MAKING MODERN LIVING POSSIBLE

Installation Guide

VLT® PROFIBUS DP MCA 101

VLT® Frequency Converter FC 102 • FC 103 • FC 202
FC 301/302 • FCP 106 • FCM 106



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Contents

1 Introduction 2

1.1 Purpose of the Manual 2
1.2 Additional Resources 2
1.3 Product Overview 2
1.4 Approvals and Certifications 2
1.5 Disposal 3
1.6 Symbols, Abbreviations, and Conventions 3

2 Safety 4

2.1 Safety Symbols 4
2.2 Qualified Personnel 4
2.3 Safety Precautions 4

3 Installation 6

3.1 Safety Instructions 6
3.2 EMC-compliant Installation 6
3.3 Grounding 6
3.4 Cable Routing 6
3.5 Mounting 6
3.5.1 Mounting in an FC Series Frequency Converter 6
3.5.2 Mounting in a VLT® DriveMotor FCP 106 Frequency Converter 8
3.6 Setting Address Switches 8
3.7 Electrical Installation 9
3.8 Reassembling Cover 13
3.9 Applying Power 13
3.10 Checking Network Cabling 13

4 Troubleshooting 14

4.1 Warnings and Alarms 14
4.2 Troubleshooting 14
4.2.1 LED Status 14
4.2.2 No Communication with the Frequency Converter 15
4.2.3 Warning 34 Fieldbus Fault Appears 15

Index 16

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1

1 Introduction

1.1 Purpose of the Manual

This installation guide provides information for quick installation of a VLT® PROFIBUS DP MCA 101 in the VLT® frequency converter.
The installation guide is intended for use by qualified personnel. Users are assumed to know the VLT® frequency converter, with PROFIBUS technology, and with the PC or PLC used as a master in the system.
Read the instructions before installation and ensure that instructions for safe installation are observed.

VLT® is a registered trademark.

1.2 Additional Resources

Resources available for the frequency converters and optional equipment:

- The *VLT® Operating Instructions* provide the necessary information for getting the frequency converter up and running.
- The *VLT® Design Guide* provides detailed information about capabilities and functionality to design motor control systems.
- The *VLT® Programming Guide* provides greater detail on working with parameters and many application examples.
- The *VLT® PROFIBUS DP MCA 101 Installation Guide* provides information about installing the PROFIBUS and troubleshooting.
- The *VLT® PROFIBUS DP MCA 101 Programming Guide* provides information about configuring the system, controlling the frequency converter, parameter access, programming, troubleshooting, and some typical application examples.

Supplementary publications and manuals are available from Danfoss. See *vlt-drives.danfoss.com/Support/Technical-Documentation/* for listings.

1.3 Product Overview

1.3.1 Intended Use

This installation guide relates to PROFIBUS interface ordering numbers 130B1100 and 130B1200.

The PROFIBUS interface enables communication between a VLT® frequency converter and any master complying with the PROFIBUS standard. Communication can be configured via MCT 10 Set-up Software. The PROFIBUS interface supports PROFIBUS DP-V1.

VLT® PROFIBUS DP MCA 101 is intended for use with:

- VLT® HVAC Drive FC 102.
- VLT® Refrigeration Drive FC 103.
- VLT® AQUA Drive FC 202.
- VLT® AutomationDrive FC 301/FC 302.
- VLT® DriveMotor FCP 106.
- VLT® DriveMotor FCM 106.

Requirements to the master:
A PLC or PC that:

- Has a serial communication card with PROFIBUS master class 1 capability.
- Supports all PROFIBUS communication services required by the application.
- Fulfils requirements of the PROFIBUS standard.
- Fulfils requirements of the PROFIBUS frequency converter profile and its company-specific implementation, PROFIdrive.
- Fulfils requirements of the relevant VLT® frequency converter.

1.3.2 Items Supplied

When the fieldbus option is not factory-mounted, the following items are supplied:

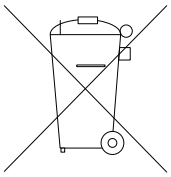
- Fieldbus option and connector.
- LCP cradle.
- Front covers (in various sizes).
- Stickers.
- Accessories bag (including EMC bracket).
- Installation Guide.

1.4 Approvals and Certifications

More approvals and certifications are available. For more information, contact a local Danfoss partner.

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1.5 Disposal



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

1.6 Symbols, Abbreviations, and Conventions

CAN	Controller area network
DP	Distributed periphery
EMC	Electromagnetic compatibility
FDT	Field device tool
HF	High frequency
LCP	Local control panel
LED	Light emitting diode
LOP	Local operating panel
PC	Personal computer
PLC	Programmable logic control
PPO	Parameter process data
STW	Status word

Table 1.1 Symbols and Abbreviations

Conventions
Numbered lists indicate procedures.
Bullet lists indicate other information and description of illustrations.
Italicised text indicates:

- Cross-reference.
- Link.
- Footnote.
- Parameter name.
- Parameter group name.
- Parameter option.

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2 Safety

2

2.1 Safety Symbols

The following symbols are used in this manual:

⚠WARNING

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

⚠CAUTION

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

NOTICE

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

2.2 Qualified Personnel

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

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

2.3 Safety Precautions

⚠WARNING

HIGH VOLTAGE

Frequency converters 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 frequency converter is connected to AC mains, DC supply, or load sharing, the motor may start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. The motor can start with 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.
To prevent unintended motor start:

- **Disconnect the frequency converter from the mains.**
- **Press [Off/Reset] on the LCP before programming parameters.**
- **Completely wire and assemble the frequency converter, motor, and any driven equipment before connecting the frequency converter to AC mains, DC supply, or load sharing.**

⚠WARNING

DISCHARGE TIME

The frequency converter contains DC-link capacitors that can remain charged even when the frequency converter is not powered. Failure to wait the specified time after power has been removed before performing service or repair work can result in death or serious injury.

- **Stop the motor.**
- **Disconnect the AC mains and remote DC-link supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters.**
- **Disconnect or lock the PM motor.**
- **Wait for the capacitors to discharge fully before performing any service or repair work. The waiting time is specified in the relevant frequency converter operating instructions, *Chapter 2 Safety*.**

⚠WARNING

LEAKAGE CURRENT HAZARD

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

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

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⚠WARNING

EQUIPMENT HAZARD

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

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

⚠CAUTION

INTERNAL FAILURE HAZARD

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

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

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3 Installation

3.1 Safety Instructions

See *chapter 2 Safety* for general safety instructions.

3.2 EMC-compliant Installation

To obtain an EMC-compliant installation, follow the instructions provided in the relevant frequency converter *operating instructions* and *design guide*. Refer to the fieldbus master manual from the PLC supplier for further installation guidelines.

3.3 Grounding

- Ensure that all stations connected to the fieldbus network are connected to the same ground potential. When distances between the stations in a fieldbus network are long, connect the individual station to the same ground potential. Install equalising cables between the system components.
- Establish a grounding connection with low HF impedance, for example by mounting the frequency converter on a conductive back plate.
- Keep the ground wire connections as short as possible.
- To establish electrical contact between the cable screen and the frequency converter enclosure, use metal cable glands or the clamps provided on the equipment.
- Use high-strand wire to reduce burst transient.

3.4 Cable Routing

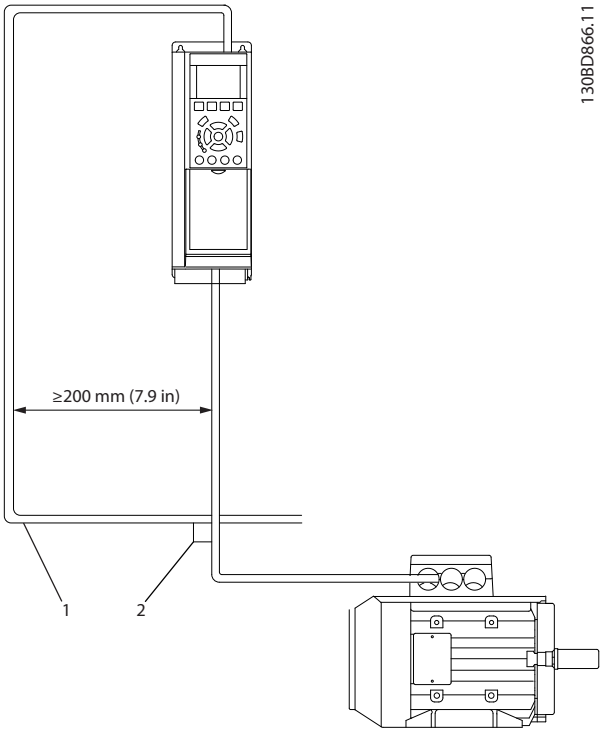
NOTICE

EMC INTERFERENCE

Use screened cables for motor and control wiring, and separate cables for fieldbus communication, motor wiring, and brake resistor. Failure to isolate fieldbus communication, motor, and brake resistor cables can result in unintended behaviour or reduced performance. Minimum 200 mm (7.9 in) clearance between power, motor, and control cables is required. For power sizes above 315 kW (450 hp), increase the minimum distance of 500 mm (20 in).

NOTICE

When the fieldbus cable intersects a motor cable or a brake resistor cable, ensure that the cables intersect at an angle of 90°.



1	Fieldbus cable
2	90° intersection

Illustration 3.1 Cable Routing

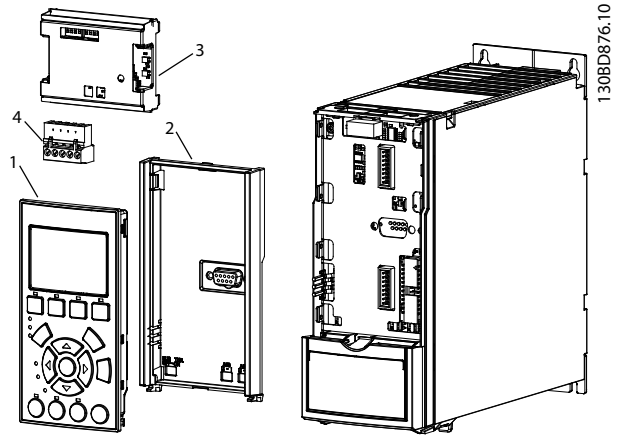
3.5 Mounting

3.5.1 Mounting in an FC Series Frequency Converter

1. Check whether the fieldbus option is already mounted in the frequency converter. If already mounted, go to step 6. If not mounted, go to step 2.
2. Remove the LCP or blind cover from the frequency converter.
3. Use a screwdriver to remove the front cover and the LCP cradle.
4. Mount the fieldbus option. Mount the option with the connector facing up for top cable entry (see *Illustration 3.3*), or with the connector facing down for bottom cable entry (see *Illustration 3.4*). If an MCB option is installed, only top cable entry is possible.
5. Remove the knock-out plate from the new LCP cradle.
6. Mount the new LCP cradle.

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7. Set the termination switch (shown in *Illustration 3.7*) on the fieldbus option to ON, when the frequency converter is the last station on the segment.



1	LCP
2	LCP cradle
3	VLT® PROFIBUS DP MCA 101 option card
4	Connector plug

Illustration 3.2 Exploded View

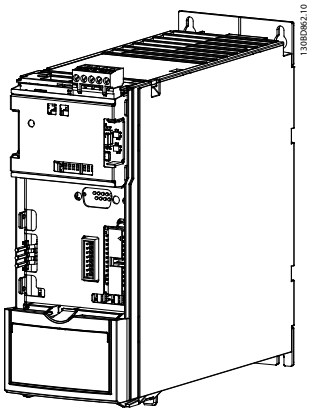


Illustration 3.3 Top Cable Entry: Option Mounted with Connector Facing Up

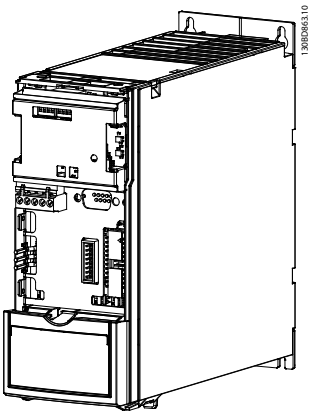


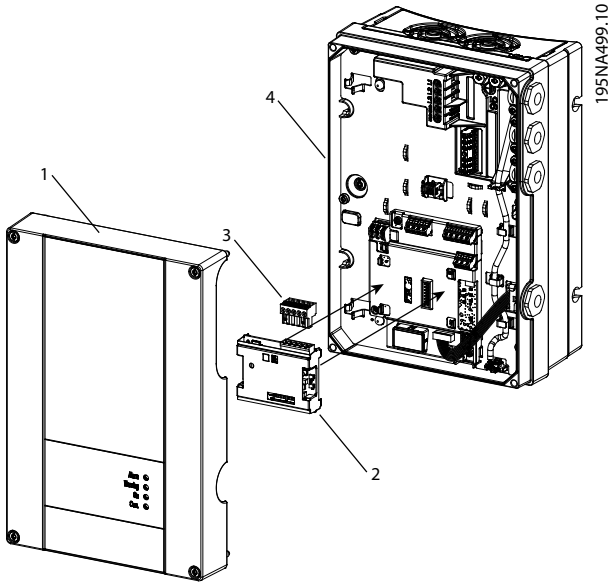
Illustration 3.4 Bottom Cable Entry: Option Mounted with Connector Facing Down

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3

3.5.2 Mounting in a VLT® DriveMotor FCP 106 Frequency Converter

1. Remove the lid from the frequency converter.
2. Check whether the fieldbus option is already mounted in the frequency converter. If already mounted, go to step 4. If not mounted, go to step 3.
3. Mount the fieldbus option.
4. Set the termination switch (shown in *Illustration 3.7*) on the fieldbus option to ON, when the frequency converter is the last station on the segment.



1	Lid
2	VLT® PROFIBUS DP MCA 101 option card
3	Connector plug
4	FCP 106

Illustration 3.5 Exploded View

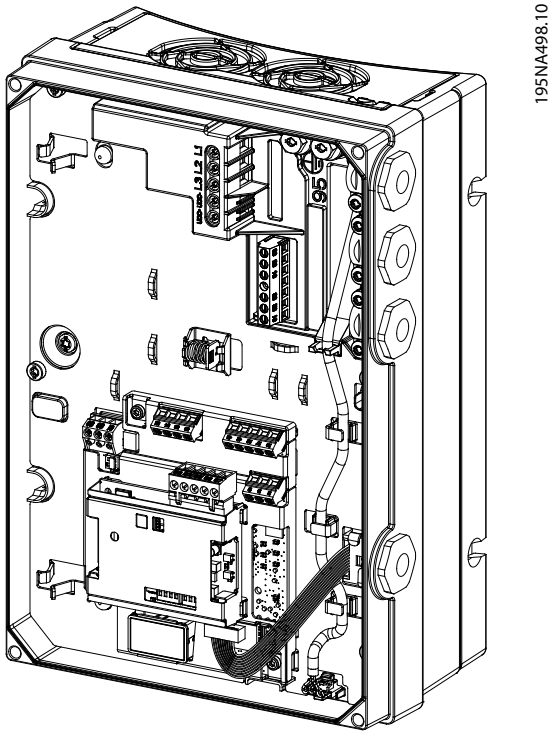


Illustration 3.6 Option Mounted in FCP 106

3.6 Setting Address Switches

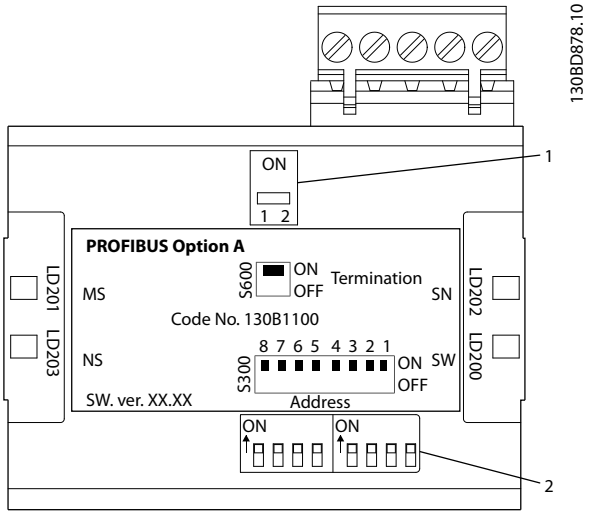
Set the address switches to give the option a unique ID. Select an address range from 0–125 (factory setting 127) according to *Table 3.1*.

Switch	8	7	6	5	4	3	2	1
Address value	Not used	+64	+32	+16	+8	+4	+2	+1
5	Not used	OFF	OFF	OFF	OFF	ON	OFF	ON
35	Not used	OFF	ON	OFF	OFF	OFF	ON	ON
82	Not used	ON	OFF	ON	OFF	OFF	ON	OFF

Table 3.1 Settings for the Address Switches

Alternatively, assign a unique ID from *parameter 9-18 Node Address*. For setting the address from *parameter 9-18 Node Address*, ensure that all address switches are set to ON. When the address is already set using address hardware switches, the address value shown in *parameter 9-18 Node Address* is read-only.

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1	Termination switch
2	Address switches

Illustration 3.7 Location and Sequence of the Address Switches

3.7 Electrical Installation

3.7.1 Cabling Requirements

- Terminate the nodes at the physical ends of each segment. If the bus segment is branched, the device furthest from the segment connector represents the end of the segment.
- Terminals 66 and 67 provide a 5 V DC supply, available for external termination.

NOTICE

The PROFIBUS D-sub 9 adapter also features a termination switch. When the D-sub 9 adapter is used, set the termination switch on the fieldbus option to OFF, to avoid double termination.

NOTICE

When the fieldbus is extended with a repeater, terminate the extension at both ends.

NOTICE

To avoid impedance mismatch, use the same cable type throughout the entire network. Refer to *chapter 3.7.2 Cable Specifications* for cable specifications.

3.7.2 Cable Specifications

Impedance at a measuring frequency from 3–20 MHz	135–165 Ω
Resistance	<110 Ω/km
Capacitance	<30 pF/m
Damping (total wire length)	Maximum 9 dB over the whole wire length
Cross-section	Maximum 0.34 mm^2, AWG 22
Cable type	Twisted in pairs, 1 x 2, 2 x 2, or 1 x 4 wires
Screening	Copper-braided screen, or braided screen and foil screen

Table 3.2 Cable Specifications

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3.7.3 Bus Segment Requirements

A maximum of 32 field devices (nodes) can be connected per fieldbus segment. Field devices include:

- Frequency converter, active node.
- Master, active node.
- Repeater, passive node.

NOTICE

A repeater represents a node in each of the 2 segments it connects.

Maximum fieldbus cable length

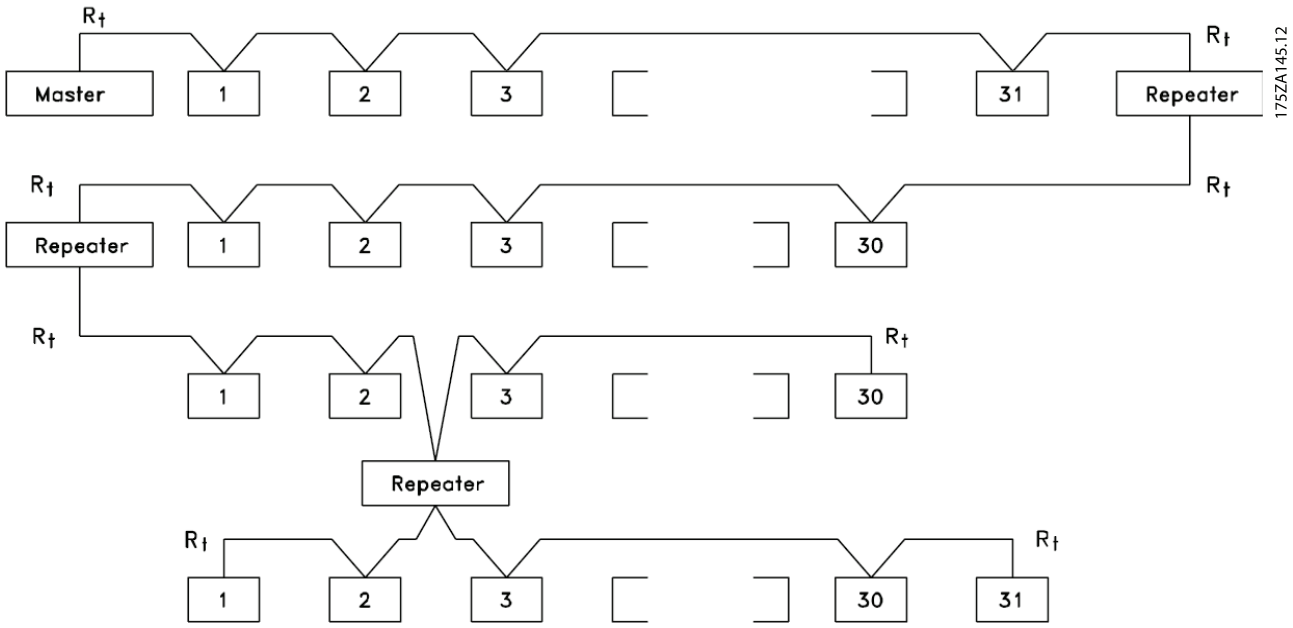


Illustration 3.8 Maximum Number of Frequency Converters per Segment

Segment	Repeater	Active nodes
1	0	32
2	1	62
3	2	92
4	3	122

Table 3.3 Number of Active Nodes per Segment

Transmission speed	1 segment [m]	2 segments [m]	3 segments [m]	4 segments [m]
9.6–187.5 kBaud	1000	2000	3000	4000
500 kBaud	400	800	1200	1600
1.5 MBaud	200	400	600	800
3–12 MBaud	100	200	300	400

Table 3.4 Maximum Total Bus Cable Length, including Drop Cables

Transmission speed	Maximum drop cable length per segment [m]
9.6–93.75 kBaud	96
187.5 kBaud	75
500 kBaud	30
1.5 MBaud	10
3–12 MBaud	None

Table 3.5 Maximum Drop Cable Length per Segment

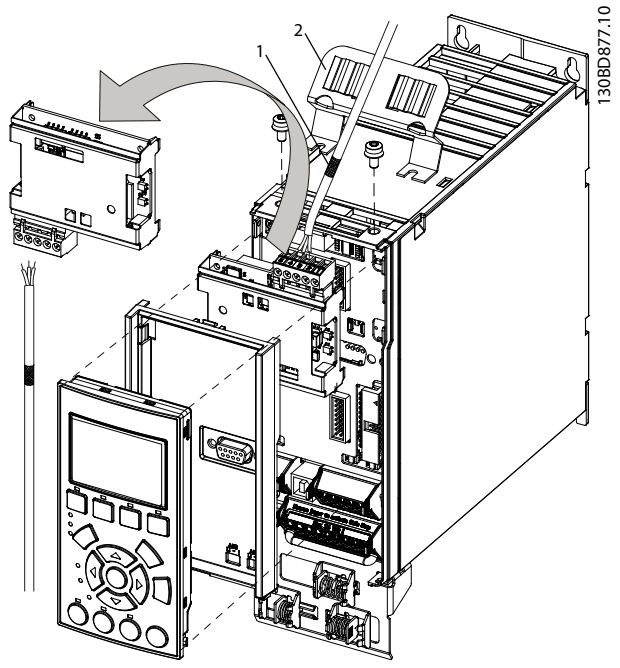
The length statements in *Table 3.4* and *Table 3.5* are valid for bus cables with the properties in *chapter 3.7.2 Cable Specifications*.

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3.7.4 Wiring Procedures

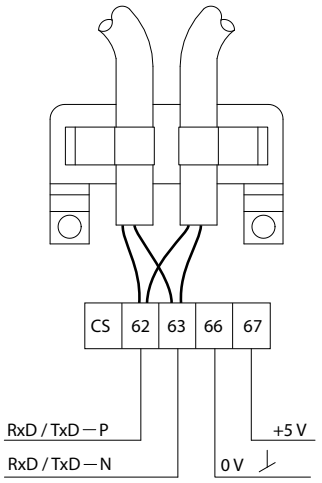
Wiring procedure for enclosure sizes A1–A3

1. Mount the fieldbus connector on the fieldbus option (terminals 62, 63, 66, and 67). For top cable entry, mount the supplied EMC bracket on top of the frequency converter with 2 screws.
2. Prepare the fieldbus cable by stripping a section of the cable insulation, so that the cable screen is in contact with the EMC bracket. Keep the unshielded wire as short as possible. For cable specifications, refer to *chapter 3.7.2 Cable Specifications*. For fieldbus cable requirements, see *chapter 3.7.3 Bus Segment Requirements*.
3. Connect the fieldbus cable wires to the terminals according to the colour code of the wires, see *Illustration 3.10*.
4. To establish mechanical fixation and electrical contact between cable screen and ground, position the stripped cable between the spring loaded metal clamps.



1	Cable screen
2	EMC bracket (used for top cable entry only)

Illustration 3.9 Wiring for Enclosure Sizes A1–A3



62	RxD/TxD-P red cable
63	RxD/TxD-N green cable
66 and 67	5 V DC supply, available for external termination
CS	Control select, 5 V DC indicates transmission from the fieldbus option

Illustration 3.10 Fieldbus Cable Terminal Connections

3

Wiring procedure for enclosure sizes A4–A5, B1–B4, and C1–C4

1. Push the cable through cable glands.
2. Mount the fieldbus connector on the fieldbus option (terminals 62, 63, 66, and 67).
3. Prepare the fieldbus cable by stripping a section of the cable insulation. Keep the unshielded wire as short as possible. For cable specifications, refer to *chapter 3.7.2 Cable Specifications*. For fieldbus cable requirements, see *chapter 3.7.3 Bus Segment Requirements*.
4. Connect the fieldbus cable wires to the terminals according to the colour code of the wires, see *Illustration 3.10*.
5. Fix the cable screen to the metal base plate using cable clamp or cable tie, see *Illustration 3.11*.
6. Tighten cable glands securely.

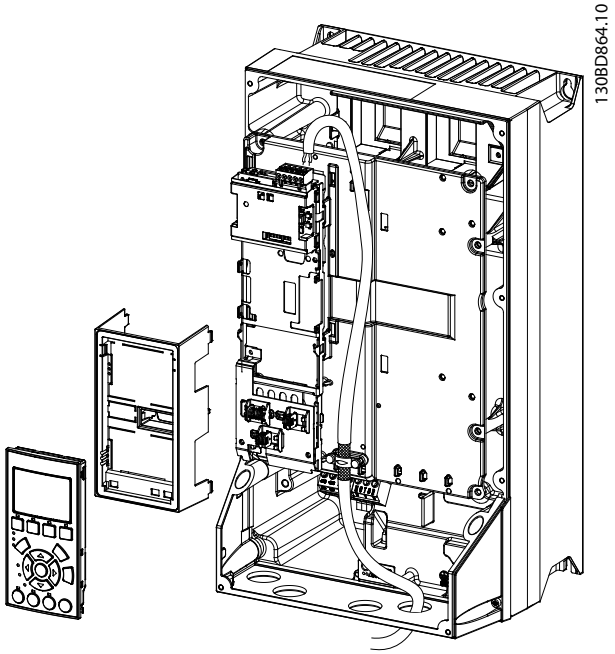


Illustration 3.11 Wiring for Enclosure Sizes A4–A5, B1–B4, and C1–C4

Wiring procedure for enclosure sizes D, E, and F

1. Mount the fieldbus connector on the fieldbus option (terminals 62, 63, 66, and 67).
2. Prepare the fieldbus cable by stripping a section of the cable insulation. Keep unshielded wire as short as possible. For cable specifications, refer to *chapter 3.7.2 Cable Specifications*. For fieldbus cable requirements, see *chapter 3.7.3 Bus Segment Requirements*.
3. Connect the fieldbus cable wires to the terminals according to the colour code of the wires, see *Illustration 3.10*.
4. Fix the cable screen to the metal base plate using cable clamp or cable tie, see *Illustration 3.12*.
5. Tie down the cable and route it with other control wires inside the unit, see *Illustration 3.12*.

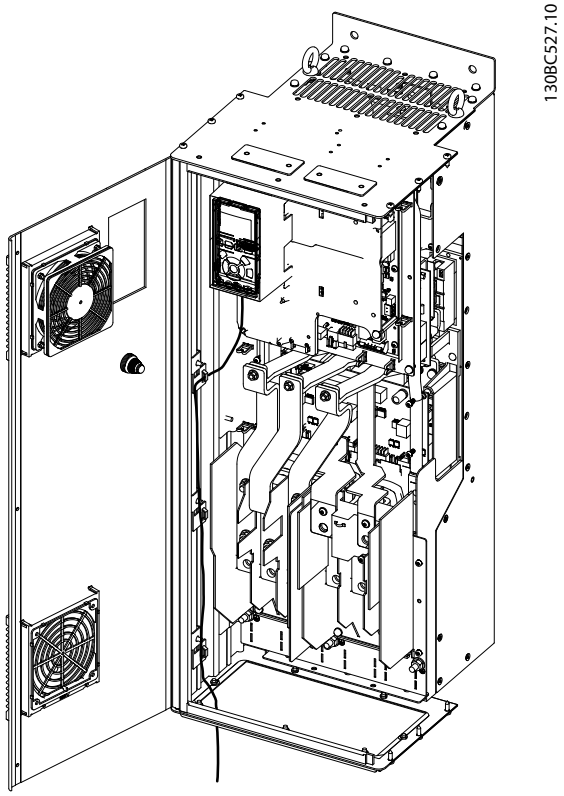


Illustration 3.12 Wiring for Enclosure Sizes D, E, and F

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Wiring procedure for VLT® DriveMotor FCP 106

1. Mount the fieldbus connector on the fieldbus option (terminals 62, 63, 66, and 67).
2. Prepare the fieldbus cable by stripping a section of the cable insulation, so that the cable screen is in contact with the EMC bracket. Keep the unshielded wire as short as possible. For cable specifications, refer to *chapter 3.7.2 Cable Specifications*. For fieldbus cable requirements, see *chapter 3.7.3 Bus Segment Requirements*.
3. Connect the fieldbus cable wires to the terminals according to the colour code of the wires, see *Illustration 3.10*.
4. To establish mechanical fixation and electrical contact between cable screen and ground, position the stripped cable between the spring loaded metal clamps.

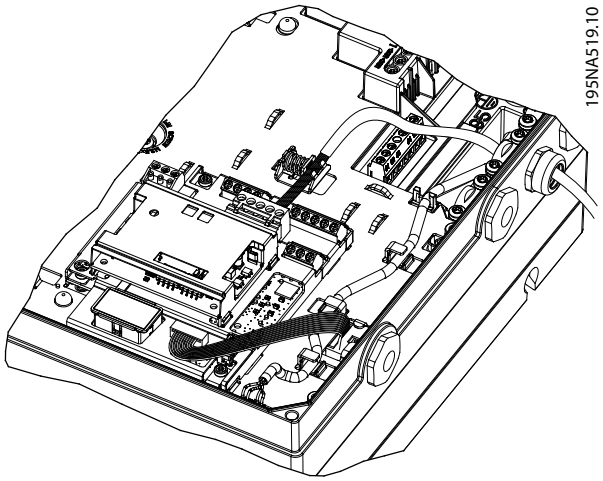


Illustration 3.13 PROFIBUS Wiring for FCP 106, MH1–MH3

3.8 Reassembling Cover

1. Mount the new front cover and the LCP.
2. Attach the sticker with the correct product name to the front cover.

3.9 Applying Power

Follow the instructions in the frequency converter *operating instructions* to commission the frequency converter. The frequency converter automatically detects the PROFIBUS interface. A new parameter group (*9-** PROFIBUS*) appears.

3.10 Checking Network Cabling

1. If the address has not been set via the address switches, go to *parameter 9-18 Node Address* to set the address.
2. Connect to a running PROFIBUS master.
3. Check that network cabling is correct:
   - 3a Check that the net status LED flashes green in any pattern, except *search baud rate*, see *Table 4.2*.
   - 3b Check if *parameter 9-63 Actual Baud Rate* shows the same baud rate as the PROFIBUS master.
   - 3c Check that the bit *baud rate search* in *parameter 9-53 Profibus Warning Word* is not active.

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4 Troubleshooting

4.1 Warnings and Alarms

NOTICE

Refer to the relevant *operating instructions* for an overview of warning and alarm types and for the full list of warnings and alarms.

Alarm word, warning word, and PROFIBUS warning word are shown on the frequency converter display in hex format. When there is more than 1 warning or alarm, the sum of all warnings or alarms is shown. Alarm word, warning word, and PROFIBUS warning word can also be shown via fieldbus in:

- *Parameter 16-90 Alarm Word*.
- *Parameter 16-92 Warning Word*.
- *Parameter 9-53 Profibus Warning Word*.

For *warning 165, Baud rate search*, refer to *Table 4.1*.

Bit (hex)	Unit diagnose bit	PROFIBUS warning word (*parameter 9-53 Profibus Warning Word*)
00000001	160	Connection with DP-master is not OK.
00000002	161	Unused
00000004	162	FDL (fieldbus data link layer) is not OK.
00000008	163	Clear data command received.
00000010	164	Actual value is not updated.
00000020	165	Baud rate search.
00000040	166	PROFIBUS ASIC is not transmitting.
00000080	167	Initialising of PROFIBUS is not OK.
00000100	152	Drive is tripped.
00000200	153	Internal CAN error.
00000400	154	Wrong configuration data from PLC.
00000800	155	Wrong ID sent by PLC.
00001000	156	Internal error occurred.
00002000	157	Not configured.
00004000	158	Timeout active.
00008000	159	Warning 34 active.

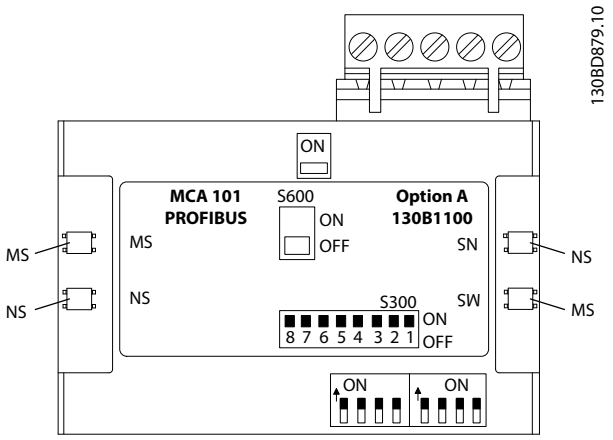
Table 4.1 Parameter 9-53 Profibus Warning Word

4.2 Troubleshooting

4.2.1 LED Status

The 2 bicolour LEDs on the PROFIBUS card indicate the status of PROFIBUS communication:

- The lower LED (NS) indicates the net status, that is, the cyclic communication to the PROFIBUS master.
- The upper LED (MS) indicates the module status, that is, acyclic DP-V1 communication from either a PROFIBUS master class 1 (PLC) or a master class 2 (MCT 10 Set-up Software, FDT tool).



MS	Upper left LED
NS	Lower left LED

Illustration 4.1 LED Panel VLT® PROFIBUS DP MCA 101

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State	LED		Description
Power on	Red: 	Solid red	The interface is defect. Contact Danfoss.
	Green: 	Flashing green	The interface is OK.
Baud rate search	Green: 	Flashing green	Searching for the baud rate. Check the connection to the master if the interface stays in this state.
Wait parameterising	Green: 	Long green flash	Baud rate found - waiting for parameters from the master.
	Red: 	Long red flash	Wrong parameters from the master.
Wait configuration	Green: 	Short green flash	Parameters from master OK – waiting for configuration data.
	Red: 	Short red flash	Wrong configuration data from the master.
Data exchange	Green: 	Solid green	Data exchange between the master and the frequency converter is active.
	Red: 	Flashing red	Clear state. *Warning 34, Fieldbus fault* is active and a bus reaction in *parameter 8-04 Control Word Timeout Function* is executed.

Table 4.2 Net Status

LED		Description
No light	Off	No PROFIBUS DP-V1 communication is active.
Green: 	Short green flash	DP-V1 communication from a master class 1 (PLC) is active.
Green: 	Long green flash	DP-V1 communication from a master class 2 (MCT 10, FDT) is active.
Green: 	Solid green	DP-V1 communication from a master class 1 and 2 is active.
Red: 	Flashing red	Internal fault.

Table 4.3 Module Status

4.2.2 No Communication with the Frequency Converter

When there is no communication with the frequency converter, check that:

- The cabling is correct.
  The red and green cables are connected to the correct terminals as shown in *Illustration 3.10*.
- The bus connection is terminated at both ends.
  If not, terminate the bus connection with termination resistors at the initial and final nodes.

4.2.3 Warning 34 Fieldbus Fault Appears

Warning 34, Fieldbus fault is not only related to wiring. *Warning 34, Fieldbus fault* appears when:

- There is no master communication for 60 s after power-up.
- The master is in stop mode.
- Master communication is not established, or is incorrectly configured.
- Wiring is incorrect.

Action:

- Check the master mode and master configuration.
- Check the wiring for correct master mode and communication.

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Index

A

Abbreviations... 3
Additional resources... 2
Address switches... 8, 13
Alarm word... 14
Alarms... 14
Applying power... 13
Approvals... 2

B

Burst transient... 6
Bus segment requirements... 10

C

Cable specifications... 9
Cabling requirements... 9
Certifications... 2
Conventions... 3

D

Discharge time... 4

E

Electrical installation... 9
EMC interference... 6
EMC-compliant installation... 6
Exploded view... 7

G

Grounding... 6

H

High voltage... 4

I

Installation, electrical... 9
Intended use... 2
Items supplied... 2

L

Leakage current... 4
LED panel... 14
LED status... 14
Load sharing... 4

M

MCT 10... 2
Module status... 15
Motor wiring... 6
Mounting... 6, 8

N

Net status... 15
Network cabling... 13

Q

Qualified personnel... 4

S

Safety... 5
Screened cable... 6
Symbols... 3

T

Termination switch... 9

U

Unintended start... 4

W

Warning 34... 15
Warning word... 14
Warnings... 14
Wiring procedure... 11

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