of the motor for regulating output motor current, thus enhancing motor performance.
- Some motors are unable to run the complete version of the test. In that case, select *Enable reduced AMA* (not for PM).
- If warnings or alarms occur, see *chapter 7.3 Warning and Alarm Code List*.
- Run this procedure on a cold motor for best results.

To run AMA using the numeric LCP

1. By default parameter setting, connect terminals 12 and 27 before running AMA.
2. Enter the *Main Menu*.
3. Go to *parameter group 1-** Load and Motor*.
4. Press [OK].
5. Set motor parameters using nameplate data for *parameter group 1-2* Motor Data*.
6. Set *parameter 1-39 Motor Poles* for IM and PM.
7. Set *parameter 1-40 Back EMF at 1000 RPM* for PM.
8. Set motor cable length in *parameter 1-42 Motor Cable Length*.
9. Go to *parameter 1-29 Automatic Motor Adaptation (AMA)*.
10. Press [OK].
11. Select *[1] Enable complete AMA*.
12. Press [OK].
13. Press [Hand On] to activate AMA.
14. The test runs automatically and indicates when it is complete.

Depending on the power size, AMA takes 3–10 minutes to complete.

NOTICE

The AMA function does not cause the motor to run, and it does not harm the motor.

5.6 Checking 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 shown is positive.
4. Verify that the wiring between the frequency converter and the motor is correct.
5. Verify that the motor running direction matches the setting in *parameter 1-06 Clockwise Direction*.

   5a When *parameter 1-06 Clockwise Direction* is set to *[0] Normal* (default clockwise):

      a. Verify that the motor turns clockwise.

      b. Verify that the LCP direction arrow is clockwise.

   5b When *parameter 1-06 Clockwise Direction* is set to *[1] Inverse* (counterclockwise):

      a. Verify that the motor turns counterclockwise.

      b. Verify that the LCP direction arrow is counterclockwise.

5.7 Checking Encoder Rotation

Only check encoder rotation if encoder feedback is used.

1. Select *[0] Open Loop* in *parameter 1-00 Configuration Mode*.
2. Select *[1] 24 V encoder* in *parameter 7-00 Speed PID Feedback Source*.
3. Press [Hand On].
4. Press [▲] for positive speed reference (*parameter 1-06 Clockwise Direction* at *[0] Normal*).
5. Check in *parameter 16-57 Feedback [RPM]* that the feedback is positive.

NOTICE

NEGATIVE FEEDBACK

If the feedback is negative, the encoder connection is wrong. Use *parameter 5-71 Term 32/33 Encoder Direction* to inverse the direction, or reverse the encoder cables.

5.8 Local-control Test

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

If acceleration or deceleration problems occur, see *chapter 7.5 Troubleshooting*. See *chapter 7.1 Warning and Alarm Types* for resetting the frequency converter after a trip.

5

5.9 System Start-up

The procedure in this section requires user-wiring and application programming to be completed. The following procedure is recommended after application set-up is completed.

1. Press [Auto On].
2. Apply an external run command.
3. Adjust the speed reference throughout the speed range.
4. Remove the external run command.
5. Check the sound and vibration levels of the motor to ensure that the system is working as intended.

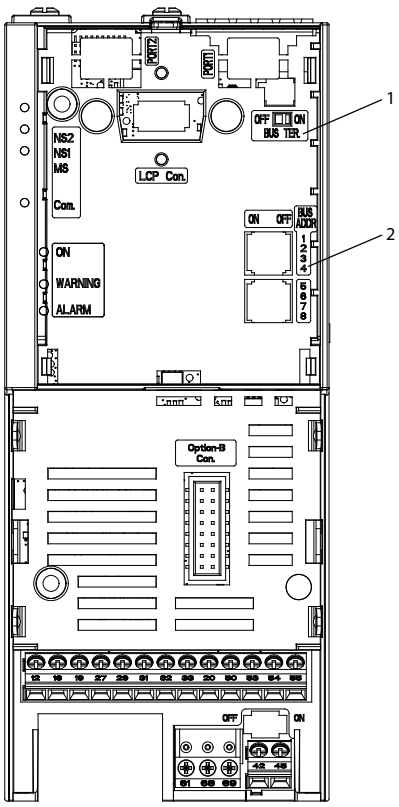
If warnings or alarms occur, see *chapter 7.1 Warning and Alarm Types* for resetting the frequency converter after a trip.

5.10 PROFIBUS

VLT® AutomationDrive FC 360 frequency converters support PROFIBUS. If PROFIBUS is needed,In both cases, ensure that *parameter 15-43 Software Version* is higher than 1.20.

- Order a new frequency converter on which the control cassette with PROFIBUS is pre-installed;
- Order a control cassette with PROFIBUS to replace the standard control cassette on an existing frequency converter. In this case, upgrade the firmware with MCT-10 Set-up Software.

Illustration 5.12 shows the front panel of a control cassette with PROFIBUS.



1	Termination resistor switch
2	PROFIBUS address selector

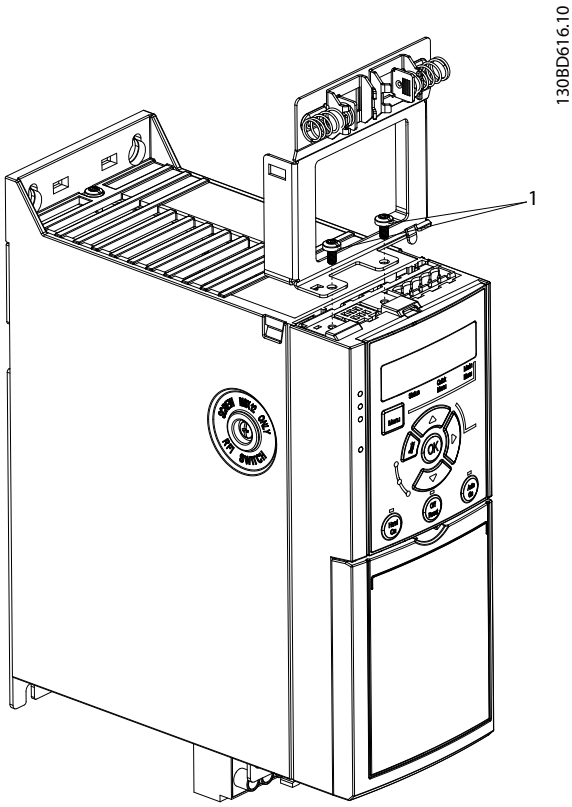
Illustration 5.12 Front Panel of a Control Cassette with PROFIBUS

The functions of the LEDs and switches on the front panel are introduced in *Table 5.14*.

LED/Switch	Description
NS2	Not used for PROFIBUS.
NS1	Indicates the network status when communicating with the PROFIBUS master. When this indicator light shows constant green, data exchange between the master and the frequency converter is active.
MS	Indicates the module status, which is acyclic DP V1 communication from either a PROFIBUS master class 1 (PLC) or a master class 2 (MCT-10 Set-up Software, FDT tool). When this indicator light shows constant green, DP V1 communication from master classes 1 and 2 is active.
COM	Communication status for RS485. Not used for PROFIBUS.
Termination resistor switch	When the switch is turned on, the termination resistor is in effect.
PROFIBUS address selector	Use the switches in the selector to set the PROFIBUS address. The address change comes into effect at the next power-up. ***NOTICE*** **Switch off the power supply before changing the switches.**

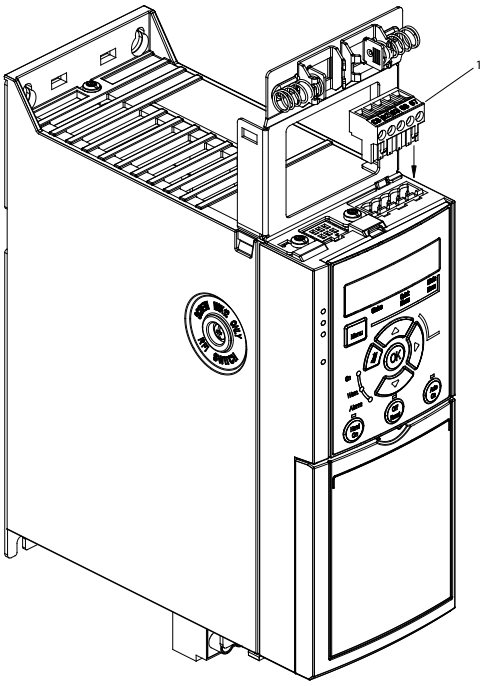
Table 5.14 Functions of LEDs and Switches

The PROFIBUS decoupling kit contains parts that are required for PROFIBUS to work. Install the kit after the control cassette with PROFIBUS is installed. *Illustration 5.13* and *Illustration 5.14* show how to install the decoupling kit on a frequency converter.



1	Screws

Illustration 5.13 Fasten the Plate with Screws



1	5-pin connector

Illustration 5.14 Push the 5-pin Connector into Place

5.11 PROFINET

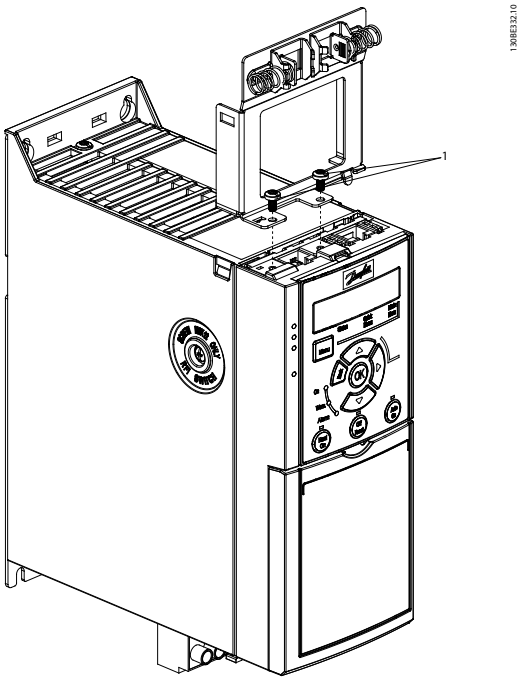
VLT® AutomationDrive FC 360 frequency converters support PROFINET. If PROFINET is needed,In both cases, ensure that *parameter 15-43 Software Version* is higher than 1.40.

- Order a new frequency converter on which the control cassette with PROFINET is pre-installed;
- Order a control cassette with PROFINET (ordering number: 132B0257) to replace the standard control cassette on an existing frequency converter. In this case, upgrade the software with MCT-10 Set-up Software. See the *service manual* for the instructions to upgrade the software.

In the package of each control cassette with PROFINET, a decoupling kit is provided for better mechanical fixation. Install the decoupling kit after the control casette is installed.

To install the decoupling kit:

1. Place the decoupling plate on the control cassette that is mounted on the frequency converter, and fasten the plate using 2 screws (supplied), as shown in *Illustration 5.15*. Tightening torque is 0.7–1.0 Nm (6.2–8.9 in-lb).



1	Screws

Illustration 5.15 Fasten the Plate with Screws

2. Push the Ethernet cable connectors into the slots on the control cassette. Place Ethernet cables between the spring loaded metal clamps, as shown in *Illustration 5.16*, to establish mechanical fixation and electrical contact between the cable and ground.

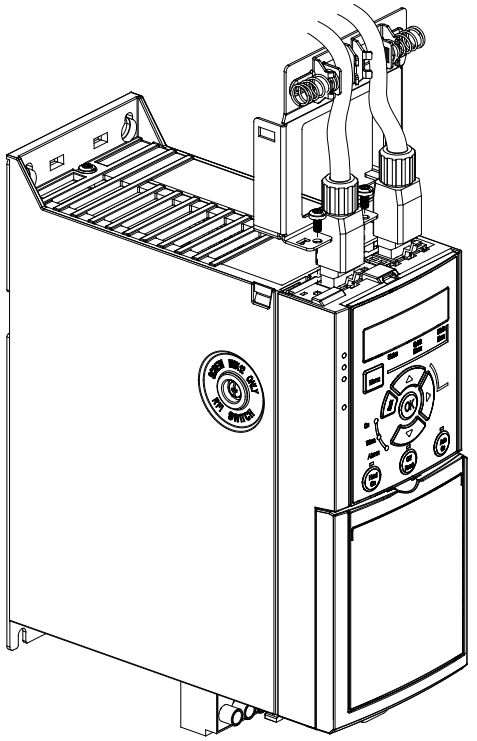


Illustration 5.16 Place Ethernet Cables between Clamps

6 Applications

6.1 Application Selections

Use the selections for quick application set-up of the most common applications by setting *parameter 0-16 Application Selection*. When necessary, the selections can be modified for individual needs. All selections are for auto-on mode.

NOTICE

When an application is selected, relevant parameters are automatically set. Customer-specific configuration of all parameters based on specific requirements is still possible.

NOTICE

It is recommended to initialize the frequency converter via *parameter 14-22 Operation Mode* or 2-finger reset before setting *parameter 0-16 Application Selection*.

NOTICE

If any of the applications are selected, relay 1 is set to [Running] and relay 2 is set to [Alarm] automatically.

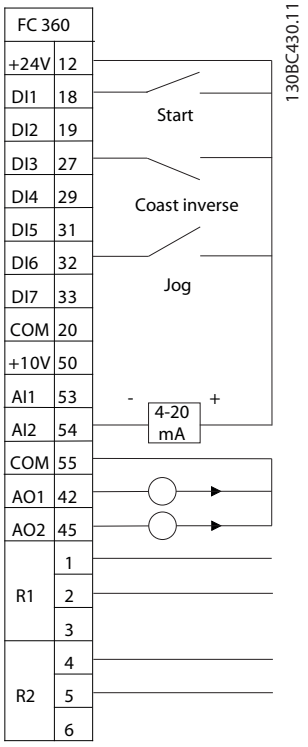
Application

Pumps, fans, compressors.

Parameter 0-16 Application Selection is set to *[1] Simple Process Close Loop*.

Description

For applications where a value (for example, pressure, temperature) must be kept at a desired level by sensor feedback.



Parameter settings

Parameter	Option/value
Parameter 1-00 Configuration Mode	*[3] Process Closed Loop*
Parameter 1-03 Torque Characteristics	*[1] Variable Torque*
Parameter 3-00 Reference Range	*[0] Min- Max*
Parameter 3-15 Reference 1 Source	*[0] No Function*
Parameter 4-12 Motor Speed Low Limit [Hz]	30.0 Hz
Parameter 4-14 Motor Speed High Limit [Hz]	50.0 Hz
Parameter 5-10 Terminal 18 Digital Input	*[8] Start*
Parameter 5-12 Terminal 27 Digital Input	*[2] Coast Inverse*
Parameter 5-14 Terminal 32 Digital Input	*[14] Jog*
Parameter 5-40 Function Relay (Relay 1 Selection)	*[5] Running*
Parameter 5-40 Function Relay (Relay 2 Selection)	*[9] Alarm*
Parameter 6-22 Terminal 54 Low Current	4.0 mA
Parameter 6-23 Terminal 54 High Current	20.0 mA
Parameter 6-29 Terminal 54 mode	*[0] Current Mode*
Parameter 6-70 Terminal 45 Mode	*[0] 0–20 mA*

Parameter 6-71 Terminal 45 Analog Output	*[100] Output frequency*
Parameter 6-90 Terminal 42 Mode	*[0] 0–20 mA*
Parameter 6-91 Terminal 42 Analog Output	*[103] Motor Current*
Parameter 7-20 Process CL Feedback 1 Resource	*[2] Analog input 54*

Table 6.1 Process Closed Loop

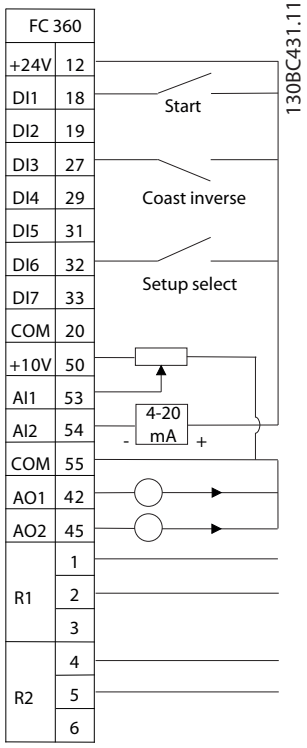
Application

Local/remote.

Parameter 0-16 Application Selection is set to *[2] Local/Remote*.

Description

For applications where the speed reference can be switched between local potentiometer and remote current signal.



Parameter settings	Set-up 1	Set-up 2
Parameter 0-10 Active Set-up	*[9] Multi Set-up*	*[9] Multi Set-up*
Parameter 0-12 Link Setups	*[20] Linked*	*[20] Linked*
Parameter 1-00 Configuration Mode	*[0] Speed Open Loop*	*[0] Speed Open Loop*
Parameter 3-00 Reference Range	*[0] Min–Max*	*[0] Min–Max*
Parameter 3-15 Reference 1 Source	*[1] AI 53*	*[2] AI 54*
Parameter 3-16 Reference 2 Source	*[0] No function*	*[0] No function*
Parameter 4-12 Motor Speed Low Limit [Hz]	25.0 Hz	25.0 Hz
Parameter 4-14 Motor Speed High Limit [Hz]	50.0 Hz	50.0 Hz
Parameter 5-10 Terminal 18 Digital Input	*[8] Start*	*[8] Start*
Parameter 5-12 Terminal 27 Digital Input	*[2] Coast Inverse*	*[2] Coast Inverse*
Parameter 5-14 Terminal 32 Digital Input	*[23] Set-up select*	*[23] Set-up select*
Parameter 5-40 Function Relay (Relay 1 Selection)	*[5] Running*	*[5] Running*
Parameter 5-40 Function Relay (Relay 2 Selection)	*[9] Alarm*	*[9] Alarm*
Parameter 6-10 Terminal 53 Low Voltage	0.07 V	
Parameter 6-11 Terminal 53 High Voltage	10 V	
Parameter 6-19 Terminal 53 mode	*[1] Voltage Mode*	
Parameter 6-22 Terminal 54 Low Current		4.0 mA
Parameter 6-23 Terminal 54 High Current		20.0 mA
Parameter 6-29 Terminal 54 mode		*[0] Current Mode*
Parameter 6-70 Terminal 45 Mode	*[0] 0–20 mA*	*[0] 0–20 mA*
Parameter 6-71 Terminal 45 Analog Output	*[100] Output frequency*	*[100] Output frequency*
Parameter 6-90 Terminal 42 Mode	*[0] 0–20 mA*	*[0] 0–20 mA*
Parameter 6-91 Terminal 42 Analog Output	*[103] Motor Current*	*[103] Motor Current*

Table 6.2 Local/Remote

6

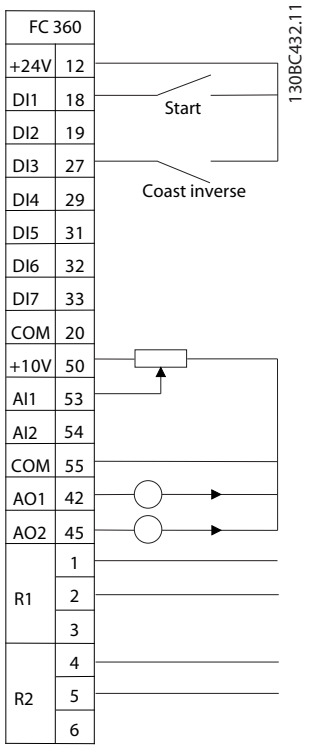
Application

Conveyors, extruders.

Parameter 0-16 Application Selection is set to *[3] Speed Open Loop*.

Description

For running at a stable speed by a voltage reference signal.



Parameter settings

Parameter	Option/value
Parameter 1-00 Configuration Mode	*[0] Speed Open Loop*
Parameter 3-00 Reference Range	*[0] Min–Max*
Parameter 3-15 Reference 1 Source	*[1] AI 53*
Parameter 4-12 Motor Speed Low Limit [Hz]	25.0 Hz
Parameter 4-14 Motor Speed High Limit [Hz]	50.0 Hz
Parameter 5-10 Terminal 18 Digital Input	*[8] Start*
Parameter 5-12 Terminal 27 Digital Input	*[2] Coast Inverse*
Parameter 5-40 Function Relay (Relay 1 Selection)	*[5] Running*
Parameter 5-40 Function Relay (Relay 2 Selection)	*[9] Alarm*
Parameter 6-10 Terminal 53 Low Voltage	0.07 V
Parameter 6-11 Terminal 53 High Voltage	10 V
Parameter 6-19 Terminal 53 mode	*[1] Voltage Mode*
Parameter 6-70 Terminal 45 Mode	*[0] 0–20 mA*
Parameter 6-71 Terminal 45 Analog Output	*[100] Output frequency*
Parameter 6-90 Terminal 42 Mode	*[0] 0–20 mA*
Parameter 6-91 Terminal 42 Analog Output	*[103] Motor Current*

Table 6.3 Speed Open Loop

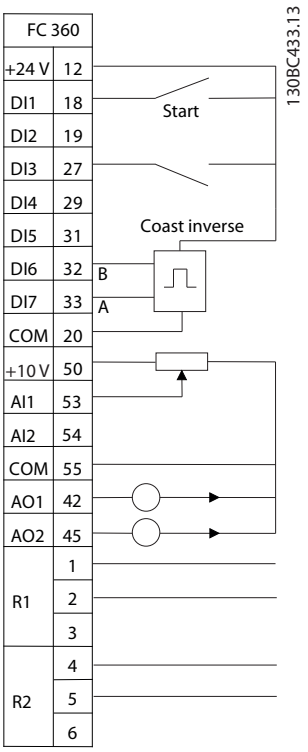
Application

Machine tools, texturizers.

Parameter 0-16 Application Selection is set to *[4] Simple Speed Closed Loop*.

Description

For precise speed applications with 24 V encoder feedback.



Parameter settings

Parameter	Option/value
Parameter 1-00 Configuration Mode	*[1] Speed Close Loop*
Parameter 3-00 Reference Range	*[0] Min–Max*
Parameter 3-15 Reference 1 Source	*[1] AI 53*
Parameter 3-16 Reference 2 Source	*[11] Local Bus Ref*
Parameter 4-12 Motor Speed Low Limit [Hz]	20.0 Hz
Parameter 4-14 Motor Speed High Limit [Hz]	50.0 Hz
Parameter 5-10 Terminal 18 Digital Input	*[8] Start*
Parameter 5-12 Terminal 27 Digital Input	*[2] Coast Inverse*
Parameter 5-14 Terminal 32 Digital Input	*[82] Encoder input B*
Parameter 5-15 Terminal 33 Digital Input	*[81] Encoder input A*
Parameter 5-40 Function Relay (Relay 1 Selection)	*[5] Running*
Parameter 5-40 Function Relay (Relay 2 Selection)	*[9] Alarm*
Parameter 6-10 Terminal 53 Low Voltage	0.07 V
Parameter 6-11 Terminal 53 High Voltage	10 V
Parameter 6-19 Terminal 53 mode	*[1] Voltage Mode*
Parameter 6-70 Terminal 45 Mode	*[0] 0–20 mA*
Parameter 6-71 Terminal 45 Analog Output	*[100] Output frequency*
Parameter 6-90 Terminal 42 Mode	*[0] 0–20 mA*

Parameter 6-91 Terminal 42 Analog Output	*[103] Motor Current*
Parameter 7-00 Speed PID Feedback Source	*[1] 24 V encoder*

Table 6.4 Speed Close Loop

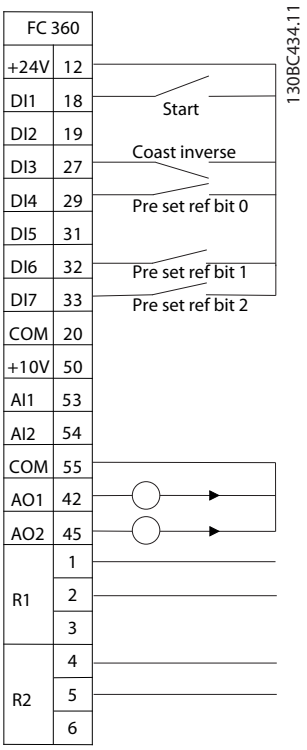
Application

Industrial washing machines, conveyors.

Parameter 0-16 Application Selection is set to *[5] Multi Speed*.

Description

For applications with 8 different speeds by digital input. By using another digital input, 16 speeds are possible.



Parameter settings	
Parameter	**Option/value**
Parameter 1-00 Configuration Mode	*[0] Speed Open Loop*
Parameter 3-00 Reference Range	*[0] Min–Max*
Parameter 3-15 Reference 1 Source	*[0] No Function*
Parameter 4-14 Motor Speed High Limit [Hz]	50.0 Hz
Parameter 5-10 Terminal 18 Digital Input	*[8] Start*
Parameter 5-12 Terminal 27 Digital Input	*[2] Coast Inverse*
Parameter 5-13 Terminal 29 Digital Input	*[16] Preset ref bit 0*
Parameter 5-14 Terminal 32 Digital Input	*[17] Preset ref bit 1*
Parameter 5-15 Terminal 33 Digital Input	*[18] Preset ref bit 2*
Parameter 6-70 Terminal 45 Mode	*[0] 0–20 mA*
Parameter 6-71 Terminal 45 Analog Output	*[100] Output frequency*
Parameter 6-90 Terminal 42 Mode	*[0] 0–20 mA*
Parameter 6-91 Terminal 42 Analog Output	*[103] Motor Current*

Table 6.5 Multi-speed

6

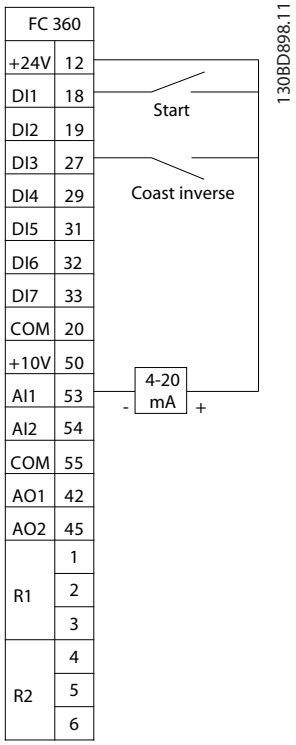
Application

One Gear Drive (OGD) LA10.

Parameter 0-16 Application Selection is set to *[6] OGD LA10*.

Description

For applications that use OGD. For example, conveyors in food and beverage industries.



Parameter settings

Parameter	Option/value
Parameter 1-00 Configuration Mode	*[0] Open Loop*
Parameter 1-01 Motor Control Principle	*[1] VVC+*
Parameter 1-08 Motor Control Bandwidth	High
Parameter 1-10 Motor Construction	*[1] PM, non-salient SPM*
Parameter 1-14 Damping Gain	120
Parameter 1-15 Low Speed Filter Time Const.	0.175
Parameter 1-16 High Speed Filter Time Const.	0.175
Parameter 1-17 Voltage filter time const.	0.035
Parameter 1-24 Motor Current	7.2
Parameter 1-25 Motor Nominal Speed	3000
Parameter 1-26 Motor Cont. Rated Torque	12.6
Parameter 1-29 Automatic Motor Adaptation (AMA)	*[0] Off*
Parameter 1-30 Stator Resistance (Rs)	0.5
Parameter 1-37 d-axis Inductance (Ld)	5
Parameter 1-39 Motor Poles	10
Parameter 1-40 Back EMF at 1000 RPM	120
Parameter 1-42 Motor Cable Length	50 m
Parameter 1-66 Min. Current at Low Speed	50
Parameter 1-73 Flying Start	*[2] Enable always*
Parameter 2-06 Parking Current	80
Parameter 2-07 Parking Time	0.5
Parameter 2-10 Brake Function	*[0] Off*
Parameter 3-03 Maximum Reference	250 Hz
Parameter 4-14 Motor Speed High Limit [Hz]	250 Hz
Parameter 4-16 Torque Limit Motor Mode	160
Parameter 4-18 Current Limit	160
Parameter 5-10 Terminal 18 Digital Input	*[8] Start*
Parameter 5-11 Terminal 19 Digital Input	*[0] No operation*
Parameter 5-12 Terminal 27 Digital Input	*[2] Coast inverse*
Parameter 5-13 Terminal 29 Digital Input	*[0] No operation*
Parameter 5-14 Terminal 32 Digital Input	*[0] No operation*
Parameter 5-15 Terminal 33 Digital Input	*[0] No operation*
Parameter 5-16 Terminal 31 Digital Input	*[0] No operation*
Parameter 6-10 Terminal 53 Low Voltage	4.0 mA
Parameter 6-11 Terminal 53 High Voltage	20.0 mA
Parameter 6-14 Terminal 53 Low Ref./ Feedb. Value	0
Parameter 6-15 Terminal 53 High Ref./ Feedb. Value	250
Parameter 6-19 Terminal 53 mode	*[0] Current Mode*
Parameter 14-01 Switching Frequency	10.0 kHz
Parameter 14-07 Dead Time Compensation Level	65
Parameter 14-64 Dead Time Compensation Zero Current Level	*[0] Disabled*
Parameter 14-65 Speed Derate Dead Time Compensation	250
Parameter 14-51 DC-Link Voltage Compensation	*[0] Off*
Parameter 30-20 High Starting Torque Time [s]	0
Parameter 30-21 High Starting Torque Current [%]	100
Parameter 30-22 Locked Rotor Protection	*[0] Off*
Parameter 30-23 Locked Rotor Detection Time [s]	1

Table 6.6 One Gear Drive (OGD) LA10

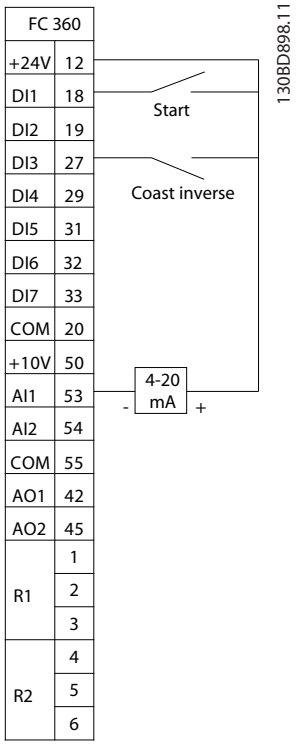
Application

One Gear Drive (OGD) V210.

Parameter 0-16 Application Selection is set to *[7] OGD V210*.

Description

For applications that use OGD. For example, conveyors in food and beverage industries.



Parameter settings

Parameter	Option/value
Parameter 1-00 Configuration Mode	*[0] Open Loop*
Parameter 1-01 Motor Control Principle	*[1] VVC+*
Parameter 1-08 Motor Control Bandwidth	High
Parameter 1-10 Motor Construction	*[1] PM, non-salient SPM*
Parameter 1-14 Damping Gain	120
Parameter 1-15 Low Speed Filter Time Const.	0.175
Parameter 1-16 High Speed Filter Time Const.	0.175
Parameter 1-17 Voltage filter time const.	0.035
Parameter 1-24 Motor Current	5.50
Parameter 1-25 Motor Nominal Speed	3000
Parameter 1-26 Motor Cont. Rated Torque	13.0
Parameter 1-29 Automatic Motor Adaptation (AMA)	*[0] Off*
Parameter 1-30 Stator Resistance (Rs)	1.000
Parameter 1-37 d-axis Inductance (Ld)	13.800
Parameter 1-39 Motor Poles	10
Parameter 1-40 Back EMF at 1000 RPM	155
Parameter 1-42 Motor Cable Length	50 m
Parameter 1-66 Min. Current at Low Speed	50
Parameter 1-73 Flying Start	*[2] Enable always*
Parameter 2-06 Parking Current	10
Parameter 2-07 Parking Time	0.5
Parameter 2-10 Brake Function	*[0] Off*
Parameter 3-03 Maximum Reference	250 Hz
Parameter 4-14 Motor Speed High Limit [Hz]	250 Hz
Parameter 4-16 Torque Limit Motor Mode	160
Parameter 4-18 Current Limit	160
Parameter 5-10 Terminal 18 Digital Input	*[8] Start*
Parameter 5-11 Terminal 19 Digital Input	*[0] No operation*
Parameter 5-12 Terminal 27 Digital Input	*[2] Coast inverse*
Parameter 5-13 Terminal 29 Digital Input	*[0] No operation*
Parameter 5-14 Terminal 32 Digital Input	*[0] No operation*
Parameter 5-15 Terminal 33 Digital Input	*[0] No operation*
Parameter 5-16 Terminal 31 Digital Input	*[0] No operation*
Parameter 6-10 Terminal 53 Low Voltage	4.0 mA
Parameter 6-11 Terminal 53 High Voltage	20.0 mA
Parameter 6-14 Terminal 53 Low Ref./ Feedb. Value	0
Parameter 6-15 Terminal 53 High Ref./ Feedb. Value	250
Parameter 6-19 Terminal 53 mode	*[0] Current Mode*
Parameter 14-01 Switching Frequency	10.0 kHz
Parameter 14-07 Dead Time Compensation Level	65
Parameter 14-64 Dead Time Compensation Zero Current Level	*[0] Disabled*
Parameter 14-65 Speed Derate Dead Time Compensation	250
Parameter 14-51 DC-Link Voltage Compensation	*[0] Off*
Parameter 30-20 High Starting Torque Time [s]	0
Parameter 30-21 High Starting Torque Current [%]	100
Parameter 30-22 Locked Rotor Protection	*[0] Off*
Parameter 30-23 Locked Rotor Detection Time [s]	1

Table 6.7 One Gear Drive (OGD) V210

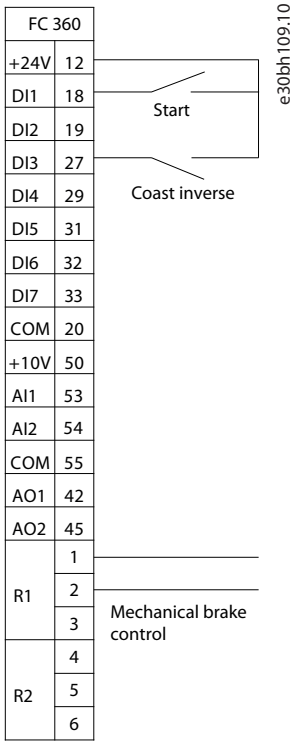
Application

Hoist

Parameter 0-16 Application Selection is set to *[8] Hoist*.

Description

For applications that use hoist.



Parameter settings	
Parameter	**Option/value**
Parameter 1-01 Motor Control Principle	*[1] VVC+*
Parameter 1-71 Start Delay	0.2
Parameter 1-72 Start Function	*[4] Horizontal operation*
Parameter 1-73 Flying Start	*[0] Disabled*
Parameter 1-76 Start Current	50% of *parameter 1-24 Motor Current*
Parameter 2-00 DC Hold/Motor Preheat Current	50%
Parameter 2-10 Brake Function	*[1] Resistor brake*
Parameter 2-17 Over-voltage Control	*[0] Disabled*
Parameter 2-20 Release Brake Current	0
Parameter 2-22 Activate Brake Speed [Hz]	*Parameter 1-23 Motor Frequency* - *parameter 1-25 Motor Nominal Speed* x *parameter 1-39 Motor Poles*/120
Parameter 2-23 Activate Brake Delay	0.1
Parameter 2-39 Mech. Brake w/ dir. Change	*[1] On*
Parameter 3-41 Ramp 1 Ramp Up Time	1
Parameter 3-42 Ramp 1 Ramp Down Time	1
Parameter 3-51 Ramp 2 Ramp Up Time	1
Parameter 3-52 Ramp 2 Ramp Down Time	1
Parameter 4-10 Motor Speed Direction	*[2] Both directions*
Parameter 4-16 Torque Limit Motor Mode	Maximum
Parameter 4-17 Torque Limit Generator Mode	Maximum
Parameter 5-40 Function Relay	*[32] Mech brake ctrl*
Parameter 14-24 Trip Delay at Current Limit	2
Parameter 14-25 Trip Delay at Torque Limit	2

Table 6.8 Hoist

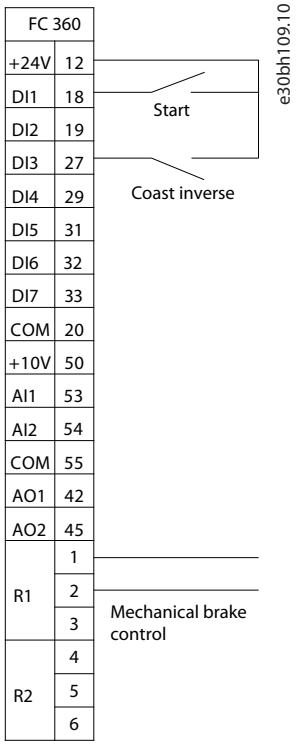
Application

Hoist speed close loop

Parameter 0-16 Application Selection is set to *[9] Hoist Speed Close Loop*.

Description

For applications that use hoist speed close loop.



Parameter settings

Parameter	Option/value
Parameter 1-00 Configuration Mode	*[1] Speed closed loop*
Parameter 1-01 Motor Control Principle	*[1] VVC+*
Parameter 1-71 Start Delay	0.2
Parameter 1-72 Start Function	*[3] Start speed cw*
Parameter 1-73 Flying Start	*[0] Disabled*
Parameter 1-75 Start Speed [Hz]	90% of nominal slip frequency
Parameter 1-76 Start Current	80% of *parameter 1-24 Motor Current*
Parameter 2-10 Brake Function	*[1] Resistor brake*
Parameter 2-17 Over-voltage Control	*[0] Disabled*
Parameter 2-20 Release Brake Current	0
Parameter 2-22 Activate Brake Speed [Hz]	*Parameter 1-23 Motor Frequency* - *parameter 1-25 Motor Nominal Speed* x *parameter 1-39 Motor Poles*/120
Parameter 2-23 Activate Brake Delay	0.3
Parameter 2-24 Stop Delay	0.2
Parameter 2-25 Brake Release Time	0.5
Parameter 2-31 Speed PID Start Proportional Gain	0.15
Parameter 2-32 Speed PID Start Integral Time	8
Parameter 2-33 Speed PID Start Lowpass Filter Time	1
Parameter 2-39 Mech. Brake w/ dir. Change	*[0] Off*
Parameter 3-41 Ramp 1 Ramp Up Time	1
Parameter 3-42 Ramp 1 Ramp Down Time	1
Parameter 3-51 Ramp 2 Ramp Up Time	1
Parameter 3-52 Ramp 2 Ramp Down Time	1
Parameter 4-10 Motor Speed Direction	*[2] Both directions*
Parameter 4-16 Torque Limit Motor Mode	Maximum
Parameter 4-17 Torque Limit Generator Mode	Maximum
Parameter 4-30 Motor Feedback Loss Function	*[2] Trip*
Parameter 4-31 Motor Feedback Speed Error	5
Parameter 5-13 Terminal 29 Digital Input	*[0] No operation*
Parameter 5-40 Function Relay	*[32] Mech brake ctrl*
Parameter 14-24 Trip Delay at Current Limit	2
Parameter 14-25 Trip Delay at Torque Limit	2

Table 6.9 Hoist Speed Close Loop

6

6.2 Application Examples

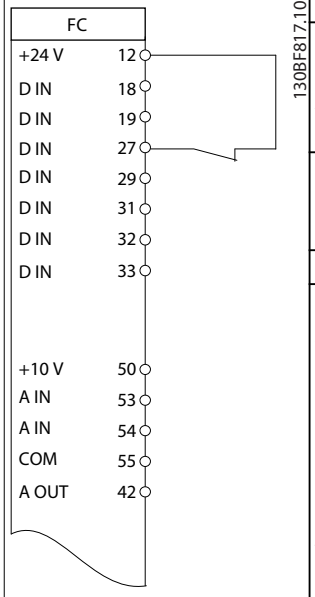
6.2.1 Introduction

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

- Parameter settings are the regional default values unless otherwise indicated (selected in *parameter 0-03 Regional Settings*).
- Parameters associated with the terminals and their settings are shown next to the drawings.
- Required switch settings for analog terminals 53 or 54 are also shown.

6

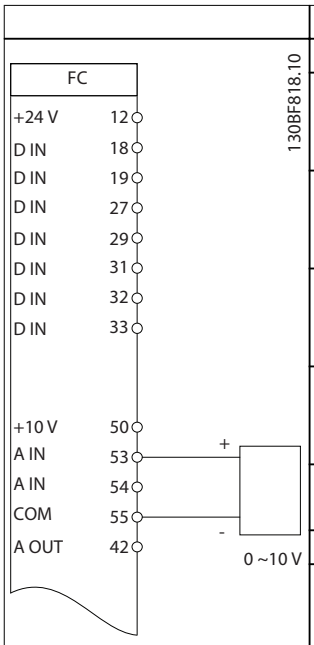
6.2.2 AMA



	Parameters	
	Function	**Setting**
	Parameter 1-29 Automatic Motor Adaptation (AMA)	*[1] Enable complete AMA*
	Parameter 5-12 Terminal 27 Digital Input	*[2] Coast inverse*
	*=Default value	
	Notes/comments: Set *parameter group 1-2* Motor Data* according to motor specifications. ***NOTICE*** **If terminals 12 and 27 are not connected, set *parameter 5-12 Terminal 27 Digital Input* to *[0] No operation*.**	

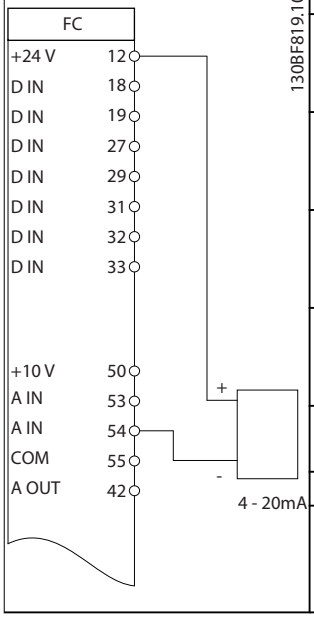
Table 6.10 AMA with T27 Connected

6.2.3 Speed



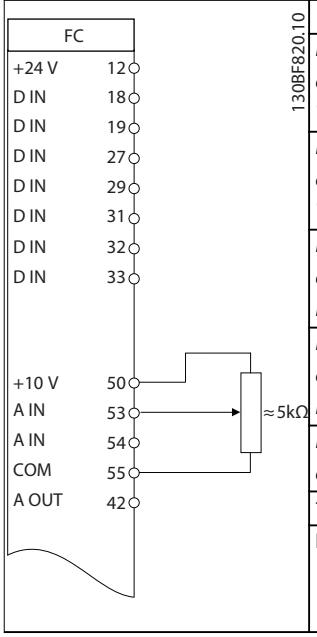
	Parameters	
	Function	**Setting**
	Parameter 6-10 Terminal 53 Low Voltage	*0.07 V
	Parameter 6-11 Terminal 53 High Voltage	*10 V
	Parameter 6-14 Terminal 53 Low Ref./Feedb. Value	*0
	Parameter 6-15 Terminal 53 High Ref./Feedb. Value	50 Hz
	Parameter 6-19 Terminal 53 mode	*[1] Voltage
	*=Default value	
	Notes/comments:	

Table 6.11 Analog Speed Reference (Voltage)



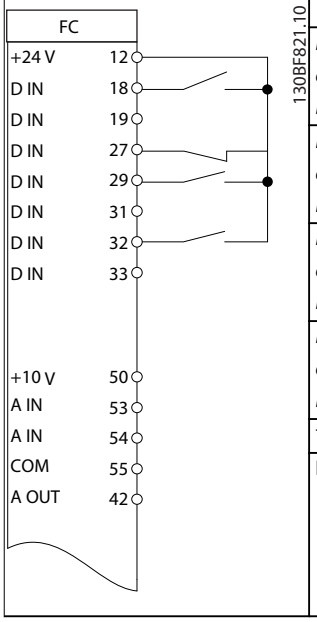
	Parameters	
	Function	**Setting**
	Parameter 6-22 Terminal 54 Low Current	*4 mA
	Parameter 6-23 Terminal 54 High Current	*20 mA
	Parameter 6-24 Terminal 54 Low Ref./Feedb. Value	*0
	Parameter 6-25 Terminal 54 High Ref./Feedb. Value	50 Hz
	Parameter 6-29 Terminal 54 mode	*[0] Current
	*=Default value	
	Notes/comments:	

Table 6.12 Analog Speed Reference (Current)



Parameters	
Function	**Setting**
Parameter 6-10 Terminal 53 Low Voltage	*0.07 V
Parameter 6-11 Terminal 53 High Voltage	*10 V
Parameter 6-14 Terminal 53 Low Ref./Feedb. Value	*0
Parameter 6-15 Terminal 53 High Ref./Feedb. Value	50 Hz
Parameter 6-19 Terminal 53 mode	*[1] Voltage
*=Default value	
Notes/comments:	

Table 6.13 Speed Reference (Using a Manual Potentiometer)



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

Table 6.14 Speed Up/Speed Down

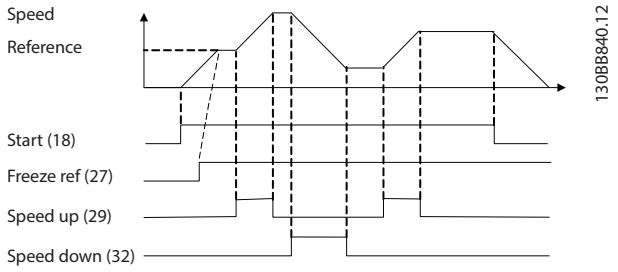
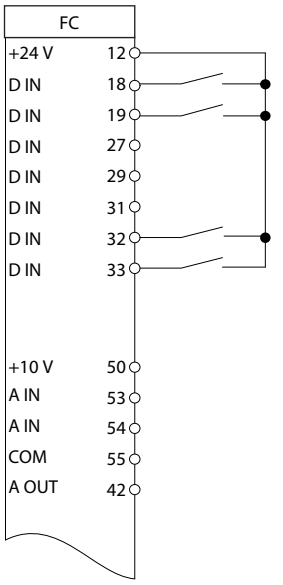


Illustration 6.1 Speed Up/Speed Down

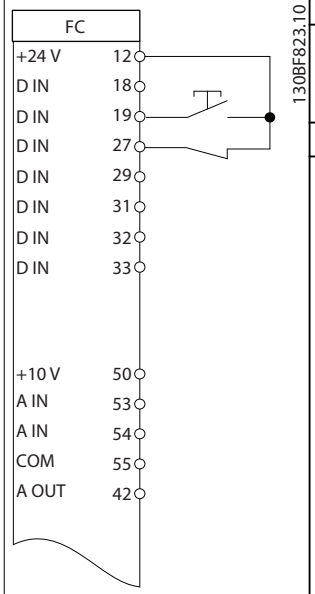
6.2.4 Start/Stop



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

Table 6.15 Start/Stop with Reversing and 4 Preset Speeds

6.2.5 External Alarm Reset



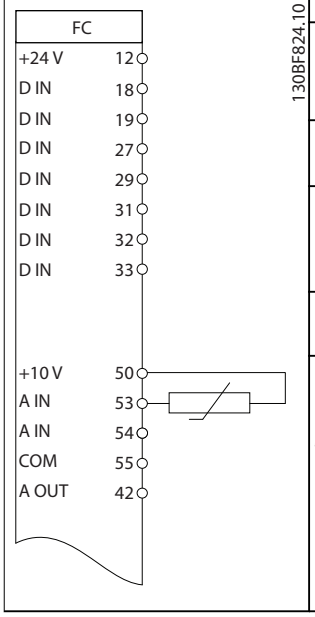
Parameters	
Function	**Setting**
Parameter 5-11 Terminal 19 Digital Input	*[1] Reset*
*=Default value	
Notes/comments:	

Table 6.16 External Alarm Reset

6.2.6 Motor Thermistor

NOTICE

To meet PELV insulation requirements, use reinforced or double insulation on the thermistors.



Parameters	
Function	**Setting**
Parameter 1-90 Motor Thermal Protection	*[2] Thermistor trip*
Parameter 1-93 Thermistor Source	*[1] Analog input 53*
Parameter 6-19 Terminal 53 mode	*[1] Voltage
* = Default value	
Notes/comments: If only a warning is needed, set *parameter 1-90 Motor Thermal Protection* to *[1] Thermistor warning*.	

Table 6.17 Motor Thermistor

7 Diagnostics and Troubleshooting

7.1 Warning and Alarm Types

Warning/ alarm type	Description
Warning	A warning indicates an abnormal operating condition that might lead to an alarm. A warning stops when the abnormal condition is removed.
Alarm	An alarm indicates a fault that requires immediate attention. The fault always triggers a trip or trip lock. Reset the frequency converter after an alarm. Reset the frequency converter in any of 4 ways: • Press [Reset]/[Off/Reset]. • Digital reset input command. • Bus communication reset input command. • Auto reset.

Trip
When tripping, the frequency converter suspends operation to prevent damage to the frequency converter and other equipment. When a trip occurs, the motor coasts to a stop. The frequency converter logic continues to operate and monitor the frequency converter status. After the fault condition is remedied, the frequency converter is ready for a reset.

Trip lock
When trip locking, the frequency converter suspends operation to prevent damage to the frequency converter and other equipment. When a trip lock occurs, the motor coasts to a stop. The frequency converter logic continues to operate and monitor the frequency converter status. The frequency converter starts a trip lock only when serious faults occur that can damage the frequency converter or other equipment. After the faults are fixed, cycle the input power before resetting the frequency converter.

7.2 Warning and Alarm Displays

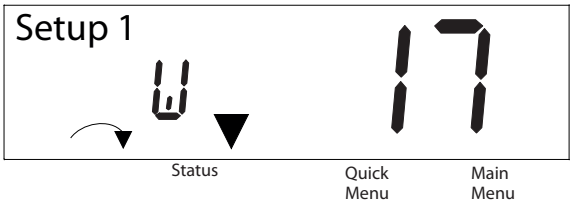


Illustration 7.1 Warning Display

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

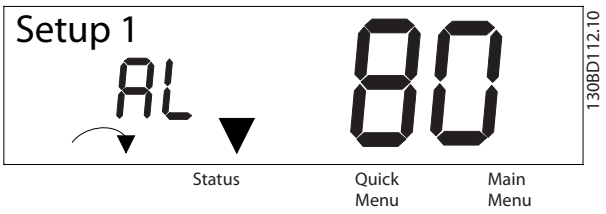


Illustration 7.2 Alarm/Trip Lock Alarm

In addition to the text and alarm code on the frequency converter display, there are 3 status indicator lights. The warning indicator light is yellow during a warning. The alarm indicator light is red and flashing during an alarm.

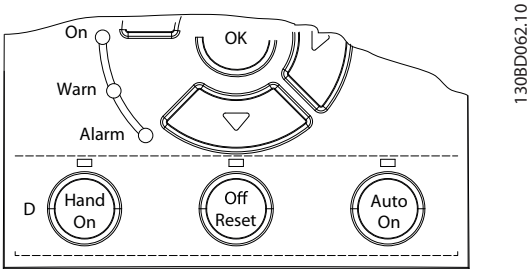


Illustration 7.3 Status Indicator Lights

7.3 Warning and Alarm Code List

An (X) marked in *Table 7.1* indicates that the warning or alarm has occurred. A warning precedes an alarm.

Number	Description	Warning	Alarm	Trip lock	Cause
2	Live zero error	X	X	–	Signal on terminal 53 or 54 is less than 50% of value set in *parameter 6-10 Terminal 53 Low Voltage*, *parameter 6-12 Terminal 53 Low Current*, *parameter 6-20 Terminal 54 Low Voltage*, and *parameter 6-22 Terminal 54 Low Current*.
3	No motor	X	–	–	No motor has been connected to the output of the frequency converter, or 1 motor phase is missing.
4	Mains phase loss[1)]	X	X	X	Missing phase on supply side, or the voltage imbalance is too high. Check the supply voltage.
7	DC overvoltage[1)]	X	X	–	Intermediate circuit voltage exceeds limit.
8	DC undervoltage[1)]	X	X	–	Intermediate circuit voltage drops below the voltage warning low limit.
9	Inverter overloaded	X	X	–	More than 100% load for too long.
10	Motor ETR overtemperature	X	X	–	Motor is too hot due to more than 100% load for too long.
11	Motor thermistor overtemperature	X	X	–	Thermistor or thermistor connection is disconnected.
12	Torque limit	X	X	–	Torque exceeds value set in either *parameter 4-16 Torque Limit Motor Mode* or *parameter 4-17 Torque Limit Generator Mode*.
13	Overcurrent	X	X	X	Inverter peak current limit is exceeded. For J1–J6 units, if this alarm occurs on power-up, check whether power cables are mistakenly connected to the motor terminals.
14	Earth fault	–	X	X	Discharge from output phases to ground.
16	Short circuit	–	X	X	Short circuit in motor or on motor terminals. For J7 units, if this alarm occurs on power-up, check whether power cables are mistakenly connected to the motor terminals.
17	Control word timeout	X	X	–	No communication to frequency converter.
18	Start failed	–	X	–	–
25	Brake resistor short-circuited	–	X	X	Brake resistor is short-circuited, thus the brake function is disconnected.
26	Brake overload	X	X	–	The power transmitted to the brake resistor over the last 120 s exceeds the limit. Possible corrections: Decrease brake energy via lower speed or longer ramp time.
27	Brake IGBT/Brake chopper short-circuited	–	X	X	Brake transistor is short-circuited, thus brake function is disconnected.
28	Brake check	–	X	–	Brake resistor is not connected/working.
30	U phase loss	–	X	X	Motor phase U is missing. Check the phase.
31	V phase loss	–	X	X	Motor phase V is missing. Check the phase.
32	W phase loss	–	X	X	Motor phase W is missing. Check the phase.
34	Fieldbus fault	X	X	–	PROFIBUS communication issues have occurred.
35	Option fault	–	X	–	Fieldbus or option B detects internal faults.
36	Mains failure	X	X	–	This warning/alarm is only active if the supply voltage to the frequency converter is lost and *parameter 14-10 Mains Failure* is NOT set to *[0] No Function*.
38	Internal fault	–	X	X	Contact the local Danfoss supplier.
40	Overload T27	X	–	–	Check the load connected to terminal 27 or remove short-circuit connection.

Number	Description	Warning	Alarm	Trip lock	Cause
41	Overload T29	X	–	–	Check the load connected to terminal 29 or remove short-circuit connection.
46	Gate drive voltage fault	–	X	X	–
47	24 V supply low	X	X	X	24 V DC may be overloaded.
50	AMA calibration	–	X	–	–
51	AMA check U_{nom} and I_{nom}	–	X	–	Wrong setting for motor voltage and/or motor current.
52	AMA low I_{nom}	–	X	–	Motor current is too low. Check the settings.
53	AMA big motor	–	X	–	The power size of the motor is too large for the AMA to operate.
54	AMA small motor	–	X	–	The power size of the motor is too small for the AMA to operate.
55	AMA parameter range	–	X	–	The parameter values of the motor are outside of the acceptable range. AMA does not run.
56	AMA interrupt	–	X	–	The AMA is interrupted.
57	AMA timeout	–	X	–	–
58	AMA internal	–	X	–	Contact Danfoss.
59	Current limit	X	X	–	Frequency converter overload.
60	External Interlock	–	X	–	–
61	Encoder loss	X	X	–	–
63	Mechanical brake low	–	X	–	Actual motor current has not exceeded release brake current within start delay time window.
65	Control card temp	X	X	X	The cutout temperature of the control card is 80 °C (176 °F).
69	Power card temp	X	X	X	–
70	Illegal FC config	–	X	X	–
80	Frequency converter initialized to default value	–	X	–	All parameter settings are initialized to default settings.
87	Auto DC brake	X	–	–	Occurs in IT mains when the frequency converter coasts and the DC voltage is higher than 830 V. Energy on DC-link is consumed by the motor. This function can be enabled/disabled in *parameter 0-07 Auto DC Braking*.
90	Feedback monitor	X	X	–	A feedback fault is detected by option B.
95	Broken belt	X	X	–	–
99	Locked rotor	–	X	–	–
101	Flow/pressure information missing	–	X	X	–
120	Position control fault	–	X	–	–
124	Tension limit	–	X	–	–
126	Motor rotating	–	X	–	–
127	Back EMF too high[2)]	X	–	–	Try to start PM motor which is rotating in an abnormal high speed.
250	New spare part	–	X	X	–
251	New type code	–	X	X	–

Table 7.1 Warnings and Alarms Code List

1) These faults may be caused by mains distortions. Installing a Danfoss line filter may rectify this problem.

2) For enclosure size J7, the warning can also be caused by high UDC voltage.

For diagnosis, read out the alarm words, warning words, and extended status words.

Bit	Hex	Dec	Alarm word (*parameter 16-90 Alarm Word*)	Alarm word 2 (*parameter 16-91 Alarm Word 2*)	Alarm word 3 (*parameter 16-97 Alarm Word 3*)	Warning word (*parameter 16-92 Warning Word*)	Warning word 2 (*parameter 16-93 Warning Word 2*)	Extended status word (*parameter 16-94 Ext. Status Word*)	Extended status word 2 (*parameter 16-95 Ext. Status Word 2*)
0	00000001	1	Brake check	Reserved	Reserved	Reserved	Reserved	Ramping	Off
1	00000002	2	Pwr. card temp	Gate drive voltage fault	Reserved	Pwr. card temp	Reserved	AMA tuning	Hand/Auto
2	00000004	4	Earth fault	Reserved	Reserved	Reserved	Reserved	Start CW/CCW	PROFIBUS OFF1 active
3	00000008	8	Ctrl. card temp	Reserved	Reserved	Ctrl. card temp	Reserved	Slowdown	PROFIBUS OFF2 active
4	00000010	16	Ctrl. word TO	Illegal FC config	Reserved	Ctrl. word TO	Reserved	Catch up	PROFIBUS OFF3 active
5	00000020	32	Overcurrent	Reserved	Reserved	Overcurrent	Reserved	Feedback high	Reserved
6	00000040	64	Torque limit	Reserved	Reserved	Torque limit	Reserved	Feedback low	Reserved
7	00000080	128	Motor Th. over	Reserved	Reserved	Motor Th. over	Reserved	Output current high	Control ready
8	00000100	256	Motor ETR over	Broken belt	Reserved	Motor ETR over	Broken belt	Output current low	Frequency converter ready
9	00000200	512	Inverter overld.	Reserved	Reserved	Inverter overld.	Reserved	Output freq. high	Quick stop
10	00000400	1024	DC undervolt.	Start failed	Reserved	DC undervolt.	Reserved	Output freq. low	DC brake
11	00000800	2048	DC overvolt.	Reserved	Reserved	DC overvolt.	Reserved	Brake check OK	Stop
12	00001000	4096	Short circuit	External interlock	Reserved	Reserved	Reserved	Braking max	Latched
13	00002000	8192	Reserved	Reserved	Reserved	Reserved	Reserved	Braking	Reserved
14	00004000	16384	Mains ph. loss	Reserved	Reserved	Mains ph. loss	Reserved	Reserved	Freeze output
15	00008000	32768	AMA not OK	Reserved	Reserved	No motor	Auto DC brake	OVC active	Reserved
16	00010000	65536	Live zero error	Reserved	Reserved	Live zero error	Reserved	AC brake	Jog
17	00020000	131072	Internal fault	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
18	00040000	262144	Brake overload	Reserved	Reserved	Brake resistor power limit	Reserved	Reserved	Start
19	00080000	524288	U phase loss	Reserved	Reserved	Reserved	Reserved	Reference high	Reserved
20	00100000	1048576	V phase loss	Option detection	Reserved	Reserved	Overload T27	Reference low	Start delay
21	00200000	2097152	W phase loss	Option fault	Reserved	Reserved	Reserved	Reserved	Sleep
22	00400000	4194304	Fieldbus fault	Locked rotor	Reserved	Fieldbus fault	Reserved	Reserved	Sleep boost

Bit	Hex	Dec	Alarm word (*parameter 16-90 Alarm Word*)	Alarm word 2 (*parameter 16-91 Alarm Word 2*)	Alarm word 3 (*parameter 16-97 Alarm Word 3*)	Warning word (*parameter 16-92 Warning Word*)	Warning word 2 (*parameter 16-93 Warning Word 2*)	Extended status word (*parameter 16-94 Ext. Status Word*)	Extended status word 2 (*parameter 16-95 Ext. Status Word 2*)
23	00800000	8388608	24 V supply low	Position ctrl. fault	Reserved	24 V supply low	Reserved	Reserved	Running
24	01000000	16777216	Mains failure	Tension Limit	Reserved	Mains failure	Reserved	Reserved	Bypass
25	02000000	33554432	Reserved	Current limit	Reserved	Current limit	Reserved	Reserved	Reserved
26	04000000	67108864	Brake resistor	Reserved	Reserved	Reserved	Reserved	Reserved	External interlock
27	08000000	134217728	Brake IGBT	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
28	10000000	268435456	Option change	Feedback fault	Reserved	Encoder loss	Reserved	Reserved	FlyStart active
29	20000000	536870912	Frequency converter initialized	Encoder loss	Reserved	Reserved	Back EMF too high	Reserved	Heat sink clean warning
30	40000000	1073741824	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
31	80000000	2147483648	Mech. brake low	Reserved	Reserved	Reserved	Reserved	Database busy	Reserved

Table 7.2 Description of Alarm Word, Warning Word, and Extended Status Word

7.4 Error Code List

LCP-related errors are shown in the format of **Err XX**, where XX indicates the error number. The LCP errors do not affect the operation of the frequency converter.

LCP error code	Description
Err 84	Communication between the LCP and the frequency converter is lost.
Err 85	The LCP key is disabled. One of the LCP keys is disabled in *parameter group 0-4* LCP Keypad*.
Err 86	Data copy failure: Occurs when data is copied from frequency converter to LCP, or from LCP to frequency converter (*parameter 0-50 LCP Copy*).
Err 87	Invalid LCP data: Occurs when data is being copied from LCP to frequency converter (*parameter 0-50 LCP Copy*).
Err 88	LCP data incompatible: Occurs when data is being copied from LCP to frequency converter (*parameter 0-50 LCP Copy*), typically because data is moved between frequency converters that have major software differences.
Err 89	An operation is issued via LCP to write a value to a parameter that is read-only.
Err 90	LCP, serial communication, or fieldbus communication attempts to update the same parameters at the same time.
Err 91	The parameter value that is input via the LCP is invalid.
Err 92	The parameter value that is input via the LCP exceeds limits.
Err 93	The LCP copy operation cannot be conducted when the frequency converter is running.
donE	A notification that the LCP Copy process is finished.
NWrun	The parameter cannot be changed while the frequency converter is running.
Err.	The password that is input via the LCP is incorrect.

Table 7.3 Error Code List

7.5 Troubleshooting

Symptom	Possible cause	Test	Solution
Motor not running	LCP stop	Check if [Off] has been pressed.	Press [Auto On] or [Hand On] (depending on operating mode) to run the motor.
	Missing start signal (standby)	Check *parameter 5-10 Terminal 18 Digital Input* of correct setting for terminal 18 (use default setting).	Apply a valid start signal to start the motor.
	Motor coast signal active (coasting)	Check *parameter 5-12 Terminal 27 Digital Input* for correct setting of terminal 27 (use default setting).	Apply 24 V on terminal 27 or program this terminal to *[0] No operation*.
	Wrong reference signal source	Check the following: • Is the reference signal local, remote, or bus reference? • Is preset reference active? • Is terminal connection correct? • Is the scaling of terminals correct? • Is the reference signal available?	Program correct settings. Set preset reference active in *parameter group 3-1* References*. Check for correct wiring. Check scaling of terminals. Check reference signal.
Motor is running in the wrong direction	Motor rotation limit	Check that *parameter 4-10 Motor Speed Direction* is programmed correctly.	Program correct settings.
	Active reversing signal	Check if a reversing command is programmed for the terminal in *parameter group 5-1* Digital inputs*.	Deactivate reversing signal.
	Wrong motor phase connection	Change *parameter 1-06 Clockwise Direction*.	

Symptom	Possible cause	Test	Solution
Motor is not reaching maximum speed	Frequency limits are set incorrectly	Check output limits in *parameter 4-14 Motor Speed High Limit [Hz]* and *parameter 4-19 Max Output Frequency*.	Program correct limits.
	Reference input signal not scaled correctly	Check reference input signal scaling in *parameter group 6-** Analog I/O mode* and *parameter group 3-1* References*.	Program correct settings.
Motor speed is unstable	Possible incorrect parameter settings	Check the settings of all motor parameters, including all motor compensation settings. For closed-loop operation, check PID settings.	Check settings in *parameter group 6-** Analog I/O mode*.
Motor runs roughly	Possible overmagnetization	Check for incorrect motor settings in all motor parameters.	Check motor settings in *parameter groups 1-2* Motor data, 1-3* Adv motor data*, and *1-5* Load indep. setting.*
Motor does not brake	Possible incorrect settings in the brake parameters. Possible too short ramp-down times.	Check brake parameters. Check ramp time settings.	Check *parameter groups 2-0* DC brake* and *3-0* Reference limits*.
Open power fuses or circuit breaker trip	Phase-to-phase short	Motor or panel has a short phase-to-phase. Check motor and panel phase for shorts.	Eliminate any shorts detected.
	Motor overload	Motor is overloaded for the application.	Perform the start-up test and verify that motor current is within specifications. If motor current exceeds the nameplate full load current, the motor may run only with reduced load. Review the specifications for the application.
	Loose connections	Perform pre-start-up check for loose connections.	Tighten loose connections.
Mains current imbalance greater than 3%	Problem with mains power (see *alarm 4, Mains phase loss* description)	Rotate input power leads into the frequency converter 1 position: A to B, B to C, C to A.	If the imbalanced leg follows the wire, it is a power problem. Check mains supply.
	Problem with the frequency converter unit	Rotate input power leads into the frequency converter 1 position: A to B, B to C, C to A.	If the imbalanced leg stays on same input terminal, it is a problem with the unit. Contact the supplier.
Motor current imbalance greater than 3%	Problem with motor or motor wiring	Rotate output motor leads 1 position: U to V, V to W, W to U.	If the imbalanced leg follows the wire, the problem is in the motor or motor wiring. Check motor and motor wiring.
	Problem with the frequency converter unit	Rotate output motor leads 1 position: U to V, V to W, W to U.	If the imbalanced leg stays on same output terminal, it is a problem with the unit. Contact the supplier.
Acoustic noise or vibration (for example a fan blade is making noise or vibrations at certain frequencies)	Resonances, for example, in the motor/fan system	Bypass critical frequencies by using parameters in *parameter group 4-6* Speed Bypass*.	Check if noise and/or vibration have been reduced to an acceptable limit.
		Turn off overmodulation in *parameter 14-03 Overmodulation*.	
		Increase resonance damping in *parameter 1-64 Resonance Dampening*.	

Table 7.4 Troubleshooting

8 Specifications

8.1 Mains Supply 3x380–480 V AC

Frequency converter typical shaft output [kW (hp)]	HK37 0.37 (0.5)	HK55 0.55 (0.75)	HK75 0.75 (1)	H1K1 1.1 (1.5)	H1K5 1.5 (2)	H2K2 2.2 (3)	H3K0 3 (4)	H4K0 4 (5.5)	H5K5 5.5 (7.5)	H7K5 7.5 (10)
Enclosure protection rating IP20	J1	J1	J1	J1	J1	J1	J2	J2	J2	J3
Output current										
Shaft output [kW]	0.37	0.55	0.75	1.1	1.5	2.2	3	4	5.5	7.5
Continuous (3x380–440 V) [A]	1.2	1.7	2.2	3	3.7	5.3	7.2	9	12	15.5
Continuous (3x441–480 V) [A]	1.1	1.6	2.1	2.8	3.4	4.8	6.3	8.2	11	14
Intermittent (60 s overload) [A]	1.9	2.7	3.5	4.8	5.9	8.5	11.5	14.4	19.2	24.8
Continuous kVA (400 V AC) [kVA]	0.84	1.18	1.53	2.08	2.57	3.68	4.99	6.24	8.32	10.74
Continuous kVA (480 V AC) [kVA]	0.9	1.3	1.7	2.5	2.8	4.0	5.2	6.8	9.1	11.6
Maximum input current										
Continuous (3x380–440 V) [A]	1.2	1.6	2.1	2.6	3.5	4.7	6.3	8.3	11.2	15.1
Continuous (3x441–480 V) [A]	1.0	1.2	1.8	2.0	2.9	3.9	4.3	6.8	9.4	12.6
Intermittent (60 s overload) [A]	1.9	2.6	3.4	4.2	5.6	7.5	10.1	13.3	17.9	24.2
Additional specifications										
Maximum cable cross-section (mains, motor, brake, and load sharing) [mm^2 (AWG)]	4 (12)									
Estimated power loss at rated maximum load [W][2)]	20.88	25.16	30.01	40.01	52.91	73.97	94.81	115.5	157.54	192.83
Weight [kg (lb)], enclosure protection rating IP20	2.3 (5.1)	2.3 (5.1)	2.3 (5.1)	2.3 (5.1)	2.3 (5.1)	2.5 (5.5)	3.6 (7.9)	3.6 (7.9)	3.6 (7.9)	4.1 (9.0)
Efficiency [%][3)]	96.2	97.0	97.2	97.4	97.4	97.6	97.5	97.6	97.7	98.0

Table 8.1 Mains Supply 3x380–480 V AC - Heavy Duty[1)]

Frequency converter typical shaft output [kW (hp)]	H11K 11 (15)	H15K 15 (20)	H18K 18.5 (25)	H22K 22 (30)	H30K 30 (40)	H37K 37 (50)	H45K 45 (60)	H55K 55 (75)	H75K 75 (100)
Enclosure protection rating IP20	J4	J4	J5	J5	J6	J6	J6	J7	J7
Output current									
Continuous (3x380–440 V) [A]	23	31	37	42.5	61	73	90	106	147
Continuous (3x441–480 V) [A]	21	27	34	40	52	65	77	96	124
Intermittent (60 s overload) [A]	34.5	46.5	55.5	63.8	91.5	109.5	135	159	220.5
Continuous kVA (400 V AC) [kVA]	15.94	21.48	25.64	29.45	42.3	50.6	62.4	73.4	101.8
Continuous kVA (480 V AC) [kVA]	17.5	22.4	28.3	33.3	43.2	54.0	64.0	79.8	103.1
Maximum input current									
Continuous (3x380–440 V) [A]	22.1	29.9	35.2	41.5	57	70.3	84.2	102.9	140.3
Continuous (3x441–480 V) [A]	18.4	24.7	29.3	34.6	49.3	60.8	72.7	88.8	121.1
Intermittent (60 s overload) [A]	33.2	44.9	52.8	62.3	85.5	105.5	126.3	154.4	210.5
Additional specifications									
Maximum cable size (mains, motor, brake) [mm^2 (AWG)]	16 (6)				50 (1/0)				95 (3/0)
Estimated power loss at rated maximum load [W][2)]	289.53	393.36	402.83	467.52	630	848	1175	1250	1507
Weight [kg (lb)], enclosure protection rating IP20	9.4 (20.7)	9.5 (20.9)	12.3 (27.1)	12.5 (27.6)	22.4 (49.4)	22.5 (49.6)	22.6 (49.8)	37.3 (82.2)	38.7 (85.3)
Efficiency [%][3)]	97.8	97.8	98.1	97.9	98.1	98.0	97.7	98.0	98.2

Table 8.2 Mains Supply 3x380–480 V AC - Heavy Duty[1)]

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Frequency converter typical shaft output [kW (hp)]	Q11K 11 (15)	Q15K 15 (20)	Q18K 18.5 (25)	Q22K 22 (30)	Q30K 30 (40)	Q37K 37 (50)	Q45K 45 (60)	Q55K 55 (75)	Q75K 75 (100)
Enclosure protection rating IP20	J4	J4	J5	J5	J6	J6	J6	J7	J7
Output current									
Continuous (3x380–440 V) [A]	23	31	37	42.5	61	73	90	106	147
Continuous (3x441–480 V) [A]	21	27	34	40	52	65	77	96	124
Intermittent (60 s overload) [A]	25.3	34.1	40.7	46.8	67.1	80.3	99	116.6	161.7
Continuous kVA (400 V AC) [kVA]	15.94	21.48	25.64	29.45	42.3	50.6	62.4	73.4	101.8
Continuous kVA (480 V AC) [kVA]	17.5	22.4	28.3	33.3	43.2	54.0	64.0	79.8	103.1
Maximum input current									
Continuous (3x380–440 V) [A]	22.1	29.9	35.2	41.5	57	70.3	84.2	102.9	140.3
Continuous (3x441–480 V) [A]	18.4	24.7	29.3	34.6	49.3	60.8	72.7	88.8	121.1
Intermittent (60 s overload) [A]	24.3	32.9	38.7	45.7	62.7	77.3	92.6	113.2	154.3
Additional specifications									
Maximum cable size (mains, motor, brake) [mm^2 (AWG)]	16 (6)				50 (1/0)				95 (3/0)
Estimated power loss at rated maximum load [W][2)]	289.53	393.36	402.83	467.52	630	848	1175	1250	1507
Weight [kg (lb)], enclosure protection rating IP20	9.4 (20.7)	9.5 (20.9)	12.3 (27.1)	12.5 (27.6)	22.4 (49.4)	22.5 (49.6)	22.6 (49.8)	37.3 (82.2)	38.7 (85.3)
Efficiency [%][3)]	97.8	97.8	98.1	97.9	98.1	98.0	97.7	98.0	98.2

Table 8.3 Mains Supply 3x380–480 V AC - Normal Duty[1)]

1) Heavy duty=150–160% current during 60 s, Normal duty=110% current during 60 s.

2) The typical power loss is at nominal load conditions and expected to be within ±15% (tolerance relates to variety in voltage and cable conditions).
Values are based on a typical motor efficiency (IE2/IE3 border line). Motors with lower efficiency add to the power loss in the frequency converter and motors with high efficiency reduce power loss.
Applies to dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may rise. LCP and typical control card power consumptions are included. Further options and customer load may add up to 30 W to the losses (though typically only 4 W extra for a fully loaded control card, fieldbus, or options for slot B).
For power loss data according to EN 50598-2, refer to www.danfoss.com/vltenergyefficiency.

3) Measured using 5 m shielded motor cables at rated load and rated frequency for enclosure sizes J1–J5, and using 33 m shielded motor cables at rated load and rated frequency for enclosure sizes J6 and J7. For energy efficiency class, see the Ambient Conditions section in chapter 8 Specifications. For part load losses, see www.danfoss.com/vltenergyefficiency.

8.2 General Technical Data

Mains supply (L1, L2, L3)	
Supply terminals	L1, L2, L3
Supply voltage	380–480 V: -15% (-25%)[1] to +10%

1) The frequency converter can run at -25% input voltage with reduced performance. The maximum output power of the frequency converter is 75% if input voltage is -25%, and 85% if input voltage is -15%.
Full torque cannot be expected at mains voltage lower than 10% below the lowest rated supply voltage of the frequency converter.

Supply frequency	50/60 Hz ±5%
Maximum 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 (10 hp)	Maximum 2 times/minute
Switching on input supply L1, L2, L3 (power-ups) 11–75 kW (15–100 hp)	Maximum 1 time/minute

The unit is suitable for use on a circuit capable of delivering less than 5000 RMS symmetrical Amperes, 480 V maximum.

Motor output (U, V, W)	
Output voltage	0–100% of supply voltage
Output frequency in U/f mode (for AM motor)	0–500 Hz
Output frequency in VVC$^+$ mode (for AM motor)	0–200 Hz
Output frequency in VVC$^+$ mode (for PM motor)	0–400 Hz
Switching on output	Unlimited
Ramp time	0.01–3600 s

Torque characteristics	
Starting torque (high overload)	Maximum 160% for 60 s[1)2)]
Overload torque (high overload)	Maximum 160% for 60 s[1)2)]
Starting torque (normal overload)	Maximum 110% for 60 s[1)2)]
Overload torque (normal overload)	Maximum 110% for 60 s[1)2)]
Starting current	Maximum 200% for 1 s
Torque rise time in VVC$^+$ (independent of f_{sw})	Maximum 50 ms

1) Percentage relates to the nominal torque. It is 150% for 11–75 kW (15–100 hp) frequency converters.
2) Once every 10 minutes.

Cable lengths and cross-sections[1)]	
Maximum motor cable length, shielded	50 m (164 ft)
Maximum motor cable length, unshielded	0.37–22 kW (0.5–30 hp): 75 m (246 ft), 30–75 kW (40–100 hp): 100 m (328 ft)
Maximum cross-section to control terminals, flexible/rigid wire	2.5 mm^2/14 AWG
Minimum cross-section to control terminals	0.55 mm^2/30 AWG

1) For power cables, see Table 8.1 to Table 8.3.

Digital inputs	
Programmable digital inputs	7
Terminal number	18, 19, 27[1)], 29[1)], 31, 32, 33
Logic	PNP or NPN
Voltage level	0–24 V DC
Voltage level, logic 0 PNP	< 5 V DC
Voltage level, logic 1 PNP	> 10 V DC
Voltage level, logic 0 NPN	> 19 V DC
Voltage level, logic 1 NPN	< 14 V DC
Maximum voltage on input	28 V DC
Pulse frequency range	4 Hz–32 kHz
(Duty cycle) minimum pulse width	4.5 ms

Input resistance, R_i	Approximately 4 kΩ

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

Analog inputs	
Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Software
Voltage level	0–10 V
Input resistance, R_i	Approximately 10 kΩ
Maximum voltage	-15 to +20 V
Current level	0/4 to 20 mA (scaleable)
Input resistance, R_i	Approximately 200 Ω
Maximum current	30 mA
Resolution for analog inputs	11 bit
Accuracy of analog inputs	Maximum error 0.5% of full scale
Bandwidth	100 Hz

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

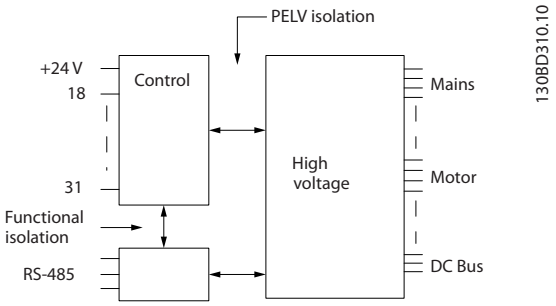

Illustration 8.1 Analog Inputs

NOTICE

HIGH ALTITUDE

For installation at altitudes above 2000 m (6562 ft), contact Danfoss hotline regarding PELV.

Pulse inputs	
Programmable pulse inputs	2
Terminal number pulse	29, 33
Maximum frequency at terminal 29, 33	32 kHz (push-pull driven)
Maximum frequency at terminal 29, 33	5 kHz (open collector)
Minimum frequency at terminal 29, 33	4 Hz
Voltage level	See the section on digital input
Maximum voltage on input	28 V DC
Input resistance, R_i	Approximately 4 kΩ
Pulse input accuracy	Maximum error: 0.1% of full scale

Analog outputs	
Number of programmable analog outputs	2
Terminal number	45, 42
Current range at analog output	0/4–20 mA
Maximum resistor load to common at analog output	500 Ω
Accuracy on analog output	Maximum error: 0.8% of full scale
Resolution on analog output	10 bit

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

Control card, RS485 serial communication	
Terminal number	68 (P,TX+, RX+), 69 (N,TX-, RX-)
Terminal number 61	Common for terminals 68 and 69

The RS485 serial communication circuit is galvanically isolated from the supply voltage (PELV).

Digital outputs	
Programmable digital/pulse outputs	2
Terminal number	27, 29[1)]
Voltage level at digital/frequency output	0–24 V
Maximum output current (sink or source)	40 mA
Maximum load at frequency output	1 kΩ
Maximum capacitive load at frequency output	10 nF
Minimum output frequency at frequency output	4 Hz
Maximum output frequency at frequency output	32 kHz
Accuracy of frequency output	Maximum error: 0.1% of full scale
Resolution of frequency output	10 bit

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

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

Control card, 24 V DC output	
Terminal number	12
Maximum load	100 mA

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

Relay outputs	
Programmable relay outputs	2
Relay 01 and 02	01–03 (NC), 01–02 (NO), 04–06 (NC), 04–05 (NO)
Maximum terminal load (AC-1)[1)] on 01–02/04–05 (NO) (Resistive load)	250 V AC, 3 A
Maximum terminal load (AC-15)[1)] on 01–02/04–05 (NO) (Inductive load @ cosφ 0.4)	250 V AC, 0.2 A
Maximum terminal load (DC-1)[1)] on 01–02/04–05 (NO) (Resistive load)	30 V DC, 2 A
Maximum terminal load (DC-13)[1)] on 01–02/04–05 (NO) (Inductive load)	24 V DC, 0.1 A
Maximum terminal load (AC-1)[1)] on 01–03/04–06 (NC) (Resistive load)	250 V AC, 3 A
Maximum terminal load (AC-15)[1)]on 01–03/04–06 (NC) (Inductive load @ cosφ 0.4)	250 V AC, 0.2 A
Maximum terminal load (DC-1)[1)] on 01–03/04–06 (NC) (Resistive load)	30 V DC, 2 A
Minimum terminal load on 01–03 (NC), 01–02 (NO)	24 V DC 10 mA, 24 V AC 20 mA

1) IEC 60947 t 4 and 5.
The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation.
The relays can be used on different loads (resistive load or inductive load) with different life cycles. The life cycle depends on the configuration of the specific load.

Control card, +10 V DC output	
Terminal number	50
Output voltage	10.5 V ±0.5 V
Maximum load	15 mA

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

Control characteristics	
Resolution of output frequency at 0–500 Hz	±0.003 Hz
System response time (terminals 18, 19, 27, 29, 32, and 33)	≤2 ms
Speed control range (open loop)	1:100 of synchronous speed
Speed accuracy (open loop)	±0.5% of nominal speed
Speed accuracy (closed loop)	±0.1% of nominal speed

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

Ambient conditions	
Enclosure sizes J1–J7	IP20
Vibration test, all enclosure sizes	1.0 g
Relative humidity	5–95% (IEC 721-3-3); Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H_2S test	Class Kd
Test method according to IEC 60068-2-43 H_2S (10 days)	
Ambient temperature (at 60 AVM switching mode)	
- with derating	Maximum 55 °C (131 °F) [1)2)]
- at full continuous output current with some power size	Maximum 50 °C (122 °F)
- at full continuous output current	Maximum 45 °C (113 °F)
Minimum ambient temperature during full-scale operation	0 °C (32 °F)
Minimum ambient temperature at reduced performance	-10 °C (14 °F)
Temperature during storage/transport	-25 to +65/70 °C (-13 to +149/158 °F)
Maximum altitude above sea level without derating	1000 m (3281 ft)
Maximum altitude above sea level with derating	3000 m (9843 ft)
EMC standards, emission	EN 61800-3, EN 61000-3-2, EN 61000-3-3, EN 61000-3-11, EN 61000-3-12, EN 61000-6-3/4, EN 55011, IEC 61800-3
EMC standards, immunity	EN 61800-3, EN 61000-6-1/2, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6
Energy efficiency class[3)]	IE2

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1) Refer to Special Conditions in the design guide for:

- *Derating for high ambient temperature.*
- *Derating for high altitude.*

2) To prevent control card overtemperature on PROFIBUS and PROFINET variants of VLT® AutomationDrive FC 360, avoid full digital/analog I/O load at ambient temperature higher than 45 °C (113 °F).

3) Determined according to EN 50598-2 at:

- *Rated load.*
- *90% rated frequency.*
- *Switching frequency factory setting.*
- *Switching pattern factory setting.*

Control card performance	
Scan interval	1 ms

Protection and features

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heat sink ensures that the frequency converter trips when the temperature reaches a predefined level. An overload temperature cannot be reset until the temperature of the heat sink is below the temperature limit.
- The frequency converter is protected against short circuits on motor terminals U, V, W.
- If a mains phase is missing, the frequency converter trips or issues a warning (depending on the load and parameter setting).
- Monitoring of the intermediate circuit voltage ensures that the frequency converter trips when the intermediate circuit voltage is too low or too high.
- The frequency converter is protected against ground faults on motor terminals U, V, W.

8.3 Fuses

Use fuses and/or circuit breakers on the supply side to protect service personnel and equipment from injuries and damage if there is component breakdown inside the frequency converter (first fault).

Branch circuit protection
Protect all branch circuits in an installation, switchgear, and machines against short circuit and overcurrent according to national/international regulations.

NOTICE

The recommendations do not cover branch circuit protection for UL.

Table 8.4 lists the recommended fuses that have been tested.

⚠WARNING

PERSONAL INJURY AND EQUIPMENT DAMAGE RISK
Malfunction or failing to follow the recommendations may result in personal risk and damage to the frequency converter and other equipment.

- **Select fuses according to recommendations. Possible damage can be limited to be inside the frequency converter.**

NOTICE

Using fuses or circuit breakers is mandatory to ensure compliance with IEC 60364 for CE.

Danfoss recommends using the fuses in *Table 8.4* on a circuit capable of delivering 100000 A_{rms} (symmetrical), 380–480 V depending on the frequency converter voltage rating. With the proper fusing, the frequency converter short circuit current rating (SCCR) is 100000 A_{rms}.

Enclosure size	Power [kW (hp)]	CE compliance fuse
J1	0.37–1.1 (0.5–1.5)	gG-10
	1.5 (2)	
	2.2 (3)	
J2	3.0 (4)	gG-25
	4.0 (5.5)	
	5.5 (7.5)	
J3	7.5 (10)	gG-32
J4	11–15 (15–20)	gG-50
J5	18.5 (25)	gG-80
	22 (30)	
J6	30 (40)	gG-125
	37 (50)	
	45 (60)	
J7	55 (75)	aR-250
	75 (100)	

Table 8.4 CE Fuse, 380–480 V, Enclosure Sizes J1–J7

8

8.4 Connection Tightening Torques

Make sure to use the right torques when tightening all electrical connections. Too low or too high torque may cause electrical connection problems. Use a torque wrench to ensure that correct torques are applied.

Enclosure size	Power [kW (hp)]	Torque [Nm (in-lb)]						
		Mains	Motor	DC connection	Brake	Ground	Control	Relay
J1	0.37–2.2 (0.5–3)	0.8 (7.1)	0.8 (7.1)	0.8 (7.1)	0.8 (7.1)	3 (26.6)	0.44 (3.89)	0.5 (4.4)
J2	3.0–5.5 (4–7.5)	0.8 (7.1)	0.8 (7.1)	0.8 (7.1)	0.8 (7.1)	3 (26.6)	0.44 (3.89)	0.5 (4.4)
J3	7.5 (10)	0.8 (7.1)	0.8 (7.1)	0.8 (7.1)	0.8 (7.1)	3 (26.6)	0.44 (3.89)	0.5 (4.4)
J4	11–15 (15–20)	1.2 (10.6)	1.2 (10.6)	1.2 (10.6)	1.2 (10.6)	1.6 (14.2)	0.44 (3.89)	0.5 (4.4)
J5	18.5–22 (25–30)	1.2 (10.6)	1.2 (10.6)	1.2 (10.6)	1.2 (10.6)	1.6 (14.2)	0.44 (3.89)	0.5 (4.4)
J6	30–45 (40–60)	3.5 (31.0)	3.5 (31.0)	3.5 (31.0)	–	1.6 (14.2)	0.44 (3.89)	0.5 (4.4)
J7	55 (75)	12 (106.2)	12 (106.2)	12 (106.2)	–	1.6 (14.2)	0.44 (3.89)	0.5 (4.4)
J7	75 (100)	14 (123.9)	14 (123.9)	14 (123.9)	–	1.6 (14.2)	0.44 (3.89)	0.5 (4.4)

Table 8.5 Tightening Torques

8

9 Appendix

9.1 Symbols, Abbreviations, and Conventions

°C	Degrees Celsius
°F	Degrees Fahrenheit
AC	Alternating current
AEO	Automatic energy optimization
AWG	American wire gauge
AMA	Automatic motor adaptation
AM motor	Asynchronous motor
DC	Direct current
EMC	Electromagnetic compatibility
ETR	Electronic thermal relay
$f_{M,N}$	Nominal motor frequency
FC	Frequency converter
GLCP	Graphical local control panel
I_{INV}	Rated inverter output current
I_{LIM}	Current limit
$I_{M,N}$	Nominal motor current
$I_{VLT,MAX}$	Maximum output current
$I_{VLT,N}$	Rated output current supplied by the frequency converter
IP	Ingress protection
LCP	Local control panel
MCT	Motion control tool
NLCP	Numerical local control panel
n_s	Synchronous motor speed
$P_{M,N}$	Nominal motor power
PELV	Protective extra low voltage
PCB	Printed circuit board
PM motor	Permanent magnet motor
PWM	Pulse width modulation
RPM	Revolutions per minute
T_{LIM}	Torque limit
$U_{M,N}$	Nominal motor voltage

Table 9.1 Symbols and Abbreviations

Conventions

- For illustrations, all dimensions are in [mm (in)].
- An asterisk (*) indicates the default setting of a parameter.
- Numbered lists indicate procedures.
- Bullet lists indicate other information.
- Italicized text indicates:
  - Cross-reference.
  - Link.
  - Parameter name.

9.2 Parameter Menu Structure

0- Operation / Display**
0-0* Basic Settings
0-01 Language
*[0] English
[10] Chinese
[28] Bras.port
0-03 Regional Settings
*[0] International
[1] North America
0-04 Operating State at Power-up
[0] Resume
*[1] Forced stop, ref=old
[2] Forced stop, ref=0
0-06 GridType
[10] 380-440V/50Hz/IT-grid
[11] 380-440V/50Hz/Delta
[12] 380-440V/50Hz
[20] 440-480V/50Hz/IT-grid
[21] 440-480V/50Hz/Delta
[22] 440-480V/50Hz
[110] 380-440V/60Hz/IT-grid
[111] 380-440V/60Hz/Delta
[112] 380-440V/60Hz
[120] 440-480V/60Hz/IT-grid
[121] 440-480V/60Hz/Delta
[122] 440-480V/60Hz
0-07 Auto DC Braking
[0] Off
*[1] On
0-1* Set-up Operations
0-10 Active Set-up
*[1] Set-up 1
[2] Set-up 2
[9] Multi Set-up
0-11 Programming Set-up
[1] Set-up 1
[2] Set-up 2
*[9] Active Set-up
0-12 Link Setups
[0] Not linked
*[20] Linked
0-14 Readout: Edit Set-ups / Channel
-2147483647 - 2147483647 *0
0-16 Application Selection
*[0] None
[1] Simple Process Close Loop
[2] Local/Remote
[3] Speed Open Loop
[4] Simple Speed Close Loop
[5] Multi Speed
[6] OGD LA10
[7] OGD V210
[8] Hoist
[9] Hoist Speed Close Loop
0-2* LCP Display
0-20 Display Line 1.1 Small
[0] None
[37] Display Text 1
[38] Display Text 2
[39] Display Text 3
[748] PCD Feed Forward
[953] Profibus Warning Word
[1501] Running Hours
[1502] kWh Counter
[1600] Control Word
[1601] Reference [Unit]
*[1602] Reference [%]
[1603] Status Word
[1605] Main Actual Value [%]
[1609] Custom Readout
[1610] Power [kW]
[1611] Power [hp]
[1612] Motor Voltage
[1613] Frequency
[1614] Motor current
[1615] Frequency [%]
[1616] Torque [Nm]
[1617] Speed [RPM]
[1618] Motor Thermal
[1622] Torque [%]
[1630] DC Link Voltage
[1633] Brake Energy /2 min
[1634] Heatsink Temp.
[1635] Inverter Thermal
[1636] Inv. Nom. Current
[1637] Inv. Max. Current
[1638] SL Controller State
[1639] Control Card Temp.
[1650] External Reference
[1652] Feedback[Unit]
[1653] Digi Pot Reference
[1657] Feedback [RPM]
[1660] Digital Input
[1661] Terminal 53 Setting
[1662] Analog input 53
[1663] Terminal 54 Setting
[1664] Analog input 54
[1665] Analog output 42 [mA]
[1666] Digital Output
[1667] Pulse input 29 [Hz]
[1668] Pulse input 33 [Hz]
[1669] Pulse output 27 [Hz]
[1670] Pulse output 29 [Hz]
[1671] Relay output
[1672] Counter A
[1673] Counter B
[1679] Analog output 45 [mA]
[1680] Fieldbus CTW 1
[1682] Fieldbus REF 1
[1684] Comm. Option STW
[1685] FC Port CTW 1
[1686] FC Port REF 1
[1690] Alarm Word
[1691] Alarm Word 2
[1692] Warning Word
[1693] Warning Word 2
[1694] Ext. Status Word
[1695] Ext. Status Word 2
[1697] Alarm Word 3
[1890] Process PID Error
[1891] Process PID Output
[1892] Process PID Clamped Output
[1893] Process PID Gain Scaled Output
[2117] Ext. 1 Reference [Unit]
[2118] Ext. 1 Feedback [Unit]
[2119] Ext. 1 Output [%]
[3401] PCD 1 Write For Application
[3402] PCD 2 Write For Application
[3403] PCD 3 Write For Application
[3404] PCD 4 Write For Application
[3405] PCD 5 Write For Application
[3406] PCD 6 Write For Application
[3407] PCD 7 Write For Application
[3408] PCD 8 Write For Application
[3409] PCD 9 Write For Application
[3410] PCD 10 Write For Application
[3421] PCD 1 Read For Application
[3422] PCD 2 Read For Application
[3423] PCD 3 Read For Application
[3424] PCD 4 Read For Application
[3425] PCD 5 Read For Application
[3426] PCD 6 Read For Application
[3427] PCD 7 Read For Application
[3428] PCD 8 Read For Application
[3429] PCD 9 Read For Application
[3430] PCD 10 Read For Application
[3450] Actual Position
[3456] Track Error
0-21 Display Line 1.2 Small
Same choices with 0-20
*[1614] Motor current
0-22 Display Line 1.3 Small
Same choices with 0-20
*[1610] Power [kW]
0-23 Display Line 2 Large
Same choices with 0-20
*[1613] Frequency
0-24 Display Line 3 Large
Same choices with 0-20
*[1502] kWh Counter
0-3* LCP Custom Readout
0-30 Custom Readout Unit
[0] None
*[1] %
[5] PPM
[10] 1/min
[11] RPM
[12] Pulse/s
[20] l/s
[21] l/min
[22] l/h
[23] m^3/s
[24] m^3/min
[25] m^3/h
[30] kg/s
[31] kg/min
[32] kg/h
[33] t/min
[34] t/h
[40] m/s
[41] m/min
[45] m
[60] °C
[70] mbar
[71] bar
[72] Pa
[73] kPa
[74] m WG
[80] kW
[120] GPM
[121] gal/s
[122] gal/min
[123] gal/h
[124] CFM
[127] ft^3/h
[140] ft/s
[141] ft/min
[160] °F
[170] psi
[171] lb/in2
[172] in WG
[173] ft WG
[180] HP
0-31 Custom Readout Min Value
0 - 999999.99 CustomReadoutUnit *0
CustomReadoutUnit
0-32 Custom Readout Max Value
0.0 - 999999.99 CustomReadoutUnit
*100 CustomReadoutUnit
0-37 Display Text 1
0 - 0 *
0-38 Display Text 2
0 - 0 *
0-39 Display Text 3
0 - 0 *
0-4* LCP Keypad
0-40 [Hand on] Key on LCP
[0] Disabled
*[1] Enabled
0-42 [Auto on] Key on LCP
[0] Disabled
*[1] Enabled
0-44 [Off/Reset] Key on LCP
[0] Disabled
*[1] Enabled
[7] Enable Reset Only
0-5* Copy/Save
0-50 LCP Copy
*[0] No copy
[1] All to LCP
[2] All from LCP
[3] Size indep. from LCP
0-51 Set-up Copy
*[0] No copy
[1] Copy from setup 1
[2] Copy from setup 2
[9] Copy from Factory setup
0-6* Password
0-60 Main Menu Password
0 - 999 *0
1- Load and Motor**
1-0* General Settings
1-00 Configuration Mode
*[0] Open Loop
[1] Speed closed loop
[2] Torque closed loop
[3] Process Closed Loop
[4] Torque open loop
[6] Surface Winder
[7] Extended PID Speed OL
1-01 Motor Control Principle
[0] U/f
*[1] VVC+
1-03 Torque Characteristics
*[0] Constant torque
[1] Variable Torque
[2] Auto Energy Optim. CT
1-06 Clockwise Direction
*[0] Normal
[1] Inverse
1-08 Motor Control Bandwidth
[0] High
[1] Medium
[2] Low
[3] Adaptive 1
[4] Adaptive 2
1-1* Motor Selection
1-10 Motor Construction
*[0] Asynchron
[1] PM, non salient SPM
[3] PM, salient IPM
1-14 Damping Gain
0 - 250 % *120 %
1-15 Low Speed Filter Time Const.
0.01 - 20 s *Size related
1-16 High Speed Filter Time Const.
0.01 - 20 s *Size related
1-17 Voltage filter time const.
0.001 - 1 s *Size related
1-2* Motor Data
1-20 Motor Power
[2] 0.12 kW - 0.16 hp
[3] 0.18 kW - 0.25 hp
[4] 0.25 kW - 0.33 hp
[5] 0.37 kW - 0.5 hp
[6] 0.55 kW - 0.75 hp
[7] 0.75 kW - 1 hp
[8] 1.1 kW - 1.5 hp
[9] 1.5 kW - 2 hp
[10] 2.2 kW - 3 hp
[11] 3 kW - 4 hp
[12] 3.7 kW - 5 hp
[13] 4 kW - 5.4 hp
[14] 5.5 kW - 7.5 hp
[15] 7.5 kW - 10 hp

[16] 11 kW - 15 hp
[17] 15 kW - 20 hp
[18] 18.5 kW - 25 hp
[19] 22 kW - 30 hp
[20] 30 kW - 40 hp
[21] 37 kW - 50 hp
[22] 45 kW - 60 hp
[23] 55 kW - 75 hp
[24] 75 kW - 100 hp
[25] 90 kW - 120 hp
1-22 Motor Voltage
50 - 1000 V *Size related
1-23 Motor Frequency
20 - 500 Hz *Size related
1-24 Motor Current
0.01 - 1000.00 A *Size related
1-25 Motor Nominal Speed
50 - 60000 RPM *Size related
1-26 Motor Cont. Rated Torque
0.1 - 10000.0 Nm *Size related
1-29 Automatic Motor Adaption (AMA)
*[0] Off
[1] Enable Complete AMA
[2] Enable Reduced AMA
1-3* Adv. Motor Data I
1-30 Stator Resistance (Rs)
0.0 - 9999.000 Ohm *Size related
1-31 Rotor Resistance (Rr)
0 - 9999.000 Ohm *Size related
1-33 Stator Leakage Reactance (X1)
0.0 - 9999.000 Ohm *Size related
1-35 Main Reactance (Xh)
0.0 - 9999.00 Ohm *Size related
1-37 d-axis Inductance (Ld)
0 - 65535 mH *Size related
1-38 q-axis Inductance (Lq)
0.000 - 65535 mH *Size related
1-39 Motor Poles
2 - 100 *Size related
1-4* Adv. Motor Data II
1-40 Back EMF at 1000 RPM
1 - 9000 V *Size related
1-42 Motor Cable Length
0 - 100 m *50 m
1-43 Motor Cable Length Feet
0 - 328 ft *164 ft
1-44 d-axis Inductance Sat. (LdSat)
0 - 65535 mH *Size related
1-45 q-axis Inductance Sat. (LqSat)
0 - 65535 mH *Size related
1-46 Position Detection Gain
20 - 200 % *100 %
1-48 Current at Min Inductance for d-axis
20 - 200 % *100 %
1-49 Current at Min Inductance for q-axis
20 - 200 % *100 %
1-5* Load Indep. Setting
1-50 Motor Magnetisation at Zero Speed
0 - 300 % *100 %
1-52 Min Speed Normal Magnetising [Hz]
0.1 - 10.0 Hz *1 Hz
1-55 U/f Characteristic - U
0 - 1000 V *Size related
1-56 U/f Characteristic - F
0 - 500.0 Hz *Size related
1-6* Load Depen. Setting
1-60 Low Speed Load Compensation
0 - 300 % *100 %
1-61 High Speed Load Compensation
0 - 300 % *100 %
1-62 Slip Compensation
-400 - 400.0 % *Size related
1-63 Slip Compensation Time Constant
0.05 - 5 s *0.1 s
1-64 Resonance Dampening
0 - 500 % *100 %
1-65 Resonance Dampening Time Constant
0.001 - 0.05 s *0.005 s
1-66 Min. Current at Low Speed
0 - 120 % *50 %
1-7* Start Adjustments
1-70 Start Mode
*[0] Rotor Detection
[1] Parking
[3] Rotor Last Position
1-71 Start Delay
0 - 10 s *0 s
1-72 Start Function
[0] DC Hold/delay time
*[2] Coast/delay time
[3] Start speed cw
[4] Horizontal operation
[5] VVC+ clockwise
1-73 Flying Start
*[0] Disabled
[1] Enabled
[2] Enabled Always
[3] Enabled Ref. Dir.
[4] Enab. Always Ref. Dir.
1-75 Start Speed [Hz]
0 - 500.0 Hz *Size related
1-76 Start Current
0 - 1000 A *Size related
1-78 Compressor Start Max Speed [Hz]
0 - 500 Hz *0 Hz
1-79 Compressor Start Max Time to Trip
0 - 10 s *5 s
1-8* Stop Adjustments
1-80 Function at Stop
*[0] Coast
[1] DC hold / Motor Preheat
[3] Pre-magnetizing
1-82 Min Speed for Function at Stop [Hz]
0 - 20 Hz *0 Hz
1-88 AC Brake Gain
1.0 - 2.0 *1.4
1-9* Motor Temperature
1-90 Motor Thermal Protection
*[0] No protection
[1] Thermistor warning
[2] Thermistor trip
[3] ETR warning 1
[4] ETR trip 1
[22] ETR Trip - Extended Detection
1-93 Thermistor Source
*[0] None
[1] Analog Input 53
[2] Analog Input 54
[3] Digital input 18
[4] Digital input 19
[5] Digital input 32
[6] Digital input 33
[7] Digital input 31
2- Brakes**
2-0* DC-Brake
2-00 DC Hold/Motor Preheat Current
0 - 160 % *50 %
2-01 DC Brake Current
0 - 150 % *50 %
2-02 DC Braking Time
0 - 60 s *10 s
2-04 DC Brake Cut In Speed
0 - 500 Hz *0 Hz
2-06 Parking Current
0 - 150 % *100 %
2-07 Parking Time
0.1 - 60 s *3 s
2-1* Brake Energy Funct.
2-10 Brake Function
*[0] Off
[1] Resistor brake
[2] AC brake
2-11 Brake Resistor (ohm)
0 - 6200 Ohm *Size related
2-12 Brake Power Limit (kW)
0.001 - 2000 kW *Size related
2-14 Brake voltage reduce
0 - 500 V *0 V
2-16 AC Brake, Max current
0 - 160 % *100 %
2-17 Over-voltage Control
*[0] Disabled
[1] Enabled (not at stop)
[2] Enabled
2-19 Over-voltage Gain
0 - 200 % *100 %
2-2* Mechanical Brake
2-20 Release Brake Current
0 - 100 A *0 A
2-22 Activate Brake Speed [Hz]
0 - 400 Hz *0 Hz
2-23 Activate Brake Delay
0 - 5 s *0 s
2-24 Stop Delay
0 - 5 s *0 s
2-25 Brake Release Time
0 - 5 s *0 s
2-31 Speed PID Start Proportional Gain
0.000 - 1.000 *0.015
2-32 Speed PID Start Integral Time
1.0 - 20000.0 ms *200.0 ms
2-33 Speed PID Start Lowpass Filter Time
0.1 - 100.0 ms *10.0 ms
2-39 Mech. Brake w/ dir. Change
*[0] OFF
[1] ON
[2] ON with start delay
3- Reference / Ramps**
3-0* Reference Limits
3-00 Reference Range
*[0] Min - Max
[1] -Max - +Max
3-01 Reference/Feedback Unit
[0] None
[1] %
[2] RPM
[3] Hz
[4] Nm
[5] PPM
[10] 1/min
[12] Pulse/s
[20] l/s
[21] l/min
[22] l/h
[23] m^3/s
[24] m^3/min
[25] m^3/h
[30] kg/s
[31] kg/min
[32] kg/h
[33] t/min
[34] t/h
[40] m/s
[41] m/min
[45] m
[60] °C
[70] mbar
[71] bar
[72] Pa
[73] kPa
[74] m WG
[80] kW
[120] GPM
[121] gal/s
[122] gal/min
[123] gal/h
[124] CFM
[125] ft^3/s
[126] ft^3/min
[127] ft^3/h
[130] lb/s
[131] lb/min
[132] lb/h
[140] ft/s
[141] ft/min
[145] ft
[150] lb ft
[160] °F
[170] psi
[171] lb/in2
[172] in WG
[173] ft WG
[180] HP
3-02 Minimum Reference
-4999.0 - 4999 ReferenceFeedbackUnit
*0 ReferenceFeedbackUnit
3-03 Maximum Reference
-4999.0 - 4999 ReferenceFeedbackUnit
*Size related
3-04 Reference Function
*[0] Sum
[1] External/Preset
3-1* References
3-10 Preset Reference
-100 - 100 % *0 %
3-11 Jog Speed [Hz]
0 - 500.0 Hz *5 Hz
3-12 Catch up/slow Down Value
0 - 100 % *0 %
3-13 Reference Site
*[0] Linked to Hand / Auto
[1] Remote
[2] Local
3-14 Preset Relative Reference
-100 - 100 % *0 %
3-15 Reference 1 Source
[0] No function
*[1] Analog Input 53
[2] Analog Input 54
[7] Frequency input 29
[8] Frequency input 33
[11] Local bus reference
[20] Digital pot.meter
[32] Bus PCD
3-16 Reference 2 Source
Same choices with 3-15
*[2] Analog Input 54
3-17 Reference 3 Source
Same choices with 3-15
*[11] Local bus reference
3-18 Relative Scaling Reference Resource
*[0] No function
[1] Analog Input 53
[2] Analog Input 54
[7] Frequency input 29
[8] Frequency input 33
[11] Local bus reference
3-4* Ramp 1
3-40 Ramp 1 Type
*[0] Linear
[2] Sine 2 Ramp
3-41 Ramp 1 Ramp Up Time
0.01 - 3600 s *Size related
3-42 Ramp 1 Ramp Down Time
0.01 - 3600 s *Size related

3-5* Ramp 2
Same content with 3-4*
3-6* Ramp 3
Same content with 3-4*
3-7* Ramp 4
Same content with 3-4*
3-8* Other Ramps
3-80 Jog Ramp Time
0.01 - 3600 s *Size related
3-81 Quick Stop Ramp Time
0.01 - 3600 s *Size related
3-9* Digital Pot.Meter
3-90 Step Size
0.01 - 200 % *0.10 %
3-92 Power Restore
*[0] Off
[1] On
3-93 Maximum Limit
-200 - 200 % *100 %
3-94 Minimum Limit
-200 - 200 % *-100 %
3-95 Ramp Delay
0 - 3600000 ms *1000 ms
4- Limits / Warnings**
4-1* Motor Limits
4-10 Motor Speed Direction
[0] Clockwise
*[2] Both directions
4-12 Motor Speed Low Limit [Hz]
0 - 400.0 Hz *0 Hz
4-14 Motor Speed High Limit [Hz]
0.1 - 500 Hz *65 Hz
4-16 Torque Limit Motor Mode
0 - 1000 % *Size related
4-17 Torque Limit Generator Mode
0 - 1000 % *100 %
4-18 Current Limit
0 - 1000 % *Size related
4-19 Max Output Frequency
0 - 500 Hz *Size related
4-2* Limit Factors
4-20 Torque Limit Factor Source
*[0] No function
[2] Analog in 53
[4] Analog in 53 inv
[6] Analog in 54
[8] Analog in 54 inv
[18] Bus Control
4-21 Speed Limit Factor Source
*[0] No function
[2] Analog in 53
[4] Analog in 53 inv
[6] Analog in 54
[8] Analog in 54 inv
[18] Bus Control
4-22 Break Away Boost
*[0] Off
[1] On
4-27 Torque Limit Bus Control
0 - 16384 *0
4-28 Speed Limit Bus Control
0 - 16384 *0
4-3* Motor Fb Monitor
4-30 Motor Feedback Loss Function
[0] Disabled
[1] Warning
*[2] Trip
[3] Jog
[4] Freeze Output
[5] Max Speed
[6] Switch to Open Loop
4-31 Motor Feedback Speed Error
0 - 50 Hz *20 Hz
4-32 Motor Feedback Loss Timeout
0 - 60 s *0.05 s
4-4* Adj. Warnings 2
4-40 Warning Freq. Low
0 - 500 Hz *Size related
4-41 Warning Freq. High
0 - 500 Hz *Size related
4-42 Adjustable Temperature Warning
0 - 200 *0
4-5* Adj. Warnings
4-50 Warning Current Low
0 - 500 A *0 A
4-51 Warning Current High
0 - 500.00 A *Size related
4-54 Warning Reference Low
-4999 - 4999 *-4999
4-55 Warning Reference High
-4999 - 4999 *4999
4-56 Warning Feedback Low
-4999 - 4999 ProcessCtrlUnit *-4999 ProcessCtrlUnit
4-57 Warning Feedback High
-4999 - 4999 ProcessCtrlUnit *4999 ProcessCtrlUnit
4-58 Missing Motor Phase Function
[0] Off
*[1] On
4-6* Speed Bypass
4-61 Bypass Speed From [Hz]
0 - 500 Hz *0 Hz
4-63 Bypass Speed To [Hz]
0 - 500 Hz *0 Hz
5- Digital In/Out**
5-0* Digital I/O mode
5-00 Digital Input Mode
*[0] PNP
[1] NPN
5-01 Terminal 27 Mode
*[0] Input
[1] Output
5-02 Terminal 29 Mode
*[0] Input
[1] Output
5-1* Digital Inputs
5-10 Terminal 18 Digital Input
[0] No operation
[1] Reset
[2] Coast inverse
[3] Coast and reset inverse
[4] Quick stop inverse
[5] DC-brake inverse
[6] Stop inverse
*[8] Start
[9] Latched start
[10] Reversing
[11] Start reversing
[12] Enable start forward
[13] Enable start reverse
[14] Jog
[15] Preset reference on
[16] Preset ref bit 0
[17] Preset ref bit 1
[18] Preset ref bit 2
[19] Freeze reference
[20] Freeze output
[21] Speed up
[22] Speed down
[23] Set-up select bit 0
[28] Catch up
[29] Slow down
[34] Ramp bit 0
[35] Ramp bit 1
[45] Latched start reverse
[51] External Interlock
[55] DigiPot increase
[56] DigiPot decrease
[57] DigiPot clear
[60] Counter A (up)
[61] Counter A (down)
[62] Reset Counter A
[63] Counter B (up)
[64] Counter B (down)
[65] Reset Counter B
[72] PID error inverse
[73] PID reset I part
[74] PID enable
[150] Go To Home
[151] Home Ref. Switch
[155] HW Limit Positive Inv
[156] HW Limit Negative Inv
[157] Pos. Quick Stop Inv
[160] Go To Target Pos.
[162] Pos. Idx Bit0
[163] Pos. Idx Bit1
[164] Pos. Idx Bit2
[165] Core diameter source
[166] New diameter select
[167] Reset diameter
[168] Winder jog forward
[169] Winder jog reverse
[170] Tension on
[180] Sync. Start
[181] Sync. Factor Up
[182] Sync. Factor Down
[183] Sync. Hold
[184] Sync. Latch Preset Factor Index
[185] Sync. Preset Factor Idx0
[186] Sync. Preset Factor Idx1
5-11 Terminal 19 Digital Input
Same choices with 5-10
*[10] Reversing
5-12 Terminal 27 Digital Input
Same choices with 5-10
*[2] Coast inverse
5-13 Terminal 29 Digital Input
Same choices with 5-10
*[14] Jog
[32] Pulse input
5-14 Terminal 32 Digital Input
Same choices with 5-10
*[0] No operation
[82] Encoder input B
5-15 Terminal 33 Digital Input
Same choices with 5-10
*[16] Preset ref bit 0
[32] Pulse input
[81] Encoder input A
5-16 Terminal 31 Digital Input
Same choices with 5-10
*[0] No operation
5-3* Digital Outputs
5-30 Terminal 27 Digital Output
*[0] No operation
[1] Control Ready
[2] Drive ready
[3] Drive rdy/rem ctrl
[4] Stand-by / no warning
[5] Running
[6] Running / no warning
[7] Run in range/no warn
[8] Run on ref/no warn
[9] Alarm
[10] Alarm or warning
[11] At torque limit
[12] Out of current range
[13] Below current, low
[14] Above current, high
[15] Out of frequency range
[16] Below frequency, low
[17] Above frequency, high
[18] Out of feedb. range
[19] Below feedback, low
[20] Above feedback, high
[21] Thermal warning
[22] Ready, no thermal warning
[23] Remote,ready,no TW
[24] Ready, no over-/ under voltage
[25] Reverse
[26] Bus OK
[27] Torque limit & stop
[28] Brake, no brake warning
[29] Brake ready, no fault
[30] Brake fault (IGBT)
[31] Relay 123
[32] Mech brake ctrl
[36] Control word bit 11
[37] Control word bit 12
[40] Out of ref range
[41] Below reference, low
[42] Above ref, high
[43] Extended PID Limit
[45] Bus ctrl.
[46] Bus control, timeout: On
[47] Bus control, timeout: Off
[55] Pulse output
[56] Heat sink cleaning warning, high
[60] Comparator 0
[61] Comparator 1
[62] Comparator 2
[63] Comparator 3
[64] Comparator 4
[65] Comparator 5
[70] Logic rule 0
[71] Logic rule 1
[72] Logic rule 2
[73] Logic rule 3
[74] Logic rule 4
[75] Logic rule 5
[80] SL digital output A
[81] SL digital output B
[82] SL digital output C
[83] SL digital output D
[91] Encoder emulate output A
[160] No alarm
[161] Running reverse
[165] Local ref active
[166] Remote ref active
[167] Start command activ
[168] Drive in hand mode
[169] Drive in auto mode
[170] Homing Completed
[171] Target Position Reached
[172] Position Control Fault
[173] Position Mech Brake
[174] TLD indicator
[175] Running on tension
[176] Ready to run
[177] End of roll
[193] Sleep Mode
[194] Broken Belt Function
5-31 Terminal 29 Digital Output
Same choices with 5-30
*[0] No operation
5-34 On Delay, Digital Output
0 - 600 s *0.01 s
5-35 Off Delay, Digital Output
0 - 600 s *0.01 s
5-4* Relays
5-40 Function Relay
[0] No operation
[1] Control Ready
[2] Drive ready

[3] Drive rdy/rem ctrl
[4] Stand-by / no warning
[5] Running
[6] Running / no warning
[7] Run in range/no warn
[8] Run on ref/no warn
[9] Alarm
[10] Alarm or warning
[11] At torque limit
[12] Out of current range
[13] Below current, low
[14] Above current, high
[15] Out of frequency range
[16] Below frequency, low
[17] Above frequency, high
[18] Out of feedb. range
[19] Below feedback, low
[20] Above feedback, high
[21] Thermal warning
[22] Ready, no thermal warning
[23] Remote,ready,no TW
[24] Ready, no over-/ under voltage
[25] Reverse
[26] Bus OK
[27] Torque limit & stop
[28] Brake, no brake warning
[29] Brake ready, no fault
[30] Brake fault (IGBT)
[31] Relay 123
[32] Mech brake ctrl
[36] Control word bit 11
[37] Control word bit 12
[40] Out of ref range
[41] Below reference, low
[42] Above ref, high
[45] Bus ctrl.
[46] Bus control, timeout: On
[47] Bus control, timeout: Off
[56] Heat sink cleaning warning, high
[60] Comparator 0
[61] Comparator 1
[62] Comparator 2
[63] Comparator 3
[64] Comparator 4
[65] Comparator 5
[70] Logic rule 0
[71] Logic rule 1
[72] Logic rule 2
[73] Logic rule 3
[74] Logic rule 4
[75] Logic rule 5
[80] SL digital output A
[81] SL digital output B
[82] SL digital output C
[83] SL digital output D
[160] No alarm
[161] Running reverse
[165] Local ref active
[166] Remote ref active
[167] Start command activ
[168] Drive in hand mode
[169] Drive in auto mode
[170] Homing Completed
[171] Target Position Reached
[172] Position Control Fault
[173] Position Mech Brake
[175] Running on tension
[176] Ready to run
[193] Sleep Mode
[194] Broken Belt Function

5-41 On Delay, Relay
0 - 600 s *0.01 s

5-42 Off Delay, Relay
0 - 600 s *0.01 s

5-5* Pulse Input

5-50 Term. 29 Low Frequency
4 - 31999 Hz *4 Hz

5-51 Term. 29 High Frequency
5 - 32000 Hz *32000 Hz

5-52 Term. 29 Low Ref./Feedb. Value
-4999 - 4999 *0

5-53 Term. 29 High Ref./Feedb. Value
-4999 - 4999 *Size related

5-55 Term. 33 Low Frequency
4 - 31999 Hz *4 Hz

5-56 Term. 33 High Frequency
5 - 32000 Hz *32000 Hz

5-57 Term. 33 Low Ref./Feedb. Value
-4999 - 4999 *0

5-58 Term. 33 High Ref./Feedb. Value
-4999 - 4999 *Size related

5-6* Pulse Output

5-60 Terminal 27 Pulse Output Variable
*[0] No operation
[45] Bus ctrl.
[48] Bus ctrl., timeout
[100] Output frequency
[101] Reference
[102] Process Feedback
[103] Motor Current
[104] Torque rel to limit
[105] Torq relate to rated
[106] Power
[107] Speed
[109] Max Out Freq
[113] PID Clamped Output

5-62 Pulse Output Max Freq 27
4 - 32000 Hz *5000 Hz

5-63 Terminal 29 Pulse Output Variable
Same choices with 5-60
*[0] No operation

5-65 Pulse Output Max Freq 29
4 - 32000 Hz *5000 Hz

5-7* 24V Encoder Input

5-70 Term 32/33 Pulses Per Revolution
1 - 4096 *1024

5-71 Term 32/33 Encoder Direction
*[0] Clockwise
[1] Counter clockwise

5-9* Bus Controlled

5-90 Digital & Relay Bus Control
0 - 0xFFFFFFFF *0

5-93 Pulse Out 27 Bus Control
0 - 100 % *0 %

5-94 Pulse Out 27 Timeout Preset
0 - 100 % *0 %

5-95 Pulse Out 29 Bus Control
0 - 100 % *0 %

5-96 Pulse Out 29 Timeout Preset
0 - 100 % *0 %

6- Analog In/Out**

6-0* Analog I/O Mode

6-00 Live Zero Timeout Time
1 - 99 s *10 s

6-01 Live Zero Timeout Function
*[0] Off
[1] Freeze output
[2] Stop
[3] Jogging
[4] Max. speed
[5] Stop and trip

6-1* Analog Input 53

6-10 Terminal 53 Low Voltage
0 - 10 V *0.07 V

6-11 Terminal 53 High Voltage
0 - 10 V *10 V

6-12 Terminal 53 Low Current
0 - 20 mA *4 mA

6-13 Terminal 53 High Current
0 - 20 mA *20 mA

6-14 Terminal 53 Low Ref./Feedb. Value
-4999 - 4999 *0

6-15 Terminal 53 High Ref./Feedb. Value
-4999 - 4999 *Size related

6-16 Terminal 53 Filter Time Constant
0.01 - 10 s *0.01 s

6-19 Terminal 53 mode
[0] Current mode
*[1] Voltage mode

6-2* Analog Input 54

6-20 Terminal 54 Low Voltage
0 - 10 V *0.07 V

6-21 Terminal 54 High Voltage
0 - 10 V *10 V

6-22 Terminal 54 Low Current
0 - 20 mA *4 mA

6-23 Terminal 54 High Current
0 - 20 mA *20 mA

6-24 Terminal 54 Low Ref./Feedb. Value
-4999 - 4999 *0

6-25 Terminal 54 High Ref./Feedb. Value
-4999 - 4999 *Size related

6-26 Terminal 54 Filter Time Constant
0.01 - 10 s *0.01 s

6-29 Terminal 54 mode
[0] Current mode
*[1] Voltage mode

6-7* Analog/Digital Output 45

6-70 Terminal 45 Mode
*[0] 0-20 mA
[1] 4-20 mA
[2] Digital Output

6-71 Terminal 45 Analog Output
*[0] No operation
[100] Output frequency
[101] Reference
[102] Process Feedback
[103] Motor Current
[104] Torque rel to limit
[105] Torq relate to rated
[106] Power
[107] Speed
[111] Speed Feedback
[113] PID Clamped Output
[139] Bus Control
[143] Ext. CL 1
[162] Tapered tension set point
[254] DC Link Voltage

6-72 Terminal 45 Digital Output
*[0] No operation
[1] Control Ready
[2] Drive ready
[3] Drive rdy/rem ctrl
[4] Stand-by / no warning
[5] Running
[6] Running / no warning
[7] Run in range/no warn
[8] Run on ref/no warn
[9] Alarm
[10] Alarm or warning
[11] At torque limit
[12] Out of current range
[13] Below current, low
[14] Above current, high
[15] Out of frequency range
[16] Below frequency, low
[17] Above frequency, high
[18] Out of feedb. range
[19] Below feedback, low
[20] Above feedback, high
[21] Thermal warning
[22] Ready, no thermal warning
[23] Remote,ready,no TW
[24] Ready, no over-/ under voltage
[25] Reverse
[26] Bus OK
[27] Torque limit & stop
[28] Brake, no brake warning
[29] Brake ready, no fault
[30] Brake fault (IGBT)
[31] Relay 123
[32] Mech brake ctrl
[36] Control word bit 11
[37] Control word bit 12
[40] Out of ref range
[41] Below reference, low
[42] Above ref, high
[45] Bus ctrl.
[46] Bus control, timeout: On
[47] Bus control, timeout: Off
[56] Heat sink cleaning warning, high
[60] Comparator 0
[61] Comparator 1
[62] Comparator 2
[63] Comparator 3
[64] Comparator 4
[65] Comparator 5
[70] Logic rule 0
[71] Logic rule 1
[72] Logic rule 2
[73] Logic rule 3
[74] Logic rule 4
[75] Logic rule 5
[80] SL digital output A
[81] SL digital output B
[82] SL digital output C
[83] SL digital output D
[160] No alarm
[161] Running reverse
[165] Local ref active
[166] Remote ref active
[167] Start command activ
[168] Drive in hand mode
[169] Drive in auto mode
[170] Homing Completed
[171] Target Position Reached
[172] Position Control Fault
[173] Position Mech Brake
[174] TLD indicator
[175] Running on tension
[176] Ready to run
[177] End of roll
[193] Sleep Mode
[194] Broken Belt Function
[198] Drive Bypass

6-73 Terminal 45 Output Min Scale
0 - 200 % *0 %

6-74 Terminal 45 Output Max Scale
0 - 200 % *100 %

6-76 Terminal 45 Output Bus Control
0 - 16384 *0

6-9* Analog/Digital Output 42

6-90 Terminal 42 Mode
*[0] 0-20 mA
[1] 4-20 mA
[2] Digital Output

6-91 Terminal 42 Analog Output
*[0] No operation
[100] Output frequency
[101] Reference
[102] Process Feedback
[103] Motor Current
[104] Torque rel to limit
[105] Torq relate to rated
[106] Power
[42] Above ref, high
[45] Bus ctrl.
[46] Bus control, timeout: On
[47] Bus control, timeout: Off
[56] Heat sink cleaning warning, high
[60] Comparator 0
[61] Comparator 1
[62] Comparator 2
[63] Comparator 3
[64] Comparator 4
[65] Comparator 5
[70] Logic rule 0
[71] Logic rule 1
[72] Logic rule 2
[73] Logic rule 3
[74] Logic rule 4
[75] Logic rule 5
[80] SL digital output A
[81] SL digital output B
[82] SL digital output C
[83] SL digital output D
[160] No alarm
[161] Running reverse
[165] Local ref active
[166] Remote ref active
[167] Start command activ
[168] Drive in hand mode
[169] Drive in auto mode
[170] Homing Completed
[171] Target Position Reached
[172] Position Control Fault
[173] Position Mech Brake
[174] TLD indicator
[175] Running on tension
[176] Ready to run
[177] End of roll
[193] Sleep Mode
[194] Broken Belt Function
[198] Drive Bypass

[107] Speed
[111] Speed Feedback
[113] PID Clamped Output
[139] Bus Control
[143] Ext. CL 1
[162] Tapered tension set point
[254] DC Link Voltage
6-92 Terminal 42 Digital Output
*[0] No operation
[1] Control Ready
[2] Drive ready
[3] Drive rdy/rem ctrl
[4] Stand-by / no warning
[5] Running
[6] Running / no warning
[7] Run in range/no warn
[8] Run on ref/no warn
[9] Alarm
[10] Alarm or warning
[11] At torque limit
[12] Out of current range
[13] Below current, low
[14] Above current, high
[15] Out of frequency range
[16] Below frequency, low
[17] Above frequency, high
[18] Out of feedb. range
[19] Below feedback, low
[20] Above feedback, high
[21] Thermal warning
[22] Ready, no thermal warning
[23] Remote,ready,no TW
[24] Ready, no over-/ under voltage
[25] Reverse
[26] Bus OK
[27] Torque limit & stop
[28] Brake, no brake warning
[29] Brake ready, no fault
[30] Brake fault (IGBT)
[31] Relay 123
[32] Mech brake ctrl
[36] Control word bit 11
[37] Control word bit 12
[40] Out of ref range
[41] Below reference, low
[42] Above ref, high
[45] Bus ctrl.
[46] Bus control, timeout: On
[47] Bus control, timeout: Off
[56] Heat sink cleaning warning, high
[60] Comparator 0
[61] Comparator 1
[62] Comparator 2
[63] Comparator 3
[64] Comparator 4
[65] Comparator 5
[70] Logic rule 0
[71] Logic rule 1
[72] Logic rule 2
[73] Logic rule 3
[74] Logic rule 4
[75] Logic rule 5
[80] SL digital output A
[81] SL digital output B
[82] SL digital output C
[83] SL digital output D
[160] No alarm
[161] Running reverse
[165] Local ref active
[166] Remote ref active
[167] Start command activ
[168] Drive in hand mode
[169] Drive in auto mode
[170] Homing Completed
[171] Target Position Reached
[172] Position Control Fault
[173] Position Mech Brake
[174] TLD indicator
[175] Running on tension
[176] Ready to run
[177] End of roll
[193] Sleep Mode
[194] Broken Belt Function
[198] Drive Bypass
6-93 Terminal 42 Output Min Scale
0 - 200 % *0 %
6-94 Terminal 42 Output Max Scale
0 - 200 % *100 %
6-96 Terminal 42 Output Bus Control
0 - 16384 *0

7- Controllers**

7-0* Speed PID Ctrl.
7-00 Speed PID Feedback Source
[1] 24V encoder
[2] MCB 102
[3] MCB 103
[6] Analog Input 53
[7] Analog Input 54
[8] Frequency input 29
[9] Frequency input 33
*[20] None
7-02 Speed PID Proportional Gain
0 - 1 *0.015
7-03 Speed PID Integral Time
2 - 20000 ms *8 ms
7-04 Speed PID Differentiation Time
0 - 200 ms *30 ms
7-05 Speed PID Diff. Gain Limit
1 - 20 *5
7-06 Speed PID Lowpass Filter Time
1 - 6000 ms *10 ms
7-07 Speed PID Feedback Gear Ratio
0.0001 - 32 *1
7-08 Speed PID Feed Forward Factor
0 - 500 % *0 %

7-1* Torque PID Ctrl.
7-12 Torque PID Proportional Gain
0 - 500 % *100 %
7-13 Torque PID Integration Time
0.002 - 2 s *0.020 s

7-2* Process Ctrl. Feedb
7-20 Process CL Feedback 1 Resource
*[0] No function
[1] Analog Input 53
[2] Analog Input 54
[3] Frequency input 29
[4] Frequency input 33
7-22 Process CL Feedback 2 Resource
*[0] No function
[1] Analog Input 53
[2] Analog Input 54
[3] Frequency input 29
[4] Frequency input 33

7-3* Process PID Ctrl.
7-30 Process PID Normal/ Inverse Control
*[0] Normal
[1] Inverse
7-31 Process PID Anti Windup
[0] Off
*[1] On
7-32 Process PID Start Speed
0 - 6000 RPM *0 RPM
7-33 Process PID Proportional Gain
0 - 10 *0.01
7-34 Process PID Integral Time
0.10 - 9999 s *9999 s
7-35 Process PID Differentiation Time
0 - 20 s *0 s
7-36 Process PID Diff. Gain Limit
1 - 50 *5
7-38 Process PID Feed Forward Factor
0 - 200 % *0 %
7-39 On Reference Bandwidth
0 - 200 % *5 %

7-4* Adv. Process PID I
7-40 Process PID I-part Reset
*[0] No
[1] Yes
7-41 Process PID Output Neg. Clamp
-100 - 100 % *-100 %
7-42 Process PID Output Pos. Clamp
-100 - 100 % *100 %
7-43 Process PID Gain Scale at Min. Ref.
0 - 100 % *100 %
7-44 Process PID Gain Scale at Max. Ref.
0 - 100 % *100 %
7-45 Process PID Feed Fwd Resource
*[0] No function
[1] Analog Input 53
[2] Analog Input 54
[7] Frequency input 29
[8] Frequency input 33
[11] Local bus reference
[32] Bus PCD
7-46 Process PID Feed Fwd Normal/ Inv. Ctrl.
*[0] Normal
[1] Inverse
7-48 PCD Feed Forward
0 - 65535 *0
7-49 Process PID Output Normal/ Inv. Ctrl.
*[0] Normal
[1] Inverse

7-5* Adv. Process PID II
7-50 Process PID Extended PID
[0] Disabled
*[1] Enabled
7-51 Process PID Feed Fwd Gain
0 - 100 *1
7-52 Process PID Feed Fwd Ramp up
0.01 - 100 s *0.01 s
7-53 Process PID Feed Fwd Ramp down
0.01 - 100 s *0.01 s
7-56 Process PID Ref. Filter Time
0.001 - 1 s *0.001 s
7-57 Process PID Fb. Filter Time
0.001 - 1 s *0.001 s

7-6* Feedback Conversion
7-60 Feedback 1 Conversion
*[0] Linear
[1] Square root
7-62 Feedback 2 Conversion
*[0] Linear
[1] Square root

8- Comm. and Options**

8-0* General Settings
8-00 Option A warning control
*[0] None
[1] Disable Warning
8-01 Control Site
*[0] Digital and ctrl.word
[1] Digital only
[2] Controlword only
8-02 Control Source
[0] None
[1] FC Port
[3] Option A
8-03 Control Timeout Time
0.1 - 6000 s *1 s
8-04 Control Timeout Function
*[0] Off
[1] Freeze output
[2] Stop
[3] Jogging
[4] Max. speed
[5] Stop and trip
8-07 Diagnosis Trigger
*[0] Disable
[1] Trigger on alarms
[2] Trigger alarm/warn.

8-1* Ctrl. Word Settings
8-10 Control Word Profile
*[0] FC profile
[1] PROFIdrive profile
8-14 Configurable Control Word CTW
[0] None
*[1] Profile default
[2] CTW Valid, active low
[4] PID error inverse
[5] PID reset I part
[6] PID enable
8-19 Product Code
0 - 2147483647 *Size related

8-3* FC Port Settings
8-30 Protocol
*[0] FC
[2] Modbus RTU
8-31 Address
0.0 - 247 *1
8-32 Baud Rate
[0] 2400 Baud
[1] 4800 Baud
[2] 9600 Baud
[3] 19200 Baud
[4] 38400 Baud
[5] 57600 Baud
[6] 76800 Baud
[7] 115200 Baud
8-33 Parity / Stop Bits
[0] Even Parity, 1 Stop Bit
[1] Odd Parity, 1 Stop Bit
[2] No Parity, 1 Stop Bit
[3] No Parity, 2 Stop Bits
8-35 Minimum Response Delay
0.0010 - 0.5 s *0.01 s
8-36 Maximum Response Delay
0.1 - 10.0 s *Size related

8-4* FC MC protocol set
8-42 PCD Write Configuration
[0] None
[1] [302] Minimum Reference
[2] [303] Maximum Reference
[3] [341] Ramp 1 Ramp up time
[4] [342] Ramp 1 Ramp down time
[5] [351] Ramp 2 Ramp up time
[6] [352] Ramp 2 Ramp down time
[7] [380] Jog Ramp Time
[8] [381] Quick Stop Time
[9] [412] Motor Speed Low Limit [Hz]
[10] [414] Motor Speed High Limit [Hz]
[11] [590] Digital & Relay Bus Control
[12] [676] Terminal45 Output Bus Control
[13] [696] Terminal 42 Output Bus Control
[15] FC Port CTW
[16] FC Port REF
[18] [311] Jog Speed [Hz]
[19] [427] Torque limit bus control
[20] [428] Speed limit bus control
8-43 PCD Read Configuration
[0] None
[1] [1500] Operation Hours
[2] [1501] Running Hours
[3] [1502] kWh Counter
[4] [1600] Control Word
[5] [1601] Reference [Unit]

[6] [1602] Reference %
[7] [1603] Status Word
[8] [1605] Main Actual Value [%]
[9] [1609] Custom Readout
[10] [1610] Power [kW]
[11] [1611] Power [hp]
[12] [1612] Motor Voltage
[13] [1613] Frequency
[14] [1614] Motor Current
[15] [1615] Frequency [%]
[16] [1616] Torque [Nm]
[17] [1618] Motor Thermal
[18] [1630] DC Link Voltage
[19] [1634] Heatsink Temp.
[20] [1635] Inverter Thermal
[21] [1638] SL Controller State
[22] [1650] External Reference
[23] [1652] Feedback [Unit]
[24] [1660] Digital Input 18,19,27,33
[25] [1661] Terminal 53 Switch Setting
[26] [1662] Analog input 53
[27] [1663] Terminal 54 Switch Setting
[28] [1664] Analog input 54
[29] [1665] Analog output 42 [mA]
[30] [1671] Relay output
[31] [1672] Counter A
[32] [1673] Counter B
[33] [1690] Alarm Word
[34] [1692] Warning Word
[35] [1694] Ext. Status Word
[38] [1622] Torque [%]
[41] [1657] Feedback [RPM]
[42] [1679] Analog Output 45 [mA]
[43] [1617] Speed [RPM]
[44] [1666] Digital Output

8-5* Digital/Bus

8-50 Coasting Select
[0] Digital input
[1] Bus
[2] Logic AND
*[3] Logic OR
8-51 Quick Stop Select
[0] Digital input
[1] Bus
[2] Logic AND
*[3] Logic OR
8-52 DC Brake Select
[0] Digital input
[1] Bus
[2] Logic AND
*[3] Logic OR
8-53 Start Select
[0] Digital input
[1] Bus
[2] Logic AND
*[3] Logic OR
8-54 Reversing Select
[0] Digital input
[1] Bus
[2] Logic AND
*[3] Logic OR
8-55 Set-up Select
[0] Digital input
[1] Bus
[2] Logic AND
*[3] Logic OR
8-56 Preset Reference Select
[0] Digital input
[1] Bus
[2] Logic AND
*[3] Logic OR
8-57 Profidrive OFF2 Select
[0] Digital input
[1] Bus
[2] Logic AND
*[3] Logic OR
8-58 Profidrive OFF3 Select
[0] Digital input
[1] Bus
[2] Logic AND
*[3] Logic OR

8-7* Protocol SW Version

8-79 Protocol Firmware version
0 - 65535 *Size related

8-8* FC Port Diagnostics

8-80 Bus Message Count
0 - 4294967295 *0
8-81 Bus Error Count
0 - 4294967295 *0
8-82 Slave Messages Rcvd
0 - 4294967295 *0
8-83 Slave Error Count
0 - 4294967295 *0
8-84 Slave Messages Sent
0 - 4294967295 *0
8-85 Slave Timeout Errors
0 - 4294967295 *0
8-88 Reset FC port Diagnostics
*[0] Do not reset
[1] Reset counter

8-9* Bus Feedback

8-90 Bus Jog 1 Speed
0 - 1500 RPM *100 RPM
8-91 Bus Jog 2 Speed
0 - 1500 RPM *200 RPM

9- PROFIdrive**

9-15 PCD Write Configuration
[0] None
[302] Minimum Reference
[303] Maximum Reference
[311] Jog Speed [Hz]
[312] Catch up/slow Down Value
[341] Ramp 1 Ramp Up Time
[342] Ramp 1 Ramp Down Time
[351] Ramp 2 Ramp Up Time
[352] Ramp 2 Ramp Down Time
[380] Jog Ramp Time
[381] Quick Stop Ramp Time
[412] Motor Speed Low Limit [Hz]
[414] Motor Speed High Limit [Hz]
[416] Torque Limit Motor Mode
[417] Torque Limit Generator Mode
[427] Torque Limit Bus Control
[428] Speed Limit Bus Control
[553] Term. 29 High Ref./Feedb. Value
[558] Term. 33 High Ref./Feedb. Value
[590] Digital & Relay Bus Control
[593] Pulse Out 27 Bus Control
[595] Pulse Out 29 Bus Control
[615] Terminal 53 High Ref./Feedb. Value
[625] Terminal 54 High Ref./Feedb. Value
[676] Terminal 45 Output Bus Control
[696] Terminal 42 Output Bus Control
[733] Process PID Proportional Gain
[734] Process PID Integral Time
[735] Process PID Differentiation Time
[748] PCD Feed Forward
[890] Bus Jog 1 Speed
[891] Bus Jog 2 Speed
[1680] Fieldbus CTW 1
[1682] Fieldbus REF 1
[3401] PCD 1 Write For Application
[3402] PCD 2 Write For Application
[3403] PCD 3 Write For Application
[3404] PCD 4 Write For Application
[3405] PCD 5 Write For Application
[3406] PCD 6 Write For Application
[3407] PCD 7 Write For Application
[3408] PCD 8 Write For Application
[3409] PCD 9 Write For Application
[3410] PCD 10 Write For Application
9-16 PCD Read Configuration
[0] None
[1500] Operating hours
[1501] Running Hours
[1502] kWh Counter
[1600] Control Word
[1601] Reference [Unit]
[1602] Reference [%]
[1603] Status Word
[1605] Main Actual Value [%]
[1609] Custom Readout
[1610] Power [kW]
[1611] Power [hp]
[1612] Motor Voltage
[1613] Frequency
[1614] Motor current
[1615] Frequency [%]
[1616] Torque [Nm]
[1617] Speed [RPM]
[1618] Motor Thermal
[1622] Torque [%]
[1630] DC Link Voltage
[1633] Brake Energy /2 min
[1634] Heatsink Temp.
[1635] Inverter Thermal
[1638] SL Controller State
[1639] Control Card Temp.
[1650] External Reference
[1652] Feedback[Unit]
[1653] Digi Pot Reference
[1657] Feedback [RPM]
[1660] Digital Input
[1661] Terminal 53 Setting
[1662] Analog input 53
[1663] Terminal 54 Setting
[1664] Analog input 54
[1665] Analog output 42 [mA]
[1666] Digital Output
[1667] Pulse input 29 [Hz]
[1668] Pulse input 33 [Hz]
[1669] Pulse output 27 [Hz]
[1670] Pulse output 29 [Hz]
[1671] Relay output
[1672] Counter A
[1673] Counter B
[1679] Analog output 45 [mA]
[1684] Comm. Option STW
[1685] FC Port CTW 1
[1690] Alarm Word
[1691] Alarm Word 2
[1692] Warning Word
[1693] Warning Word 2
[1694] Ext. Status Word
[1695] Ext. Status Word 2
[1697] Alarm Word 3
[3421] PCD 1 Read For Application
[3422] PCD 2 Read For Application
[3423] PCD 3 Read For Application
[3424] PCD 4 Read For Application
[3425] PCD 5 Read For Application
[3426] PCD 6 Read For Application
[3427] PCD 7 Read For Application
[3428] PCD 8 Read For Application
[3429] PCD 9 Read For Application
[3430] PCD 10 Read For Application
[3450] Actual Position
[3456] Track Error
9-18 Node Address
1 - 126 *126
9-19 Drive Unit System Number
0 - 65535 *1037
9-22 Telegram Selection
[1] Standard telegram 1
*[100] None
[101] PPO 1
[102] PPO 2
[103] PPO 3
[104] PPO 4
[105] PPO 5
[106] PPO 6
[107] PPO 7
[108] PPO 8
[200] Custom telegram 1
9-23 Parameters for Signals
*[0] None
[302] Minimum Reference
[303] Maximum Reference
[311] Jog Speed [Hz]
[312] Catch up/slow Down Value
[341] Ramp 1 Ramp Up Time
[342] Ramp 1 Ramp Down Time
[351] Ramp 2 Ramp Up Time
[352] Ramp 2 Ramp Down Time
[380] Jog Ramp Time
[381] Quick Stop Ramp Time
[412] Motor Speed Low Limit [Hz]
[414] Motor Speed High Limit [Hz]
[416] Torque Limit Motor Mode
[417] Torque Limit Generator Mode
[553] Term. 29 High Ref./Feedb. Value
[558] Term. 33 High Ref./Feedb. Value
[590] Digital & Relay Bus Control
[593] Pulse Out 27 Bus Control
[595] Pulse Out 29 Bus Control
[615] Terminal 53 High Ref./Feedb. Value
[625] Terminal 54 High Ref./Feedb. Value
[676] Terminal 45 Output Bus Control
[696] Terminal 42 Output Bus Control
[733] Process PID Proportional Gain
[734] Process PID Integral Time
[735] Process PID Differentiation Time
[748] PCD Feed Forward
[890] Bus Jog 1 Speed
[891] Bus Jog 2 Speed
[1500] Operating hours
[1501] Running Hours
[1502] kWh Counter
[1600] Control Word
[1601] Reference [Unit]
[1602] Reference [%]
[1603] Status Word
[1605] Main Actual Value [%]
[1609] Custom Readout
[1610] Power [kW]
[1611] Power [hp]
[1612] Motor Voltage
[1613] Frequency
[1614] Motor current
[1615] Frequency [%]
[1616] Torque [Nm]
[1617] Speed [RPM]
[1618] Motor Thermal
[1622] Torque [%]
[1630] DC Link Voltage
[1633] Brake Energy /2 min
[1634] Heatsink Temp.
[1635] Inverter Thermal
[1638] SL Controller State
[1639] Control Card Temp.
[1652] Feedback[Unit]
[1653] Digi Pot Reference
[1657] Feedback [RPM]
[1660] Digital Input

[1661] Terminal 53 Setting
[1662] Analog input 53
[1663] Terminal 54 Setting
[1664] Analog input 54
[1665] Analog output 42 [mA]
[1667] Pulse input 29 [Hz]
[1668] Pulse input 33 [Hz]
[1669] Pulse output 27 [Hz]
[1670] Pulse output 29 [Hz]
[1671] Relay output
[1672] Counter A
[1673] Counter B
[1679] Analog output 45 [mA]
[1680] Fieldbus CTW 1
[1682] Fieldbus REF 1
[1684] Comm. Option STW
[1685] FC Port CTW 1
[1690] Alarm Word
[1691] Alarm Word 2
[1692] Warning Word
[1693] Warning Word 2
[1694] Ext. Status Word
[1695] Ext. Status Word 2
[1697] Alarm Word 3
[3401] PCD 1 Write For Application
[3402] PCD 2 Write For Application
[3403] PCD 3 Write For Application
[3404] PCD 4 Write For Application
[3405] PCD 5 Write For Application
[3406] PCD 6 Write For Application
[3407] PCD 7 Write For Application
[3408] PCD 8 Write For Application
[3409] PCD 9 Write For Application
[3410] PCD 10 Write For Application
[3421] PCD 1 Read For Application
[3422] PCD 2 Read For Application
[3423] PCD 3 Read For Application
[3424] PCD 4 Read For Application
[3425] PCD 5 Read For Application
[3426] PCD 6 Read For Application
[3427] PCD 7 Read For Application
[3428] PCD 8 Read For Application
[3429] PCD 9 Read For Application
[3430] PCD 10 Read For Application
[3450] Actual Position
[3456] Track Error
9-27 Parameter Edit
[0] Disabled
*[1] Enabled
9-28 Process Control
[0] Disable
*[1] Enable cyclic master
9-44 Fault Message Counter
0 - 65535 *0
9-52 Fault Situation Counter
0 - 1000 *0
9-53 Profibus Warning Word
0 - 65535 *0
9-63 Actual Baud Rate
[0] 9,6 kbit/s
[1] 19,2 kbit/s
[2] 93,75 kbit/s
[3] 187,5 kbit/s
[4] 500 kbit/s
[6] 1500 kbit/s
[7] 3000 kbit/s
[8] 6000 kbit/s
[9] 12000 kbit/s
[10] 31,25 kbit/s
[11] 45,45 kbit/s
*[255] No baudrate found
9-65 Profile Number
0 - 0 *0
9-70 Edit Set-up
[1] Set-up 1
[2] Set-up 2
*[9] Active Set-up
9-71 Profibus Save Data Values
*[0] Off
[1] Store all setups
9-72 ProfibusDriveReset
*[0] No action
[1] Power-on reset
[2] Power-on reset prep
[3] Comm option reset
9-80 Defined Parameters (1)
0 - 9999 *0
9-81 Defined Parameters (2)
0 - 9999 *0
9-82 Defined Parameters (3)
0 - 9999 *0
9-83 Defined Parameters (4)
0 - 9999 *0
9-84 Defined Parameters (5)
0 - 9999 *0
9-85 Defined Parameters (6)
0 - 9999 *0
9-90 Changed Parameters (1)
0 - 9999 *0
9-91 Changed Parameters (2)
0 - 9999 *0
9-92 Changed Parameters (3)
0 - 9999 *0
9-93 Changed Parameters (4)
0 - 9999 *0
9-94 Changed Parameters (5)
0 - 9999 *0

12- Ethernet**

12-0* IP Settings

12-00 IP Address Assignment
[0] MANUAL
[1] DHCP
[2] BOOTP
*[10] DCP
[20] From node ID
12-01 IP Address
0 - 4294967295 *0
12-02 Subnet Mask
0 - 4294967295 *0
12-03 Default Gateway
0 - 4294967295 *0
12-04 DHCP Server
0 - 2147483647 *0
12-05 Lease Expires
0 - 4294967295 *0
12-06 Name Servers
0 - 4294967295 *0
12-07 Domain Name
1 - 48 *0
12-08 Host Name
1 - 48 *0
12-09 Physical Address
0 - 17 *0

12-1* Ethernet Link Parameters

12-10 Link Status
*[0] No Link
[1] Link
12-11 Link Duration
0 - 0 *Size related
12-12 Auto Negotiation
[0] Off
*[1] On
12-13 Link Speed
*[0] None
[1] 10 Mbps
[2] 100 Mbps
12-14 Link Duplex
[0] Half Duplex
*[1] Full Duplex

12-8* Other Ethernet Services

12-80 FTP Server
*[0] Disabled
[1] Enabled
12-81 HTTP Server
*[0] Disabled
[1] Enabled
12-82 SMTP Service
*[0] Disabled
[1] Enabled
12-89 Transparent Socket Channel Port
0 - 65535 *4000

12-9* Advanced Ethernet Services

12-90 Cable Diagnostic
*[0] Disabled
[1] Enabled
12-91 Auto Cross Over
[0] Disabled
*[1] Enabled
12-92 IGMP Snooping
[0] Disabled
*[1] Enabled
12-93 Cable Error Length
0 - 65535 *0
12-94 Broadcast Storm Protection
-1 - 20 % *-1 %
12-95 Broadcast Storm Filter
*[0] Broadcast only
[1] Broadcast & Multicast
12-96 Port Config
[0] Normal
[1] Mirror Port 1 to 2
[2] Mirror Port 2 to 1
[10] Port 1 disabled
[11] Port 2 disabled
[254] Mirror Int. Port to 1
[255] Mirror Int. Port to 2
12-98 Interface Counters
0 - 4294967295 *4000
12-99 Media Counters
0 - 4294967295 *0

13- Smart Logic**

13-0* SLC Settings

13-00 SL Controller Mode
*[0] Off
[1] On
13-01 Start Event
[0] False
[1] True
[2] Running
[3] In range
[4] On reference
[7] Out of current range
[8] Below I low
[9] Above I high
[16] Thermal warning
[17] Mains out of range
[18] Reversing
[19] Warning
[20] Alarm (trip)
[21] Alarm (trip lock)
[22] Comparator 0
[23] Comparator 1
[24] Comparator 2
[25] Comparator 3
[26] Logic rule 0
[27] Logic rule 1
[28] Logic rule 2
[29] Logic rule 3
[33] Digital input DI18
[34] Digital input DI19
[35] Digital input DI27
[36] Digital input DI29
*[39] Start command
[40] Drive stopped
[42] Auto Reset Trip
[50] Comparator 4
[51] Comparator 5
[60] Logic rule 4
[61] Logic rule 5
[83] Broken Belt
13-02 Stop Event
Same choices with 13-01
*[40] Drive stopped
13-03 Reset SLC
*[0] Do not reset SLC
[1] Reset SLC

13-1* Comparators

13-10 Comparator Operand
*[0] Disabled
[1] Reference %
[2] Feedback %
[3] Motor speed
[4] Motor Current
[6] Motor power
[7] Motor voltage
[8] DC-link voltage
[12] Analog input AI53
[13] Analog input AI54
[18] Pulse input FI29
[19] Pulse input FI33
[20] Alarm number
[30] Counter A
[31] Counter B
13-11 Comparator Operator
[0] Less Than (<)
*[1] Approx.Equal (~)
[2] Greater Than (>)
13-12 Comparator Value
-9999 - 9999 *0

13-2* Timers

13-20 SL Controller Timer
0 - 3600 s *0 s

13-4* Logic Rules

13-40 Logic Rule Boolean 1
*[0] False
[1] True
[2] Running
[3] In range
[4] On reference
[7] Out of current range
[8] Below I low
[9] Above I high
[16] Thermal warning
[17] Mains out of range
[18] Reversing
[19] Warning
[20] Alarm (trip)
[21] Alarm (trip lock)
[22] Comparator 0
[23] Comparator 1
[24] Comparator 2
[25] Comparator 3
[26] Logic rule 0
[27] Logic rule 1
[28] Logic rule 2
[29] Logic rule 3
[30] SL Time-out 0
[31] SL Time-out 1
[32] SL Time-out 2
[33] Digital input DI18
[34] Digital input DI19
[35] Digital input DI27
[36] Digital input DI29
[39] Start command
[40] Drive stopped

[42] Auto Reset Trip
[50] Comparator 4
[51] Comparator 5
[60] Logic rule 4
[61] Logic rule 5
[70] SL Time-out 3
[71] SL Time-out 4
[72] SL Time-out 5
[73] SL Time-out 6
[74] SL Time-out 7
[83] Broken Belt
13-41 Logic Rule Operator 1
*[0] Disabled
[1] AND
[2] OR
[3] AND NOT
[4] OR NOT
[5] NOT AND
[6] NOT OR
[7] NOT AND NOT
[8] NOT OR NOT
13-42 Logic Rule Boolean 2
Same choices with 13-40
*[0] False
13-43 Logic Rule Operator 2
Same choices with 13-41
*[0] Disabled
13-44 Logic Rule Boolean 3
Same choices with 13-40
*[0] False
13-5* States
13-51 SL Controller Event
*[0] False
[1] True
[2] Running
[3] In range
[4] On reference
[7] Out of current range
[8] Below I low
[9] Above I high
[16] Thermal warning
[17] Mains out of range
[18] Reversing
[19] Warning
[20] Alarm (trip)
[21] Alarm (trip lock)
[22] Comparator 0
[23] Comparator 1
[24] Comparator 2
[25] Comparator 3
[26] Logic rule 0
[27] Logic rule 1
[28] Logic rule 2
[29] Logic rule 3
[30] SL Time-out 0
[31] SL Time-out 1
[32] SL Time-out 2
[33] Digital input DI18
[34] Digital input DI19
[35] Digital input DI27
[36] Digital input DI29
[39] Start command
[40] Drive stopped
[42] Auto Reset Trip
[50] Comparator 4
[51] Comparator 5
[60] Logic rule 4
[61] Logic rule 5
[70] SL Time-out 3
[71] SL Time-out 4
[72] SL Time-out 5
[73] SL Time-out 6
[74] SL Time-out 7
[83] Broken Belt
13-52 SL Controller Action
*[0] Disabled
[1] No action
[2] Select set-up 1
[3] Select set-up 2
[10] Select preset ref 0
[11] Select preset ref 1
[12] Select preset ref 2
[13] Select preset ref 3
[14] Select preset ref 4
[15] Select preset ref 5
[16] Select preset ref 6
[17] Select preset ref 7
[18] Select ramp 1
[19] Select ramp 2
[22] Run
[23] Run reverse
[24] Stop
[25] Qstop
[26] DC Brake
[27] Coast
[28] Freeze output
[29] Start timer 0
[30] Start timer 1
[31] Start timer 2
[32] Set digital out A low
[33] Set digital out B low
[34] Set digital out C low
[35] Set digital out D low
[38] Set digital out A high
[39] Set digital out B high
[40] Set digital out C high
[41] Set digital out D high
[60] Reset Counter A
[61] Reset Counter B
[70] Start Timer 3
[71] Start Timer 4
[72] Start Timer 5
[73] Start Timer 6
[74] Start Timer 7
14- Special Functions**
14-0* Inverter Switching
14-01 Switching Frequency
[0] Ran3
[1] Ran5
[2] 2.0 kHz
[3] 3.0 kHz
[4] 4.0 kHz
[5] 5.0 kHz
[6] 6.0 kHz
[7] 8.0 kHz
[8] 10.0 kHz
[9] 12.0 kHz
[10] 16.0 kHz
14-03 Overmodulation
[0] Off
*[1] On
14-07 Dead Time Compensation Level
0 - 100 *Size related
14-08 Damping Gain Factor
0 - 100 % *Size related
14-09 Dead Time Bias Current Level
0 - 100 % *Size related
14-1* Mains On/Off
14-10 Mains Failure
*[0] No function
[1] Ctrl. ramp-down
[2] Ctrl. ramp-down, trip
[3] Coasting
[4] Kinetic back-up
[5] Kinetic back-up, trip
[6] Alarm
[7] Kin. back-up, trip w recovery
14-11 Mains Fault Voltage Level
100 - 800 V *342 V
14-12 Response to Mains Imbalance
*[0] Trip
[1] Warning
[2] Disabled
[3] Derate
[4] Fast Trip
[5] Fast Warning
14-15 Kin. Back-up Trip Recovery Level
0 - 500.000 ReferenceFeedbackUnit
*Size related
14-17 Fast Mains Phase Loss Level
0 - 500 % *300 %
14-18 Fast Mains Phase Loss Min Power
0 - 100 % *10 %
14-2* Reset Functions
14-20 Reset Mode
*[0] Manual reset
[1] Automatic reset x 1
[2] Automatic reset x 2
[3] Automatic reset x 3
[4] Automatic reset x 4
[5] Automatic reset x 5
[6] Automatic reset x 6
[7] Automatic reset x 7
[8] Automatic reset x 8
[9] Automatic reset x 9
[10] Automatic reset x 10
[11] Automatic reset x 15
[12] Automatic reset x 20
[13] Infinite auto reset
[14] Reset at power-up
14-21 Automatic Restart Time
0 - 600 s *10 s
14-22 Operation Mode
*[0] Normal operation
[2] Initialisation
14-24 Trip Delay at Current Limit
0 - 60 s *60 s
14-25 Trip Delay at Torque Limit
0 - 60 s *60 s
14-27 Action At Inverter Fault
[0] Trip
*[1] Warning
14-29 Service Code
0 - 0x7FFFFFFF *0
14-3* Current Limit Ctrl.
14-30 Current Lim Ctrl, Proportional Gain
0 - 500 % *100 %
14-31 Current Lim Ctrl, Integration Time
0.002 - 2 s *0.020 s
14-32 Current Lim Ctrl, Filter Time
1 - 100 ms *5 ms
14-4* Energy Optimising
14-40 VT Level
40 - 90 % *66 %
14-41 AEO Minimum Magnetisation
40 - 75 % *66 %
14-44 d-axis current optimization for IPM
0 - 200 % *100 %
14-5* Environment
14-50 RFI Filter
[0] Off
[1] On
*[2] Grid Type
14-51 DC-Link Voltage Compensation
[0] Off
*[1] On
14-52 Fan Control
*[5] Constant-on mode
[6] Constant-off mode
[7] On-when-Inverter-is-on-else-off Mode
[8] Variable-speed mode
14-55 Output Filter
*[0] No Filter
[1] Sine-Wave Filter
14-6* Auto Derate
14-61 Function at Inverter Overload
*[0] Trip
[1] Derate
14-63 Min Switch Frequency
*[2] 2.0 kHz
[3] 3.0 kHz
[4] 4.0 kHz
[5] 5.0 kHz
[6] 6.0 kHz
[7] 8.0 kHz
[8] 10.0 kHz
[9] 12.0 kHz
[10] 16.0 kHz
14-64 Dead Time Compensation Zero Current Level
*[0] Disabled
[1] Enabled
14-65 Speed Derate Dead Time Compensation
20 - 1000 Hz *Size related
14-8* Options
14-89 Option Detection
*[0] Protect Option Config.
[1] Enable Option Change
14-9* Fault Settings
14-90 Fault Level
[0] Off
*[3] Trip Lock
[4] Trip w. delayed reset
[5] Flystart
15- Drive Information**
15-0* Operating Data
15-00 Operating hours
0 - 0x7fffffff. h *0 h
15-01 Running Hours
0 - 0x7fffffff. h *0 h
15-02 kWh Counter
0 - 2147483647 kWh *0 kWh
15-03 Power Up's
0 - 2147483647 *0
15-04 Over Temp's
0 - 65535 *0
15-05 Over Volt's
0 - 65535 *0
15-06 Reset kWh Counter
*[0] Do not reset
[1] Reset counter
15-07 Reset Running Hours Counter
*[0] Do not reset
[1] Reset counter
15-3* Alarm Log
15-30 Alarm Log: Error Code
0 - 255 *0
15-31 InternalFaultReason
-32767 - 32767 *0
15-4* Drive Identification
15-40 FC Type
0 - 0 *0
15-41 Power Section
0 - 20 *0
15-42 Voltage
0 - 20 *0
15-43 Software Version
0 - 0 *0
15-44 Ordered TypeCode
0 - 41 *0
15-45 Actual Typecode String
0 - 40 *0
15-46 Drive Ordering No
0 - 0 *0

15-48 LCP Id No
0 - 0 *0
15-49 SW ID Control Card
0 - 0 *0
15-50 SW ID Power Card
0 - 0 *0
15-51 Drive Serial Number
0 - 0 *0
15-53 Power Card Serial Number
0 - 0 *0
15-6* Option Ident
15-60 Option Mounted
0 - 30 *Size related
15-61 Option SW Version
0 - 20 *Size related
15-62 Option Ordering No
0 - 8 *Size related
15-63 Option Serial No
0 - 18 *Size related
15-70 Option in Slot A
0 - 30 *0
15-71 Slot A Option SW Version
0 - 20 *0
15-9* Parameter Info
15-92 Defined Parameters
0 - 2000 *0
15-97 Application Type
0 - 0xFFFFFFFF *0
15-98 Drive Identification
0 - 56 *0
15-99 Parameter Metadata
0 - 9999 *0
16- Data Readouts**
16-0* General Status
16-00 Control Word
0 - 65535 *0
16-01 Reference [Unit]
-4999 - 4999 ReferenceFeedbackUnit *0
ReferenceFeedbackUnit
16-02 Reference [%]
-200 - 200 % *0 %
16-03 Status Word
0 - 65535 *0
16-05 Main Actual Value [%]
-200 - 200 % *0 %
16-09 Custom Readout
0 - 9999 CustomReadoutUnit *0
CustomReadoutUnit
16-1* Motor Status
16-10 Power [kW]
0 - 1000 kW *0 kW
16-11 Power [hp]
0 - 1000 hp *0 hp
16-12 Motor Voltage
0 - 65535 V *0 V
16-13 Frequency
0 - 6553.5 Hz *0 Hz
16-14 Motor current
0 - 655.35 A *0 A
16-15 Frequency [%]
0 - 6553.5 % *0 %
16-16 Torque [Nm]
-30000 - 30000 Nm *0 Nm
16-17 Speed [RPM]
-30000 - 30000 RPM *0 RPM
16-18 Motor Thermal
0 - 100 % *0 %
16-22 Torque [%]
-200 - 200 % *0 %
16-3* Drive Status
16-30 DC Link Voltage
0 - 65535 V *0 V
16-33 Brake Energy /2 min
0 - 10000 kW *0 kW
16-34 Heatsink Temp.
-128 - 127 °C *0 °C
16-35 Inverter Thermal
0 - 255 % *0 %
16-36 Inv. Nom. Current
0 - 655.35 A *0 A
16-37 Inv. Max. Current
0 - 655.35 A *0 A
16-38 SL Controller State
0 - 20 *0
16-39 Control Card Temp.
0 - 65535 °C *0 °C
16-5* Ref. & Feedb.
16-50 External Reference
-200 - 200 % *0 %
16-52 Feedback[Unit]
-4999 - 4999 ProcessCtrlUnit *0
ProcessCtrlUnit
16-53 Digi Pot Reference
-200 - 200 *0
16-57 Feedback [RPM]
-30000 - 30000 RPM *0 RPM
16-6* Inputs & Outputs
16-60 Digital Input
0 - 65535 *0
16-61 Terminal 53 Setting
[0] Current mode
[1] Voltage mode
16-62 Analog input 53
0 - 20 *1
16-63 Terminal 54 Setting
[0] Current mode
[1] Voltage mode
16-64 Analog input 54
0 - 20 *1
16-65 Analog output 42 [mA]
0 - 20 mA *0 mA
16-66 Digital Output
0 - 63 *0
16-67 Pulse input 29 [Hz]
0 - 130000 *0
16-68 Pulse input 33 [Hz]
0 - 130000 *0
16-69 Pulse output 27 [Hz]
0 - 40000 *0
16-70 Pulse output 29 [Hz]
0 - 40000 *0
16-71 Relay output
0 - 65535 *0
16-72 Counter A
-32768 - 32767 *0
16-73 Counter B
-32768 - 32767 *0
16-79 Analog output 45 [mA]
0 - 20 mA *0 mA
16-8* Fieldbus & FC Port
16-80 Fieldbus CTW 1
0 - 65535 *0
16-82 Fieldbus REF 1
-32768 - 32767 *0
16-84 Comm. Option STW
0 - 65535 *0
16-85 FC Port CTW 1
0 - 65535 *1084
16-86 FC Port REF 1
-32768 - 32767 *0
16-9* Diagnosis Readouts
16-90 Alarm Word
0 - 0xFFFFFFFFUL *0
16-91 Alarm Word 2
0 - 0xFFFFFFFFUL *0
16-92 Warning Word
0 - 0xFFFFFFFFUL *0
16-93 Warning Word 2
0 - 0xFFFFFFFFUL *0
16-94 Ext. Status Word
0 - 0xFFFFFFFFUL *0
16-95 Ext. Status Word 2
0 - 0xFFFFFFFFUL *0
16-97 Alarm Word 3
0 - 0xFFFFFFFFUL *0
17- Feedback Options**
17-1* Inc.Enc.Interface
17-10 Signal Type
[0] None
*[1] RS422 (5V TTL)
[2] Sinusoidal 1Vpp
17-11 Resolution (PPR)
10 - 16384 *1024
17-5* Resolver Interface
17-50 Poles
2 - 2 *2
17-51 Input Voltage
2 - 8 V *7 V
17-52 Input Frequency
2 - 15 kHz *10 kHz
17-53 Transformation Ratio
0.1 - 1.1 *0.5
17-56 Encoder Sim. Resolution
*[0] Disabled
[1] 512
[2] 1024
[3] 2048
[4] 4096
17-59 Resolver Interface
*[0] Disabled
[1] Enabled
17-6* Monitoring and App.
17-60 Feedback Direction
*[0] Clockwise
[1] Counter clockwise
17-61 Feedback Signal Monitoring
[0] Disabled
*[1] Warning
[2] Trip
[3] Jog
[4] Freeze Output
[5] Max Speed
[6] Switch to Open Loop
18- Data Readouts 2**
18-8* Center Winder Readout
18-81 Tension PID Output
-5000 - 5000 Hz *0 Hz
18-82 Center Winder Output
-5000 - 5000 Hz *0 Hz
18-83 Line Speed
-5000 - 5000 Hz *0 Hz
18-84 Diameter
0 - 100 % *0 %
18-85 Tapered Tension Set Point
0 - 100 % *0 %
18-86 Tension Feedback
0 - 100 % *0 %
18-9* PID Readouts
18-90 Process PID Error
-200 - 200 % *0 %
18-91 Process PID Output
-200 - 200 % *0 %
18-92 Process PID Clamped Output
-200 - 200 % *0 %
18-93 Process PID Gain Scaled Output
-200 - 200 % *0 %
21- Ext. Closed Loop**
21-0* Ext. CL Autotuning
21-09 Extended PID Enable
*[0] Disabled
[1] Enabled Ext CL1 PID
21-1* Ext. CL 1 Ref./Fb.
21-11 Ext. 1 Minimum Reference
-999999.999 - 999999.999 ExtPID1Unit
*0 ExtPID1Unit
21-12 Ext. 1 Maximum Reference
-999999.999 - 999999.999 ExtPID1Unit
*100 ExtPID1Unit
21-13 Ext. 1 Reference Source
*[0] No function
[1] Analog Input 53
[2] Analog Input 54
[7] Frequency input 29
[8] Frequency input 33
21-14 Ext. 1 Feedback Source
*[0] No function
[1] Analog Input 53
[2] Analog Input 54
[3] Frequency input 29
[4] Frequency input 33
21-15 Ext. 1 Setpoint
-999999.999 - 999999.999 ExtPID1Unit
*0 ExtPID1Unit
21-17 Ext. 1 Reference [Unit]
-999999.999 - 999999.999 ExtPID1Unit
*0 ExtPID1Unit
21-18 Ext. 1 Feedback [Unit]
-999999.999 - 999999.999 ExtPID1Unit
*0 ExtPID1Unit
21-19 Ext. 1 Output [%]
0 - 100 % *0 %
21-2* Ext. CL 1 PID
21-20 Ext. 1 Normal/Inverse Control
*[0] Normal
[1] Inverse
21-21 Ext. 1 Proportional Gain
0 - 10 *0.01
21-22 Ext. 1 Integral Time
0.01 - 10000 s *10000 s
21-23 Ext. 1 Differentation Time
0 - 10 s *0 s
21-24 Ext. 1 Dif. Gain Limit
1 - 50 *5
22- Appl. Functions**
22-0* Miscellaneous
22-02 Sleepmode CL Control Mode
*[0] Normal
[1] Simplified
22-4* Sleep Mode
22-40 Minimum Run Time
0 - 600 s *10 s
22-41 Minimum Sleep Time
0 - 600 s *10 s
22-43 Wake-Up Speed [Hz]
0 - 400.0 *10
22-44 Wake-Up Ref./FB Diff
0 - 100 % *10 %
22-45 Setpoint Boost
-100 - 100 % *0 %
22-46 Maximum Boost Time
0 - 600 s *60 s
22-47 Sleep Speed [Hz]
0 - 400.0 *0
22-48 Sleep Delay Time
0 - 3600 s *0 s
22-49 Wake-Up Delay Time
0 - 3600 s *0 s
22-6* Broken Belt Detection
22-60 Broken Belt Function
*[0] Off
[1] Warning
[2] Trip
22-61 Broken Belt Torque
5 - 100 % *10 %
22-62 Broken Belt Delay

0 - 600 s *10 s

30- Special Features**

30-2* Adv. Start Adjust

30-20 High Starting Torque Time [s]
0 - 60 s *Size related

30-21 High Starting Torque Current [%]
0 - 200.0 % *Size related

30-22 Locked Rotor Protection
*[0] Off
[1] On

30-23 Locked Rotor Detection Time [s]
0.05 - 1 s *0.10 s

32- Motion Control Basic Settings**

32-1* User Unit

32-11 User Unit Denominator
1 - 65535 *1

32-12 User Unit Numerator
1 - 65535 *1

32-5* Feadback Source

32-50 Source Slave
*[0] 24V-Encoder
[1] MCB102
[2] MCB103

32-52 Source Master
[0] 24V-Encoder
*[1] MCB102
[2] MCB103
[3] VM

32-6* PID

32-60 Proportional factor
0.000 - 1000.000 *1.000

32-61 Derivative factor
0.000 - 1000.000 *0.000

32-62 Integral factor
0.0000 - 100.0000 *0.0000

32-63 Limit Value for Integral Sum[%]
0.0 - 100.0 % *100.0 %

32-64 PID Bandwidth[%]
0.0 - 100.0 % *100.0 %

32-65 Velocity Feed-Forward
0.000 - 100.000 *1.000

32-66 Acceleration Feed-Forward
0.000 - 100.000 *0.000

32-67 Max. Tolerated Position Error
1 - 2147483648 *2000000

32-68 Reverse Behavior for Slave
*[0] Reversing allowed
[1] Reversing follow master
[2] Reversing blocked

32-69 PID Sample Time
1 - 1000 ms *16 ms

32-71 Size of the Control Window (Activation)
0 - 1073741823 *0

32-72 Size of the Control Window (Deactiv.)
0 - 1073741823 *0

32-74 Position error filter time
0 - 10000 ms *0 ms

32-8* Velocity & Acceleration

32-80 Maximum Allowed Velocity
1 - 30000 RPM *1500 RPM

32-81 Motion Ctrl Quick Stop Ramp
50 - 3600000 ms *1000 ms

33- Motion Control Adv. Settings**

33-0* Home Motion

33-00 Homing Mode
*[0] Not forced
[1] Forced manual homing
[2] Forced automated homing

33-01 Home Offset
-1073741824 - 1073741824 *0

33-02 Home Ramp Time
1 - 1000 ms *10 ms

33-03 Homing Velocity
-1500 - 1500 RPM *100 RPM

33-04 Homing Behaviour
*[1] Reverse no index
[3] Forward no index

33-1* Synchronization

33-13 Accuracy Window
-1073741824 - 1073741823 *1000

33-14 Relative Slave Velocity Limit[%]
0 - 100 % *50 %

33-27 Offset Filter Time
0 - 1073741823 ms *0 ms

33-4* Limit Handling

33-41 Negative Software Limit
-1073741824 - 1073741824 *-500000

33-42 Positive Software Limit
-1073741824 - 1073741824 *500000

33-43 Negative Software Limit Active
*[0] Inactive
[1] Active

33-44 Positive Software Limit Active
*[0] Inactive
[1] Active

33-45 Time in Target Window
0 - 10 ms *0 ms

33-46 Target Window LimitValue
1 - 10000 *1

33-47 Target Position Window
1 - 10000 *512

33-8* Global Parameters

33-83 Behaviour After Error
*[0] Coast
[2] Controlled stop

34- Motion Control Data Readouts**

34-0* PCD Write Par.

34-01 PCD 1 Write For Application
0 - 65535 *0

34-02 PCD 2 Write For Application
0 - 65535 *0

34-03 PCD 3 Write For Application
0 - 65535 *0

34-04 PCD 4 Write For Application
0 - 65535 *0

34-05 PCD 5 Write For Application
0 - 65535 *0

34-06 PCD 6 Write For Application
0 - 65535 *0

34-07 PCD 7 Write For Application
0 - 65535 *0

34-08 PCD 8 Write For Application
0 - 65535 *0

34-09 PCD 9 Write For Application
0 - 65535 *0

34-10 PCD 10 Write For Application
0 - 65535 *0

34-2* PCD Read Par.

34-21 PCD 1 Read For Application
0 - 65535 *0

34-22 PCD 2 Read For Application
0 - 65535 *0

34-23 PCD 3 Read For Application
0 - 65535 *0

34-24 PCD 4 Read For Application
0 - 65535 *0

34-25 PCD 5 Read For Application
0 - 65535 *0

34-26 PCD 6 Read For Application
0 - 65535 *0

34-27 PCD 7 Read For Application
0 - 65535 *0

34-28 PCD 8 Read For Application
0 - 65535 *0

34-29 PCD 9 Read For Application
0 - 65535 *0

34-30 PCD 10 Read For Application
0 - 65535 *0

34-5* Process Data

34-50 Actual Position
-1073741824 - 1073741824 *0

34-52 Actual Master Position
-1073741824 - 1073741823 *0

34-56 Track Error
-2147483647 - 2147483647 *0

34-57 Synchronizing Error
-2147483647 - 2147483647 *0

34-58 Actual Velocity
-2147483647 - 2147483647 *0

34-59 Actual Master Velocity
-2147483647 - 2147483647 *0

34-60 Synchronizing Status
0 - 4294967295 *0

37- Application Settings**

37-0* ApplicationMode

37-00 Application Mode
*[0] Drive mode
[1] Center winder
[2] Position Control
[3] Synchronization

37-1* Position Control

37-01 Pos. Feedback Source
*[0] 24V Encoder
[1] MCB102
[2] MCB103

37-02 Pos. Target
-1073741824 - 1073741824 *0

37-03 Pos. Type
*[0] Absolute
[1] Relative

37-04 Pos. Velocity
1 - 30000 RPM *100 RPM

37-05 Pos. Ramp Up Time
50 - 100000 ms *5000 ms

37-06 Pos. Ramp Down Time
50 - 100000 ms *5000 ms

37-07 Pos. Auto Brake Ctrl
[0] Disable
*[1] Enable

37-08 Pos. Hold Delay
0 - 10000 ms *0 ms

37-09 Pos. Coast Delay
0 - 1000 ms *200 ms

37-10 Pos. Brake Delay
0 - 1000 ms *200 ms

37-11 Pos. Brake Wear Limit
0 - 1073741824 *0

37-12 Pos. PID Anti Windup
[0] Disable
*[1] Enable

37-13 Pos. PID Output Clamp
1 - 10000 *1000

37-14 Pos. Ctrl. Source
*[0] DI
[1] FieldBus

37-15 Pos. Direction Block
*[0] No Blocking
[1] Block Reverse
[2] Block Forward

37-17 Pos. Ctrl Fault Behaviour
*[0] Ramp Down&Brake
[1] Brake Directly

37-18 Pos. Ctrl Fault Reason
*[0] No Fault
[1] Homing Needed
[2] Pos. HW Limit
[3] Neg. HW Limit
[4] Pos. SW Limit
[5] Neg. SW Limit
[7] Brake Wear Limit
[8] Quick Stop
[9] PID Error Too Big
[12] Rev. Operation
[13] Fwd. Operation
[20] Can not find home position

37-19 Pos. New Index
0 - 255 *0

37-2* Center Winder

37-20 Winder Mode Selection
*[0] Wind
[1] Unwind

37-21 Tension Set Point
0 - 100 % *0 %

37-22 Taper Set Point
-110 - 110 % *0 %

37-23 Partial Roll Diameter Value
5 - 100 % *5 %

37-24 Core1 Diameter
5 - 100 % *5 %

37-25 Core2 Diameter
5 - 100 % *5 %

37-26 Winder Jog Speed
0 - 100 % *0 %

37-27 TLD Low Limit
0 - 100 % *0 %

37-28 TLD High Limit
0 - 100 % *0 %

37-29 TLD Timer
0.001 - 5 s *0.001 s

37-30 TLDOnDelay
[0] Disabled
*[1] Enabled

37-31 Diameter Limit Detector
0 - 100 % *100 %

37-32 Initial Diameter Measurement
*[0] Set diameter when diameter reset
[1] Set diameter based on analog signal

37-33 Diameter Measurement Input
*[0] No Function
[1] Input53(0~10 VDC or 0~20 mA)
[2] Input54(0~10 VDC or 0~20 mA)

37-34 Reading at Core
0 - 10 *0

37-35 Reading at Full Roll
0 - 10 V *0 V

37-36 Tension Set Point Input
*[0] Par.3721
[1] Input53(0~10 VDC or 0~20 mA)
[2] Input54(0~10 VDC or 0~20 mA)

37-37 Taper Set Point Input
*[0] Par.3722
[1] Input53(0~10 VDC or 0~20 mA)
[2] Input54(0~10 VDC or 0~20 mA)

37-38 Tension Feedback Input
*[0] No Function
[1] Input53(0~10 VDC or 0~20 mA)
[2] Input54(0~10 VDC or 0~20 mA)

37-39 Tension Feedback Type
*[0] Load cell
[1] Dancer

37-40 Center Winder Cmd Src
[0] Digital and parameter
*[1] Parameter 3754~3759 control the functions
[2] Digital input control

37-41 Diameter Change Rate
0.001 - 0.05 % *0.001 %

37-42 Tapered Tension Change Rate
0.1 - 1 % *0.1 %

37-43 Diameter Calculator Min Speed
0 - 100 % *0 %

37-44 Line Acceleration Feed Forward
-20 - 20 *0

37-45 Line Speed Source

*[0] No function
[1] 24V encoder
[2] MCB102
[3] MCB103
[4] Analog input 53
[5] Analog input 54
[6] Frequency input 29
[7] Frequency input 33
37-46 Winder Speed Match Scale
0.001 - 1000 *1
37-47 Tension PID Profile
0 - 100 % *0 %
37-48 Tension PID Proportional Gain
0 - 10 *0
37-49 Tension PID Derivate Time
0 - 20 s *0 s
37-50 Tension PID Integral Time
0.01 - 501 s *501 s
37-51 Tension PID Out Limit
0 - 100 % *0 %
37-52 Tension PID Der Gain Limit
1 - 50 *5
37-53 Tension PID Anti Windup
[0] Disabled
*[1] Enabled
37-54 Winder Jog Reverse
*[0] No Function
[1] Jog reverse
37-55 Winder Jog Forward
*[0] No function
[1] Jog forward
37-56 New Diameter Select
*[0] Core diameter
[1] Partial roll diameter
37-57 Tension On/Off
*[0] Off
[1] On
37-58 Core Select
*[0] Core1 diameter
[1] Core2 diameter
37-59 Diameter Reset
*[0] Off
[1] On

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