

ENGINEERING
TOMORROW



Operating Guide

VLT® Decentral Drive FCD 302

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1 Introduction

1.1 Purpose of this Operating Guide

This Operating Guide provides information for safe installation and commissioning of the AC drive. It is intended for use by qualified personnel.

Read and follow the instructions to use the drive safely and professionally.

Pay particular attention to the safety instructions and general warnings. Always keep this Operating Guide with the drive.

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1.2 Additional Resources

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

- The VLT® Decentral Drive FCD 302 Design Guide provides detailed information about capabilities and functionality to design motor control systems.
- The VLT® AutomationDrive FC 301/302 Programming Guide provides greater detail on working with parameters and many application examples.
- Instructions for operation with optional equipment.

Supplementary publications and manuals are available at www.danfoss.com.

1.3 Manual and Software Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome.

Table 1: Manual and Software Version

Edition	Remarks	Software version
AQ267036816112, version 0201	Editorial update	8.5X

1.4 Product Overview

1.4.1 Intended Use

The drive is an electronic motor controller intended for:

- Regulation of motor speed in response to system feedback or to remote commands from external controllers. A power-drive system consists of the drive, the motor, and equipment driven by the motor.
- System and motor status surveillance.

The drive can also be used for motor protection.

Depending on the configuration, the drive can be used in standalone applications or form part of a larger appliance or installation.

The VLT® Decentral Drive FCD 302 is designed for decentral mounting, for example, in the food and beverage industry, or for other material handling applications. With the FCD 302, it is possible to reduce costs by placing the power electronics decentrally. Central panels are then rendered obsolete, saving cost, space, and effort for installation and wiring. The basic design is service-friendly with a pluggable electronic part and a flexible and spacious wiring box. It is easy to change electronics without the need for rewiring.

Installation environment: The drive is allowed for use in residential, industrial, and commercial environments in accordance with local laws and standards.

NOTICE

RADIO INTERFERENCE

In a residential environment, this product can cause radio interference, in which case supplementary mitigation measures can be required.

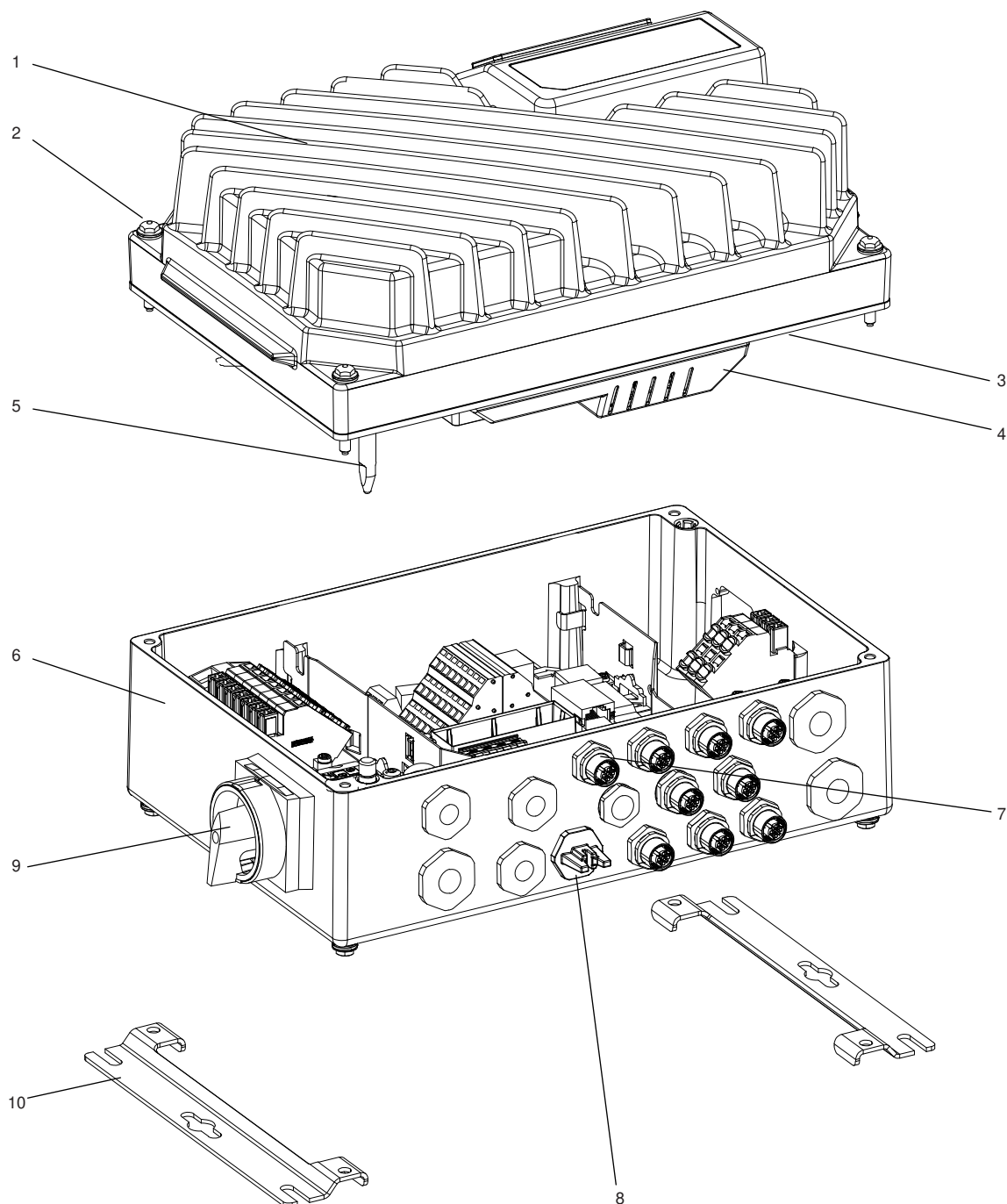
- Take the necessary precautions.

Foreseeable misuse

Do not use the drive in applications which are non-compliant with specified operating conditions and environments.

Ensure compliance with the conditions specified in [7.4.1 Environment](#).

1.4.2 Exploded Views



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Illustration 1: Exploded View Small Unit

1	Inverter part	6	Installation box
2	Fastening screws (4 x, 1 in each corner)	7	Display connection
3	Sealing gasket	8	Access to USB port
4	Inverter part plastic cover	9	Service switch-motor side (alternatively, switch located on mains side, or not mounted)
5	Ground connection pin	10	Flat mounting brackets

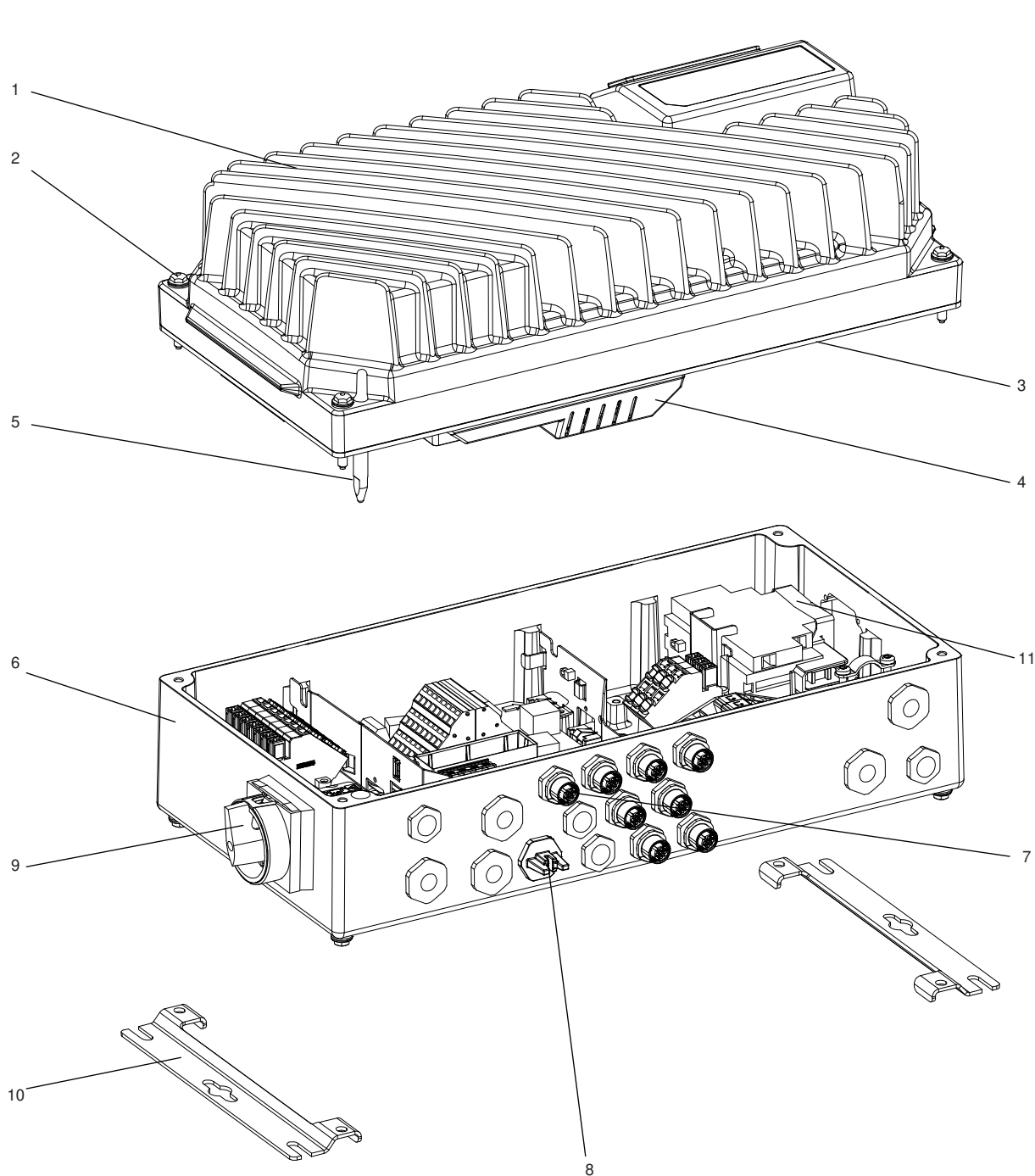


Illustration 2: Exploded View Large Unit

1	Inverter part	7	Display connection
2	Fastening screws (4 x, 1 in each corner)	8	Access to USB port
3	Sealing gasket	9	Service switch ⁽¹⁾ motor side (alternatively, switch located on mains side, or not mounted)
4	Inverter part plastic cover	10	Flat mounting brackets
5	Ground connection pin	11	Circuit breaker ⁽¹⁾ (optional)
6	Installation box		

¹ The unit can be configured with either service switch or circuit breaker, not both. The illustration shown is not configurable in practice, but shows the respective positions of components only.

1.4.3 Block Diagram of the Drive

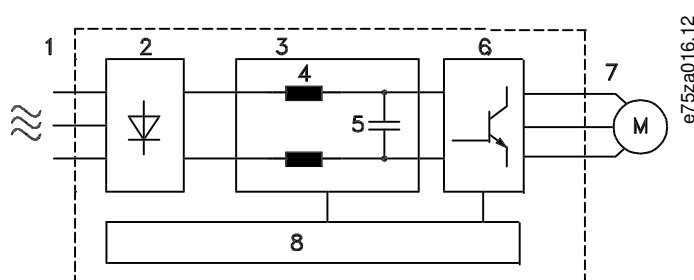



















Illustration 3: Block Diagram

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

1.5 Type Approvals and Certifications

The following list is a selection of possible type approvals and certifications for Danfoss drives:

Table 2: Type Approvals and Certifications

N O T I C E

The specific approvals and certification for the drive are on the nameplate of the drive. For more information, contact the local Danfoss office or partner.

1.6 CE Declaration

ENGINEERING
TOMORROW**Danfoss A/S**6430 Nordborg
Denmark
CVR nr.: 20 16 57 15Telephone: +45 7488 2222
Fax: +45 7449 0949**EU DECLARATION OF CONFORMITY****Danfoss A/S****Danfoss Drives A/S**

declares under our sole responsibility that the

Product category: Frequency Converter**Type designation(s):** FCD302PXXXT4*****

Character XXX: K37, K55, K75, 1K1, 1K5, 2K2, 3K0

* may be any number or letter indicating drive options which do not impact this DoC.

The meaning of the 39 characters in the type code string can be found in appendix 00729776.

Covered by this declaration is in conformity with the following directive(s), standard(s) or other normative document(s), provided that the product is used in accordance with our instructions.

Low Voltage Directive 2014/35/EU

EN61800-5-1:2007 + A1:2017

Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy.

EMC Directive 2014/30/EU

EN61800-3:2004 + A1:2012

Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods.

RoHS Directive 2011/65/EU including amendment 2015/863.

EN63000: 2018

Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Date: 2020.10.08 Place of issue: Graasten, DK	Issued by  Signature: Name: Gert Kjær Title: Senior Director, GDE	Date: 2020.10.08 Place of issue: Graasten, DK	Approved by  Signature: Name: Michael Termansen Title: VP, PD Center Denmark
---------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Danfoss only vouches for the correctness of the English version of this declaration. In the event of the declaration being translated into any other language, the translator concerned shall be liable for the correctness of the translation

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Revision No: A,4

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Classified as Business

2 Safety

2.1 Safety Precautions

⚠ WARNING ⚠

HIGH VOLTAGE

AC 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.

⚠ WARNING ⚠

UNINTENDED START

When the drive is connected to the AC mains, the motor may start at any time, causing risk of death, serious injury, and equipment or property damage. The motor may start by activation of an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up software, or after a cleared fault condition.

- Press [Off] on the LCP before programming parameters.
- Disconnect the drive from the mains whenever personal safety considerations make it necessary to avoid unintended motor start.
- Check that the drive, motor, and any driven equipment are in operational readiness.

⚠ WARNING ⚠

DISCHARGE TIME

The drive contains DC-link capacitors, which can remain charged even when the drive is not powered. High voltage can be present even when the warning indicator lights are off.

Failure to wait the specified time after power has been removed before performing service or repair work could result in death or serious injury.

- Stop the motor.
- Disconnect AC mains, permanent magnet type motors, and remote DC-link supplies, including battery back-ups, UPS, and DC-link connections to other drives.
- Wait for the capacitors to discharge fully. The time for full discharge of the capacitors is minimum 4 minutes for VLT® Decentral Drive FCD 302, 400 V AC, 0.37–3.0 kW (0.5–4.0 hp).
- Before performing any service or repair work, use an appropriate voltage measuring device to make sure that the capacitors are fully discharged.

⚠ CAUTION ⚠

INTERNAL FAILURE HAZARD

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

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

3 Mechanical Installation

3.1 Unpacking

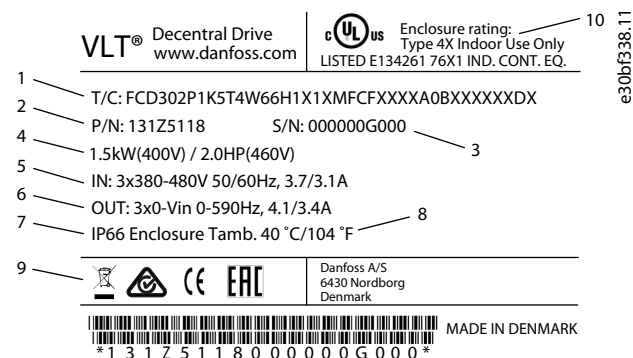
3.1.1 Items Supplied

The packaging contains:

- Accessories bag, supplied only with order of installation box. The bag contains:
 - 2 cable clamps.
 - Bracket for motor/loads cables.
 - Elevation bracket for cable clamp.
 - Screw 4 mm, 20 mm.
 - Thread forming 3.5 mm, 8 mm.
- Operating Guide.
- Drive.

Depending on options fitted, the box contains 1 or 2 bags and 1 or more booklets.

- Make sure that the items supplied and the information on the nameplate correspond to the order confirmation.
- Check the packaging and the drive visually for damage caused by inappropriate handling during shipment. File any claim for damage with the carrier. Retain damaged parts for clarification.



1	Type code	6	Output voltage, frequency, and current (at low/high voltages)
2	Ordering number	7	Enclosure type and IP rating
3	Serial number	8	Maximum ambient temperature
4	Power rating	9	Certifications
5	Input voltage, frequency, and current (at low/high voltages)	10	Enclosure rating

NOTICE

LOSS OF WARRANTY

Do not remove the nameplate from the drive.

3.1.2 Storage

Ensure that the requirements for storage are fulfilled, see [7.4.1 Environment](#).

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 drive.

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

Vibration and shock

The drive 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, refer to [7.4.1 Environment](#).

3.3 Mounting

3.3.1 Cooling

The VLT® Decentral DriveFCD 302 has no forced cooling. It relies only on natural convection for cooling using the cooling fins.

- A minimum of 100 mm (4 in) top and bottom air cooling clearance must be provided.
- Derating starts above 40 °C (104 °F) and 1000 m (3280 ft) elevation above sea level. See the VLT® Decentral DriveFCD 302 Design Guide for detailed information.

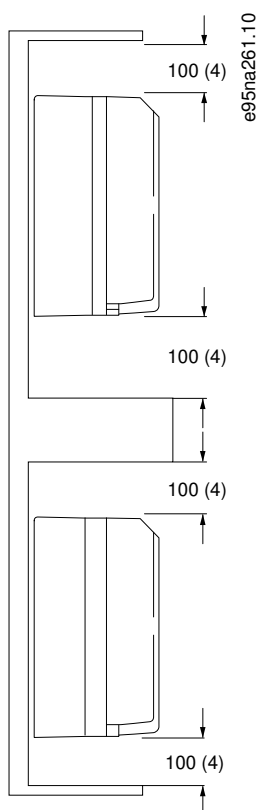


Illustration 4: Top and Bottom Cooling Clearance

3.3.2 Recommended Tools and Equipment

Table 3: Recommended Tools and Equipment

Equipment	Size	Description
Screwdrivers	–	–
Socket (Hex)	8	For fastening inverter screws/mounting of brackets
Slotted	0.4x2.5	For spring loaded power and control terminals
Slotted/Torx	1.0x5.5/TX20	For cable clamps inside the installation box
Spanner	19, 24, 28	For blind-plugs
LCP, ordering number 130B1078	–	Local control panel
LCP cable, ordering number 130B5776	–	Connection cable for local control panel

3.3.3 Mounting

The VLT® Decentral DriveFCD 302 consists of 2 parts:

- Installation box
- Electronic part

See [1.4.2 Exploded Views](#).

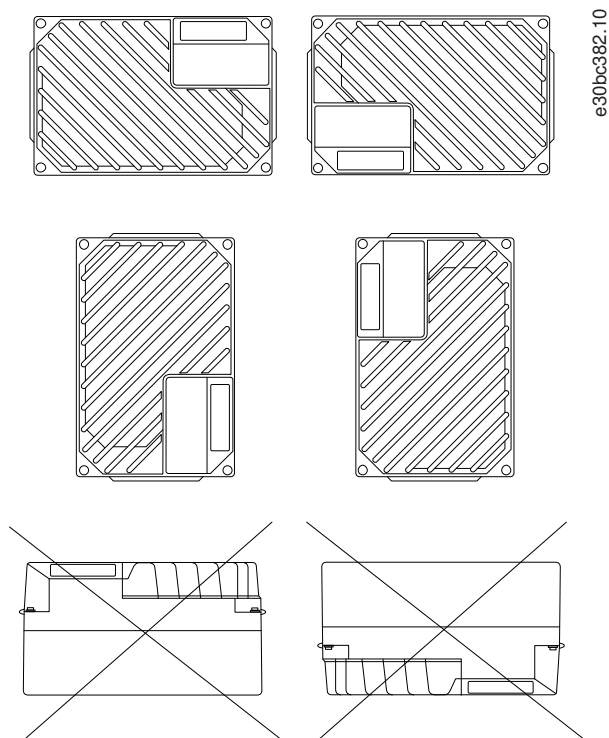


Illustration 5: Allowed Mounting Positions - Standard Applications

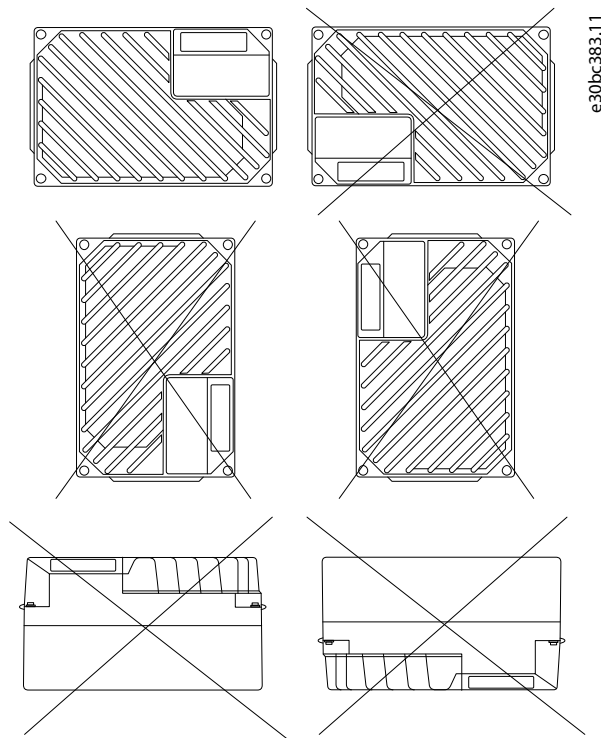


Illustration 6: Allowed Mounting Positions - Hygienic Applications

3.3.3.1 Mounting the Installation Box

⚠ WARNING ⚠

ELECTRICAL HAZARD

Applying power to the unit at this stage could result in death or serious injury.

- Do not apply power before the electrical installation is complete.

⚠ WARNING ⚠

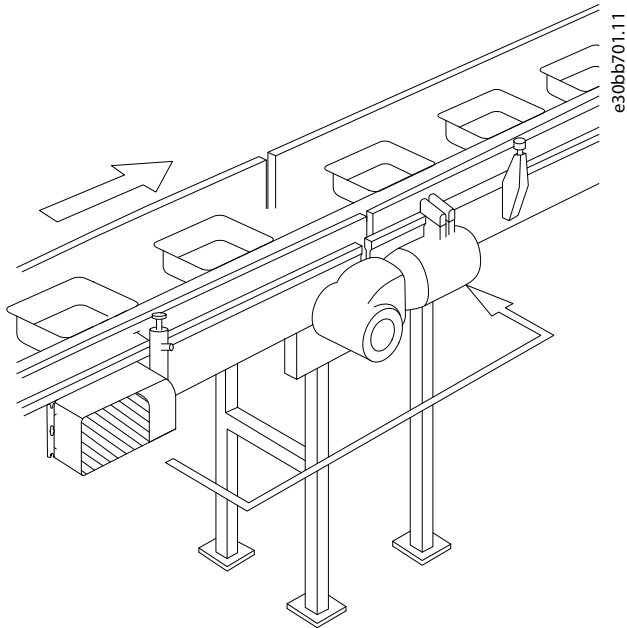
PERSONAL INJURY OR PROPERTY DAMAGE

Do not switch on the mains before the 4 screws are tightened. Failure to tighten these screws can result in personal injury or material damage when the unit is loaded.

- Tighten screws before switching on power.
- Ensure that the strength of the mounting location can support the unit weight.

- Use the holes on the rear of the installation box to fix mounting brackets.
- Use proper mounting screws or bolts.
- For hygienic versions, use cable glands designed to meet hygienic application requirements, for example Rittal HD 2410.110/120/130.

1. Mount the VLT® Decentral Drive FCD 302 vertically on a wall or machine frame. For hygienic versions ensure that liquids drain off the enclosure and orient the unit so the cable glands are located at the base.

Example**Illustration 7: FCD 302 Standalone Mounted with Mounting Brackets****3.3.3.2 Installing the Inverter Part**

Procedure for compressing the gasket between the 2 parts.

Procedure

1. Tighten the 4 connection screws to torque 2.8–3.0 Nm (24–26 in-lb).
2. Tighten the 4 screws in diagonally opposite order.
3. Tighten the 2 grounding spears to torque 3.0 (26 in-lb).

4 Electrical Installation

4.1 Safety Instructions

See [2.1 Safety Precautions](#) for general safety instructions.

⚠ WARNING ⚠

INDUCED VOLTAGE

Induced voltage from output motor cables that run together can charge equipment capacitors, even with the equipment turned off and locked out. Failure to run output motor cables separately or to use shielded cables could result in death or serious injury.

- Run output motor cables separately or use shielded cables.
- Simultaneously lock out all the drives.

⚠ WARNING ⚠

SHOCK HAZARD

The unit can cause a DC current in the PE conductor. Failure to use a Type B residual current-operated protective device (RCD) may lead to the RCD not providing the intended protection and therefore may result in death or serious injury.

- When an RCD is used for protection against electrical shock, only a Type B device is allowed on the supply side.

Overcurrent protection

- Extra protective equipment, such as short-circuit protection or motor thermal protection between drive and motor, is required for applications with multiple motors.
- Input fusing is required to provide short circuit and overcurrent protection. If not factory-supplied, the installer must provide fuses. See maximum fuse ratings in [7.7.2 Recommended Maximum Pre-fuse Size 25 A](#).

Wire type and ratings

- All wiring must comply with local and national regulations regarding cross-section and ambient temperature requirements.
- Power connection wire recommendation: Minimum 75 °C (167 °F) rated copper wire. See [7.1 Electrical Data](#) for recommended wire sizes and types.

4.2 EMC-compliant Installation

To obtain an EMC-compliant installation, follow the instructions provided in [4.3 Grounding](#), [4.4 Wiring Schematic](#), [4.7 Connecting the Motor](#), and [4.10.1 Control Wiring](#).

NOTICE

POTENTIAL EQUALIZATION

Risk of burst transient when the ground potential between the drive and the control system is different. Install equalizing cables between the system components. Recommended cable cross-section: 16 mm² (6 AWG).

4.3 Grounding

For electrical safety

- Ground the drive in accordance with applicable standards and directives.
- Use a dedicated ground wire for input power, motor power, and control wiring.
- Do not ground 1 drive to another in a daisy chain fashion.
- Keep the ground wire connections as short as possible.
- Follow motor manufacturer's wiring requirements.
- Minimum cable cross-section: 10 mm² (7 AWG) (or 2 rated ground wires terminated separately).

For EMC-compliant installation

- Establish electrical contact between the cable shield and the drive enclosure by using metal cable glands or by using the clamps provided on the equipment.
- Use high-strand wire to reduce electrical interference.
- Do not use pigtails.

NOTICE

POTENTIAL EQUALIZATION

Risk of burst transient when the ground potential between the drive and the control system is different. Install equalizing cables between the system components. Recommended cable cross-section: 16 mm² (6 AWG).

CAUTION

PE CONNECTION

The metal pins in the corners of the electronic part and the holes on the corner of the installation box are essential for the protective earth connection. Make sure that they are not loosened, removed, or violated in any way. Tightening torque requirement is 3 Nm (26.6 in-lb).

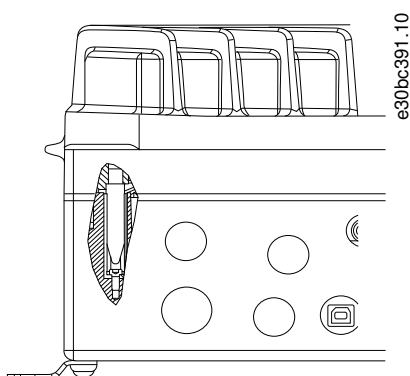


Illustration 8: PE Connection Between the Installation Box and the Electronic Part

NOTICE

The external grounding terminal is available as an accessory (ordering number 130B5833).

4.4 Wiring Schematic

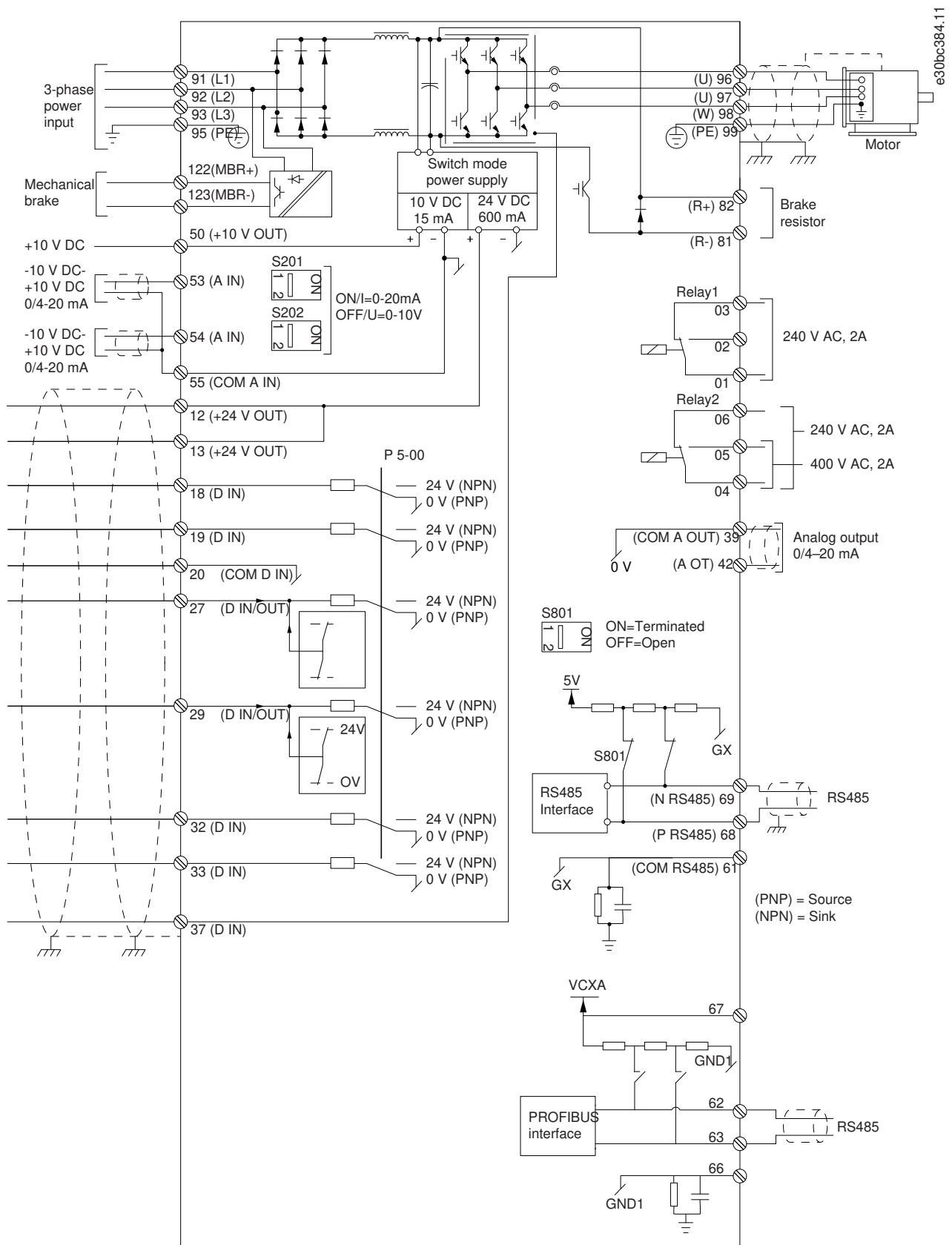


Illustration 9: Basic Wiring Schematic

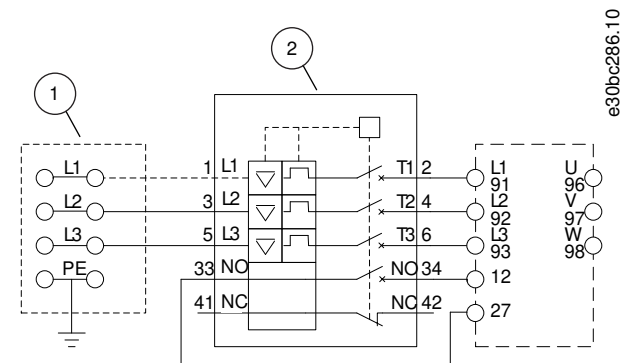


Illustration 10: Large Unit only: Circuit Breaker and Mains Disconnect

1	Looping terminals
2	Circuit breaker

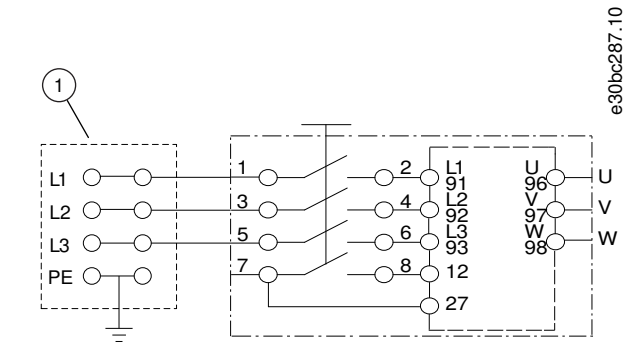
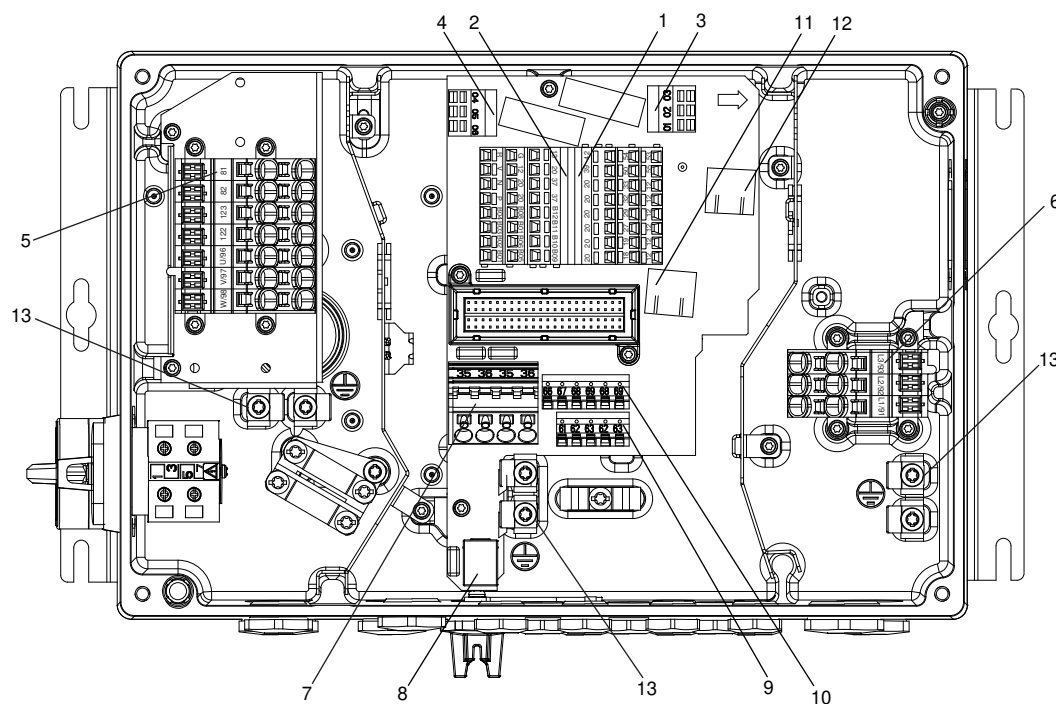


Illustration 11: Large Unit only: Service Switch at Mains with Looping Terminals

1	Looping terminals
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4.5 Location of Terminals



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Illustration 12: Location of Terminals (Small Unit)

1	Digital and analog inputs/outputs	8	USB port
2	Safe Torque Off (STO), LCP connection, B-option	9	Standard bus/RS485
3	Relay 1	10	PROFIBUS
4	Relay 12	11	Ethernet port
5	Motor, mechanical brake, brake resistor	12	Ethernet port
6	Mains	13	Protective Earth (PE)
7	24 V DC back-up input		

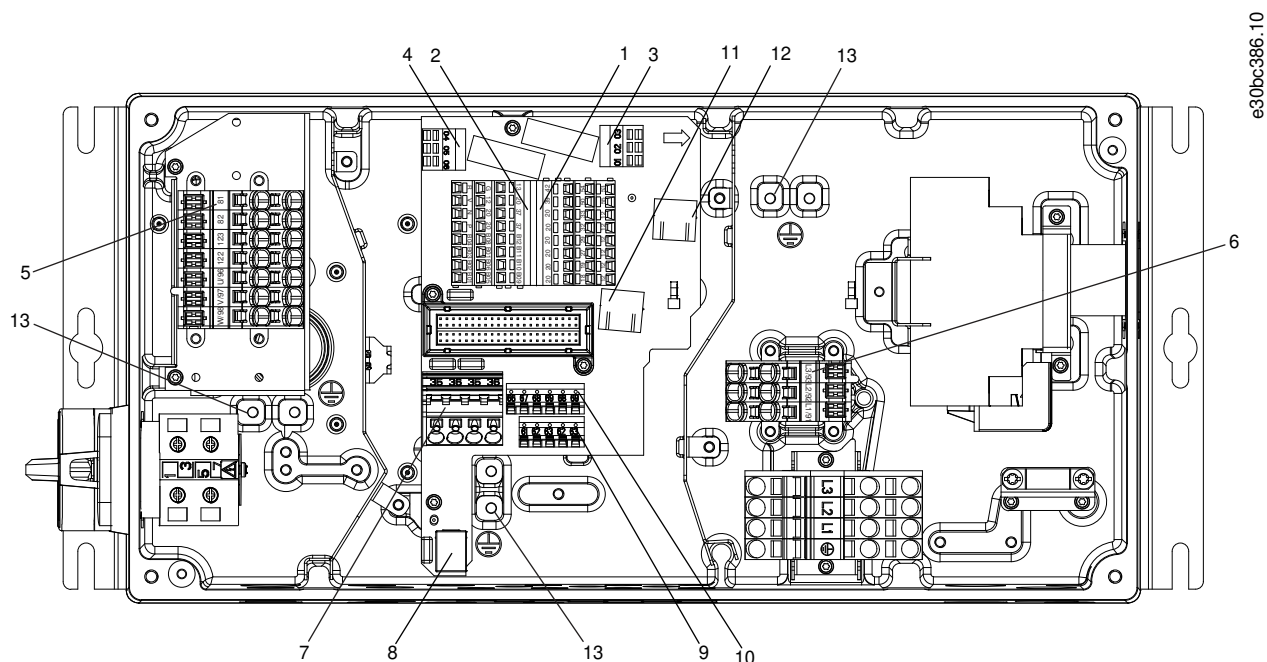


Illustration 13: Location of Terminals (Large Unit)

1	Digital and analog inputs/outputs	8	USB port
2	Safe Torque Off (STO), LCP connection, B-option	9	Standard bus/RS485
3	Relay 1	10	PROFIBUS
4	Relay 12	11	Ethernet port
5	Motor, mechanical brake, brake resistor	12	Ethernet port
6	Mains	13	Protective Earth (PE)
7	24 V DC back-up input		

For both small and large units, the service switch is optional. The switch is shown mounted on the motor side. Alternatively, the switch can be on the mains side or omitted.

For the large unit, the circuit breaker is optional. The large unit can be configured with either service switch or circuit breaker, not both. The illustration shown is not configurable in practice, but shows the respective positions of components only.

4.6 Terminal Types

Motor, control, and mains terminals are spring loaded (CAGE-CLAMP) type.

1. Open the contact by inserting a small screwdriver into the slot above the contact, as shown in [Illustration 14](#).
2. Insert the stripped wire into the contact.
3. Remove the screwdriver to fasten the wire into the contact.

4. Ensure that the contact is firmly established and not loose. Loose wiring can result in equipment faults or injury.

Example

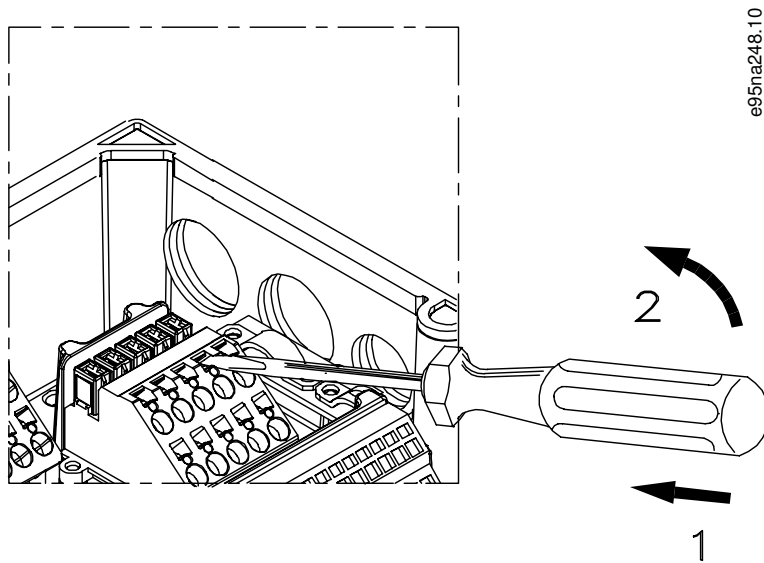


Illustration 14: Opening the Terminals

4.7 Connecting the Motor

⚠ WARNING ⚠

INDUCED VOLTAGE

Induced voltage from output motor cables that run together can charge equipment capacitors, even with the equipment turned off and locked out. Failure to run output motor cables separately or to use shielded cables could result in death or serious injury.

- Run output motor cables separately or use shielded cables.
- Simultaneously lock out all the drives.

NOTICE

MOTOR PROTECTION

Protection against motor overload is not included in the factory setting. If this function is desired, set *parameter 1-90 Motor Thermal Protection* to trip or warning. Refer to the VLT® AutomationDrive FC 301/FC 302 Programming Guide for further information.

- For correct dimensioning of cable cross-section, see [7.1 Electrical Data](#).

Table 4: Terminals 96, 97, 98

Terminal			
96	97	98	Motor voltage 0–100% of mains voltage
U	V	W	3 wires out of motor
U1	V1	W1	6 wires out of motor
W2	U2	V2	6 wires out of motor
U1	V1	W1	6 wires out of motor, star connected. Connect U2, V2, W2

Terminal			
			separately (optional terminal block)
PE			Ground connection

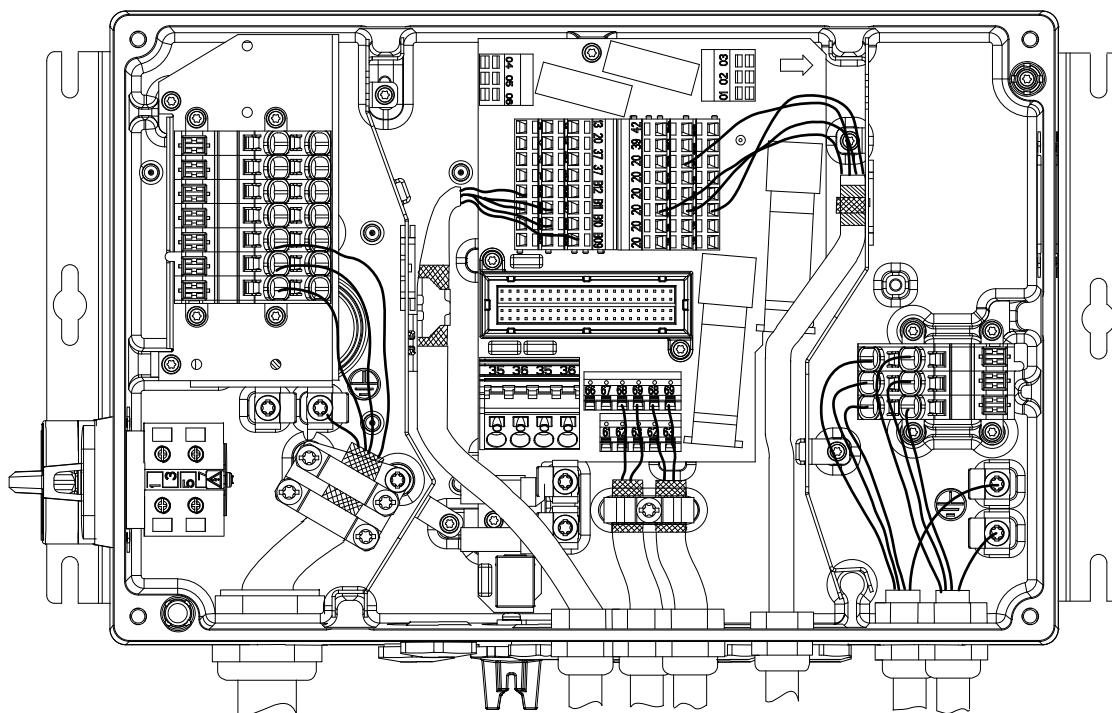
N O T I C E

Do not install power factor correction capacitors between the drive and the motor. Do not wire a starting or pole-changing device between the drive and the motor.

1. Connect the motor to terminals 96, 97, 98.
2. Connect ground to PE terminal.
3. Make sure that the shield of the motor cable is properly grounded at both ends (motor and drive).

4.7.1 Grounding Shielded Cable

Grounding clamps are provided for motor and control wiring.



e30bc403.10

Illustration 15: Grounding Clamp for Motor and Control Wiring (Small Unit)

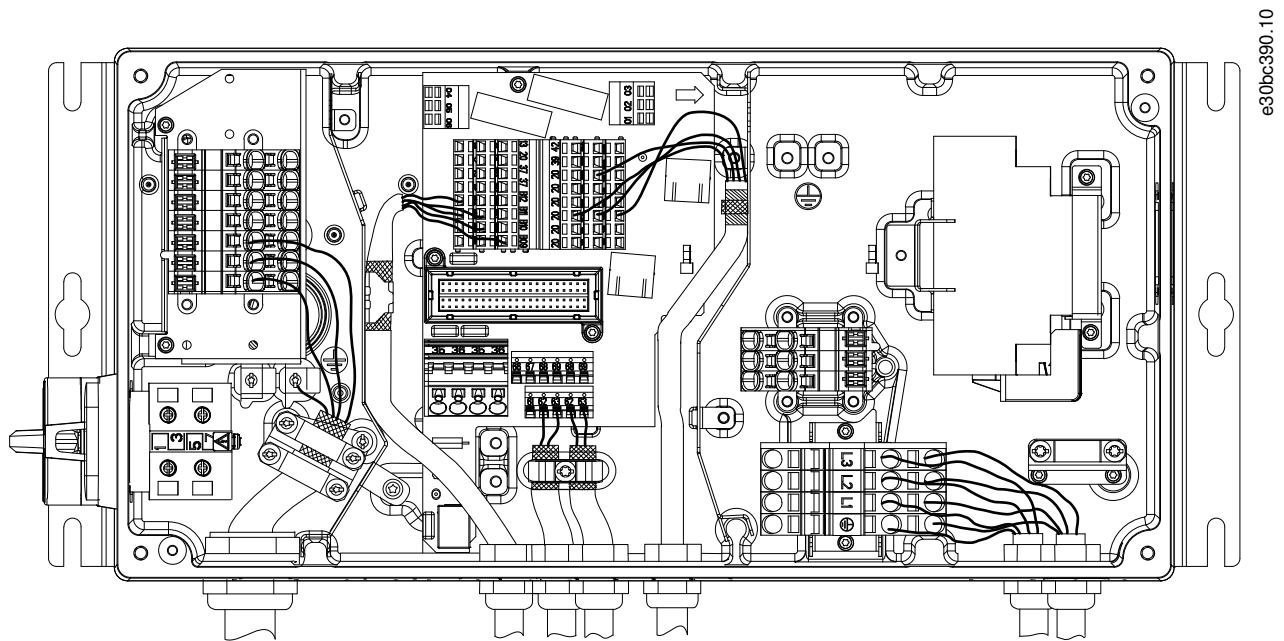


Illustration 16: Grounding Clamp for Motor and Control Wiring (Large Unit)

Procedure

1. Use a wire stripper to remove the insulation for proper grounding.
2. Secure the grounding clamp to the stripped portion of the wire with the screws provided.
3. Secure the grounding wire to the grounding clamp provided.

4.7.2 Connecting Several Motors

The drive can control several parallel-connected motors. The total current consumption of the motors must not exceed the rated output current $I_{M,N}$ for the drive.

NOTICE

Installations with cables connected in a common joint are only recommended for short cable lengths (maximum 10 m (38.2 ft)). When motors are connected in parallel, *parameter 1-29 Automatic Motor Adaptation (AMA)* cannot be used.

NOTICE

The electronic thermal relay (ETR) of the drive cannot be used as motor protection for the individual motor in systems with parallel-connected motors. Provide further motor protection by thermistors in each motor or individual thermal relays. Circuit breakers are not suitable as protection.

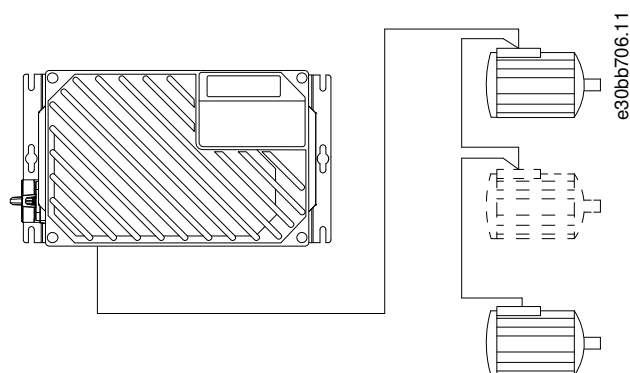


Illustration 17: Parallel Connection of Motors

Problems can arise at start-up and at low RPM values when motor sizes differ widely. Motors of low rated motor power have a relatively high ohmic resistance in the stator. This high resistance calls for a higher voltage at start and at low RPM values. To resolve such a problem:

- Reduce the load during start-up on the motor of lowest rated motor power.
- Configure parallel connections only between motors of comparable rated motor power.

4.8 Connecting AC Mains

- Size the wiring based on the input current of the drive. For maximum wire sizes, see [7.1 Electrical Data](#).
- Comply with local and national electrical codes for cable sizes.

4.8.1 Connecting the Drive to Mains

Table 5: Terminals 91, 92, and 93

Terminals			
91	92	93	Mains voltage 3x380–480 V
L1	L2	L3	
PE			Ground connection

Procedure

1. Connect the 3-phase AC input power wiring to terminals L1, L2, and L3.
2. Depending on the configuration of the equipment, connect the input power to the mains input terminals or the input disconnect.
3. Ground the cable in accordance with the grounding instructions, see [4.3 Grounding](#) and [4.7.1 Grounding Shielded Cable](#).
4. When supplied from an isolated mains source (IT mains or floating delta) or TT/TN-S mains with a grounded leg (grounded delta), ensure that *parameter 14-50 RFI Filter* is set to [0] Off. This setting prevents damage to the DC link and reduces ground capacity currents in accordance with IEC 61800-3.

4.9 Motor and Mains Connection with Service Switch

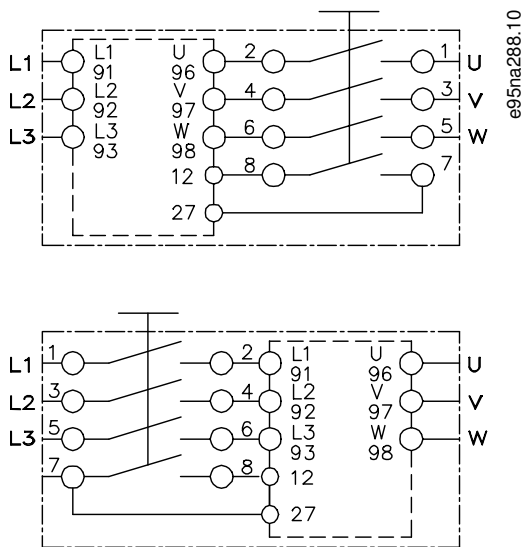


Illustration 18: Motor and Mains Connection with Service Switch

4.10 Control Terminals

4.10.1 Control Wiring

⚠ WARNING ⚠

UNINTENDED START

When the drive is connected to the AC mains, DC supply, or load sharing, the motor may start at any time, causing risk of death, serious injury, and equipment or property damage. The motor may start by activation of an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up software, or after a cleared fault condition.

- Press [Off] on the LCP before programming parameters.
- Disconnect the drive from the mains whenever personal safety considerations make it necessary to avoid unintended motor start.
- Check that the drive, motor, and any driven equipment are in operational readiness.

- It is recommended that control wiring is rated for 600 V.
- Isolate control wiring from high-power components in the drive.
- If the drive is connected to a thermistor, for PELV isolation, ensure that control wiring is reinforced/double insulated.

4.10.2 Terminal Functions

Table 6: Terminal Functions

Terminal Number	Functions
01, 02, 03	Relay 1 output. Usable for AC or DC voltage and resistive or inductive loads.
04, 05, 06	Relay 2 output. Usable for AC or DC voltage and resistive or inductive loads.
12, 13	24 V DC digital supply voltage. Useable for digital inputs and external transducers. To use the 24 V DC for digital input common, programme <i>parameter 5-00 Digital I/O Mode</i> for PNP operation.
18, 19, 32, 33	Digital inputs. Selectable for NPN or PNP function in <i>parameter 5-00 Digital I/O Mode</i> . Default is PNP.

Terminal Number	Functions
27, 29	Digital inputs or outputs. Program <i>parameter 5-01 Terminal 27 Mode</i> for terminal 27 and <i>parameter 5-02 Terminal 29 Mode</i> for terminal 29 for selecting the input/output functions. Default setting is input.
35	Common (-) for external 24 V control back-up supply. Optional.
36	External + 24 V control back up supply. Optional.
37	Safe Stop.
20	Common for digital inputs. To use for digital input common, programme <i>parameter 5-00 Digital I/O Mode</i> for NPN operation.
39	Common for analog output.
42	Analog output. Programmable for various functions in <i>parameter group 6-5* Analog Output 1</i> . The analog signal is 0–20 mA or 4–20 mA at a maximum of 500 Ω.
50	10 V DC analog supply voltage. 15 mA maximum commonly used for a potentiometer or thermistor.
53, 54	Analog input. Selectable for voltage (0 to ±10 V) or current (0 or 4 to ± 20 mA). Closed is for current and open is for voltage. Switches are located on the drive control card. See 4.10.6 DIP Switches .
55	Common for analog inputs.
61	Common for serial communication (RS485 interface). See 4.3 Grounding .
68 (+), 69 (-)	RS485 interface. When the drive is connected to an RS485 serial communication bus, a switch on the control card is provided for termination resistance. Set the switch to ON for termination and OFF for no termination.
62	RxD/TxD –P (red cable) for PROFIBUS. See dedicated literature for VLT® PROFIBUS DP V1 MCA 101) for details.
63	RxD/TxD –N (green cable) for PROFIBUS.
66	0 V for PROFIBUS.
67	+5 V for PROFIBUS.
B01-B12	B-option. See dedicated literature for details.
G, R, V, N, P	Connection of LCP.

4.10.3 Brake Resistor

Table 7: Brake Resistor Terminals

Terminal	Function	
81 (optional function)	R-	Brake resistor terminals
82 (optional function)	R+	

- The connection cable to the brake resistor must be shielded/armored. Connect the shield to the metal cabinet of the drive and to the metal cabinet of the brake resistor with cable clamps.
- Dimension the cross-section of the brake cable to match the brake torque.

4.10.4 Mechanical Brake

Table 8: Terminals 122 and 123

Number	Function		
122 (optional function)	MBR+	Mechanical brake • UDC = 0.45 x RMS mains voltage • Maximum current = 0.8 A	
123 (optional function)	MBR-		

In hoisting/lowering applications, control of electro-mechanical brake is required:

- The brake is controlled using the special mechanical brake control/supply terminals 122 and 123.
- Select [32] *Mechanical brake control* in *parameter group 5-4* Relays, [1] Array, Relay 2* for applications with an electro-mechanical brake.
- The brake is released when the motor current exceeds the preset value in *parameter 2-20 Release Brake Current*.
- The brake is engaged when the output frequency is less than the frequency set in *parameter 2-21 Activate Brake Speed [RPM]* or *parameter 2-22 Activate Brake Speed [Hz]*. The brake engages only when the drive performs a stop command.

When the drive enters alarm mode or is exposed to an overvoltage situation, the mechanical brake immediately cuts in. For more detailed information, refer to the VLT® AutomationDrive FC 301/FC 302 Programming Guide.

NOTICE

When the mechanical brake control/supply terminals 122 and 123 are set through *parameter group 5-4* Relays, [1] Array, Relay 2*, only 1 relay output (Relay 1) is available for free programming.

4.10.5 Connection of Sensors/Actuators on M12 Sockets

Table 9: 4 x M12 Connection Input

Pin	Wire color	Terminal	Function
1	Brown	12	+24 V
3	Blue	20	0 V
4	Black	18, 19, 32, 33	Digital input

Table 10: 2 x M12 Connection Output

Pin	Wire color	Terminal	Function
1	Brown	Reserved ⁽¹⁾	Reserved
3	Blue	20	0 V
4	Black	02, 05	N.O. (24 V)

¹ When reserved wires for option are used. If not utilized, they can be cut off.

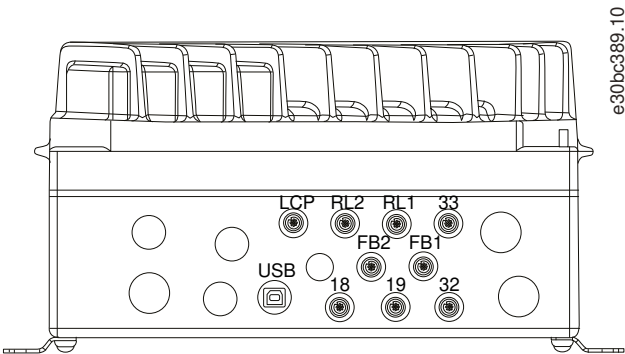


Illustration 19: Connection of Sensors/Actuators on M12 Sockets

4.10.6 DIP Switches

- Analog input terminals 53 and 54 can select either voltage (0-10 V) or current (0-20 mA) input signals.
- Set switches S201 (terminal 53) and S202 (terminal 54) to select the signal type. ON is for current, OFF for voltage.
- Terminal 53 default is for a speed reference in open loop.
- Terminal 54 default is for a feedback signal in closed loop.

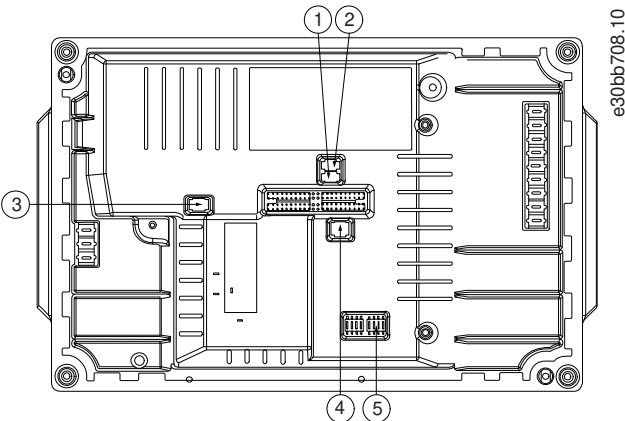


Illustration 20: Location of DIP Switches

1	S201 - terminal 53	4	PROFIBUS termination
2	S202 - terminal 54	5	Fieldbus address
3	S801 - standard bus termination		

NOTICE

Switches 4 and 5 are only valid for units fitted with fieldbus options.

Refer to VLT® PROFIBUS DP V1 MCA 101 Programming Guide for further information.

4.10.7 Safe Torque Off (STO)

To run STO, additional wiring for the drive is required.
Refer to the VLT® Frequency Converters Safe Torque Off Operating Guide for further information.

4.10.8 RS485 Serial Communication

- Use shielded serial communication cable.
- See [4.3 Grounding](#) for proper grounding.

- 2 communication protocols are internal to the drive:
 - Danfoss FC.
 - Modbus RTU.
- 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 that protocol and makes more protocol-specific parameters available.
- Option cards for the drive are available to provide extra communication protocols. See the option card documentation for installation and operating guides.

4.10.8.1 Connecting and Setting Up RS485

Procedure

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

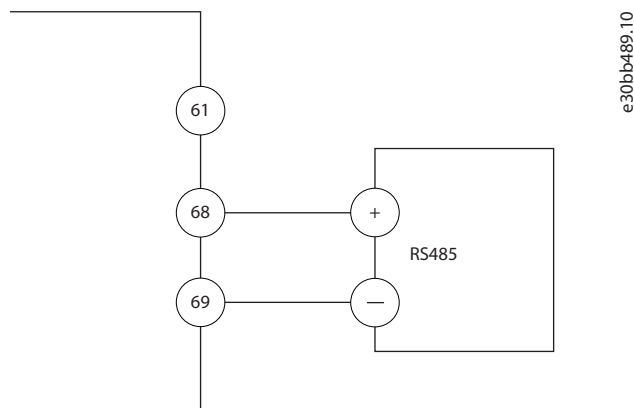


Illustration 21: Serial Communication Wiring Diagram

2. Select the protocol type in *parameter 8-30 Protocol*.
3. Set the drive address in *parameter 8-31 Address*.
4. Set the baud rate in *parameter 8-32 Baud Rate*.

4.11 Installation Checklist

Before completing installation of the unit, inspect the entire installation as detailed in [Table 11](#). Check and mark the items when completed.

Table 11: Start-up Checklist

Inspect for	Description	<input checked="" type="checkbox"/>
Auxiliary equipment	<ul style="list-style-type: none"> • Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers located on the input power side of the drive, or the output side to the motor. Examine their operational readiness and ensure that they are ready in all respects for operation at full speed. • Check function and installation of any sensors used for feedback to the drive. • Remove power factor correction caps on motor(s), if present. 	
Cable routing	Ensure that input power, motor wiring and control wiring are separated or in 3 separate metallic conduits for high-frequency noise isolation.	
Control wiring	<ul style="list-style-type: none"> • Check for broken or damaged wires and connections. • Check the voltage source of the signals, if necessary. • The use of shielded cable or twisted pair is recommended. Ensure that the shield is terminated correctly at both ends. 	

Inspect for	Description	<input checked="" type="checkbox"/>
EMC considerations	Check for proper installation regarding electromagnetic compatibility.	
Environmental considerations	See the equipment label for the maximum ambient operating temperature limits. Temperature is not to exceed 40°C (104°F). Humidity levels must be 5-95% non-condensing.	
Cooling clearance	Units require top and bottom clearance adequate to ensure proper air flow for cooling.	
Fusing and circuit breakers	Check that all fuses are inserted firmly and in operational condition and that all circuit breakers are in the open position. Check for proper fusing or circuit breakers.	
Input and output power wiring	<ul style="list-style-type: none"> • Check for loose connections. • Check for proper fusing or circuit breakers. 	
Switches	Ensure that all switch and disconnect settings are in the proper position.	
Grounding	The equipment requires a dedicated ground wire from its chassis to the plant ground. Check for good ground connections that are tight and free of oxidation.	
Installation box and electronics part	Ensure the installation box and the electronics part is properly closed. Check that all 4 fastening screws are tightened with the right torque.	
Cable glands and blind plugs	Ensure the cable glands and blind plugs are properly tightened to guarantee that the right enclosure protection degree is achieved. Liquids and/or excessive dust ingress in the drive can cause sub-optimal performance or damage.	
Vibration	Ensure the equipment is not exposed to a high level of vibration. Mount the panel solidly or use shock mounts as necessary.	

⚠ CAUTION ⚠

INTERNAL FAILURE HAZARD

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

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

5 Commissioning

5.1 Safety Instructions

See [2.1 Safety Precautions](#) for general safety instructions.

⚠ WARNING ⚠

HIGH VOLTAGE

AC 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.

5.1.1 Before Applying Power

Procedure

1. Close the safety 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 drive 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 drive and the motor.
8. Inspect the drive for loose connections on the terminals.
9. Confirm that the supply voltage matches the voltage of the drive and the motor.

5.2 Applying Power

⚠ WARNING ⚠

UNINTENDED START

When the drive is connected to the AC mains, DC supply, or load sharing, the motor may start at any time, causing risk of death, serious injury, and equipment or property damage. The motor may start by activation of an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up software, or after a cleared fault condition.

- Press [Off] on the LCP before programming parameters.
- Disconnect the drive from the mains whenever personal safety considerations make it necessary to avoid unintended motor start.
- Check that the drive, motor, and any driven equipment are in operational readiness.

Procedure

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 drive now. For units with a disconnect switch, turn it to the ON position to apply power to the drive.

5.3 Local Control Panel Operation

5.3.1 Local Control Panel

The local control panel (LCP) is the combined display and keypad on the front of the unit.

LCP functions

- Control drive speed in hand-on mode.
- Start, stop, and control speed when in local control.
- Show operational data, status, warnings, and cautions.
- Program drive functions.
- Manually reset the drive after a fault when auto reset is inactive.

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

NOTICE

For commissioning via PC, install the MCT 10 Set-up Software. The software is available for download (basic version) or for ordering (advanced version, code number 130B1000). For more information and downloads, see www.danfoss.com.

5.3.2 LCP Layout

The LCP is divided into 4 functional groups:

- A: Display area
- B: Display menus and keys
- C: Navigation keys and indicator lights (LEDs)
- D: Operation keys and reset

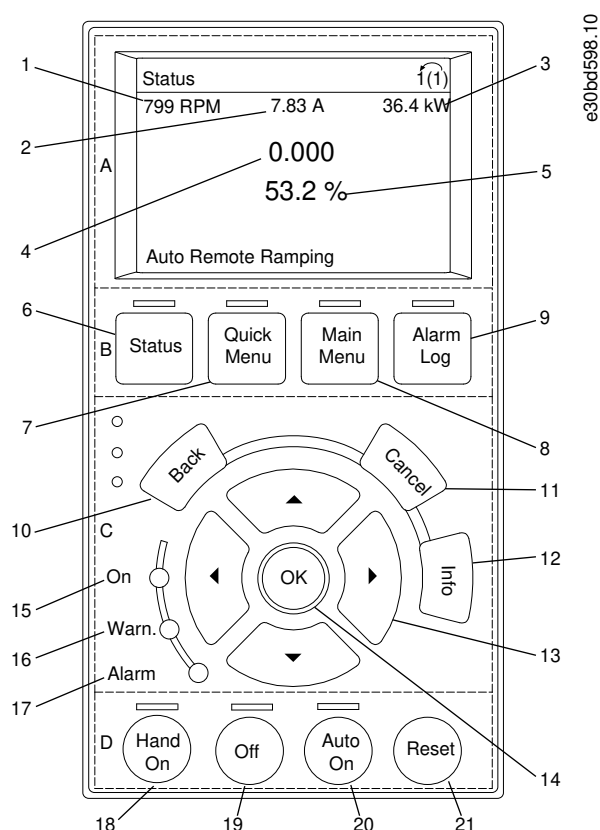


Illustration 22: Local Control Panel (LCP)

Area A: Display area

The display area is activated when the drive receives power from mains voltage, a DC bus terminal, or an external 24 V DC supply. The information shown on the LCP can be customized for user application. Select options in the Quick Menu Q3-13 *Display Settings*.

Table 12: Legend to Area A, Display Area

Callout	Parameter	Default setting
1	Parameter 0-20 Display Line 1.1 Small	[1617] Speed [RPM]
2	Parameter 0-21 Display Line 1.2 Small	[1614] Motor Current
3	Parameter 0-22 Display Line 1.3 Small	[1610] Power [kW]
4	Parameter 0-23 Display Line 2 Large	[1613] Frequency
5	Parameter 0-24 Display Line 3 Large	[1602] Reference %

Area B: Display menu keys

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

Table 13: Legend to Area B, Display Menu Keys

Callout	Key	Function
6	Status	Shows operational information.
7	Quick Menu	Allows access to programming parameters for initial setup 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.

Area C: Navigation keys and indicator lights (LEDs)

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

Table 14: Legend to Area C, Navigation Keys

Callout	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	Press to move between items in the menu.
14	OK	Press to access parameter groups or to enable a choice.

Table 15: Legend to Area C, Indicator Lights (LEDs)

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

Area D: Operation keys and reset

Operation keys are at the bottom of the LCP.

Table 16: Legend to Area D, Operation Keys and Reset

Callout	Key	Function
18	Hand On	Starts the drive in local control. <ul style="list-style-type: none"> An external stop signal by control input or serial communication overrides the local control.
19	Off	Stops the motor but does not remove power to the drive.
20	Auto On	Puts the system in remote control. <ul style="list-style-type: none"> Responds to an external start command by control terminals or serial communication.
21	Reset	Resets the drive manually after a fault has been cleared.

N O T I C E

The display contrast can be adjusted by pressing [Status] and [▲]/[▼] keys.

5.3.3 Parameter Settings

Establishing the correct programming for applications often requires setting functions in several related parameters. Programming data are stored internally in the drive.

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

5.3.4 Uploading/Downloading Data to/from the LCP

Procedure

- Press [Off] to stop the motor before uploading or downloading data.
- Press [Main Menu].
- Go to *parameter 0-50 LCP Copy* and press [OK].
- Select [1] *All to LCP* to upload data to the LCP, or select [2] *All from LCP* to download data from the LCP.
- Press [OK].

 A progress bar shows the uploading or downloading process.

- Press [Hand On] or [Auto On] to return to normal operation.

5.3.5 Changing Parameter Settings

Parameter settings can be accessed and changed via the [Quick Menu] or [Main Menu] keys. The *Quick Menu* only gives access to a limited number of parameters.

Procedure

- Press [Quick Menu] or [Main Menu] on the LCP.
- Press [▲]/[▼] to browse through the parameter groups, press [OK] to select a parameter group.
- Press [▲]/[▼] to browse through the parameters, press [OK] to select a parameter.
- Press [▲]/[▼] to change the value of a parameter setting.
- Press [←]/[→] to shift digit when a decimal parameter is in the editing state.
- Press [OK] to accept the change.
- Press either [Back] twice to enter *Status*, or press [Main Menu] once to enter *Main Menu*.

5.3.6 Restoring Default Settings

NOTICE

RISK OF LOSING DATA

When restoring default settings, there is a risk of losing programming, motor data, localization, and monitoring records.

- Provide a back-up by uploading data to the LCP before initialization.

Restoring the default parameter settings is done by initialization of the drive. Initialization is carried out via *parameter 14-22 Operation Mode* (recommended) or manually.

- Initialization via *parameter 14-22 Operation Mode* does not reset the drive settings such as hours run, serial communication selections, personal menu settings, fault log, alarm log, and other monitoring functions.
- Manual initialization erases all motor programming, localization, and monitoring data, and restores factory default settings.

5.3.6.1 Recommended Initialization

Procedure

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



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

6. *Alarm 80, Drive initialised* is shown.
7. Press [Reset] to return to operating mode.

5.3.6.2 Manual Initialization

Procedure

1. Remove power to the unit and wait for the display to turn off.
2. Press and hold [Status], [Main Menu], and [OK] at the same time 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 might take slightly longer than normal.

Manual initialization resets parameter settings except for the settings in:

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

5.4 Basic Operational Programming

Drives require basic operational programming before running for best performance. Basic operational programming requires entering motor nameplate data for the motor being operated and the minimum and maximum motor speeds. Enter the data in accordance with the following procedure. See [5.3.2 LCP Layout](#) for detailed instructions on entering data through the LCP. Enter the data with power ON, but before operating the drive.

1. Press [Quick Menu] on the LCP.

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

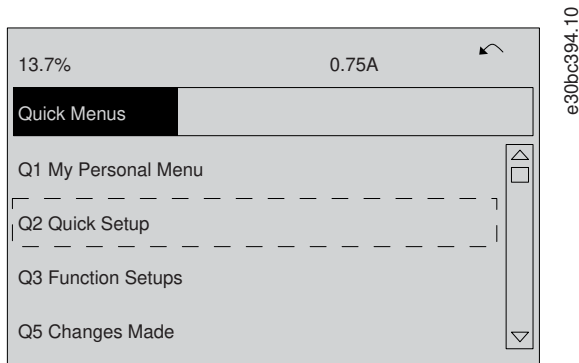


Illustration 23: Quick Menu

3. Select language and press [OK].
4. Enter the motor data in *parameter 1-20 Motor Power [kW]/parameter 1-21 Motor Power [HP]* through *parameter 1-25 Motor Nominal Speed*. The information can be found on the motor nameplate. The entire quick menu is shown in International/ North American default parameter settings.
 - *Parameter 1-20 Motor Power [kW]*
 - *Parameter 1-21 Motor Power [HP]*
 - *Parameter 1-22 Motor Voltage*
 - *Parameter 1-23 Motor Frequency*
 - *Parameter 1-24 Motor Current*
 - *Parameter 1-25 Motor Nominal Speed*

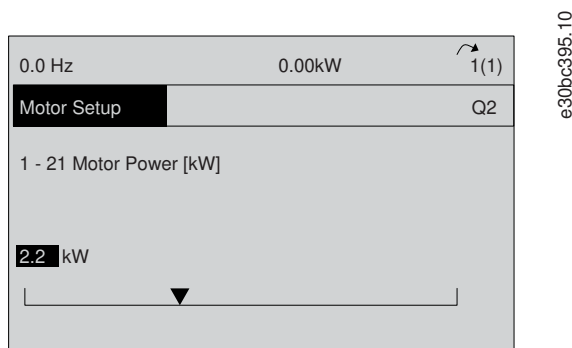


Illustration 24: Motor Set-up

5. Continue set-up of Quick Menu parameters:
 - a. *Parameter 5-12 Terminal 27 Digital Input*. If terminal default is [2] Coast inverse, it is possible to change this setting to [0] No operation.
 - b. *Parameter 1-29 Automatic Motor Adaptation (AMA)*. Set desired AMA function. Enable complete AMA is recommended.
 - c. *Parameter 3-02 Minimum Reference*. Set the minimum speed of the motor shaft.
 - d. *Parameter 3-03 Maximum Reference*. Set the maximum speed of the motor shaft.
 - e. *Parameter 3-41 Ramp 1 Ramp Up Time*. Set the ramping up time regarding synchronous motor speed, ns.
 - f. *Parameter 3-42 Ramp 1 Ramp Down Time*. Set the ramping down time regarding synchronous motor speed, ns.
 - g. *Parameter 3-13 Reference Site*. Set the site from where the reference must work.

5.5 Automatic Motor Adaptation (AMA)

NOTICE

AMA is not relevant for permanent magnet motors.

Automatic motor adaptation (AMA) is a procedure that optimizes compatibility between the drive and the motor.


- The drive builds a mathematical model of the motor for regulating output motor current. The procedure also tests the input phase balance of electrical power. It compares the motor characteristics with the data entered in *parameters 1-20 to 1-25*.
- The motor shaft does not turn and no harm is done to the motor while running AMA.
- Some motors may be unable to run the complete version of the test. In that case, select *[2] Enable reduced AMA*.
- If an output filter is connected to the motor, select *[2] Enable reduced AMA*.
- If warnings or alarms occur, see [6.8 List of Warnings and Alarms](#).
- Run this procedure on a cold motor for best results.

5.5.1 Running AMA

Enter the advanced motor data in *parameter group 1-3* Adv. Motor Data*.

Procedure

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

 The test runs automatically and indicates when it is complete.

5.6 Local-control Test

To reset the drive after a trip, see [6.6 Warning and Alarm Types](#).

Procedure

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

5.7 System Start-up

The procedure in this section requires wiring and application programming to be completed. The following procedure is recommended after application setup is completed.

If warnings or alarms occur, see [6.6 Warning and Alarm Types](#) and [6.8 List of Warnings and Alarms](#).

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.

6 Maintenance, Diagnostics and Troubleshooting

6.1 Maintenance and Service

Under normal operating conditions and load profiles, the drive is maintenance-free throughout its designed lifetime. To prevent breakdown, danger, and damage, examine the drive for loose terminal connections, excessive dust buildup, and so on, at regular intervals. Replace worn or damaged parts with Danfoss authorized parts. For service and support, contact the local Danfoss supplier.

⚠ WARNING ⚠

UNINTENDED START

When the drive is connected to the AC mains, DC supply, or load sharing, the motor may start at any time, causing risk of death, serious injury, and equipment or property damage. The motor may start by activation of an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up software, or after a cleared fault condition.

- Press [Off] on the LCP before programming parameters.
- Disconnect the drive from the mains whenever personal safety considerations make it necessary to avoid unintended motor start.
- Check that the drive, motor, and any driven equipment are in operational readiness.

6.2 Cleaning

The enclosure (IP66/NEMA type 4x indoor) provides protection against dirt and water ingress. The enclosure is suitable for cleaning methods and solvents used in food and beverage plants. Use the solvent concentration recommended by the manufacturer. Avoid high-pressure hot water cleaning at close proximity or of long duration, because this method of cleaning can damage gaskets and labels.

6.3 Frontal LEDs

The actual status can be read via 6 LEDs, which signal the actual status of the unit.

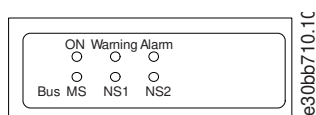


Illustration 25: Frontal LEDs

Table 17: Description of Frontal LEDs

Name	Color	Status	Indication, frontal LEDs
ON	Green	On	The drive receives power from mains voltage or external 24 V supply.
		Off	No power from mains voltage or external 24 V supply.
Warning	Yellow	On	Warning situation is present.
		Off	No warning is present.
Alarm	Red	Flashing	Alarm is present.
		Off	No alarm is present

Name	Color	Status	Indication, frontal LEDs
Bus MS	Only relevant if optional fieldbus is present. See fieldbus-dedicated manuals for specific information.		Bus Module Status
Bus NS1	Only relevant if optional fieldbus is present. See fieldbus-dedicated manuals for specific information.		Bus Network Status 1
Bus NS2	Only relevant if optional fieldbus is present. See fieldbus-dedicated manuals for specific information.		Bus Network Status 2

6.4 Status Display

When the drive is in Status mode, status messages are generated automatically and appear in the bottom line of the display, see [Illustration 26](#).

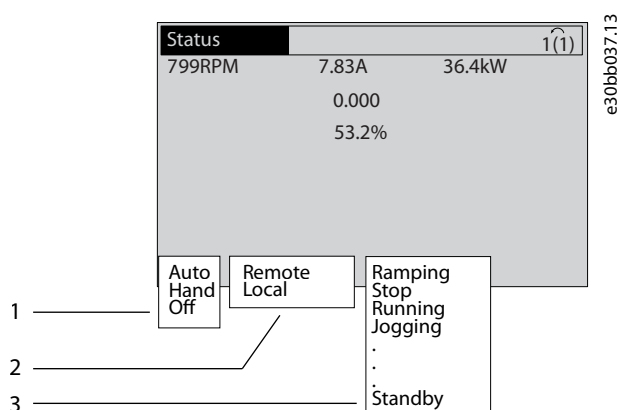


Illustration 26: Status Display

1	Operating mode (see Table 18)	3	Operation status (see Table 20)
2	Reference site (see Table 19)		

6.5 Status Message Definitions

See [Table 18](#) to [Table 20](#) for definitions of the status messages.

Table 18: Operating Mode

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

Table 19: Reference Site

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

Operating Guide

Table 20: Operation Status

AC Brake	[2] AC brake is selected in <i>parameter 2-10 Brake Function</i> . The AC brake overmagnetizes the motor to achieve a controlled slow down.
AMA finish OK	AMA was carried out successfully.
AMA ready	AMA is ready to start. Press [Hand On] to start.
AMA running	AMA process is in progress.
Braking	The brake chopper is in operation. Generative energy is absorbed by the brake resistor.
Braking max.	The brake chopper is in operation. The power limit for the brake resistor defined in <i>parameter 2-12 Brake Power Limit (kW)</i> has been reached.
Coast	<ul style="list-style-type: none"> Coast inverse was selected as a function for a digital input (<i>parameter group 5-1* Digital Inputs</i>). The corresponding terminal is not connected. Coast activated by serial communication.
Ctrl. ramp-down	<p>[1] Control Ramp-down was selected in <i>parameter 14-10 Mains Failure</i>.</p> <ul style="list-style-type: none"> The mains voltage is below the value set in <i>parameter 14-11 Mains Voltage at Mains Fault</i>. The drive ramps down the motor using a controlled ramp down.
Current High	The drive output current is above the limit set in <i>parameter 4-51 Warning Current High</i> .
Current Low	The drive output current is below the limit set in <i>parameter 4-52 Warning Speed Low</i> .
DC Hold	[1] DC hold is selected in <i>parameter 1-80 Function at Stop</i> and a stop command is active. The motor is held by a DC current set in <i>parameter 2-00 DC Hold/Preheat Current</i> .
DC Stop	<p>The motor is held with a DC current (<i>parameter 2-01 DC Brake Current</i>) for a specified time (<i>parameter 2-02 DC Braking Time</i>).</p> <ul style="list-style-type: none"> The DC brake cut in speed is reached in <i>parameter 2-03 DC Brake Cut In Speed [RPM]</i> and a stop command is active. [5] DC-brake inverse is selected as a function for a digital input (<i>parameter group 5-1* Digital Inputs</i>). The corresponding terminal is not active. The DC brake is activated via serial communication.
Feedback high	The sum of all active feedbacks is above the feedback limit set in <i>parameter 4-57 Warning Feedback High</i> .
Feedback low	The sum of all active feedbacks is below the feedback limit set in <i>parameter 4-56 Warning Feedback Low</i> .
Freeze output	<p>The remote reference is active, which holds the present speed.</p> <ul style="list-style-type: none"> [20] Freeze output is selected as a function for a digital input (<i>parameter group 5-1* Digital Inputs</i>). The corresponding terminal is active. Speed control is only possible via the terminal options [21] Speed up and [22] Speed down. Hold ramp is activated via serial communication.
Freeze output request	A freeze output command was given, but the motor remains stopped until a run permissive signal is received.

Freeze ref.	[19] <i>Freeze reference</i> is selected as a function for a digital input (<i>parameter group 5-1* Digital Inputs</i>). The corresponding terminal is active. The drive saves the actual reference. Changing the reference is now only possible via terminal options [21] <i>Speed up</i> and [22] <i>Speed down</i> .
Jog request	A jog command was given, but the motor remains stopped until a run permissive signal is received via a digital input.
Jogging	<p>The motor is running as programmed in <i>parameter 3-19 Jog Speed [RPM]</i>.</p> <ul style="list-style-type: none"> [14] <i>Jog</i> was selected as a function for a digital input (<i>parameter group 5-1* Digital Inputs</i>). The corresponding terminal (for example, terminal 29) is active. The jog function is activated via the serial communication. The jog function is selected as a reaction for a monitoring function (for example, for the no signal function). The monitoring function is active.
Motor check	In <i>parameter 1-80 Function at Stop</i> , [2] <i>Motor Check</i> is selected. A stop command is active. To ensure that a motor is connected to the drive, a permanent test current is applied to the motor.
OVC control	Overvoltage control is activated via <i>parameter 2-17 Over-voltage Control</i> , [2] <i>Enabled</i> . The connected motor supplies the drive with generative energy. The overvoltage control adjusts the V/Hz ratio to run the motor in controlled mode and to prevent the drive from tripping.
PowerUnit Off	(Only drives with a 24 V external supply installed). Mains supply to the drive was removed, and the control card is supplied by the external 24 V.
Protection md	<p>Protection mode is active. The unit detected a critical status (overcurrent or overvoltage).</p> <ul style="list-style-type: none"> To avoid tripping, switching frequency is reduced to 4 kHz. If possible, protection mode ends after approximately 10 s. Protection mode can be restricted in <i>parameter 14-26 Trip Delay at Inverter Fault</i>.
QStop	<p>The motor is decelerating using <i>parameter 3-81 Quick Stop Ramp Time</i>.</p> <ul style="list-style-type: none"> [4] <i>Quick stop inverse</i> is selected as a function for a digital input (<i>parameter group 5-1* Digital Inputs</i>). The corresponding terminal is not active. The quick stop function is activated via serial communication.
Ramping	The motor is accelerating/decelerating using the active ramp up/down. The reference, a limit value, or a standstill is not yet reached.
Ref. high	The sum of all active references is above the reference limit set in <i>parameter 4-55 Warning Reference High</i> .
Ref. low	The sum of all active references is below the reference limit set in <i>parameter 4-54 Warning Reference Low</i> .
Run on ref.	The drive is running in the reference range. The feedback value matches the setpoint value.
Run request	A start command was given, but the motor remains stopped until a run permissive signal is received via digital input.
Running	The drive drives the motor.
Sleep Mode	The energy-saving function is enabled. The motor has stopped, but restarts automatically when required.
Speed high	Motor speed is above the value set in <i>parameter 4-53 Warning Speed High</i> .
Speed low	Motor speed is below the value set in <i>parameter 4-52 Warning Speed Low</i> .
Standby	In auto-on mode, the drive starts the motor with a start signal from a digital input or serial communication.
Start delay	In <i>parameter 1-71 Start Delay</i> , a delay starting time was set. A start command is activated, and the motor starts after the start delay time expires.

Start fwd/rev	[12] Enable start forward and [13] Enable start reverse are selected as options for 2 different digital inputs (parameter group 5-1* Digital Inputs). The motor starts in forward or reverse direction depending on which terminal is activated.
Stop	The drive received a stop command from the LCP, digital input, or serial communication.
Trip	An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, the drive can be reset manually by pressing [Reset] or remotely by control terminals or serial communication.
Trip lock	An alarm occurred, and the motor is stopped. When the cause of the alarm is cleared, cycle power to the drive. The drive can then be reset manually by pressing [Reset], or remotely by control terminals or serial communication.

N O T I C E

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

6.6 Warning and Alarm Types

Warnings

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

Alarms

An alarm indicates a fault that requires immediate attention. The fault always triggers a trip or a trip lock. Reset the system after an alarm.

Trip

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

Trip lock

Input power is cycled. The motor coasts to a stop. The drive continues to monitor the drive status. Remove input power to the drive, correct the cause of the fault, and reset the drive.

Resetting the drive after a trip/trip lock

A trip can be reset in any of 4 ways:

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

6.7 Warning and Alarm Displays

- A warning is shown in the LCP along with the warning number.
- An alarm flashes along with the alarm number.

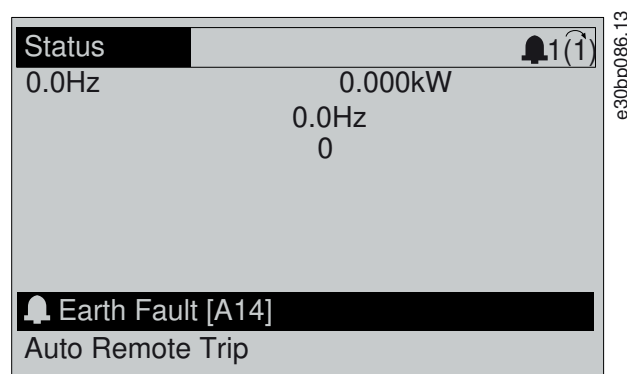


Illustration 27: Alarm Example

In addition to the text and alarm code in the LCP there are 3 status indicator lights.

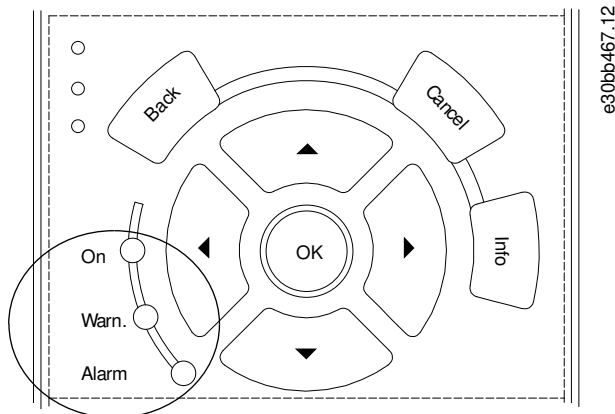


Illustration 28: Status Indicator Lights

	Warning indicator light	Alarm indicator light
Warning	On	Off
Alarm	Off	On (flashing)
Trip lock	On	On (flashing)

6.8 List of Warnings and Alarms

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

6.8.1 WARNING/ALARM 4, Mains Phase Loss

Cause

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

Troubleshooting

- Check the supply voltage and supply currents to the drive.

6.8.2 WARNING 5, DC Link Voltage High

Cause

The DC-link voltage (DC) is higher than the high-voltage warning limit. The limit depends on the drive voltage rating. The unit is still active.

6.8.3 WARNING 6, DC Link Voltage Low

Cause

The DC-link voltage (DC) is lower than the low voltage warning limit. The limit depends on the drive voltage rating. The unit is still active.

6.8.4 WARNING/ALARM 8, DC Undervoltage

Cause

If the DC-link voltage drops below the undervoltage limit, the drive checks for 24 V DC back-up supply. If no 24 V DC back-up supply is connected, the drive trips after a fixed time delay. The time delay varies with unit size.

Troubleshooting

- Check that the supply voltage matches the drive voltage.
- Perform an input voltage test.
- Perform a soft-charge circuit test.

6.8.5 WARNING/ALARM 9, Inverter Overload

Cause

The drive has run with more than 100% overload for too long and is about to cut out. The counter for electronic thermal inverter protection issues a warning at 98% and trips at 100% with an alarm. The drive cannot be reset until the counter is below 90%.

Troubleshooting

- Compare the output current shown on the LCP with the drive rated current.
- Compare the output current shown on the LCP with the measured motor current.
- Show the thermal drive load on the LCP and monitor the value. When running above the drive continuous current rating, the counter increases. When running below the drive continuous current rating, the counter decreases.

6.8.6 WARNING/ALARM 10, Motor Overload Temperature

Cause

According to the electronic thermal protection (ETR), the motor is too hot.

Select 1 of these options:

- The drive issues a warning or an alarm when the counter is >90% if *parameter 1-90 Motor Thermal Protection* is set to warning options.
- The drive trips when the counter reaches 100% if *parameter 1-90 Motor Thermal Protection* is set to trip options.

The fault occurs when the motor runs with more than 100% overload for too long.

Troubleshooting

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

6.8.7 WARNING/ALARM 11, Motor Thermistor Overtemp

The motor thermistor indicates that the motor temperature is too high.

Troubleshooting

- Check for motor overheating.
- Check that the thermistor is securely connected.
- Check if the motor is mechanically overloaded.
- When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 and 54 is set for voltage. Check that *parameter 1-93 Thermistor Resource* selects 53 or 54.
- When using terminal 18, 19, 31, 32, or 33 (digital inputs), check that the thermistor is connected correctly between the digital input terminal used (digital input PNP only) and terminal 50. Select the terminal to use in *parameter 1-93 Thermistor Resource*.

6.8.8 WARNING/ALARM 12, Torque Limit

Cause

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

Troubleshooting

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

6.8.9 WARNING/ALARM 13, Overcurrent

Cause

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts approximately 1.5 s, then the drive trips and issues an alarm. Shock loading or quick acceleration with high-inertia loads can cause this fault. If the acceleration during ramp-up is quick, the fault can also appear after kinetic back-up. If extended mechanical brake control is selected, a trip can be reset externally.

Troubleshooting

- Remove power and check if the motor shaft can be turned.
- Check that the motor size matches the drive.
- Check that the motor data is correct in *parameters 1-20 to 1-25*.

6.8.10 ALARM 14, Earth (Ground) Fault

Cause

There is current from the output phase to ground, either in the cable between the drive and the motor, or in the motor itself. The current transducers detect the ground fault by measuring current going out from the drive and current going into the drive from the motor. Ground fault is issued if the deviation of the 2 currents is too large. The current going out of the drive must be the same as the current going into the drive.

Troubleshooting

- Remove power to the drive and repair the ground fault.
- Check for ground faults in the motor by measuring the resistance to ground of the motor cables and the motor with a megohmmeter.
- Reset any potential individual offset in the 3 current transducers in the drive. Perform a manual initialization or perform a complete AMA. This method is most relevant after changing the power card.

6.8.11 ALARM 15, Hardware Mismatch

Cause

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

Troubleshooting

Record the value of the following parameters and contact Danfoss.

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

6.8.12 ALARM 16, Short Circuit

Cause

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

Troubleshooting

⚠ WARNING ⚠

HIGH VOLTAGE

AC 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.

- Disconnect power before proceeding.
- Remove the power to the drive and repair the short circuit.

6.8.13 WARNING/ALARM 17, Control Word Timeout

Cause

There is no communication to the drive. The warning is only active when *parameter 8-04 Control Word Timeout Function* is NOT set to [0] Off.

If *parameter 8-04 Control Word Timeout Function* is set to [5] Stop and trip, a warning appears, and the drive ramps down to a stop and shows an alarm.

Troubleshooting

- Check the connections on the serial communication cable.
- Increase *parameter 8-03 Control Word Timeout Time*.
- Check the operation of the communication equipment.
- Verify that proper EMC installation was performed.

6.8.14 WARNING/ALARM 22, Hoist Mechanical Brake

Cause

The value of this warning/alarm shows the type of warning/alarm.

0 = The torque reference was not reached before timeout (*parameter 2-27 Torque Ramp Up Time*).

1 = Expected brake feedback was not received before timeout (*parameter 2-23 Activate Brake Delay*, *parameter 2-25 Brake Release Time*).

6.8.15 WARNING 23, Internal Fan Fault

Cause

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

For drives with DC fans, a feedback sensor is mounted in the fan. If the fan is commanded to run and there is no feedback from the sensor, this alarm appears. For drives with AC fans, the voltage to the fan is monitored.

Troubleshooting

- Check for proper fan operation.
- Cycle power to the drive and check that the fan operates briefly at start-up.
- Check the sensors on the control card.

6.8.16 WARNING 25, Brake Resistor Short Circuit

Cause

The brake resistor is monitored during operation. If a short circuit occurs, the brake function is disabled and the warning appears. The drive is still operational, but without the brake function.

Troubleshooting

- Remove the power to the drive and replace the brake resistor (refer to *parameter 2-15 Brake Check*).

6.8.17 WARNING/ALARM 26, Brake Resistor Power Limit

Cause

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

6.8.18 WARNING/ALARM 27, Brake Chopper Fault

Cause

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

Troubleshooting

- Remove the power to the drive and remove the brake resistor.

6.8.19 WARNING/ALARM 28, Brake Check Failed

Cause

The brake resistor is not connected or not working.

Troubleshooting

- Check *parameter 2-15 Brake Check*.

6.8.20 ALARM 29, Heat Sink Temp

Cause

The maximum temperature of the heat sink is exceeded. The temperature fault is not reset until the temperature drops below a defined heat sink temperature. The trip and reset points are different based on the drive power size.

Troubleshooting

Check for the following conditions:

- The ambient temperature is too high.
- The motor cables are too long.
- Incorrect airflow clearance above and below the drive.
- Blocked airflow around the drive.
- Damaged heat sink fan.
- Dirty heat sink.

6.8.21 ALARM 30, Motor Phase U Missing

Cause

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

Troubleshooting

⚠ WARNING ⚠

HIGH VOLTAGE

AC 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.

- Disconnect power before proceeding.
- Remove the power from the drive and check motor phase U.

6.8.22 ALARM 31, Motor Phase V Missing

Cause

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

Troubleshooting

⚠ WARNING ⚠

HIGH VOLTAGE

AC 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.

- Disconnect power before proceeding.
- Remove the power from the drive and check motor phase V.

Operating Guide

6.8.23 ALARM 32, Motor Phase W Missing

Cause

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

Troubleshooting

⚠ WARNING ⚠

HIGH VOLTAGE

AC 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.

- Disconnect power before proceeding.
- Remove the power from the drive and check motor phase W.

6.8.24 ALARM 33, Inrush Fault

Cause

Too many power-ups have occurred within a short time period.

Troubleshooting

- Let the unit cool to operating temperature.
- Check potential DC-link fault to ground.

6.8.25 WARNING/ALARM 34, Fieldbus Communication Fault

Cause

The fieldbus on the communication option card is not working.

6.8.26 WARNING/ALARM 36, Mains Failure

Cause

This warning/alarm is only active if the supply voltage to the drive is lost and *parameter 14-10 Mains Failure* is not set to [0] No Function.

Troubleshooting

- Check the fuses to the drive and mains supply to the unit.

6.8.27 ALARM 37, Phase Imbalance

Cause

There is a current imbalance between the power units.

6.8.28 ALARM 38, Internal Fault

Cause

When an internal fault occurs, a code number defined in [Table 21](#) is shown.

Troubleshooting

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

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

Table 21: Internal Fault Codes

Number	Text
0	The serial port cannot be initialized. Contact the Danfoss supplier or Danfoss service department.
256–258	The power EEPROM data is defective or too old. Replace the power card.
512–519	Internal fault. Contact the Danfoss supplier or Danfoss service department.

Number	Text
783	Parameter value outside of minimum/maximum limits.
1024–1284	Internal fault. Contact the Danfoss supplier or Danfoss service department.
1299	The option software in slot A is too old.
1300	The option software in slot B is too old.
1302	The option software in slot C1 is too old.
1315	The option software in slot A is not supported/allowed.
1316	The option software in slot B is not supported/ allowed.
1318	The option software in slot C1 is not supported/ allowed.
1379–2819	Internal fault. Contact the Danfoss supplier or Danfoss service department.
1792	Hardware reset of digital signal processor.
1793	Motor-derived parameters not transferred correctly to the digital signal processor.
1794	Power data not transferred correctly at power-up to the digital signal processor.
1795	The digital signal processor has received too many unknown SPI telegrams. The AC drive also uses this fault code if the MCO does not power up correctly. This situation can occur due to poor EMC protection or improper grounding.
1796	RAM copy error.
2561	Replace the control card.
2820	LCP stack overflow.
2821	Serial port overflow.
2822	USB port overflow.
3072–5122	Parameter value is outside its limits.
5123	Option in slot A: Hardware incompatible with the control board hardware.
5124	Option in slot B: Hardware incompatible with the control board hardware.
5125	Option in slot C0: Hardware incompatible with the control board hardware.
5126	Option in slot C1: Hardware incompatible with the control board hardware.
5376–6231	Internal fault. Contact the Danfoss supplier or Danfoss service department.

6.8.29 WARNING 40, Overload of Digital Output Terminal 27

Troubleshooting

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

6.8.30 WARNING 41, Overload of Digital Output Terminal 29

Troubleshooting

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

Operating Guide

6.8.31 WARNING 42, Ovrlld X30/6-7

Troubleshooting

For terminal X30/6:

- Check the load connected to the terminal, or remove the short-circuit connection.
- Check *parameter 5-32 Term X30/6 Digi out (MCB 101)* (VLT® General Purpose I/O MCB 101).

For terminal X30/7:

- Check the load connected to the terminal, or remove the short-circuit connection.
- Check *parameter 5-33 Term X30/7 Digi Out (MCB 101)* (VLT® General Purpose I/O MCB 101).

6.8.32 ALARM 43, Ext. Supply

Either connect a 24 V DC external supply or specify that no external supply is used via *parameter 14-80 Option Supplied by External 24VDC, [0] No*. A change in *parameter 14-80 Option Supplied by External 24VDC* requires a power cycle.

Cause

VLT® Extended Relay Option MCB 113 is mounted without 24 V DC.

Troubleshooting

Choose 1 of the following:

- Connect a 24 V DC external supply.
- Specify that no external supply is used via *parameter 14-80 Option Supplied by External 24VDC, [0] No*. A change in *parameter 14-80 Option Supplied by External 24VDC* requires a power cycle.

6.8.33 ALARM 45, Earth Fault 2

Cause

Ground fault.

Troubleshooting

- Check for proper grounding and loose connections.
- Check for proper wire size.
- Check the motor cables for short circuits or leakage currents.

6.8.34 ALARM 46, Power Card Supply

Cause

The supply on the power card is out of range. Another reason can be a defective heat sink fan.

There are 3 supplies generated by the switch mode supply (SMPS) on the power card:

- 24 V.
- 5 V.
- ± 18 V.

When powered with VLT® 24 V DC Supply MCB 107, only 24 V and 5 V supplies are monitored. When powered with 3-phase mains voltage, all 3 supplies are monitored.

Troubleshooting

- Check for a defective power card.
- Check for a defective control card.
- Check for a defective option card.
- If a 24 V DC supply is used, verify proper supply power.
- Check for a defective heat sink fan.

6.8.35 WARNING 47, 24 V Supply Low

Cause

The supply on the power card is out of range.

There are 3 supplies generated by the switch mode supply (SMPS) on the power card:

- 24 V
- 5 V
- ± 18 V

Troubleshooting

- Check for a defective power card.

6.8.36 WARNING 48, 1.8 V Supply Low

Cause

The 1.8 V DC supply used on the control card is outside of the allowed limits. The supply is measured on the control card.

Troubleshooting

- Check for a defective control card.
- If an option card is present, check for overvoltage.

6.8.37 WARNING 49, Speed Limit

Cause

The warning is shown when the speed is outside of the specified range in *parameter 4-11 Motor Speed Low Limit [RPM]* and *parameter 4-13 Motor Speed High Limit [RPM]*. When the speed is below the specified limit in *parameter 1-86 Trip Speed Low [RPM]* (except when starting or stopping), the drive trips.

6.8.38 ALARM 50, AMA Calibration Failed

Troubleshooting

- Contact the Danfoss supplier or service department.

6.8.39 ALARM 51, AMA Check Unom and Inom

Cause

The settings for motor voltage, motor current, and motor power are wrong.

Troubleshooting

- Check settings in *parameters 1-20 to 1-25*.

6.8.40 ALARM 52, AMA Low Inom

Cause

The motor current is too low.

Troubleshooting

- Check the settings in *parameter 1-24 Motor Current*.

6.8.41 ALARM 53, AMA Motor Too Big

Cause

The motor is too big for the AMA to operate.

6.8.42 ALARM 54, AMA Motor Too Small

Cause

The motor is too small for the AMA to operate.

6.8.43 ALARM 55, AMA Parameter Out of Range

Cause

The AMA cannot run because the parameter values of the motor are out of the acceptable range.

6.8.44 ALARM 56, AMA Interrupted by User

Cause

The AMA is manually interrupted.

6.8.45 ALARM 57, AMA Internal Fault

Cause

Try to restart the AMA. Repeated restarts can overheat the motor.

Operating Guide

6.8.46 ALARM 58, AMA Internal Fault

Troubleshooting

Contact the Danfoss supplier.

6.8.47 WARNING 59, Current Limit

Cause

The current is higher than the value in *parameter 4-18 Current Limit*.

Troubleshooting

- Ensure that the motor data in *parameters 1-20 to 1-25* is set correctly.
- Increase the current limit if necessary. Ensure that the system can operate safely at a higher limit.

6.8.48 WARNING 60, External Interlock

Cause

A digital input signal indicates a fault condition external to the drive. An external interlock has commanded the drive to trip.

Troubleshooting

- Clear the external fault condition.
- To resume normal operation, apply 24 V DC to the terminal programmed for external interlock.
- Reset the drive.

6.8.49 WARNING/ALARM 61, Feedback Error

Cause

An error between calculated speed and speed measurement from feedback device.

Troubleshooting

- Check the settings for warning/alarm/disabling in *parameter 4-30 Motor Feedback Loss Function*.
- Set the tolerable error in *parameter 4-31 Motor Feedback Speed Error*.
- Set the tolerable feedback loss time in *parameter 4-32 Motor Feedback Loss Timeout*.

6.8.50 WARNING 62, Output Frequency at Maximum Limit

Cause

The output frequency has reached the value set in *parameter 4-19 Max Output Frequency*.

Troubleshooting

- Check the application for possible causes.
- Increase the output frequency limit. Be sure that the system can operate safely at a higher output frequency.

The warning clears when the output drops below the maximum limit.

6.8.51 ALARM 63, Mechanical Brake Low

Cause

The actual motor current has not exceeded the release brake current within the start delay time window.

6.8.52 WARNING 64, Voltage Limit

Cause

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

6.8.53 WARNING/ALARM 65, Control Card Overtemperature

Cause

The cutout temperature of the control card has exceeded the upper limit.

Troubleshooting

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

6.8.54 WARNING 66, Heat Sink Temperature Low

Cause

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

Troubleshooting

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

6.8.55 ALARM 67, Option Module Configuration has Changed

Cause

One or more options have either been added or removed since the last power-down.

Troubleshooting

- Check that the configuration change is intentional and reset the unit.

6.8.56 ALARM 68, Safe Stop Activated

Cause

Safe Torque Off (STO) has been activated.

Troubleshooting

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

6.8.57 ALARM 70, Illegal FC Configuration

Cause

The control card and power card are incompatible.

Troubleshooting

- To check compatibility, contact the Danfoss supplier with the type code from the unit nameplate and the part numbers on the cards.

6.8.58 ALARM 71, PTC 1 Safe Stop

Cause

Because the motor is too warm, the VLT®PTC Thermistor Card MCB 112 activated the Safe Torque Off (STO).

Troubleshooting

- Once the motor temperature reaches an acceptable level and the digital input from MCB 112 is deactivated, perform 1 of the following:
 - Send a reset signal via bus or digital I/O.
 - Press [Reset].

6.8.59 ALARM 72, Dangerous Failure

Cause

Safe Torque Off (STO) with trip lock.

Troubleshooting

An unexpected combination of STO commands has occurred:

- VLT®PTC Thermistor Card MCB 112 enables X44/10, but STO is not enabled.
- MCB 112 is the only device using STO (specified through selection [4] *PTC 1 alarm* or [5] *PTC 12 warning* in *parameter 5-19 Terminal 37 Safe Stop*). STO is activated, but X44/10 is not activated.

6.8.60 WARNING 73, Safe Stop Auto Restart

Cause

STO activated.

Troubleshooting

- With automatic restart enabled, the motor can start when the fault is cleared.

Operating Guide

6.8.61 ALARM 74, PTC Thermistor

Cause

The PTC is not working. Alarm is related to VLT®PTC Thermistor Card MCB 112.

6.8.62 ALARM 75, Illegal Profile Sel.

Cause

Do not write the parameter value while the motor is running.

Troubleshooting

- Stop the motor before writing the MCO profile to *parameter 8-10 Control Word Profile*.

6.8.63 WARNING 77, Reduced Power Mode

Cause

The drive is operating in reduced power mode (less than allowed number of inverter sections). The warning is generated on power cycle when the drive is set to run with fewer inverters and remains on.

6.8.64 ALARM 78, Tracking Error

Cause

The difference between setpoint value and actual value exceeds the value in *parameter 4-35 Tracking Error*.

Troubleshooting

- Disable the function or select an alarm/warning in *parameter 4-34 Tracking Error Function*.
- Investigate the mechanics around the load and motor. Check feedback connections from motor encoder to drive.
- Select motor feedback function in *parameter 4-30 Motor Feedback Loss Function*.
- Adjust the tracking error band in *parameter 4-35 Tracking Error* and *parameter 4-37 Tracking Error Ramping*.

6.8.65 ALARM 79, Illegal Power Section Configuration

Cause

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

6.8.66 ALARM 80, Drive Initialized to Default Value

Cause

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

6.8.67 ALARM 81, CSIV Corrupt

Cause

The CSIV file has syntax errors.

6.8.68 ALARM 82, CSIV Parameter Error

Cause

CSIV failed to initialize a parameter.

6.8.69 ALARM 83, Illegal Option Combination

Cause

The mounted options are incompatible.

6.8.70 ALARM 84, No Safety Option

Cause

The safety option was removed without applying a general reset.

Troubleshooting

Reconnect the safety option.

6.8.71 ALARM 88, Option Detection

Cause

A change in the option layout is detected. *Parameter 14-89 Option Detection* is set to [0] Frozen configuration and the option layout has been changed.

Troubleshooting

- To apply the change, enable option layout changes in *parameter 14-89 Option Detection*.
- Alternatively, restore the correct option configuration.

6.8.72 WARNING 89, Mechanical Brake Sliding

Cause

The hoist brake monitor detects a motor speed exceeding 10 RPM.

6.8.73 ALARM 90, Feedback Monitor

Troubleshooting

- Check the connection to the encoder/resolver option and, if necessary, replace the VLT[®] Encoder Input MCB 102 or VLT[®] Resolver Input MCB 103.

6.8.74 ALARM 91, Analog Input 54 Wrong Settings

Troubleshooting

- Set switch S202 in position OFF (voltage input) when a KTY sensor is connected to analog input terminal 54.

6.8.75 ALARM 99, Locked Rotor

Cause

The rotor is blocked.

Troubleshooting

- Check if the motor shaft is locked.
- Check if the start current triggers the current limit set in *parameter 4-18 Current Limit*.
- Check if it increases the value in *parameter 30-23 Locked Rotor Detection Time [s]*.

6.8.76 WARNING/ALARM 104, Mixing Fan Fault

Cause

The fan is not operating. The fan monitor checks that the fan is spinning at power-up or whenever the mixing fan is turned on. The mixing fan fault can be configured as a warning or an alarm in *parameter 14-53 Fan Monitor*.

Troubleshooting

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

6.8.77 WARNING/ALARM 122, Mot. Rotat. Unexp.

Cause

The drive performs a function that requires the motor to be at standstill, for example DC hold for PM motors.

6.8.78 WARNING 163, ATEX ETR Cur.Lim.Warning

Cause

The drive has run above the characteristic curve for more than 50 s. The warning is activated at 83% and deactivated at 85% of the allowed thermal overload.

6.8.79 ALARM 164, ATEX ETR Cur.Lim.Alarm

Cause

Running above the characteristic curve for more than 60 s within a period of 600 s activates the alarm, and the drive trips.

6.8.80 WARNING 165, ATEX ETR Freq.Lim.Warning

Cause

The drive has run for more than 50 s below the allowed minimum frequency (*parameter 1-98 ATEX ETR Interpol. Points Freq.*).

6.8.81 ALARM 166, ATEX ETR Freq.Lim.Alarm

The drive has run for more than 60 s (in a period of 600 s) below the allowed minimum frequency (*parameter 1-98 ATEX ETR Interpol. Points. Freq.*).

6.8.82 WARNING 251, New Typecode

Cause

The power card or other components have been replaced, and the typecode has changed.

7 Specifications

7.1 Electrical Data

Table 22: Shaft Output, Output Current, and Input Current

Mains Supply 3x380–480 V AC							
Drive	PK37	PK55	PK75	P1K1	P1K5	P2K2	P3K0
Rated shaft output [kW]	0.37	0.55	0.75	1.1	1.5	2.2	3.0
Rated shaft output [hp]	0.5	0.75	1.0	1.5	2.0	3.0	4.0
Maximum input current							
Continuous (3x380–440 V) [A]	1.2	1.6	2.2	2.7	3.7	5.0	6.5
Intermittent (3x380–440 V) [A]	1.9	2.6	3.5	4.3	5.9	8.0	10.4
Continuous (3x441–480 V) [A]	1.0	1.4	1.9	2.7	3.1	4.3	5.7
Intermittent (3x441–480 V) [A]	1.6	2.2	3.0	4.3	5.0	6.9	9.1
Recommended maximum fuse size (non UL)	gG-25						
Built-in circuit breaker (large unit)	CTI-25M ordering number: 047B3151						
Recommended circuit breaker Danfoss CTI-25M (small and large unit) part number:							
0.37, 0.55 kW	Ordering number: 047B3148						
0.75, 1.1 kW	Ordering number: 047B3149						
1.5, 2.2, and 3 kW	Ordering number: 047B3151						
Recommended circuit breaker Danfoss CTI-45MB (small unit) part number: ⁽¹⁾							
0.55, 0.75 kW	Ordering number: 047B3160						
1.1 kW	Ordering number: 047B3161						
1.5 kW	Ordering number: 047B3162						
2.2 kW	Ordering number: 047B3163						
Power loss at maximum load [W] ⁽²⁾	35	42	46	58	62	88	116
Efficiency ⁽³⁾	0.93	0.95	0.96	0.96	0.97	0.97	0.97
Weight, small unit [kg (lb)]	9.8 (21.6)						
Weight, large unit [kg (lb)]	13.9 (30.6)						
Output current							
Continuous (3x380–440 V) [A]	1.3	1.8	2.4	3.0	4.1	5.2	7.2
Intermittent (3x380–440 V) [A]	2.1	2.9	3.8	4.8	6.6	8.3	11.5

Mains Supply 3x380–480 V AC							
Continuous (3x441–480 V) [A]	1.2	1.6	2.1	3.0	3.4	4.8	6.3
Intermittent (3x441–480 V) [A]	1.9	2.6	3.4	4.8	5.4	7.7	10.1
Continuous kVA (400 V AC) [kVA]	0.9	1.3	1.7	2.1	2.8	3.9	5.0
Continuous kVA (460 V AC) [kVA]	0.9	1.3	1.7	2.4	2.7	3.8	5.0
Maximum cable size: (mains, motor, brake) [mm ² /AWG]	solid cable 6/10 flexible cable 4/12						

¹ Type CTI-45MB circuit breakers are not available for 3 kW (4 hp) units.

² Applies to the dimensioning of drive cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumption are included. For power loss data according to EN 50598-2, refer to www.danfoss.com.

³ Efficiency measured at nominal current. For energy efficiency class, see [7.4.1 Environment](#). For part load losses see www.danfoss.com.

7.2 Mains Supply (L1, L2, L3)

Supply voltage ⁽¹⁾⁽²⁾	380–480 V/500–600 V ±10%
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 ($\cos \Phi$)	Near unity (>0.98)
Switching on the input supply L1, L2, L3 (power-ups)	Maximum 2 times per minute

¹ Mains voltage low/mains drop-out: During low mains voltage or a mains dropout, the drive continues until the DC-link voltage drops below the minimum stop level, which corresponds typically to 15% below the drive's lowest rated supply voltage. Power-up and full torque cannot be expected at mains voltage lower than 10% below the drive's lowest rated supply voltage.

² The unit is suitable for use on a circuit capable of delivering not more than 100000 RMS symmetrical Amperes, 240/500/600/690 V maximum.

7.3 Motor Output and Motor Data

7.3.1 Motor Output (U, V, W)

Output voltage	0–100% of supply voltage
Output frequency	0–590 Hz ⁽¹⁾
Output frequency in flux mode	0–300 Hz
Switching on output	Unlimited
Ramp times	0.01–3600 s

¹ Dependent on voltage and power.

7.3.2 Torque Characteristics

Starting torque (constant torque)	Maximum 160% for 60 s ⁽¹⁾
Starting torque	Maximum 180% up to 0.5 s ⁽¹⁾
Overload torque (constant torque)	Maximum 160% for 60 s ⁽¹⁾
Starting torque (variable torque)	Maximum 110% for 60 s ⁽¹⁾
Overload torque (variable torque)	Maximum 110% for 60 s ⁽¹⁾

¹ Percentage relates to the nominal torque of the drive, dependent on power size.

7.4 Ambient Conditions

7.4.1 Environment

Enclosure rating	IP66/Type 4X
Vibration test for units without circuit breaker	1.7 g RMS
Mount unit with integrated circuit breaker on a level, vibration-proof, and torsionally rigid support structure.	
Maximum relative humidity	5–95% (IEC 721-3-3); Class 3K3 (non-condensing) during operation
Ambient temperature ⁽¹⁾	Maximum 40 °C (75 °F) (24-hour average maximum 35 °C (95 °F))
Minimum ambient temperature during full-scale operation	0 °C (32 °F)
Minimum ambient temperature at reduced speed performance	-10 °C (14 °F)
Temperature during storage/transport	-25 to +65/70 °C (-13 to +149/158 °F)
Maximum altitude above sea level	1000 m (3280 ft)
Energy efficiency class ⁽²⁾	IE2

¹ See Special Conditions in the design guide for:

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

² Determined according to EN 50598-2 at:

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

7.5 Cable Lengths and Cross-sections

Maximum motor cable length, shielded	10 m (32.8 ft)
Maximum motor cable length, unshielded, without fulfilling emission specification	10 m (32.8 ft)
Maximum cross-section to control terminals, flexible/rigid wire without cable end sleeves	1.5 mm ² /16 AWG
Maximum cross-section to control terminals, flexible wire with cable end sleeves	1.5 mm ² /16 AWG
Maximum cross-section to control terminals, flexible wire with cable end sleeves with collar	1.5 mm ² /16 AWG
Minimum cross-section to control terminals	0.25 mm ² /24 AWG
Maximum cross-section to mains and motor, stranded/rigid wire	6 mm ² /10 AWG
Maximum cross-section to mains and motor, flexible wire	4 mm ² /12 AWG
Maximum cross-section to mains and motor, flexible with/without plastic sleeve	4 mm ² /12 AWG
Maximum cross-section to mains and motor, flexible with TWIN ferrule	1 mm ² /17 AWG
Minimum cross-section to mains and motor, flexible/rigid/stranded	0.5 mm ² /20 AWG
Nominal/rated current	25 A (up to 50 A with optional looping terminals)

See electrical data tables in [7.1 Electrical Data](#) for more information.

It is mandatory to ground the mains connection properly using T95 (PE) of the drive. The ground connection cable cross-section must be at least 10 mm² (8 AWG) or 2 rated mains wires terminated separately according to EN 50178. Use unshielded cable.

See also [4.3 Grounding](#).

7.6 Control Input/Output and Control Data

7.6.1 Digital Inputs

Programmable digital inputs	4 (6) ⁽¹⁾
Terminal number	18, 19, 27 ⁽¹⁾ , 29 ⁽¹⁾ , 32, 33
Logic	PNP or NPN
Voltage level	0–24 V
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	0–110 kHz
(Duty cycle) Minimum pulse width	4.5 ms
Input resistance, R_i	Approximately 4 k Ω

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

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

7.6.2 STO Terminal 37 (Terminal 37 is Fixed PNP Logic)

Voltage level	0–24 V DC
Voltage level, logic 0 PNP	<4 V DC
Voltage level, logic 1 PNP	>20 V DC
Typical input current at 24 V	50 mA rms
Typical input current at 20 V	60 mA rms
Input capacitance	400 nF

7.6.3 Analog Inputs:

Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switch S201 and switch S202
Voltage mode	Switch S201/switch S202 = OFF (U)
Voltage level	0–10 V (scaleable)
Input resistance, R_i	Approximately 10 k Ω
Maximum voltage	± 20 V
Current mode	Switch S201/S202 = ON (I)
Current level	0/4–20 mA (scaleable)
Input resistance, R_i	Approximately 200 Ω
Maximum current	30 mA
Resolution for analog inputs	10 bit (+ sign)
Accuracy of analog inputs	Maximum error 0.5% of full scale
Bandwidth	200 Hz

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

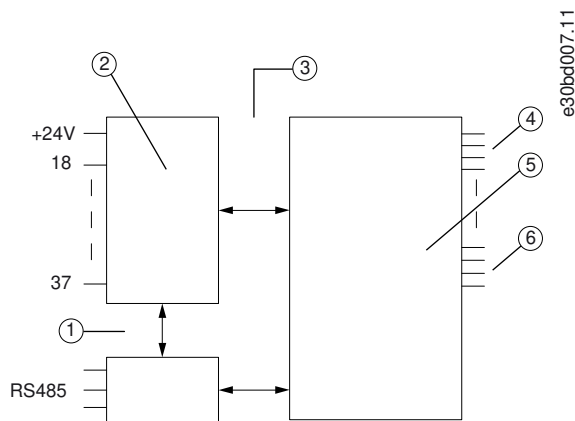


Illustration 29: Analog Inputs

1	Functional isolation	4	Mains
2	Control	5	High voltage
3	PELV isolation	6	Motor

7.6.4 Pulse/Encoder Inputs

Programmable pulse/encoder inputs	2/1
Terminal number pulse/encoder	29 ⁽¹⁾ , 33 ⁽²⁾ /32 ⁽³⁾ , 33 ⁽³⁾
Maximum frequency at terminals 29, 32, 33	110 kHz (Push-pull driven)
Maximum frequency at terminals 29, 32, 33	5 kHz (Open collector)
Maximum frequency at terminals 29, 32, 33	4 Hz
Voltage level	See 7.6.1 Digital Inputs .
Maximum voltage on input	28 V DC
Input resistance, R_i	Approximately 4 k Ω
Pulse input accuracy (0.1–1 kHz)	Maximum error: 0.1% of full scale
Encoder input accuracy (1–11 kHz)	Maximum error: 0.05% of full scale

¹ FC 302 only.

² Pulse inputs are 29 and 33.

³ Encoder inputs: 32=A, 33=B.

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

7.6.5 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 k Ω
Maximum capacitive load at frequency output	10 nF
Minimum output frequency at frequency output	0 Hz
Maximum output frequency at frequency output	32 kHz
Accuracy of frequency output	Maximum error: 0.1% of full scale

Resolution of frequency outputs	12 bit
---------------------------------	--------

¹ Terminals 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.

7.6.6 Analog Output

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

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

7.6.7 Control Card, 24 V DC Output

Terminal number	12, 13
Output voltage	24 V +1, -3 V
Maximum load	600 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.

7.6.8 Control Card, +10 V DC Output

Terminal number	50
Output voltage	10.5 V \pm 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.

7.6.9 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).

7.6.10 Control Card, USB Serial Communication

USB standard	1.1 (full speed)
USB plug	USB type B plug

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

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

The USB ground connection is not galvanically isolated from protective earth. Use only an isolated laptop as PC connection to the USB connector on the drive.

7.6.11 Relay Outputs

Programmable relay outputs	2
Relay 01 terminal number	1–3 (break), 1–2 (make)
Maximum terminal load (AC-1) ⁽¹⁾ on 1–3 (NC), 1–2 (NO) (resistive load)	240 V AC, 2 A
Maximum terminal load (AC-15) ⁽¹⁾ (inductive load @ $\cos\phi$ 0.4)	240 V AC, 0.2 A

Maximum terminal load (DC-1) ⁽¹⁾ on 1–2 (NO), 1–3 (NC) (resistive load)	48 V DC, 1 A
Maximum terminal load (DC-13) ⁽¹⁾ (inductive load)	24 V DC, 0.1 A
Relay 02 terminal number	4–6 (break), 4–5 (make)
Maximum terminal load (AC-1) ⁽¹⁾ on 4–5 (NO) (resistive load) ⁽²⁾⁽³⁾	400 V AC, 2 A
Maximum terminal load (AC-15) ⁽¹⁾ on 4–5 (NO) (inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Maximum terminal load (DC-1) ⁽¹⁾ on 4–5 (NO) (resistive load)	80 V DC, 2 A
Maximum terminal load (DC-13) ⁽¹⁾ on 4–5 (NO) (inductive load)	24 V DC, 0.1 A
Maximum terminal load (AC-1) ⁽¹⁾ on 4–6 (NC) (resistive load)	240 V AC, 2 A
Maximum terminal load (AC-15) ⁽¹⁾ on 4–6 (NC) (inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Maximum terminal load (DC-1) ⁽¹⁾ on 4–6 (NC) (resistive load)	48 V DC, 1 A
Maximum terminal load (DC-13) ⁽¹⁾ on 4–6 (NC) (inductive load)	24 V DC, 0.1 A
Minimum terminal load on 1–3 (NC), 1–2 (NO), 4–6 (NC), 4–5 (NO)	24 V DC 10 mA, 24 V AC 20 mA
Environment according to EN 60664-1	Overvoltage category III/pollution degree 2

¹ IEC 60947 parts 4 and 5. The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation (PELV).

² Overvoltage Category II.

³ UL applications 300 V AC 2 A.

7.6.12 Control Card Performance

Scan interval	1 ms
---------------	------

7.6.13 Control Characteristics

Resolution of output frequency at 0–590 Hz	±0.003 Hz
Repeat accuracy of precise start/stop (terminals 18, 19)	≤±0.1 ms
System response time (terminals 18, 19, 27, 29, 32, 33)	≤2 ms
Speed control range (open loop)	1:100 of synchronous speed
Speed control range (closed loop)	1:1000 of synchronous speed
Speed accuracy (open loop)	30–4000 RPM: Error ±8 RPM
Speed accuracy (closed loop), depending on resolution of feed-back device	0–6000 RPM: Error ±0.15 RPM
Torque control accuracy (speed feedback)	Maximum error ±5% of rated torque

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

7.7 Fuses and Circuit Breakers

7.7.1 Recommendations

- American Wire Gauge. Maximum cable cross-section is the largest cable cross-section that can be attached to the terminals. Always observe national and local regulations.
- Type gG pre-fuses must be used. To maintain UL/cUL, use pre-fuses of these types (see [Table 23](#)).
- Measured using a 10 m (32.8 ft) shielded/armored motor cable with a rated load and rated frequency.

Fuses

The unit is suitable for use on a circuit capable of delivering not more than 100000 RMS symmetrical Amperes, 500 V maximum.

Circuit breaker

The unit is suitable for use on a circuit capable of delivering not more than 10000 RMS symmetrical Amperes, 500 V maximum.

7.7.2 Recommended Maximum Pre-fuse Size 25 A

Table 23: FCD 302 Pre-fuses Meeting UL/cUL Requirements

Brand	Fuse type ⁽¹⁾	UL file number	UL category (CCN code)
Bussmann	FWH-	E91958	JFHR2
Bussmann	KTS-R	E4273	RK1/JDDZ
Bussmann	JKS-	E4273	J/JDDZ
Bussmann	JJS-	E4273	T/JDDZ
Bussmann	FNQ-R-	E4273	CC/JDDZ
Bussmann	KTK-R-	E4273	CC/JDDZ
Bussmann	LP-CC-	E4273	CC/JDDZ
SIBA	5017906-	E180276	RK1/JDDZ
Little Fuse	KLS-R	E81895	RK1/JDDZ
Ferraz-Shawmut	ATM-R	E2137	CC/JDDZ
Ferraz-Shawmut	A6K-R	E2137	RK1/JDDZ
Ferraz-Shawmut	HSJ	E2137	J/HSJ

¹ 5 A (0.37 kW (0.5 hp)), 7 A (0.55 kW (0.75 hp)), 9 A (0.75 kW (1.0 hp)), 12 A (1.1 kW (1.5 hp)), 15 A (1.5 kW (2.0 hp)), 20 A (2.2 kW (3.0 hp)), 25 A (3 kW (4.0 hp))

Table 24: FCD 302 DC Voltage Level

DC voltage level	380–480 V units (V DC)
Inverter undervoltage disable	373
Undervoltage warning	410
Inverter undervoltage re-enable (warning reset)	398
Overvoltage warning (without brake)	778
Dynamic brake turn on	778
Inverter overvoltage re-enable (warning reset)	795
Overvoltage warning (with brake)	810
Overvoltage trip	820

7.8 Mechanical Dimensions

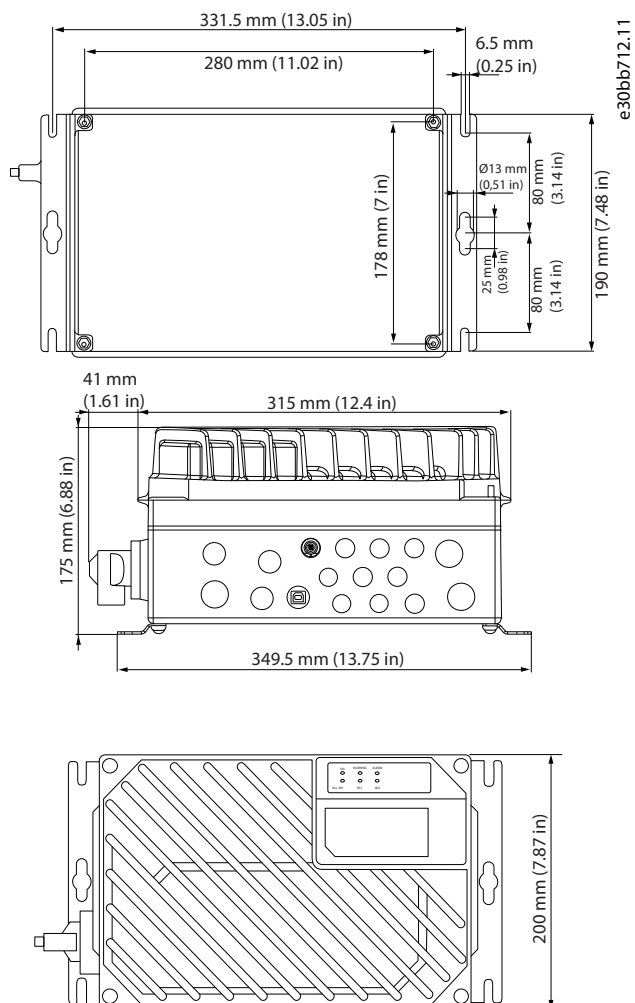


Illustration 30: Cable Entries and Hole Sizes (Small Unit)

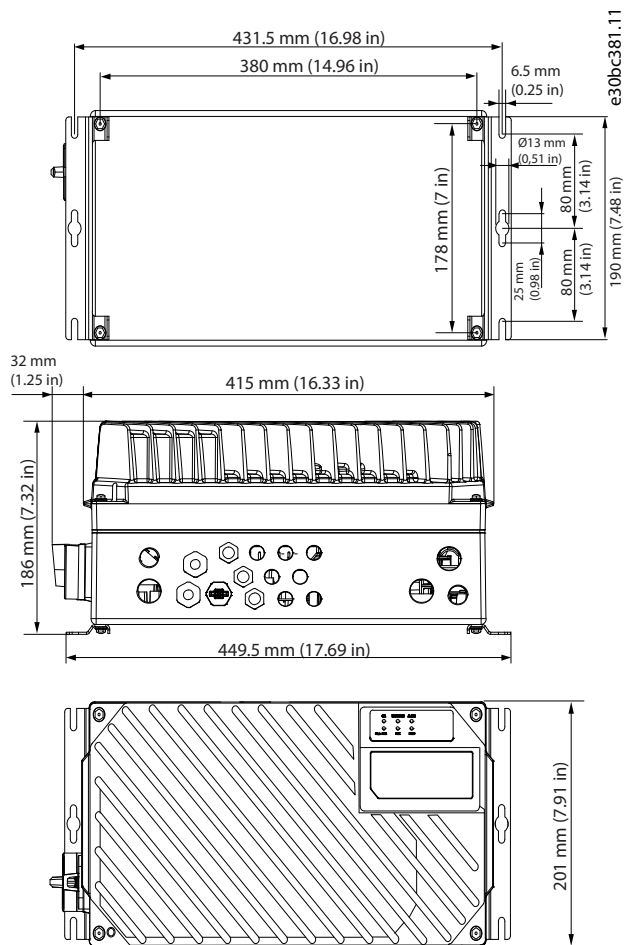


Illustration 31: Cable Entries and Hole Sizes (Large Unit)

Table 25: Mechanical Dimensions

Motor side	1xM20, 1xM25
Control side	2xM20, 9xM16 ⁽¹⁾
Mains side	2xM25

¹ Also used for 4xM12/6xM12 sensor/actuator sockets.

8 Appendix

8.1 Symbols, Abbreviations and Conventions

8.1.1 Symbols and Abbreviations

°C	Degrees Celsius
°F	Degrees Fahrenheit
AC	Alternating current
AEO	Automatic energy optimization
AWG	American wire gauge
AMA	Automatic motor adaptation
DC	Direct current
EMC	Electro-magnetic compatibility
ETR	Electronic thermal relay
$f_{M,N}$	Nominal motor frequency
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 drive
IP	Ingress protection
LCP	Local control panel
MCT	Motion control tool
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 motor
RPM	Revolutions per minute

Regen	Regenerative terminals
T _{LIM}	Torque limit
U _{M,N}	Nominal motor voltage

8.2 Quick Menu Parameters

Table 26: Parameter 0-01 Language

Option		Function
		Defines the language. The drive is delivered with 4 different language packages. English and German are included in all packages. English cannot be erased or manipulated.
[0]*	English	Part of language packages 1–4
[1]	Deutsch	Part of language packages 1–4
[2]	Français	Part of language package 1
[3]	Dansk	Part of language package 1
[4]	Spanish	Part of language package 1
[5]	Italiano	Part of language package 1
[6]	Svenska	Part of language package 1
[7]	Nederlands	Part of language package 1
[10]	Chinese	Part of language package 2
[20]	Suomi	Part of language package 1
[22]	English US	Part of language package 4
[27]	Greek	Part of language package 4
[28]	Bras.Port	Part of language package 4
[36]	Slovenian	Part of language package 3
[39]	Korean	Part of language package 2
[40]	Japanese	Part of language package 2
[41]	Turkish	Part of language package 4
[42]	Trad. Chinese	Part of language package 2
[43]	Bulgarian	Part of language package 3
[44]	Srpski	Part of language package 3
[45]	Romanian	Part of language package 3
[46]	Magyar	Part of language package 3
[47]	Czech	Part of language package 3
[48]	Polski	Part of language package 4
[49]	Russian	Part of language package 3

Option		Function
[50]	Thai	Part of language package 2
[51]	Bahasa Indonesia	Part of language package 2
[52]	Hrvatski	Part of language package 3

Table 27: Parameter 1-20 Motor Power [kW]

Range		Function
Size related*	[0.09 - 3000.00 kW]	<p style="text-align: center;">NOTICE</p> <p>This parameter cannot be adjusted while the motor is running.</p> <p>Enter the nominal motor power in kW according to the motor nameplate data. The default value corresponds to the nominal rated output of the drive. This parameter is visible in the LCP if <i>parameter 0-03 Regional Settings</i> is set to [0] <i>International</i>.</p>

Table 28: Parameter 1-22 Motor Voltage

Range		Function
Size related*	[10 - 1000 V]	Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the drive.

Table 29: Parameter 1-23 Motor Frequency

Range		Function
Size related*	[20 - 1000 Hz]	<p style="text-align: center;">NOTICE</p> <p>From software version 6.72 onwards, the output frequency of the drive is limited to 590 Hz.</p> <p>Select the motor frequency value from the motor nameplate data. If a value other than 50 Hz or 60 Hz is selected, adapt the load-independent settings in <i>parameter 1-50 Motor Magnetization at Zero Speed</i> to <i>parameter 1-53 Model Shift Frequency</i>. For 87 Hz, adapt <i>parameter 4-13 Motor Speed High Limit [RPM]</i> and <i>parameter 3-03 Maximum Reference</i>.</p>

Table 30: Parameter 1-24 Motor Current

Range		Function
Size related*	[0.10 - 10000.00 A]	<p style="text-align: center;">NOTICE</p> <p>This parameter cannot be adjusted while the motor is running.</p> <p>Enter the nominal motor current value from the motor nameplate data. The data is used for calculating motor torque, motor thermal protection, and so on.</p>

Table 31: Parameter 1-25 Motor Nominal Speed

Range		Function
Size related*	[100 - 60000 RPM]	<p style="text-align: center;">NOTICE</p> <p>This parameter cannot be adjusted while the motor is running.</p>

Range		Function
		Enter the nominal motor speed value from the motor nameplate data. The data is used for calculating automatic motor compensations.

Table 32: Parameter 5-12 Terminal 27 Digital Input

Option		Function
		Select the function from the available digital input range.
[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	
[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]	Setup select bit 0	
[24]	Setup select bit 1	
[28]	Catch up	
[29]	Slow down	
[32]	Pulse input	
[34]	Ramp bit 0	
[35]	Ramp bit 1	

Option		Function
[36]	Mains failure inverse	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[62]	Reset Counter A	
[65]	Reset Counter B	

Table 33: Parameter 1-29 Automatic Motor Adaptation (AMA)

Option		Function
		<p style="text-align: center;">N O T I C E</p> <p>This parameter cannot be adjusted while the motor is running.</p> <p>The AMA function optimizes dynamic motor performance by automatically optimizing the advanced motor parameters (<i>parameter 1-30 Stator Resistance (Rs)</i> to <i>parameter 1-35 Main Reactance (Xh)</i>) at motor standstill. Activate the AMA function by pressing [Hand On] after selecting [1] <i>Enable complete AMA</i> or [2] <i>Enable reduced AMA</i>. After a normal sequence, the display reads <i>Press [OK] to finish AMA</i>. After pressing [OK], the drive is ready for operation.</p>
[0]*	OFF	
[1]	Enable complete AMA	Performs AMA of the stator resistance R_s , the rotor resistance R_r , the stator leakage reactance X_1 , the rotor leakage reactance X_2 , and the main reactance X_h .
[2]	Enable reduced AMA	Performs a reduced AMA of the stator resistance R_s in the system only. Select this option if an LC filter is used between the drive and the motor.

N O T I C E

For the best adaptation of the drive, run AMA on a cold motor.

N O T I C E

AMA cannot be performed while the motor is running.

N O T I C E

AMA cannot be performed on permanent magnet motors.

N O T I C E

It is important to set *parameter group 1-* Motor Data* correctly since these parameters form part of the AMA algorithm. An AMA must be performed to achieve optimum dynamic motor performance. Depending on the power rating of the motor, it takes up to 10 minutes.

N O T I C E

To avoid generating external torque during AMA, disconnect the motor shaft from the application.

N O T I C E

If 1 of the settings in *parameter group 1-2* Motor Data* is changed, *parameter 1-30 Stator Resistance (Rs)* to *parameter 1-39 Motor Poles*, the Advanced Motor parameters return to their default settings.

Table 34: Parameter 3-02 Minimum Reference

Range		Function
Size related*	[-999999.999 - <i>parameter 3-03 ReferenceFeedbackUnit</i>]	<p>Enter the minimum reference. The minimum reference is the lowest value obtainable by summing all references. Minimum reference is active only when <i>parameter 3-00 Reference Range</i> is set to [0] Min.–Max. The minimum reference unit matches:</p> <ul style="list-style-type: none"> The configuration of <i>parameter 1-00 Configuration Mode</i> for [1] Speed closed loop set to RPM and for [2] Torque set to Nm. The unit selected in <i>parameter 3-01 Reference/Feedback Unit</i>. <p>If option [10] Synchronization is selected in <i>parameter 1-00 Configuration Mode</i>, this parameter defines the maximum speed deviation when performing the position offset defined in <i>parameter 3-26 Master Offset</i>.</p>

Table 35: Parameter 3-03 Maximum Reference

Range		Function
Size related*	[<i>parameter 3-02</i> - 999999.999 ReferenceFeedbackUnit]	<p>Enter the maximum reference. The maximum reference is the highest value obtainable by summing all references. The maximum reference unit matches:</p> <ul style="list-style-type: none"> The configuration of <i>parameter 1-00 Configuration Mode</i> for [1] Speed closed loop set to RPM and for [2] Torque set to Nm. The unit selected in <i>parameter 3-00 Reference Range</i>. <p>If option [9] Positioning is selected in <i>parameter 1-00 Configuration Mode</i>, this parameter defines the default speed for positioning.</p>

Table 36: Parameter 3-41 Ramp 1 Ramp Up Time

Range		Function
Size related*	[0.01 - 3600 s]	<p>Enter the ramp-up time, that is, the acceleration time from 0 RPM to the synchronous motor speed n_s. Select a ramp-up time which prevents the output current from exceeding the current limit in <i>parameter 4-18 Current Limit</i> during ramping. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in <i>parameter 3-42 Ramp 1 Ramp Down Time</i>.</p>

Table 37: Parameter 3-42 Ramp 1 Ramp Down Time

Range		Function
Size related*	[0.01 - 3600 s]	<p>Enter the ramp-down time, that is, the deceleration time from the synchronous motor speed n_s to 0 RPM. Select a ramp-down time such that no overvoltage occurs in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit in <i>parameter 4-18 Current Limit</i>. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in <i>parameter 3-41 Ramp 1 Ramp Up Time</i>.</p>

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