

Additional DC Connector

VLT® Automation Drive FC 302 18-55 kW

1 Introduction

1.1 Purpose of this Operating Guide

This operating guide provides information for safe installation and commissioning of the product. It is intended for use by qualified personnel. To use the drive safely and professionally, read and follow the instructions. Pay particular attention to the safety instructions and general warnings. Always keep this operating guide available with the product.

1.2 Trademarks

VLT® is a registered trademark for Danfoss A/S.

1.3 Additional Resources

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

- The *VLT® Automation Drive FC 301/FC 302 Programming Guide* provides information on how to program and includes complete parameter descriptions.
- The *VLT® Automation Drive FC 301/FC 302 Design Guide* provides detailed information about the design and applications of the drive.
- Application Note *MN.90.T1 Fuses and Circuit Breakers*.

Supplementary publications and manuals are available from the Danfoss website.

1.4 Version History

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

The original language of this guide is English.

Table 1: Version History

Version	Remarks
AQ481923946457, version 0101	First release

1.5 Type Approvals and Certifications

1.5.1 CE Mark

The CE mark (Conformité Européenne) indicates that the product manufacturer conforms to all applicable EU directives.

The EU directives applicable to the design and manufacture of drives are:

- The Low Voltage Directive.
- The EMC Directive.
- The Machinery Directive (for units with an integrated safety function).

The CE mark is intended to eliminate technical barriers to free trade between the EC and EFTA states inside the ECU. The CE mark does not regulate the quality of the product. Technical specifications cannot be deduced from the CE mark.

1.5.2 Low Voltage Directive

Drives are classified as electronic components and must be CE-labeled in accordance with the Low Voltage Directive. The directive applies to all electrical equipment in the 50–1000 V AC and the 75–1500 V DC voltage ranges.

The directive mandates that the equipment design must ensure the safety and health of people and livestock, and the preservation of material by ensuring the equipment is properly installed, maintained, and used as intended. Danfoss CE labels comply with the Low Voltage Directive, and Danfoss provides a declaration of conformity upon request.

1.5.3 EMC Directive

The purpose of the EMC (electromagnetic compatibility) Directive is to reduce electromagnetic interference and enhance immunity of electrical equipment and installations. The basic protection requirement of the EMC Directive states that devices that generate electromagnetic interference (EMI), or whose operation could be affected by EMI, must be designed to limit the generation of electromagnetic interference and shall have a suitable degree of immunity to EMI when properly installed, maintained, and used as intended. Electrical equipment devices used alone or as part of a system must bear the CE mark. Systems do not require the CE mark, but must comply with the basic protection requirements of the EMC Directive.

1.6 Disposal



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

2 Safety

2.1 Safety Symbols

The following symbols are used in Danfoss documentation.

DANGER

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

WARNING

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




CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates information considered important, but not hazard-related (for example, messages relating to property damage).

The guide also includes ISO warning symbols related to hot surfaces and burn hazard, high voltage and electrical shock, and referring to the instructions.

	ISO warning symbol for hot surfaces and burn hazard
	ISO warning symbol for high voltage and electrical shock
	ISO action symbol for referring to the instructions

2.2 Qualified Personnel

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

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

2.3 Safety Precautions

WARNING



HAZARDOUS VOLTAGE

AC drives contain hazardous voltage when connected to the AC mains or connected on the DC terminals. Failure to perform installation, start-up, and maintenance by skilled personnel can result in death or serious injury.

- Only skilled personnel must perform installation, start-up, and maintenance.

WARNING

UNINTENDED START

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

- Disconnect the drive from the mains.
- Press *[Off/Reset]* on the LCP before programming parameters.
- Ensure that the drive is fully wired and assembled when it is connected to AC mains, DC supply, or when an external device is connected to the additional DC connector.

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 backups, UPS, and DC-link connections to other drives.
- Wait for the capacitors to discharge fully before performing any service or repair work or accessing the additional DC connectors. The discharge time for FC 302 is specified on the drive product label.
- Use a measuring device to make sure that there is no voltage before opening the drive or performing any work on the cables.

WARNING

LEAKAGE CURRENT HAZARD

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

- Ensure that the minimum size of the ground conductor complies with the local safety regulations for high touch current equipment.

WARNING

EQUIPMENT HAZARD

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

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

WARNING



UNINTENDED MOTOR ROTATION WINDMILLING

Unintended rotation of permanent magnet motors creates voltage and can charge the unit, resulting in death, serious injury, or equipment damage.

- Ensure that permanent magnet motors are blocked to prevent unintended rotation.

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.

NOTICE

According to the EMC Directive, a system is defined as a combination of several types of equipment, finished products, and/or components combined, designed and/or put together by the same person (system manufacturer) intended to be placed on the market for distribution as a single functional unit for an end user and intended to be installed and operated together to perform a specific task.

The EMC directive applies to products/systems and installations, but in case the installation is built up of CE-marked products/systems, the installation can also be considered compliant with the EMC directive. Installations are not CE-marked.

According to the EMC Directive, Danfoss as a manufacturer of products/systems is responsible for obtaining the essential requirements of the EMC directive and attaching the CE mark. For systems involving additional DC connector and other DC terminals, Danfoss can only ensure compliance with the EMC directive when combinations of Danfoss products are connected as described in the technical documentation.

If any third-party products are connected to the load share or other DC terminals on the AC drives, Danfoss cannot guarantee that the EMC requirements are fulfilled.

If installed in residential environments, and not compliant to class C1, the drive may not provide adequate protection to radio reception in such locations.

- In such cases, supplementary mitigation measures might be required, for example, the use of shielding or increasing the distance between affected products.

3 Fuses

3.1 Installation of DC Fuses

Install fuses in series with additional DC connector terminals of all connected units to protect the DC bus against short circuits and the frequency converters from overload.

The following specifications apply:

- The voltage class of the fuse must be able to handle the maximum DC bus voltage ($1.35 \times U_{LL}$).
- The fuse must be semiconductor type, for example, aR or gR.



NOTE: For fuse selection guide, refer to the Application Note *Fuses and Circuit Breakers* in [1.3 Additional Resources](#).

- The maximum fuse current rating must not exceed the mains fuse current rating for the individual frequency converter ($I_{fuse\ DC-link, max} \leq I_{fuse\ mains}$).

Calculation of DC-bus fuse size.



NOTE: Nominal voltage U_{LL} is reduced by 10% to allow for tolerances.

$$I_{DC} = \frac{P_{in}}{U_{DC}} = \frac{P_{in}}{1.35 \times U_{LL, n} \times 0.9}$$

Round up to the next available fuse size and select a fuse 1 size bigger.

Example: $U_{LL} = 230\text{ V}$ and $P_{in} = 3.7\text{ kW}$ equal to $I_{DC} = 13.2$

The next available fuse is aR-16 hence an aR-20 is selected.

Table 2: DC-bus Semiconductor Fuse Selection (Recommendation)

Power [kW]	DC-bus fuse size (380 V) [A]
18.5	aR-63
22	aR-63
30	aR-100
37	aR-125
45	aR-125
55	aR-160



NOTE: The recommendations are valid for ambient temperatures of 20 °C (68 °F). At 40 °C (104 °F) gR/aR fuses are rounded 1 size further up. Round up to the nearest fuse size and select the fuse size 2 further sizes up at 40 °C (104 °F). For high ambient temperatures, contact the fuse supplier.

4 Additional DC Connector

4.1 Additional DC Connector Overview

- Power backup:
 - During mains failure Danfoss VLT® AutomationDrive can be supplied through the DC link from a backup. The application can thus continue running or go through a controlled shutdown process.

4.2 Preconditions for using the Additional DC Connector

Before connecting an external device to an additional DC connector, ensure that the following preconditions are met.

- Read the electrical installation guide lines for additional connections in the *VLT® AutomationDrive FC 301/FC 302 Design Guide*.
- R+ 82 and R- 81 terminals are the high voltage additional DC connector terminals. The inrush control of the drive is designed only for internal DC capacitors. Adding additional capacitors in additional DC connector must be used with pre-charge control protection to avoid the inrush.
- Do not initiate the application before drive ready status.
- Verify the DC power terminals polarity before connecting an external device to the drive.
 - Polarity protected load is recommended on DC additional DC connector.
- The low-energy capacitor bank does not match the application while mains cut off. Use the capacitor bank energy module rating based on the required application.
- Drive cooling is designed only for internal components in terms of output motor load. The terminals are not rated to handle any additional heat generated by load through the terminals.
- The use of additional capacitor on additional DC connector terminals 81 and 82 can increase the leakage current. EN/IEC61800-5-1 requires special care if the leakage current exceeds 3.5 mA. Reinforce the grounding in one of the following ways.
 - Ground wire (terminal 95) of minimum 10 mm² (8 AWG).
 - 2 separate ground wires both complying with the dimensioning rules. Dimensioning rules for ground wires, refer to EN/IEC61800-5-1 and EN 50178.
- Addition of an external capacitor bank causes an increase in the total harmonic distortion (THD) of the drive.
- Short-circuit protection: To protect the DC bus against short circuits and the drives from overload, install DC fuses in series with the additional DC connector terminals of all connected units.

4.2.1 Additional DC Connector Option

The additional DC connector R+ 82 and R- 81 is used to keep the drive powered on through an external capacitor bank during short power interruption from mains.

NOTE: An R on position 18 in the type code string indicates that the drive has terminals connected to the DC capacitor.

Example of type code string: FC-302P55KT5E20H2RXCDXXS267XAYBRCXXXXDX

The following illustrations show the additional DC connector entry on the FC 302 drives.

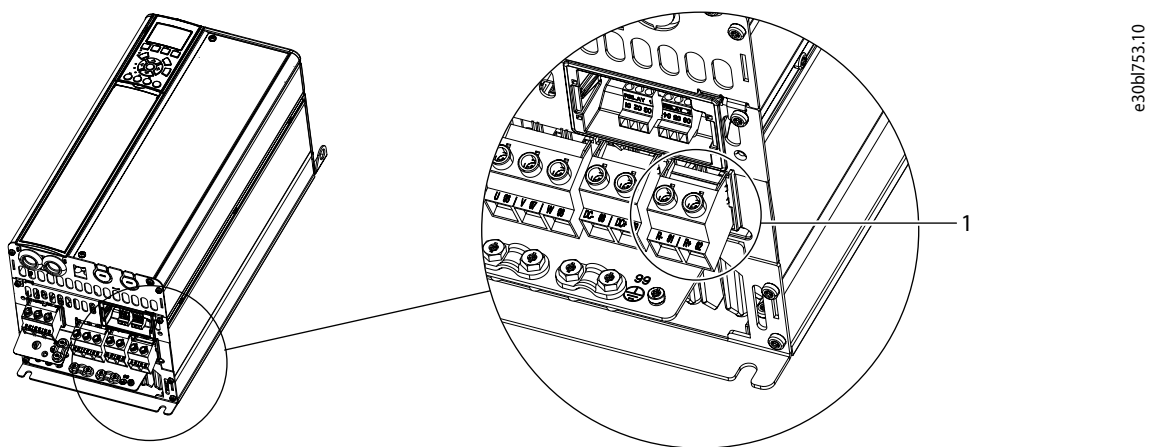
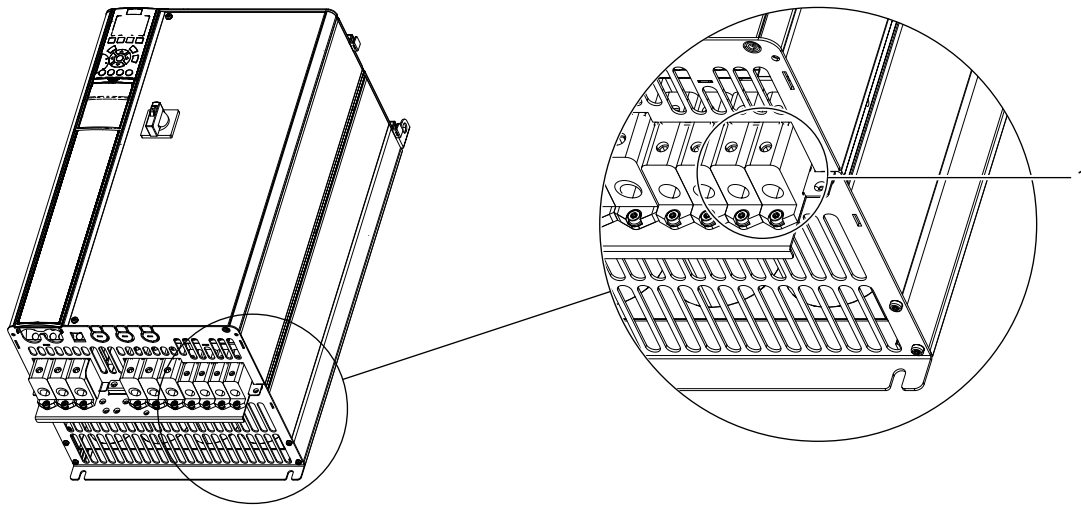


Figure 1: Additional DC Connector Entry B-frame

- | | |
|---|--|
| 1 | Additional DC connector entry for FC 302 B-frame |
|---|--|



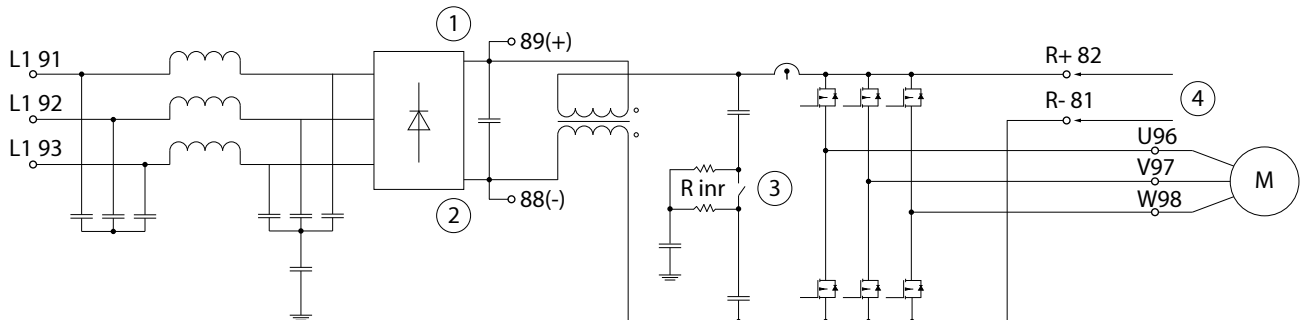
e30bl754.10

Figure 2: Additional DC Connector Entry C-frame

- 1 Additional DC connector entry for FC 302 C-frame

4.2.2 Wiring Diagram for Additional DC Connector

The following illustration is the wiring diagram for the additional DC connector.




e30bl703.10

Figure 3: Wiring Diagram Additional DC Connector

- 1 Load sharing +
- 2 Load sharing -
- 3 Inrush
- 4 Additional DC connector

5 Electrical Installation

5.1 Safety instructions

 **NOTE:** See [2.3 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/tagged 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/tag out all the drives.

WARNING



ELECTRICAL SHOCK AND FIRE HAZARD – RCD COMPLIANCE

The drive can cause a DC fault current in the PE conductor. Failure to use a Type B residual current-operated protective device (RCD) can lead to the RCD not providing the intended protection and therefore can result in death, fire, or other serious hazard.

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

5.2 Cable Specification

Cables in general:

All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. Copper 75 °C (167 °F) conductors are recommended. See also additional specifications in [5.3 Electrical Data](#).

The connection cable must be short-end with proper cable routing and shielded to avoid EMC impact. The maximum length from the external capacitor bank to the DC bar is limited to 2 m (6.5 ft).

The general guidelines for EMC performance are stated in the *VLT® AutomationDrive FC 301/FC 302 0.25–75 kW Design Guide*.

Table 3: Tightening Torque

Enclosure Type	Shaft output [kW (hp)]	Purpose	Tightening torque [Nm (in-lb)]
B4	18.5–30 (25–40)	Mains, additional DC connector, motor cables	4.5 (39.8)
		Relay	0.5–0.6 (4.4–5.3)
		Ground	2–3 (17.7–26.6)
C3	30–37 (40–50)	Mains, additional DC connector, motor cables	10 (89)
		Relay	0.5–0.6 (4.4–5.3)
		Ground	2–3 (17.7–26.6)
C4	55	Additional DC connector	14 (124)
		Relay	0.5–0.6 (4.4–5.3)
		Ground	2–3 (17.7–26.6)

5.3 Electrical Data

Table 4: Mains Supply 380–500 V (FC 302), P18K–P55K

Type designation	P18K		P22K		P30K		P37K		P45K		P55K	
High/normal overload ⁽¹⁾	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW (hp)]	18.5 (25)	22.0 (30)	22.0 (30)	30 (40)	30 (40)	37 (50)	37 (50)	45 (60)	45 (60)	55 (75)	55 (75)	75 (100)
Enclosure IP20	B4		B4		B4		C3		C3		C4	
Additional specifications												
IP20 maximum cable cross-section for mains and motor [mm ² (AWG)]	35,-,- (2,-,-)		35,-,- (2,-,-)		35 (2)		50 (1)		50 (1)		150 (300 MCM)	
IP20 maximum cable cross-section for additional DC connector [mm ² (AWG)]	35,-,- (2,-,-)		35,-,- (2,-,-)		35 (2)		50 (1)		50 (1)		95 (4/0)	
Maximum cable cross-section for disconnect [mm ² (AWG)]	16, 10, 10 (6, 8, 8)				50, 35, 35 (1, 2, 2)				50, 35, 35 (1, 2, 2)		95, 70, 70 (3/0, 2/0, 2/0)	

1) High overload=150% or 160% torque for a duration of 60 s. Normal overload=110% torque for a duration of 60 s.

6 How to Order a Drive

6.1 Drive Configurator

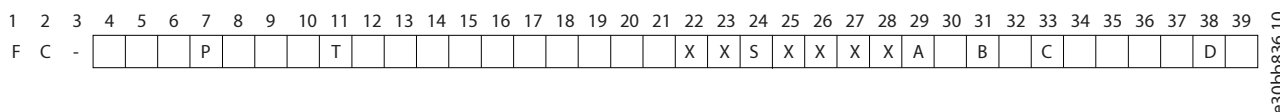


Figure 4: Type Code Example

Configure the right drive for the right application from the internet-based Drive Configurator and generate the type code string. The Drive Configurator automatically generates an 8-digit sales number to be delivered to the local sales office. Furthermore, it is possible to establish a project list with several products and send it to a Danfoss sales representative.

The Drive Configurator can be found on the global website: www.danfoss.com/drives.

6.1.1 Type Code

An example of the type code is:

FC-302PK75T5E20H1RGCXXS267XA0BXCXXXD0

The meaning of the characters in the string is in [Table 5](#)

See position 18 and 24–27 for details about the newly added additional DC connector and software string.

Table 5: Type Code Characters 18 and 24–27, Enclosure Sizes A, B, and C

Description	Position	Possible options
Additional DC connector	18	R: additional DC connector after DC reactor
Software release	24–27	S267: Latest release, standard software



NOTE: For power sizes over 75 kW, refer to the VLT® AutomationDrive FC 301/FC 302 90–1200 kW Design Guide.

Danfoss A/S
Ulsnaes 1
DK-6300 Graasten
drives.danfoss.com

.....
Any information, including, but not limited to information on selection of product, its application or use, product design, weight, dimensions, capacity or any other technical data in product manuals, catalog descriptions, advertisements, etc. and whether made available in writing, orally, electronically, online or via download, shall be considered informative, and is only binding if and to the extent, explicit reference is made in a quotation or order confirmation. Danfoss cannot accept any responsibility for possible errors in catalogs, brochures, videos and other material. Danfoss reserves the right to alter its products without notice. This also applies to products ordered but not delivered provided that such alterations can be made without changes to form, fit or function of the product. All trademarks in this material are property of Danfoss A/S or Danfoss group companies. Danfoss and the Danfoss logo are trademarks of Danfoss A/S. All rights reserved.
.....

M00442

