MAKING MODERN LIVING POSSIBLE

Operating Instructions

VLT® PROFINET MCA 120

VLT® HVAC Drive FC 102 • VLT® AQUA Drive FC 202 • VLT® AutomationDrive FC 301/302 • VLT® Decentral Drive FCD 302

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VLT® THE REAL DRIVE

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1 Safety

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It has been assumed that all devices are sitting behind a firewall that does packet filtering and the environment has implemented restrictions on the software that can run inside the firewall. All nodes are assumed to be "trusted" nodes.

1.2 Safety Note

⚠WARNING

HIGH VOLTAGE

The voltage of the frequency converter is dangerous whenever connected to mains. Incorrect installation of the motor, frequency converter, or fieldbus may damage the equipment, cause serious personal injury, or death. Consequently, the instructions in this manual, as well as national and local rules and safety regulations, must be complied with.

1.3 Safety Regulations

1. The frequency converter must be disconnected from mains before carrying out repair work. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
2. The off-command on the serial bus does not disconnect the equipment from mains and should not be used as a safety switch.
3. Correct protective earthing or grounding of the equipment must be established. The user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The earth leakage currents are higher than 3.5 mA.
5. Do not remove the plugs for the motor and mains supply while the frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.

1.4 Warning against Uninteded Start

1. The motor can be brought to a stop with bus commands while the frequency converter is connected to mains. These stop functions do NOT provide protection against unintended starts.
2. While parameters are being changed, there is a risk that motor starts.
3. Electronic faults in the frequency converter and cease of
   - temporary overload
   - faults in supply mains, or
   - fault in the motor connection

   can cause an unintended start.

⚠WARNING

ELECTRICAL HAZARD

Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.

2 Introduction

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2.1 About this Manual

First time users can obtain the most essential information for quick installation and set-up in these chapters:

- *Chapter 2 Introduction*
- *Chapter 3 How to Install*
- *Chapter 5 How to Configure the System*

For more detailed information including the full range of set-up options and diagnosis tools, refer to the chapters:

- *Chapter 5 How to Configure the System*
- *Chapter 6 How to Control the Frequency Converter*
- *Chapter 8 Parameters*
- *Chapter 10 Troubleshooting*

Terminology
In this manual several terms for Ethernet are used.

- **PROFINET**, is the term used to describe the PROFINET protocol.
- **Ethernet**, is a common term used to describe the physical layer of the network and does not relate to the application protocol.

2.2 Technical Overview

Since the introduction in 2001, PROFINET has been updated to handle low and medium performance requirement supported by PROFINET RT (Real Time) up to High end servo performance in PROFINET IRT (Isochronous Real Time). With this, PROFINET is the Ethernet Based Fieldbus offering the most scalable and versatile technology today.

PROFINET provides users with the network tools to deploy standard Ethernet technology for manufacturing applications while enabling Internet and enterprise connectivity.

2.3 Assumptions

These operating instructions are under the conditions that the Danfoss PROFINET option is used with a Danfoss FC 102/FC 202/FC 301/FC 302/FCD 302 frequency converter. It is also assumed that the installed controller supports the interfaces described in this document and that all the requirements stipulated in the controller, as well as the frequency converter, are strictly observed along with all limitations herein.

2.4 Hardware

This manual relates to the PROFINET option MCA 120, type no. 130B1135 (uncoated) and 130B1235 (conformal coated).

2.5 Background Knowledge

The Danfoss PROFINET Option Card is designed to communicate with any system complying with the PROFINET schema version 2.2 and 2.3 standards. For earlier versions of PROFINET, which support schema version 2.1 and earlier, Danfoss recommends an upgrade of the master and other devices connected to the PROFINET network to schema version 2.2 and version 2.3. Familiarity with this technology is assumed. Issues regarding hardware or software produced by other manufacturers, including commissioning tools, are beyond the scope of this manual, and are not the responsibility of Danfoss.

For information regarding commissioning tools, or communication to a non-Danfoss node, consult the appropriate manuals.

2.6 Available Literature

Available Literature for FC 102/FC 202/FC 301/FC 302/FCD 302

- The *Operating Instructions,* provides the necessary information for getting the central frequency converter up and running.
- The *FCD 302 Operating Instructions,* provides the necessary information for getting the de-central frequency converter up and running.
- The *Design Guide,* includes all technical information about the central frequency converter design and applications including encoder, resolver, and relay options.
- The *FCD 302 Design Guide,* includes all technical information about the de-central frequency converter design and applications including encoder, resolver, and relay options.
- The *VLT® AutomationDrive Profibus Operating Instructions* provides the information required for controlling, monitoring, and programming the frequency converter via a Profibus fieldbus.
- The *VLT® AutomationDrive DeviceNet Operating Instructions* provides the information required for controlling, monitoring, and programming the frequency converter via a DeviceNet fieldbus.
- The *VLT® AutomationDrive MCT 10 Set-up Software Operating Instructions,* provides information for

installation and use of the configuration tool on a PC.

- The *VLT® AutomationDrive IP21/Type 1 Instruction,* provides information for installing the IP21/Type 1 option.
- The *VLT® AutomationDrive 24 V DC Backup Instruction,* provides information for installing the 24 V DC Backup option.

Danfoss technical literature is also available online at *www.danfoss.com/BusinessAreas/DrivesSolutions/*.

2.7 Abbreviations

Abbreviation	Definition
API	Actual Packet Interval
CC	Control Card
CTW	Control Word
DCP	Discovery and Configuration Protocol
DHCP	Dynamic Host Configuration Protocol
EMC	Electromagnetic Compatibility
I/O	Input/Output
IP	Internet Protocol
LCP	Local Control Panel
LED	Light Emitting Diode
LSB	Least Significant Bit
MAV	Main Actual Value (actual output)
MSB	Most Significant Bit
MRV	Main Reference Value
N/A	Not applicable
PC	Personal Computer
PCD	Process Control Data
PLC	Programmable Logic Controller
PNU	Parameter Number
REF	Reference (=MRV)
STW	Status Word

Table 2.1 Abbreviations

3 How to Install

3.1 Installation

3

3.1.1 How to Install Option in Frequency Converter

Items required for installing a fieldbus option in the frequency converter

- The fieldbus option
- Fieldbus option adaptor frame for the FC 102/FC 202/FC 301/FC 302. This frame is deeper than the standard frame, to allow space for the fieldbus option beneath
- Strain relief (only for A1 and A2 enclosures)

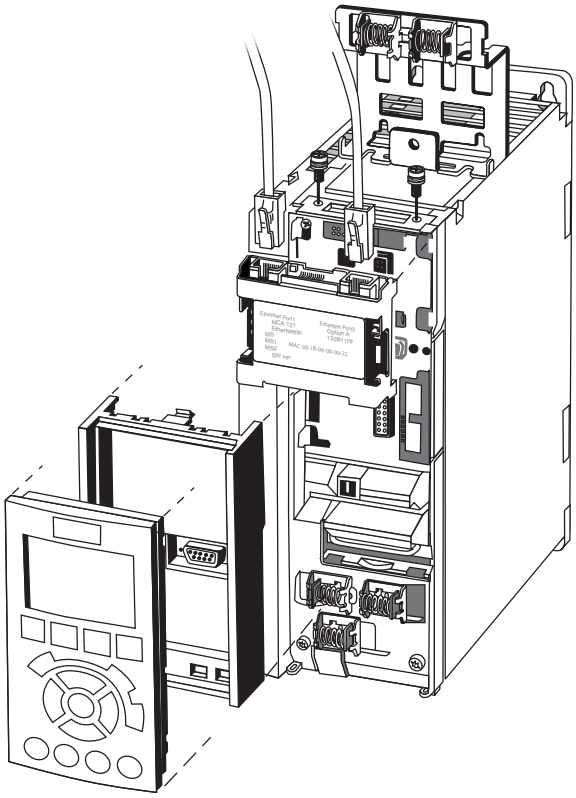


Illustration 3.1 Fieldbus Option Adaptor Frame

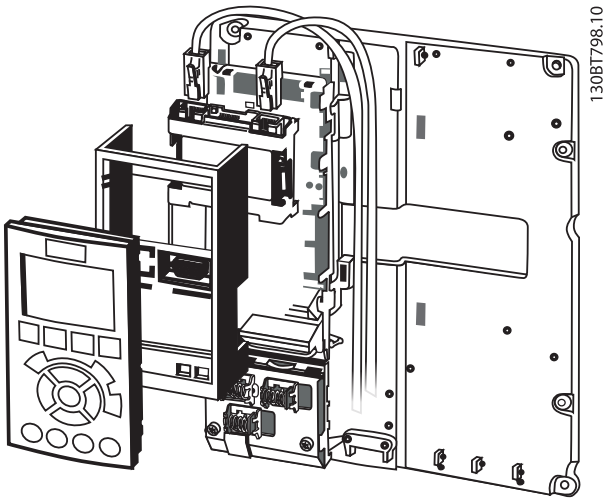


Illustration 3.2 The Fieldbus Option

Instructions

- Remove LCP panel from the FC 102/FC 202/FC 301/FC 302.
- Remove the frame located beneath and discard it.
- Push the option into place. The Ethernet connectors must be facing upwards.
- Remove top knock-out on the fieldbus option adaptor frame.
- Push the fieldbus option adaptor frame for the FC 102/FC 202/FC 301/FC 302 into place.
- Replace the LCP and attach cable.

NOTICE

Do not strip the Ethernet cable and ground it via the strain relief-plate! The grounding of screened Ethernet cables are done through the RJ45 connector on the interface.

NOTICE

After installing the MCA 120 option, be aware of the following parameter settings:
8-01 Control Site*: *[2] Control word only* or *[0] Digital and control word
parameter 8-02 Control Source*: *[3] Option A

3.1.2 The PROFINET Interface for the FCD 302

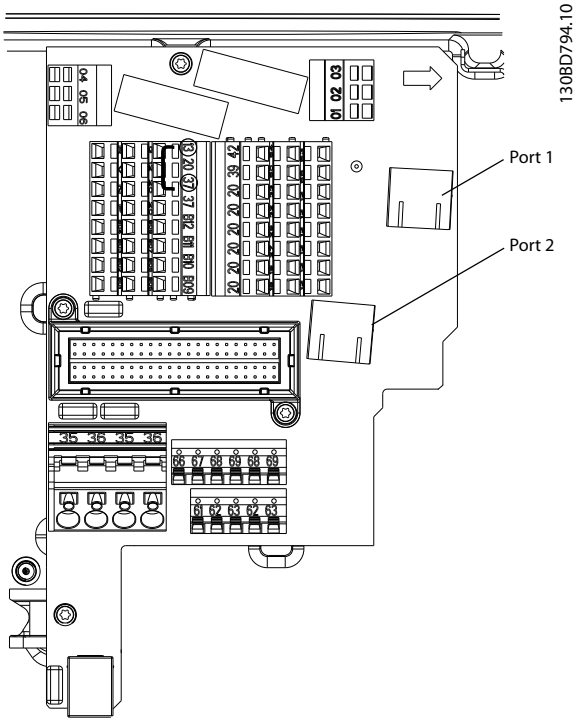


Illustration 3.3 Ethernet Connection on the Control Card

Ethernet ports MK101 and MK102 are placed on the installation board. MK101 is port 1.

The shield of the two RJ45 connectors is connected to ground via a RC connection. This guides EMC noise to ground without risk of a ground loop connection via the Ethernet cables.

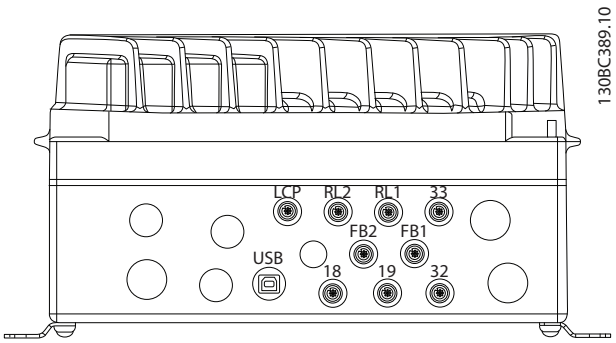
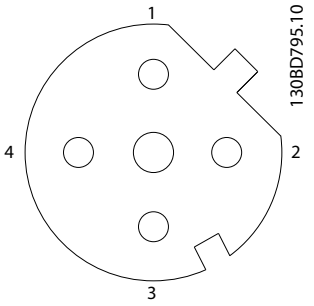


Illustration 3.4 Pluggable Solution



M12 PIN #	Signal
1	RX +
2	TX +
3	RX -
4	TX -

Illustration 3.5 M12 Connector

In the pluggable solution the fieldbus is connected directly to the M12 connection FB1 and FB2 outside the frequency converter. M12 connector is a “female” connector. FB1 is connected to port 1. The pluggable solution supports an easy plug and play solution, where the Ethernet is plugged to the Ethernet interface. Note that the housing of the M12 plug is connected directly to ground. If the shield of the Ethernet cable has to be isolated from ground, a isolated reduction ring has to be mounted between the M12 connector and the installation box.

3.1.3 Network

It is of high importance that the media chosen for Ethernet data transmission are suitable. Normally CAT5e and CAT6 cables are recommended for industrial applications. Both types are available as unshielded twisted pair and shielded twisted pair. Shielded cables are recommended for use in industrial environments and with frequency converters. A maximum cable-length of 100 m is allowed between switches.

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3.1.4 PROFINET Cables

PROFINET cables used are based electrically on category 5 balanced LAN cables according to ISO/IEC 11801 Edition 2.0, Class D.
Type C cables can be used in special applications (for example, the use of trailing cables and frequently moved machine parts) even though their design and mechanical parameters can deviate from the specifications of type A and type B cables. Still, most of the electrical parameters (e.g. impedance levels) are retained. Highly flexible copper cables generally have the finest stranded conductors and, for example, a highly resistant polyurethane outer sheath.
Various outer sheath materials are permitted to meet the various demands regarding resistance of industrial environments and exterior/underground laying (natural and synthetic oil, grease, coolants/lubricants, chemicals, high and low temperatures, UV radiation, etc.).

Cable type	**Application type A**	**Application type B**	**Application type C**
Design	Data Cable	Data Cable	Data Cable
Cable Installation Type	Stationary, no movement after installation	Flexible, occasional movement or vibration	Special Applications (e.g. highly flexible, permanent movement, vibration or torsion)
Cable marking	**PROFINET type A**	**PROFINET type B**	**PROFINET type C**
Core Cross Section	AWG 22/1	AWG 22/7	AWG 22/..
Outer Diameter	5.5-8.0 mm		Application
Core Diameter	1.5 ± 0.1 mm		Application
Colour (Outer Sheath)	Green RAL6018		Application
Core Identification (colours) star quad 2 pair	white, yellow, blue, orange Pair 1: white (RXD+), blue (RXD-) Pair 2: yellow(TXD+), orange(TXT-)		
Number of Cores	4		
Cable Design	2 pairs or 1 star quad		
Shielding Design Type	Aluminum Foil + Cu braiding		Application
Which Plug for which Cable Type	RJ-45 (IP20 or IP65/67)/M12		

Table 3.1 All Balanced Cables used shall Comply with these Parameters

Relevant Standard	ISO/IEC 11801 Edition 2.0, IEC 61156 (minimum Category 5)
Delay Skew	<≤20 ns/100 m
Transfer Impedance	<≤50 m Ohm/m at 10 MHz

Table 3.2 Transmission Performance Requirements

3.1.5 Topology

The PROFINET module features a built-in Ethernet-switch, thus having 2 Ethernet RJ45/M12 connectors. This enables the possibility for connecting several PROFINET options in a line topology as an alternative to the traditional star-topology.

The 2 ports are equal, in the sense that they are transparent for the option, and thus it is free to select which of the 2 ports to be used.

Star Topology

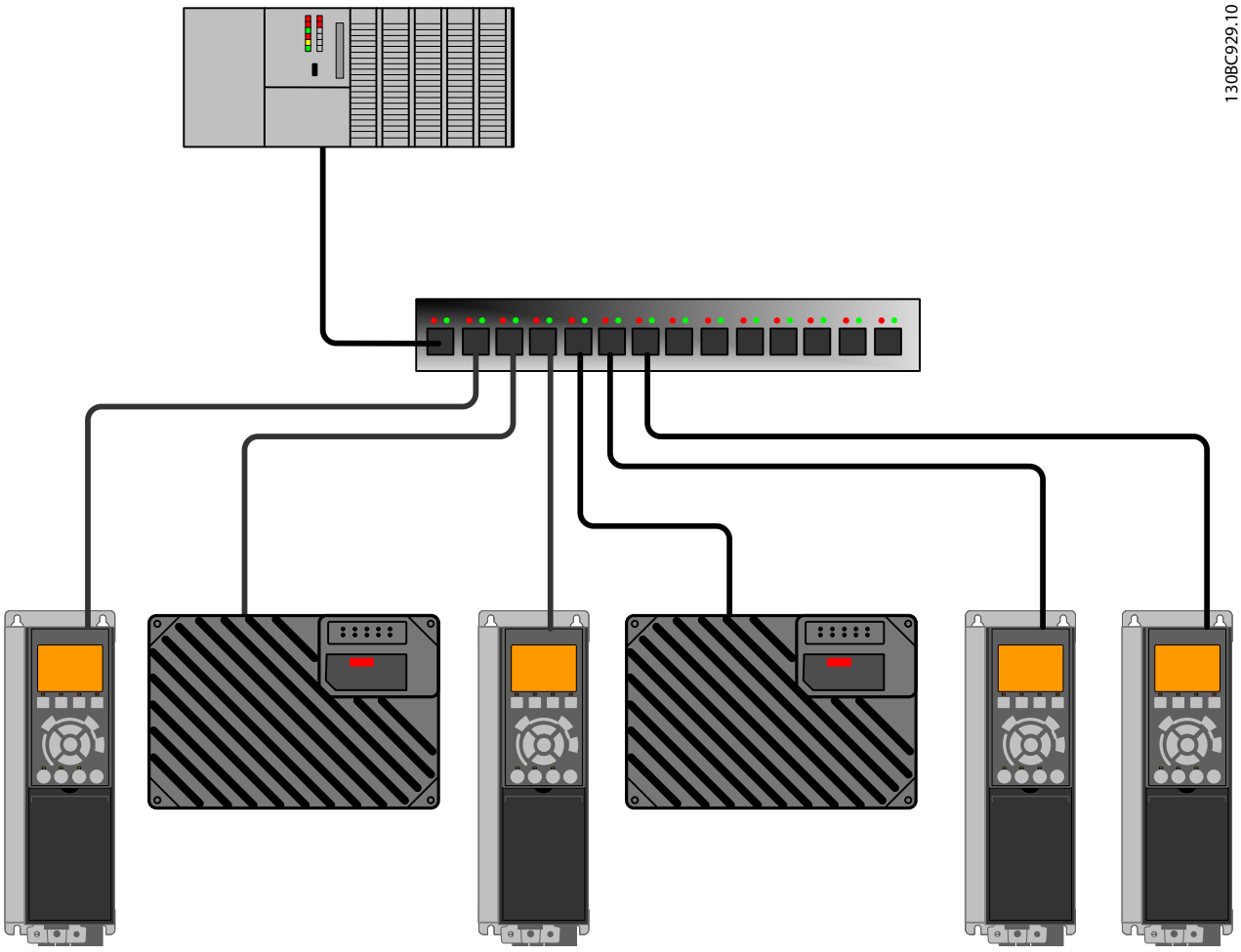

Illustration 3.6 Star Topology

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Line Topology

In many installations, the use of line topology has several benefits, such as simpler cabling, use of smaller/fewer Ethernet switches. The PROFINET interface supports line topology with its 2 ports and built-in Ethernet switch. If line topology is used, precautions must be taken if more than 8 frequency converters in a line is installed. Each frequency converter in the line will, due to the built-in Ethernet switch add a small delay the communication. This can lead to time out in the PLC, if the the update time has been selected to a low value. If more than 8 frequency converters in line are installed, the update time has to be set higher than 2 ms. Typically 4 ms does allow up to 16 frequency converters with a line. With 8 ms 32 frequency converters can be installed. The numbers given are typical values and may vary from installation to installation.

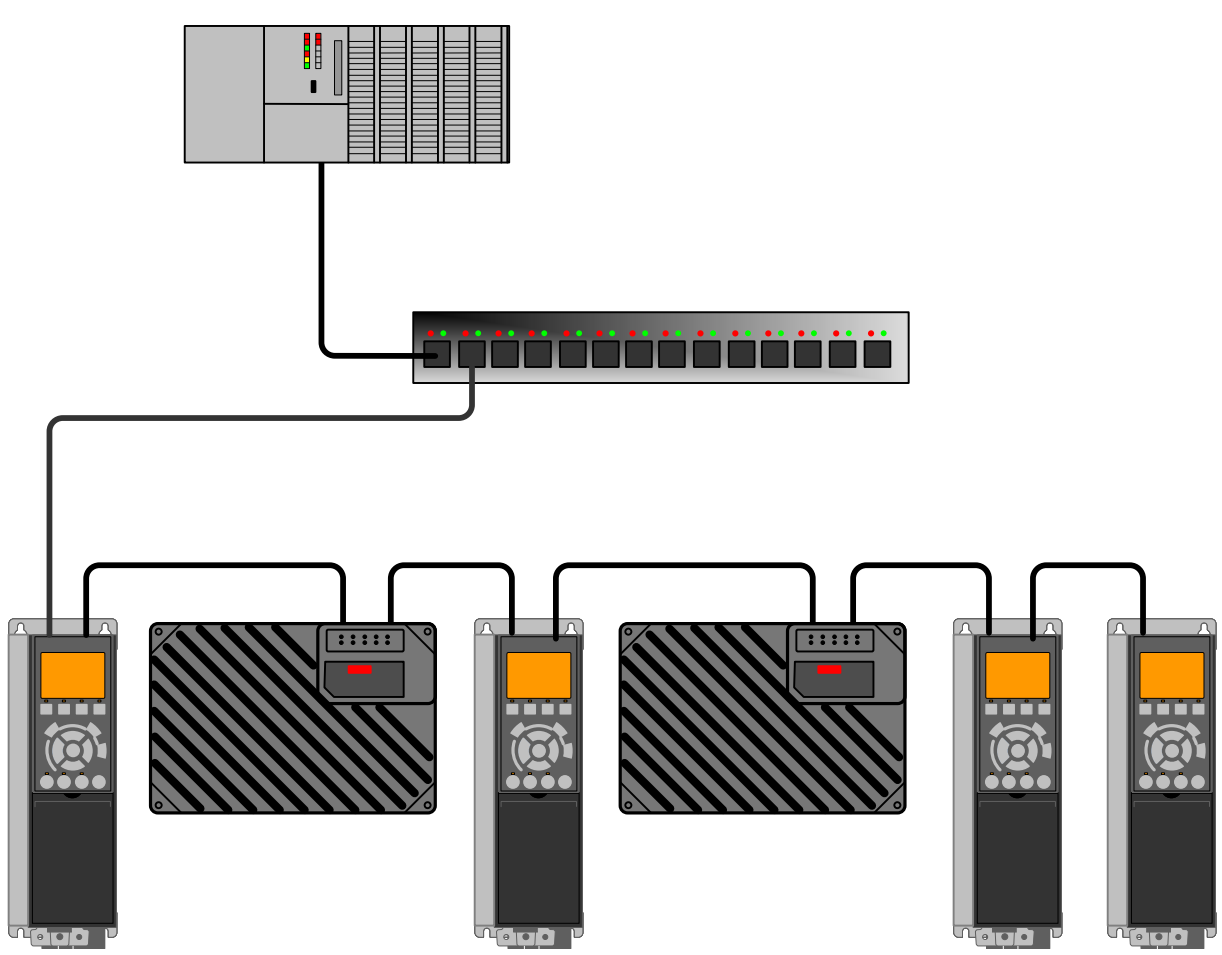

Illustration 3.7 Line Topology

NOTICE

In a line topology, all frequency converters must be powered either by mains, or by a 24 V DC option card, in order the built-in switch to work.

Operate installing frequency converter of different power-sizes in a line topology may result in unwanted power-off behavior, while using controlword timeout (*parameter 8-02 Control Source* to *parameter 8-06 Reset Control Timeout*. It is recommended to mount the frequency converters with the longest discharge time first in the line topology. In normal operation, frequency converters with bigger powersize has a longer discharge time.

Ring/Redundant Line Topology

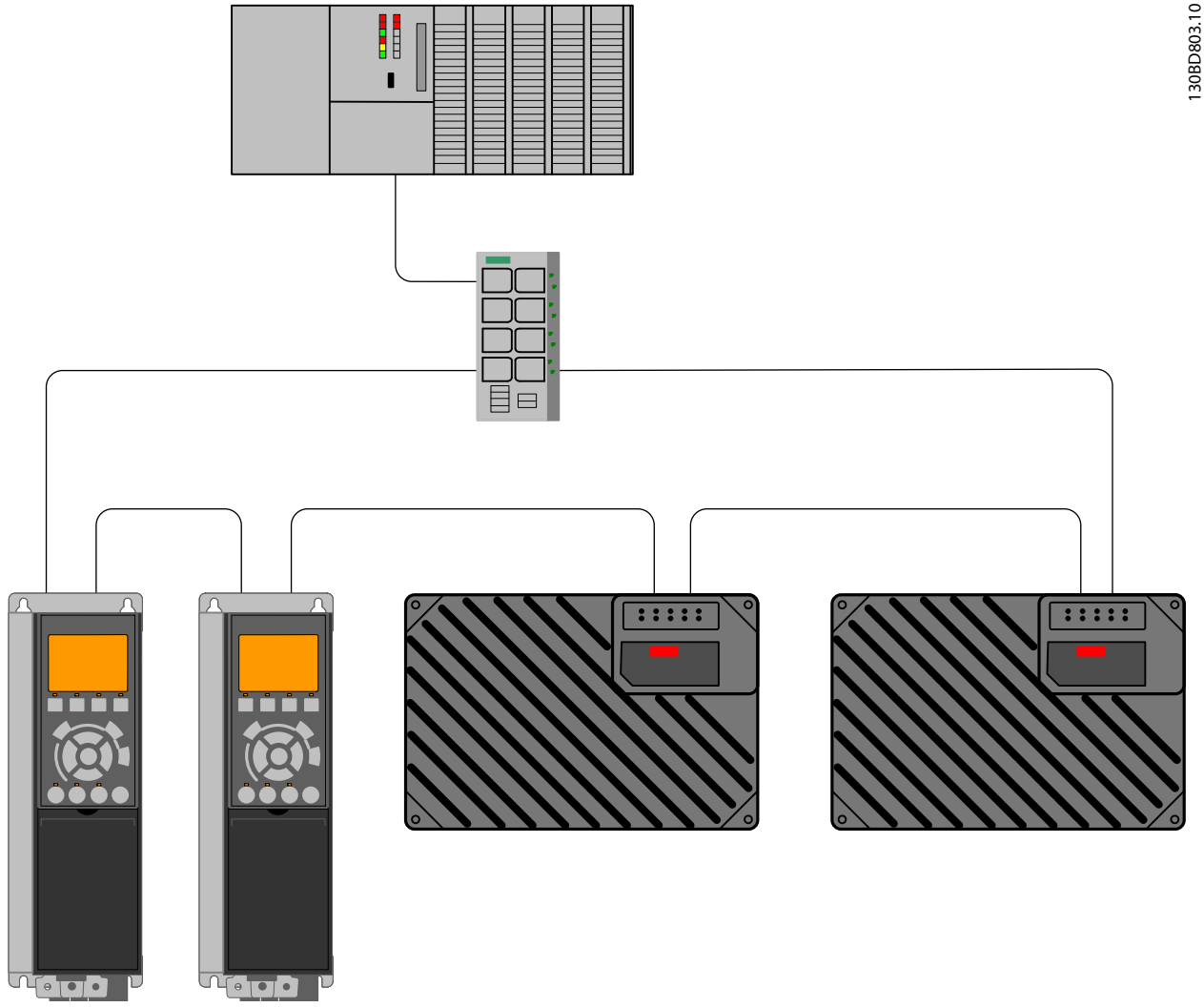

Illustration 3.8 Ring/Redundant Line Topology

For higher availability of a Ethernet network the usage of ring topology can increase the availability. For ring topology, a special switch (redundancy manager) has to be installed between the PLC and the frequency converters. The redundancy manager switch has to be configured so that the ports that connects to the ring are clearly defined. The main redundancy manager hereafter sends test frames into the ring to detect if the ring is still up and working. If the switch does detect a fault in the ring, it reconfigures the ring into 2 lines instead. The transition from one ring into 2 lines can take up to 500 ms depending on the connected components that are installed in the ring. If the PLC has to run through this time without fault, the PLC's timing has to be set, so that this time does not lead to time out fault.

NOTICE

For this type of topology it is crucial that the network switch supports detection of loss of line topology. The switch inside the PROFINET option does not support this, but it must be supported in the redundancy manager that connects the ring to the controller/network. Consult the manual of the switch for more information.

3

3.1.6 Recommended Design Rules

While designing Ethernet networks special attention and caution must be taken regarding active network components. While designing a network for line topology it is important to notice that a small delay is added with each switch in the line.

It is not recommended to connect more than 32 frequency converter in a line. Exceeding the recommended design rules, may result in unstable or faulted communication.

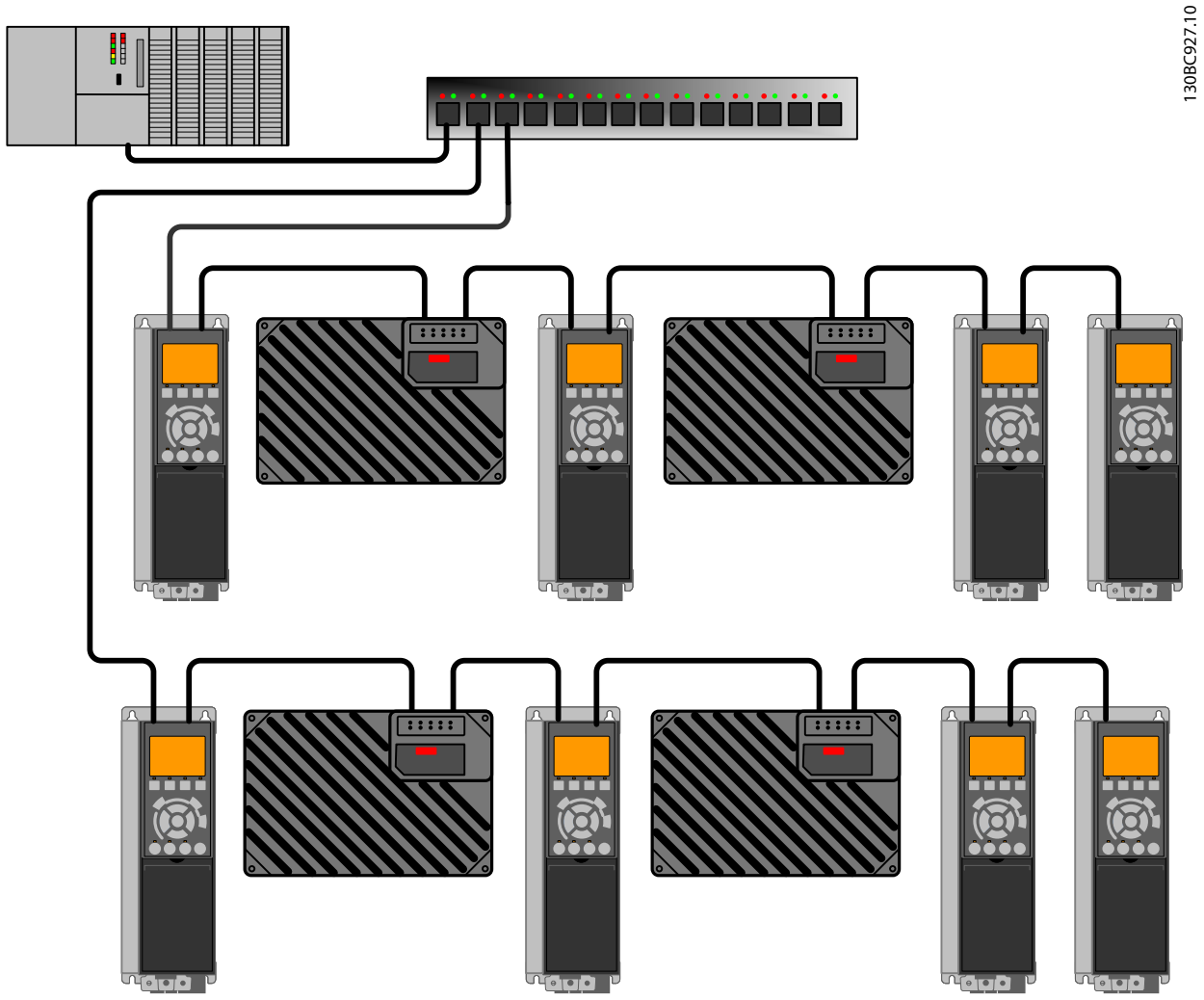

Illustration 3.9 Recommended Design Rules

3.1.7 EMC Precautions

The following EMC precautions are recommended in order to achieve interference-free operation of the Ethernet network. Additional EMC information is available in the FC 102/FC 202/FC 301/FC 302/FCD 302 series Design Guide.

NOTICE

Relevant national and local regulations, for example regarding protective earth connection, must be observed.

The Ethernet communication cable must be kept away from motor and brake resistor cables to avoid coupling of high frequency noise from one cable to the other. Normally, a distance of 200 mm (8 inches) is sufficient, but maintaining the greatest possible distance between the cables is recommended, especially where cables run in parallel over long distances. For power sizes above 315 kW, it is recommended to increase the minimum distance of 500 mm (20 inches). When crossing is unavoidable, the Ethernet cable must cross motor and brake resistor cables at an angle of 90°. *Illustration 3.10* shows an FC 302 to illustrate the frequency converter. This is also valid for an FCD.

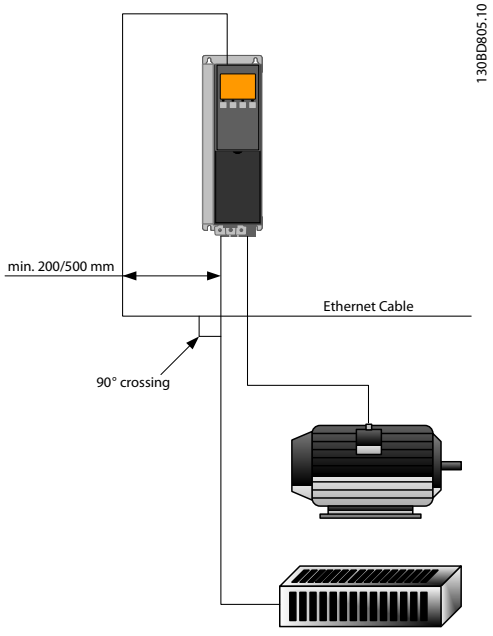

Illustration 3.10 EMC Precautions (Example)

3.2 Using the Hardware Switches

The option has hardware switches, that can be used for setting the station name (Host Name). When all switches are set in the "On" position, or all are set in the "OFF" position, it is possible to change the station name via the *12-08 Host Name* or via DCP command. In all other combinations the hardware switches have priority over the parameter setting. The station name is set based on the value in *15-40 FC Type*, and a 3-digit number - where the number selected from the DIP settings.

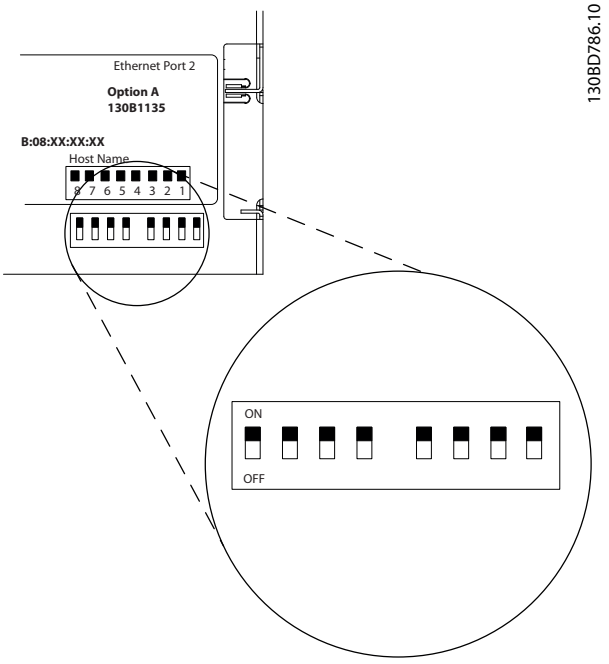

Illustration 3.11 DIP Switch (FC 302)

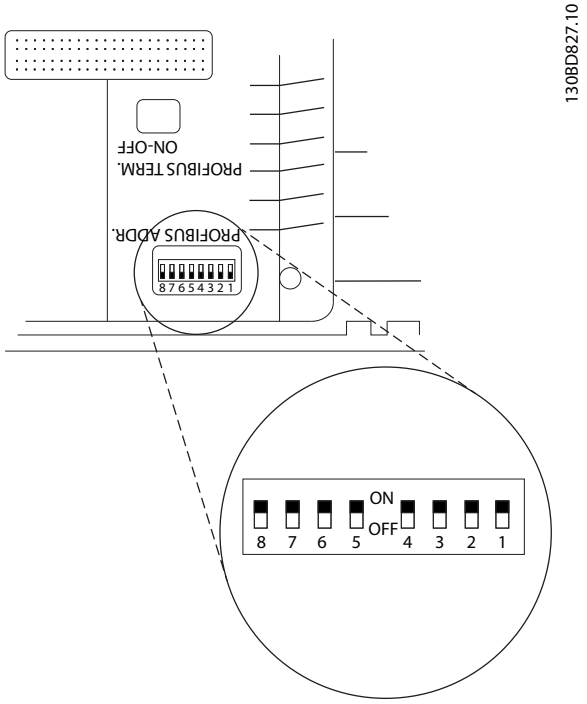

Illustration 3.12 DIP Switch (FCD 302)

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By using the hardware switches it is possible to set 253 different station names according to *Table 3.3* (FC 302 used in this example):

Switch	8	7	6	5	4	3	2	1
12-08 Host Name	+128	+64	+32	+16	+8	+4	+2	+1
'FC-302-005'	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON
'FC-302-035'	OFF	OFF	ON	OFF	OFF	OFF	ON	ON
'FC-302-082'	OFF	ON	OFF	ON	OFF	OFF	ON	OFF
'FC-302-212'	ON	ON	OFF	ON	OFF	ON	OFF	OFF

Table 3.3 Host Names Setting

The Host Name change comes into effect at the next power-up, and can be read in *12-08 Host Name*.

3.3 LED Behaviour

The option has 3 bi-coloured LEDs that allow a fast and detailed diagnosis. The 3 LEDs are each linked to its unique part of the PROFINET option, see *Table 3.4*.

LED label	Description
MS	Module Status, reflects the activity on the PROFINET stack
NS1	Network Status 1, reflects the activity on port 1
NS2	Network Status 2, reflects the activity on port 2

Table 3.4 LED Label

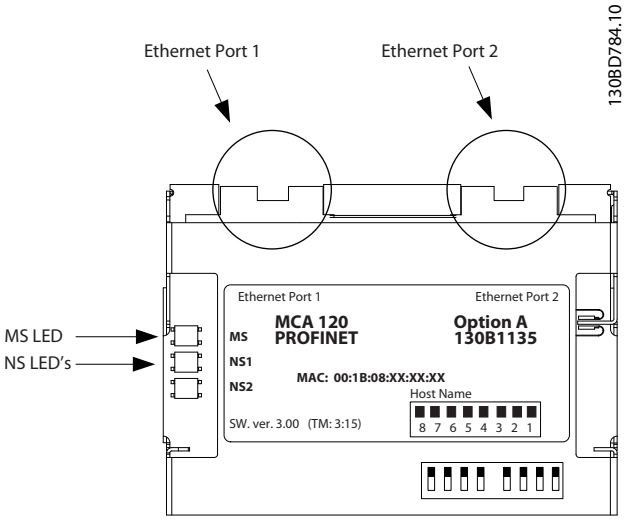


Illustration 3.13 Overview of the Option

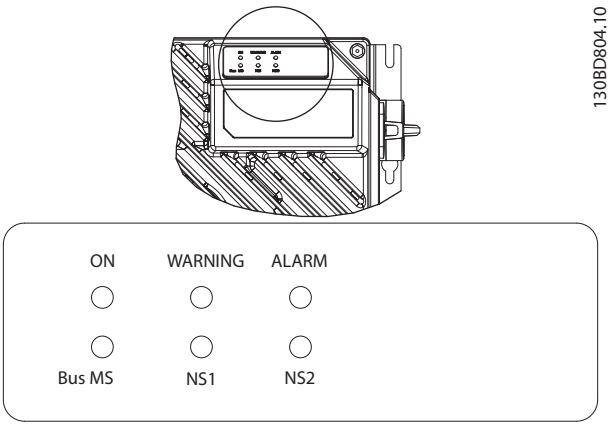


Illustration 3.14 LED Panel for FCD 302

The LED is visible from the outside of an FCD 302.

Module status

Status	Tri-colour LED	
No IP Address assigned	Off	
No Communication to PROFINET module. Module is waiting for configuration telegram from Controller.	Green:	
IO AR established	Green:	
Supervisor AR established, No IO AR.	Green:	
Internal Error	Red:	
Wink	Yellow:	

Table 3.5 MS: Module Status

Network Status

Phases	Status	Tri-colour LED	
Power Off	No Power or No Link on the corresponding port	Off	
Power On	IP Address Conflict	Red:	
	Waiting for configuration	Green:	
Running	In Data Exchange Mode	Green:	
	Wrong Configuration	Red:	
Data exchange	No increment in "In Octets" counter of corresponding port in last 60 s	Yellow:	

Table 3.6 Indication on Network Status LED

During normal operation the MS and at least one NS LED shows a constant green light.

Wink command

The option responds to a Wink command from the network by yellow flashing of all 3 LEDs simultaneously.

4 PROFINET Parameters

4.1 Settings Communication Parameters

All basic communication parameters are located in parameter group *12-0* IP Settings*: The parameters are all set to PROFINET standard values, so that only a minimum change is necessary.

4

- *12-00 IP Address Assignment*
- *12-01 IP Address*
- *Parameter 12-02 Subnet Mask*
- *Parameter 12-03 Default Gateway*
- *Parameter 12-04 DHCP Server*
- *Parameter 12-05 Lease Expires*
- *Parameter 12-06 Name Servers*
- *Parameter 12-07 Domain Name*
- *Parameter 12-08 Host Name*
- *Parameter 12-09 Physical Address*

The PROFINET interface offers several ways of address assignment. Typically DCP is used, and then the PLC assigns the IP address, Subnet mask and other relevant parameters when the communication is established. The following examples does show setting, if the PROFINET DCP assignment is used.

Parameter	Value
Parameter 12-00 IP Address Assignment	[10] DCP
Parameter 12-01 IP Address	0.0.0.0 (From PLC)
Parameter 12-02 Subnet Mask	0.0.0.0 (From PLC)
Parameter 12-03 Default Gateway	0.0.0.0 (From PLC)
Parameter 12-04 DHCP Server	*

Table 4.1 Setting up Frequency Converter with Manual assigned IP Address

**= Host Name can be set via the LCP, Through DCP command or by setting the DIP Switches on the PROFINET interface.*

Parameter	Value
Parameter 12-00 IP Address Assignment	[1] DHCP/[2] BOOTP
Parameter 12-01 IP Address	Read only
12-02 Subnet Mask	Read only
Parameter 12-03 Default Gateway	Read only

Table 4.2 Setting up Drive with Automatic (BOOTP/DHCP) assigned IP Address

By IP address assigned by DHCP/BOOTP/DCP server, the assigned *IP Address* and *Subnet Mask* can be read out in *parameter 12-01 IP Address* and *12-02 Subnet Mask*. In *parameter 12-04 DHCP Server* the IP address of the found DHCP or BOOTP server is displayed. For DHCP only: The remaining lease-time can be read-out in *12-05 Lease Expires*. If lease time is set to 0 (zero), the timer never expires.

12-09 Physical Address reads out the MAC address of option, which is also printed on the label of the option.

Parameter 12-03 Default Gateway is optional and only used in routed networks.

NOTICE

It is only possible to assign valid class A, B, and C IP address to the option. The valid ranges are shown in *Table 4.3*.

Class A	1.0.0.1-126.255.255.254
Class B	128.1.0.1-191.255.255.254
Class C	192.0.1.1-223.255.254.254

Table 4.3 Valid Ranges for IP Address to the Option

4.2 Ethernet Link Parameters

Parameter group *12-1* Ethernet Link Parameters*:

- *Parameter 12-10 Link Status*
- *12-11 Link Duration*
- *Parameter 12-12 Auto Negotiation*
- *Parameter 12-13 Link Speed*
- *12-14 Link Duplex*

Each port has unique Ethernet Link Parameters.

Parameter 12-10 Link Status and *12-11 Link Duration* displays information on the link status, per port.
Parameter 12-10 Link Status displays Link or No Link according to the status of the present port.
12-11 Link Duration displays the duration of the link on the present port. If the link is lost, the counter is reset.

Parameter 12-12 Auto Negotiation is a feature that enables 2 connected Ethernet devices to select common transmission parameters, such as speed and duplex mode. In this process, the connected devices first share their capabilities and then select the fastest transmission mode they both support.
Incapability between the connected devices could lead to decreased communication performance.
To prevent this, Auto Negotiation can be disabled.
If *parameter 12-12 Auto Negotiation* is set to OFF, link speed and duplex mode can be configured manually in *parameter 12-13 Link Speed* and *parameter 12-12 Auto Negotiation*.

Parameter 12-13 Link Speed - displays/sets the link speed for each port. If no link is present, “None” is displayed.

12-14 Link Duplex - displays/sets the duplex mode for each port.

5 How to Configure the System

5.1 Configure the PROFINET Network

All PROFINET devices that are connected to the same bus network must have a unique station name (Host Name).

The PROFINET Host Name of the frequency converter can be set via:
12-08 Host Name, or as described in *chapter 3.2 Using the Hardware Switches* via Hardware switches.

5.2 Configure the Controller

5.2.1 GSD File

To configure a PROFINET Controller, the configuration tool needs a GSD file for each type of slave on the network. The GSD file is a PROFINET xml file containing the necessary communication setup data for a slave. Download the GSD file for the FC 100, FC 200, FC 300 and FCD 302 frequency converters at www.danfoss.com/BusinessAreas/DrivesSolutions/profinet. The name of the GSD file may vary compared to this manual. Download the latest version from the website. The following example shows an FC 302. The steps for FCD 302 and the other frequency converter series are the same.

PROFINET SW version (*15-61 Option SW Version*)	GSD file
FC 102/FC 202/FC 301/FC 302	GSDML-V2.2-Danfoss-FC-20090620.xml or GSDML-V2.3-Danfoss-FC-20131010.xml
FCD 302	GSDML-V2.2-Danfoss-FCD-20090620.xml or GSDML-V2.3-Danfoss-FCD-20131010.xml

Table 5.1 GSD file

The first step in configuration of the PROFINET Controller is to import the GSD file in the configuration tool. The following steps outlined show how to add a new GSD file to the Simatic Manager software tool. For each drive series, a GSD file is typically imported once only, following the initial installation of the software tool.

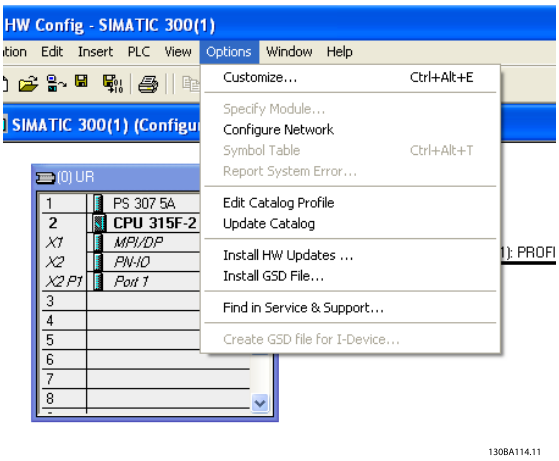


Illustration 5.1 Import the GSD File in the Configuration Tool

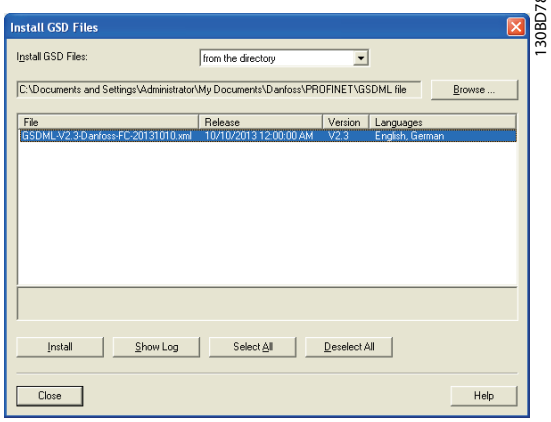
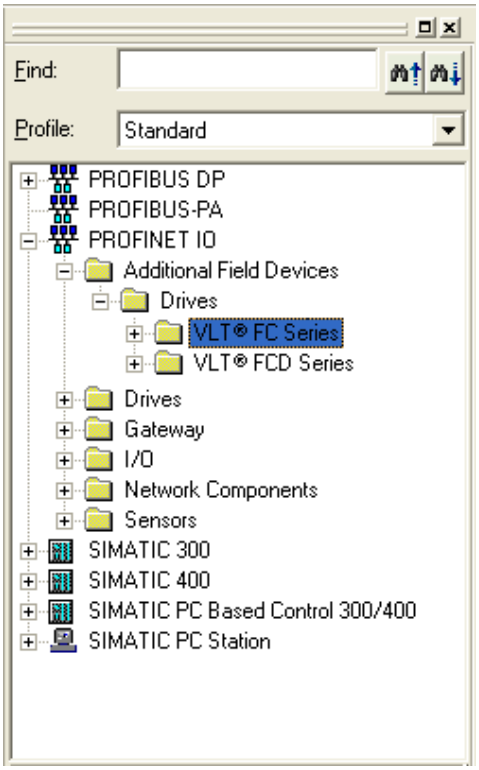


Illustration 5.2 Add a New GSD File to the Simatic Manager Software Tool

The FC 102/FC 202/FC 301/FC 302/FCD 302 GSD file is now imported and is accessible via the following path in the Hardware catalogue:



130BC925.10

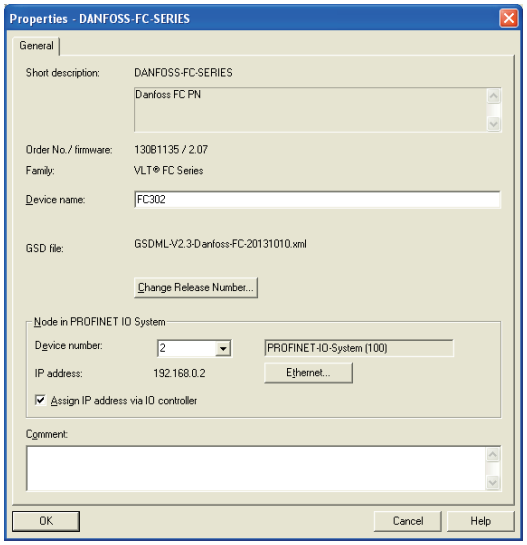
Illustration 5.3 Path in the Hardware Catalogue

Open a Project, set up the Hardware and add a PROFINET Master system. Select Danfoss FC PN then drag and drop it onto the PROFINET IO system.

Open the properties for the inserted frequency converter, to enter the device name..

NOTICE

The name must match the name in *12-08 Host Name*. If the checkmark *Assign IP address via the IO controller* is set, the controller downloads the IP address to the IO device that has the corresponding device name. The IP address is stored in the non volatile memory of the frequency converters.

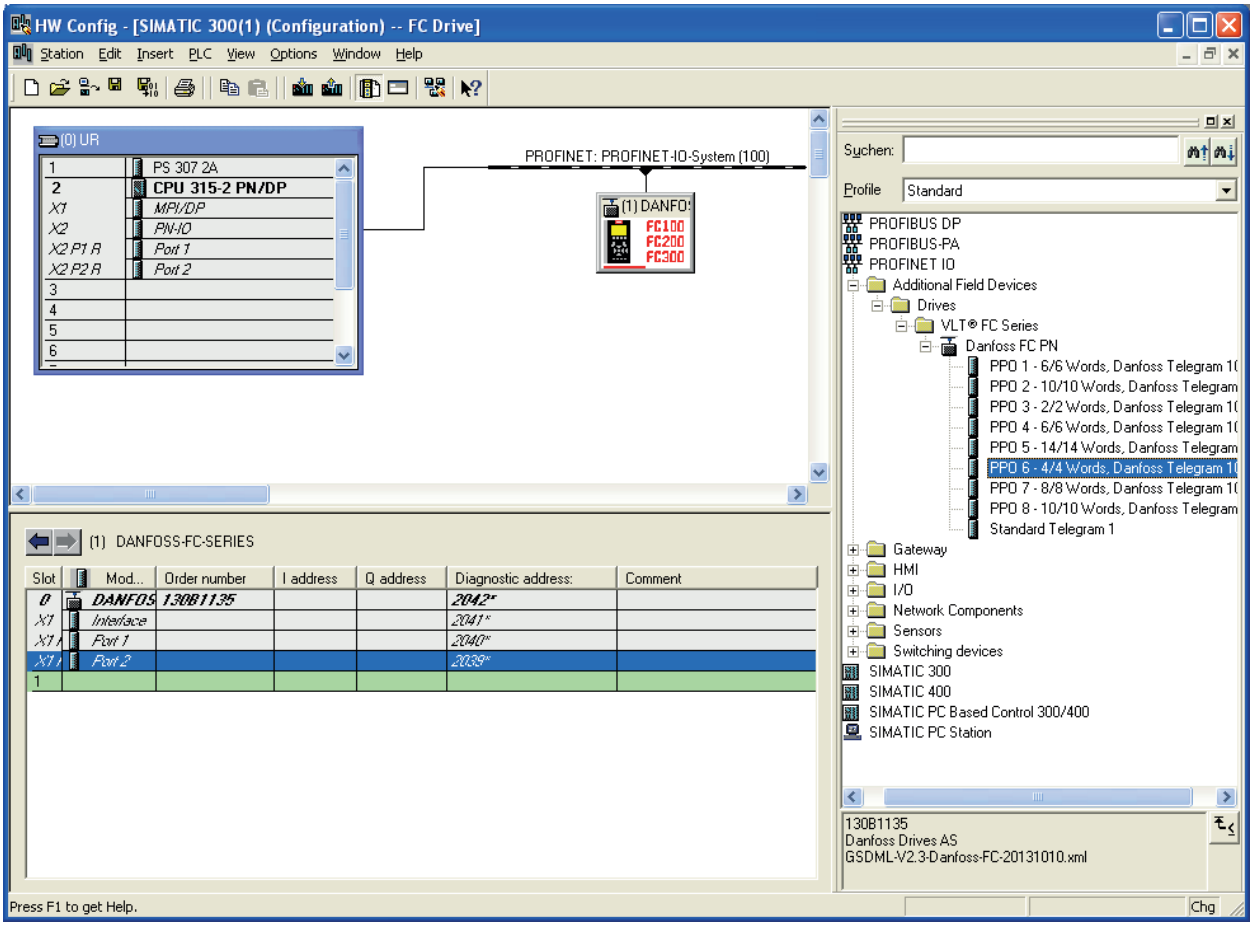


130BD781.10

Illustration 5.4 Set Up the Hardware and Add a PROFINET Master System

The next step is to set up the peripheral input and output data. Data set up in the peripheral area is transmitted cyclically via telegrams/PPO types. In the example below, a PPO type 6 is dragged and dropped to slot 1.

See the PPO types in *chapter 6 How to Control the Frequency Converter* for more information.



130BD783.10

Illustration 5.5 Set up the Peripheral Input and Output Data

The configuration tool automatically assigns addresses in the peripheral address area. In this example the input and output area have the following configuration:

PPO type 6

PCD word number	0	1	2	3
Input address	256-257	258-259	260-261	262-263
Set-up	STW	MAV	*9-16 PCD Read Configuration*.2	*9-16 PCD Read Configuration*.3

Table 5.2 PCD Read (VLT to PLC)

PCD word number	0	1	2	3
Output address	256-257	258-259	260-261	262-263
Set-up	CTW	MRV	*9-15 PCD Write Configuration*.2	*9-15 PCD Write Configuration*.3

Table 5.3 PCD Write (PLC to VLT)

Assign the PCDs via *9-16 PCD Read Configuration* for inputs and *9-15 PCD Write Configuration* for outputs.

Download the configuration file to the PLC. The PROFINET system should start data exchange when the PLC is set to Run mode.

5.3 Configure the Frequency Converter

5.3.1 VLT Parameters

Pay particular attention to the following parameters when configuring the frequency converter with a PROFINET interface.

- *0-40 [Hand on] Key on LCP*. If [Hand On] is activated, control of the frequency converter via the PROFINET interface is disabled
- After an initial power up the frequency converter automatically detects whether a fieldbus option is installed in slot A, and set *parameter 8-02 Control Source* to [Option A]. If an option is added, changed, or removed from an already commissioned frequency converter, it will not change *parameter 8-02 Control Source* but enter Trip Mode, and the frequency converter displays an error
- *Parameter 8-10 Control Profile*. Choose between the Danfoss frequency converter Profile and the PROFIdrive profile
- *8-50 Coasting Select* to *8-56 Preset Reference Select*. Selection of how to gate PROFINET control commands with digital input command of the control card.

NOTICE

When Parameter *8-01 Control Site* is set to *[2] Control word only*, then the settings in Parameter*8-50 Coasting Select* to Parameter *8-56 Preset Reference Select* is overruled, and only act on Bus-control.

6 How to Control the Frequency Converter

6.1 PPO Types

The PROFIdrive profile for frequency converters specifies a number of communication objects (Parameter Process data Objects, PPO), which are suitable for data exchange between a process controller, such as a PLC, and frequency converters. All PPOs are defined for cyclic data transfer, so that process data (PCD) can be transferred from the controller to the slave and vice versa. *Table 6.1* shows the PPO types available for the FC 102/FC 202/FC 301/FC 302/FCD 302.

PPO types 3, 4, 6, 7 and 8 are pure process data objects for applications requiring no cyclic parameter access. The PLC sends out process control data, and the frequency converter then responds with a PPO of the same length, containing process status data. The first two bytes of the process data area (PCD 0) comprise a fixed part present in all PPO types. The first two words of the process data area (PCD 0 and PCD1) comprise a fixed part present in all PPO types. The following data (PCD 2 to PCD 9) are flexible for PCD write entries (*9-15 PCD Write Configuration*, and for PCD read entries (*9-16 PCD Read Configuration*. The parameters can be parameterised with process signals from the list on *parameter 9-23 Parameters for Signals*. PPO types 1, 2 and 5 are mixed process data objects for applications requiring and cyclic parameter access. These PPO types has a PCD part where the PLC sends out process control data, and the frequency converter responds with a PPO of the same length, containing process this is a feature like in PPO 3, 4, 6 and 8. In the front of the PCD data, the three PPO types has the PCA (Parameter Characteristics Access) part. In the PCA data it is possible to read or write to the drives parameters, with up to four byte of data.

Select the signals for transmission from the master to the frequency converter in *9-15 PCD Write Configuration* (request from master to the frequency converter). Select the signals for transmission from the frequency converter to the master in *9-16 PCD Read Configuration* (response: FC → master). PPO types 1, 2 and 5 has a PCV part and a PCD part. The PCV (Parameter Characteristics Value) allows the acyclic access to Parameters via the cyclical data exchange.

The choice of PPO type is made in the master configuration, and is then automatically recorded in the frequency converter. No manual setting of PPO types in the frequency converter is required. The current PPO type can be read in *parameter 9-22 Telegram Selection*.

Selection *[1] Standard telegram 1* is equivalent to PPO type 3.

	PCV								PCD																			
									1		2		3		4		5		6		7		8		9		10	
	9-15 PCD Write Configuration + *9-16 PCD Read Configuration* index. no.								[0]		[1]		[2]		[3]		[4]		[5]		[6]		[7]		[8]		[9]	
	PCA		IND		PVA				CTW		MRV		PCD		PCD		PCD		PCD		PCD		PCD		PCD		PCD	
									STW		MAV																	
Byte no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Type 1:																												
Type 2:																												
Type 3:																												
Type 4:																												
Type 5:																												
Type 6:																												
Type 7:																												
Type 8:																												

PCV	Parameter Characteristics Value	CTW:	Control word
PCD	Process Data	STW:	Status word
PCA	Parameter Characteristics (Bytes 1, 2)	MRV:	Main reference value
IND	Sub index (Byte 3. Byte 4 is not used)	MAV:	Main actual value (Actual output frequency)
PVA	Parameter value (Bytes 5 to 8)		

Table 6.1 PPO Types

6.2 PCV Parameter Access

Parameter access via the PCV channel is performed by the PROFINET cyclical data exchange, where the PCV channel is part of the PPOs described in *chapter 6 How to Control the Frequency Converter*.

Using the PCV channel it is possible to read and write parameter values, as well as readout of a number of describing attributes of each parameter.

6.2.1 PCA Handling

The PCA part of PPO types 1, 2 and 5 can handle several tasks. The master can control and supervise parameters and request a response from the slave, whereas the slave can respond to a request from the master. *Requests and responses* is a handshake procedure and cannot be batched, meaning that if the master sends out a read/write request, it has to wait for the response, before it sends a new request. The request or response data value will be limited to maximum 4 bytes, which implies that text strings are not transferable. For further information, see *chapter 9 Application Examples*.

6.2.2 PCA - Parameter Characteristics

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RC				SMP	PNU										

Table 6.2 PCA - Parameter Characteristics

RC: Request/response characteristics (Range 0..15)
SMP: Spontaneous Message (Not supported)
PNU : Parameter no. (Range 1..1999)

6.2.3 Request/Response Handling

The RC portion of the PCA word defines the requests that may be issued from the master to the slave as well as what other portions of the PCV (IND and PVA) are involved. The PVA portion transmits word-size parameter values in bytes 7 and 8, while long word size values require bytes 5 to 8 (32 bits). If the Response/Request contains array elements, the IND carries the Array Sub-index. If parameter descriptions are involved, the IND holds the Record Sub-index of the parameter description.

6.2.4 RC Content

Request	Function
0	No request
1	Request parameter value
2	Change parameter value (word)
3	Change parameter value (long word)
4	Request description element
5	Change description element
6	Request parameter value (array)
7	Change parameter value (array word)
8	Change parameter value (array long word)
9	Request number of array elements
10-15	Not used

Table 6.3 Request

If the slave rejects a request from the master, the RC word in the PPO-read indicates this by assuming the value 7. The fault number is carried by bytes 7 and 8 in the PVA element.

Response	Function
0	No response
1	Transfer parameter value (word)
2	Transfer parameter value (long word)
3	Transfer description element
4	Transfer parameter value (array word)
5	Transfer parameter value (array long word)
6	Transfer number of array elements
7	Request rejected (incl. fault #, see below)
8	Not serviceable by PCV interface
9	Not used
10	Not used
11	Not used
12	Not used
13-15	Not used

Table 6.4 Response

Fault no.	Interpretation
0	Illegal PNU
1	Parameter value cannot be changed
2	Upper or lower limit exceeded
3	Subindex corrupted
4	No array
5	Data type false
6	Cannot be set by user (reset only)
7	Description element cannot be changed
8	IR required PPO-write not available
9	Description data not available
10	Access group
11	No parameter write access
12	Key word missing
13	Text in cyclical transmission not readable
14	Name in cyclical transmission not readable
15	Text array not available
16	PPO-write missing
17	Request temporarily rejected
18	Other fault
19	Data in cyclical transmission not readable
130	There is no bus access to the parameter called
131	Data change is not possible because factory setup has been selected

Table 6.5 Fault No.

6.2.5 Example

This example shows how to use PPO type 1 to change the ramp-up time (*3-41 Ramp 1 Ramp Up Time*) to 10 s and to command a start and speed reference of 50%.

Frequency converter parameter settings:
8-50 Coasting Select: Bus
parameter 8-10 Control Profile: PROFIdrive profile

6.2.6 PCV

PCA Parameter Characteristics
PCA part (byte 1-2).
The RC part tells what the PCV part must be used for. The functions available appear from the table, see *chapter 6.2.1 PCA Handling*.

When a parameter is changed, choose value 2 or 3. In this example 3 is chosen, because *3-41 Ramp 1 Ramp Up Time* covers a long word (32 bits).
3-41 Ramp 1 Ramp Up Time=155 hex: In this example byte 1 and 2 are set to 3155.

IND (bytes 3-4)
Used when reading/changing parameters with sub-index, for example *9-15 PCD Write Configuration*. In the example bytes 3 and 4 are set to 00 Hex.

PVA (bytes 5-8)
The data value of *3-41 Ramp 1 Ramp Up Time* must be changed to 10.00 seconds. The value transmitted must be 1000, because the conversion index for *3-41 Ramp 1 Ramp Up Time* is 2. This means that the value received by the frequency converter is divided by 100, such that the frequency converter perceives 1000 as 10.00. Bytes 5-8=1000=03E8 Hex. See *chapter 8.6 Object and Data Types Supported*.

6.2.7 PCD

Control word (CTW) according to PROFIdrive profile:
Control words consist of 16 bits. The meaning of each bit is explained in the section Control word and Status word.
The following bit pattern sets all necessary start commands:
0000 0100 0111 1111=047F Hex.*
0000 0100 0111 1110=047E Hex.*
0000 0100 0111 1111=047F Hex.
Quick stop: 0000 0100 0110 1111=046F Hex.
Stop: 0000 0100 0011 1111=043F Hex.

NOTICE

*** For restart after power up: Bit 1 and 2 of the CTW must be set to 1 and bit 0 toggled from 0 to 1.**

6.2.8 MRV

Speed reference, the data format is "Standardized value". 0 Hex=0% and 4000 Hex=100%.
In the example, 2000 Hex is used, corresponding to 50% of maximum frequency (*3-03 Maximum Reference*).
The whole PPO therefore has the following values in Hex:

		Byte	Value
PCV	PCA	1	31
	PCA	2	55
	IND	3	00
	IND	4	00
	PVA	5	00
	PVA	6	00
	PVA	7	03
	PVA	8	E8
PCD	CTW	9	04
	CTW	10	7F
	MRV	11	20
	MVR	12	00

Table 6.6 PPO Values in Hex

The process data within the PCD part acts immediately upon the frequency converter, and can be updated from the master as quickly as possible. The PCV part is a "handshake" procedure which means that the frequency converter has to acknowledge the command, before a new one can be written.

A positive response to the preceding example may look like this:

		Byte	Value
PCV	PCA	1	21
	PCA	2	55
	IND	3	00
	IND	4	00
	PVA	5	00
	PVA	6	00
	PVA	7	03
	PVA	8	E8
PCD	STW	9	0F
	STW	10	07
	MAV	11	20
	MAR	12	00

Table 6.7 Positive Response

The PCD part responds according to the state and parameterization of the frequency converter.

The PCV part responds as

- PCA: As the request telegram, but here the RC part is taken from *Table 6.4*. In this example, RC is 2 Hex, which is a confirmation that a parameter value of the type long word (32 bit) has been transferred. IND is not used in this example.
- PVA: 03E8Hex in the PVA part tells that the value of *3-41 Ramp 1 Ramp Up Time* is 1000, which corresponds to 10.00.
- STW: 0F07 Hex means that the motor is running and there are no warnings or faults (for details see *Table 6.15*).
- MAV: 2000 Hex indicates that the output frequency is 50% of the maximum reference.

A negative response may look like this:

		Byte	Value
PCV	PCA	1	70
	PCA	2	00
	IND	3	00
	IND	4	00
	PVA	5	00
	PVA	6	00
	PVA	7	00
	PVA	8	02
PCD	STW	9	0F
	STW	10	07
	MAV	11	20
	MAR	12	00

Table 6.8 Negative Response

RC is 7 Hex, which means that the request has been rejected, and the fault number can be found in the PVA part. In this case the fault number is 2, which means that the upper or lower limit of the parameter is exceeded, see *Table 6.5*.

6.3 Process Data

Use the process data part of the PPO for controlling and monitoring the frequency converter via the PROFINET.

6.3.1 Process Control Data

Process data sent from the PLC to the frequency converter are defined as Process Control Data (PCD).

0	1	2	.....	9
CTW	MRV	PCD	.....	PCD
		PCD write		

Table 6.9 Master Slave

PCD 0 contains a 16-bit control word, where each bit controls a specific function of the frequency converter, see *chapter 6.4 Control Profile*. PCD 1 contains a 16-bit speed set point in percentage format. See *chapter 6.3.3 Reference Handling*.

The content of PCD 2 to PCD 9 is programmed in *9-15 PCD Write Configuration* and *9-16 PCD Read Configuration*.

6.3.2 Process Status Data

Process data sent from the frequency converter contain information about the current state of the frequency converter.

0	1	2	.....	9
STW	MAV	PCD	.....	PCD
		PCD read		

Table 6.10 Slave Master

PCD 0 contains a 16-bit status word, where each bit contains information regarding a possible state of the frequency converter.
PCD 1 contains per default the value of the current speed of the frequency converter in percentage format (see *chapter 6.3.3 Reference Handling*).

The content of PCD 2 to PCD 9 is programmed in *9-16 PCD Read Configuration*.

6.3.3 Reference Handling

The reference handling in FC 102/FC 202/FC 301/FC 302/FCD 302 is an advanced mechanism that sums up references from different sources.

For more information on reference handling, refer to the FC 102/FC 202/FC 301/FC 302/FCD 302 Design Guides.

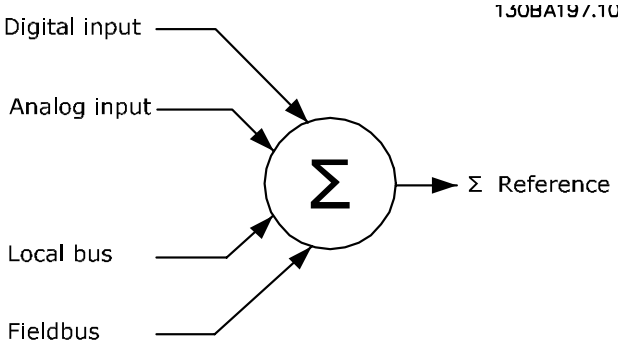


Illustration 6.1 Reference Handling

The reference, or speed set point (MRV, send via PROFINET is always transmitted to the frequency converter in percentage format as integers represented in hexadecimal (0-4000 hex).

Depending on the setting of *3-00 Reference Range* the reference and MAV are scaled accordingly:

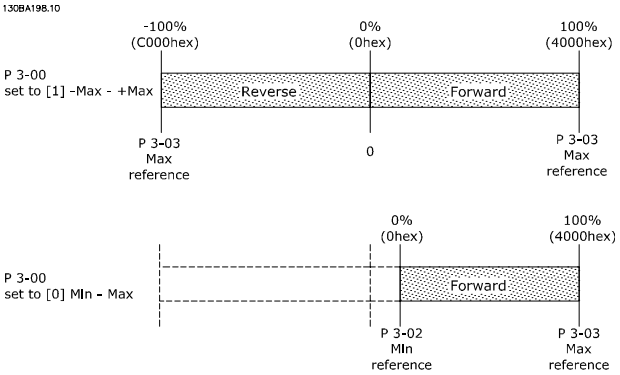


Illustration 6.2 Scaled MAV

6

NOTICE

If *3-00 Reference Range* is set to *[0] Min - Max*, a negative reference will be handled as 0%.

The actual output of the frequency converter is limited by the speed limit parameters in *4-11 Motor Speed Low Limit [RPM]* to *4-14 Motor Speed High Limit [Hz]*.
The final speed limit is set by *4-19 Max Output Frequency*.

The reference and the MAV have the format which appears in *Table 6.11*.

MRV/MAV	Integer in hex	Integer in decimal
100%	4000	16.384
75%	3000	12.288
50%	2000	8.192
25%	1000	4.096
0%	0	0
-25%	F000	-4.096
-50%	E000	-8.192
-75%	D000	-12.288
-100%	C000	-16.384

Table 6.11 The Format of Reference and the MAV

NOTICE

Negative numbers are formed as two's complement.

NOTICE

The data type for MRV and MAV is a N2 16 bit standardised value, meaning it can express a range from -200% to +200% (8001 to 7FFF).

1-00 Configuration Mode set to *[0] Speed open loop*.
3-00 Reference Range set to *[0] Min-Max*.
3-02 Minimum Reference set to 100 RPM.
3-03 Maximum Reference set to 3000 RPM.

MRV/MAV		Actual speed
0%	0 hex	100 RPM
25%	1000 hex	825 RPM
50%	2000 hex	1550 RPM
75%	3000 hex	2275 RPM
100%	4000 hex	3000 RPM

Table 6.12

6.3.4 Process Control Operation

In process control operation *1-00 Configuration Mode* is set to *[3] Process*.
The reference range in *3-00 Reference Range* is always *[0] Min-Max*.
- MRV represents the process setpoint.
- MAV expresses the actual process feedback (range ±200%).

6.3.5 Influence of the Digital Input Terminals upon FC Control Mode, *8-50 Coasting Select* to *8-56 Preset Reference Select*

The influence of the digital input terminals upon control of the frequency converter can be programmed in *8-50 Coasting Select* to *8-56 Preset Reference Select*.

NOTICE

The *8-01 Control Site* overrules the settings in *8-50 Coasting Select* to *8-56 Preset Reference Select*, and Terminal 37 *Coasting Stop (safe)* overrules any parameter.

Each of the digital input signals can be programmed to logic AND, logic OR, or to have no relation to the corresponding bit in the control word. In this way a specific control command that is, stop/coast, can be initiated by fieldbus only, fieldbus AND Digital Input, or Ether Fieldbus OR Digital input terminal.

⚠CAUTION

In order to control the frequency converter via PROFINET, *8-50 Coasting Select* must be set to either *[1] Bus*, or to *[2] Logic AND*, and *8-01 Control Site* must be set to *[0]* or *[2]*.

More detailed information and examples of logical relationship options are provided in *chapter 10 Trouble-shooting*.

6.4 Control Profile

The frequency converter can be controlled according to the PROFIdrive profile, or the Danfoss frequency converter profile. Select the desired control profile in *parameter 8-10 Control Profile*. The choice of profile affects the control and status word only.

6.5 PROFIdrive Control Profile

This section describes the functionality of the control word and status word in the PROFIdrive profile. Select this profile by setting *parameter 8-10 Control Profile*.

6.5.1 Control Word according to PROFIdrive Profile (CTW)

The Control word is used to send commands from a master (for example, a PC) to a slave.

Bit	Bit=0	Bit=1
00	OFF 1	ON 1
01	OFF 2	ON 2
02	OFF 3	ON 3
03	Coasting	No coasting
04	Quick stop	Ramp
05	Hold frequency output	Use ramp
06	Ramp stop	Start
07	No function	Reset
08	Jog 1 OFF	Jog 1 ON
09	Jog 2 OFF	Jog 2 ON
10	Data invalid	Data valid
11	No function	Slow down
12	No function	Catch up
13	Parameter set-up	Selection lsb
14	Parameter set-up	Selection msb
15	No function	Reverse

Table 6.13 Control Word Bits

Explanation of the control bits

Bit 00, OFF 1/ON 1
Normal ramp stops using the ramp times of the actual selected ramp.
Bit 00="0" leads to the stop and activation of the output relay 1 or 2 if the output frequency is 0 Hz and if [Relay 123] has been selected in *5-40 Function Relay*.
When bit 0="1", the frequency converter is in State 1: "Switching on inhibited".
Refer to *Illustration 6.3*.

Bit 01, OFF 2/ON 2
Coasting stop
When bit 01="0", a coasting stop and activation of the output relay 1 or 2 occurs if the output frequency is 0 Hz and if [Relay 123] has been selected in *5-40 Function Relay*.
When bit 01="1", the frequency converter is in State 1: "Switching on inhibited". Refer to *Illustration 6.3*.

Bit 02, OFF 3/ON 3
Quick stop using the ramp time of *3-81 Quick Stop Ramp Time*. When bit 02="0", a quick stop and activation of the output relay 1 or 2 occurs if the output frequency is 0 Hz and if [Relay 123] has been selected in *5-40 Function Relay*.
When bit 02="1", the frequency converter is in State 1: "Switching on inhibited".
Refer to *Illustration 6.3*.

Bit 03, Coasting/No coasting
Coasting stop Bit 03="0" leads to a stop.
When bit 03="1", the frequency converter can start if the other start conditions are satisfied.

NOTICE

The selection in *8-50 Coasting Select* determines how bit 03 is linked with the corresponding function of the digital inputs.

Bit 04, Quick stop/Ramp
Quick stop using the ramp time of *3-81 Quick Stop Ramp Time*.
When bit 04="0", a quick stop occurs.
When bit 04="1", the frequency converter can start if the other start conditions are satisfied.

NOTICE

The selection in *parameter 8-51 Quick Stop Select* determines how bit 04 is linked with the corresponding function of the digital inputs.

Bit 05, Hold frequency output/Use ramp
When bit 05="0", the current output frequency is being maintained even if the reference value is modified.
When bit 05="1", the frequency converter can perform its regulating function again; operation occurs according to the respective reference value.

Bit 06, Ramp stop/Start
Normal ramp stop using the ramp times of the actual ramp as selected. In addition, activation of the output relay 01 or 04 if the output frequency is 0 Hz if Relay 123 has been selected in *5-40 Function Relay*. Bit 06="0" leads to a stop. When bit 06="1", the frequency converter can start if the other start conditions are satisfied.

NOTICE

The selection in *8-53 Start Select* determines how bit 06 is linked with the corresponding function of the digital inputs.

Bit 07, No function/Reset
Reset after switching off.
Acknowledges event in fault buffer.
When bit 07="0", no reset occurs.
When there is a slope change of bit 07 to "1", a reset occurs after switching off.

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Bit 08, Jog 1 OFF/ON
Activation of the pre-programmed speed in *8-90 Bus Jog 1 Speed*. JOG 1 is only possible if bit 04="0" and bit 00-03="1".

Bit 09, Jog 2 OFF/ON
Activation of the pre-programmed speed in *8-91 Bus Jog 2 Speed*. JOG 2 is only possible if bit 04="0" and bit 00-03="1".

Bit 10, Data invalid/valid
Is used to tell the frequency converter whether the control word is to be used or ignored. Bit 10="0" causes the control word to be ignored, giving the opportunity to turn off the control word when updating/reading parameters. Bit 10="1" causes the control word to be used. This function is relevant, because the control word is always contained in the telegram, regardless of which type of telegram is used.

Bit 11, No function/Slow down
Is used to reduce the speed reference value by the amount given in *3-12 Catch up/slow Down Value* value. When bit 11="0", no modification of the reference value occurs. When bit 11="1", the reference value is reduced.

Bit 12, No function/Catch up
Is used to increase the speed reference value by the amount given in *3-12 Catch up/slow Down Value*.
When bit 12="0", no modification of the reference value occurs.
When bit 12="1", the reference value is increased.
If both slowing down and accelerating are activated (bit 11 and 12="1"), slowing down has priority, that is, the speed reference value is reduced.

Bits 13/14, Set-up selection
Bits 13 and 14 are used to choose between the 4 parameter set-ups according to *Table 6.14*.

The function is only possible if *[9] Multi Set-up* has been chosen in *0-10 Active Set-up*. The selection in *8-55 Set-up Select* determines how bits 13 and 14 are linked with the corresponding function of the digital inputs. Changing set-up while running is only possible if the set-ups have been linked in *0-12 This Set-up Linked to*.

Set-up	Bit 13	Bit 14
1	0	0
2	1	0
3	0	1
4	1	1

Table 6.14 Parameter Set-ups

Bit 15, No function/Reverse
Bit 15="0" causes no reversing.
Bit 15="1" causes reversing.

NOTICE

In the factory setting reversing is set to *[0] Digital input* in *parameter 8-54 Reversing Select*.

NOTICE

Bit 15 causes reversing only when *Ser. communication, Logic or* or *Logic and* is selected.

6.5.2 Status Word according to PROFIdrive Profile (STW)

The status word is used to notify a master (for example, a PC) about the status of a follower.

Bit	Bit=0	Bit=1
00	Control not ready	Control ready
01	Drive not ready	Drive ready
02	Coasting	Enable
03	No error	Trip
04	OFF 2	ON 2
05	OFF 3	ON 3
06	Start possible	Start not possible
07	No warning	Warning
08	Speed ≠ reference	Speed=reference
09	Local operation	Bus control
10	Out of frequency limit	Frequency limit ok
11	No operation	In operation
12	Drive OK	Stopped, autostart
13	Voltage OK	Voltage exceeded
14	Torque OK	Torque exceeded
15	Timer OK	Timer exceeded

Table 6.15 Status Word Bits

Explanation of the status bits
Bit 00, Control not ready/ready
When bit 00="0", bit 00, 01 or 02 of the control word is "0" (OFF 1, OFF 2 or OFF 3) - or the frequency converter is switched off (trip).
When bit 00="1", the frequency converter control is ready, but there is not necessarily power supply to the unit present (in the event of external 24 V supply of the control system).

Bit 01, VLT not ready/ready
Same significance as bit 00, however, there is a supply of the power unit. The frequency converter is ready when it receives the necessary start signals.

Bit 02, Coasting/Enable
When bit 02="0", bit 00, 01 or 02 of the control word is "0" (OFF 1, OFF 2 or OFF 3 or coasting) - or the frequency converter is switched off (trip).
When bit 02="1", bit 00, 01 or 02 of the control word is "1"; the frequency converter has not tripped.

Bit 03, No error/Trip
When bit 03="0", no error condition of the frequency converter exists.
When bit 03="1", the frequency converter has tripped and requires a reset signal before it can start.

Bit 04, ON 2/OFF 2
When bit 01 of the control word is "0", then bit 04="0".
When bit 01 of the control word is "1", then bit 04="1".

Bit 05, ON 3/OFF 3
When bit 02 of the control word is "0", then bit 05="0".
When bit 02 of the control word is "1", then bit 05="1".

Bit 06, Start possible/Start not possible
If PROFIdrive has been selected in *parameter 8-10 Control Profile*, bit 06 is "1" after a switch-off acknowledgment, after activation of OFF2 or OFF3, and after switching on the mains voltage. Start not possible is reset, with bit 00 of the control word being set to "0" and bit 01, 02 and 10 being set to "1".

Bit 07, No warning/Warning
Bit 07="0" means that there are no warnings.
Bit 07="1" means that a warning has occurred.

Bit 08, Speed≠reference/Speed=reference
When bit 08="0", the current speed of the motor deviates from the set speed reference value. This may occur, for example, when the speed is being changed during start/stop through ramp up/down.
When bit 08="1", the current speed of the motor corresponds to the set speed reference value.

Bit 09, Local operation/Bus control
Bit 09="0" indicates that the frequency converter has been stopped with [Stop] on the LCP, or that [Linked to hand] or [Local] has been selected in *3-13 Reference Site*.
When bit 09="1", the frequency converter can be controlled through the serial interface.

Bit 10, Out of frequency limit/Frequency limit OK
When bit 10="0", the output frequency is outside the limits set in *4-52 Warning Speed Low* and *4-53 Warning Speed High*.
When bit 10="1", the output frequency is within the indicated limits.

Bit 11, No operation/Operation
When bit 11="0", the motor does not turn.
When bit 11="1", the frequency converter has a start signal, or the output frequency is higher than 0 Hz.

Bit 12, Drive OK/Stopped, autostart
When bit 12="0", there is no temporary overloading of the inverter.
When bit 12="1", the inverter has stopped due to overloading. However, the frequency converter has not switched off (trip) and starts again after the overloading has ended.

Bit 13, Voltage OK/Voltage exceeded
When bit 13="0", the voltage limits of the frequency converter are not exceeded.
When bit 13="1", the direct voltage in the intermediate circuit of the frequency converter is too low or too high.

Bit 14, Torque OK/Torque exceeded
When bit 14="0", the motor torque is below the limit selected in *4-16 Torque Limit Motor Mode* and *4-17 Torque Limit Generator Mode*.
When bit 14="1", the limit selected in *4-16 Torque Limit Motor Mode* or *4-17 Torque Limit Generator Mode* is exceeded.

Bit 15, Timer OK/Timer exceeded
When bit 15="0", the timers for the thermal motor protection and thermal frequency converter protection have not exceeded 100%.
When bit 15="1", one of the timers has exceeded 100%.

6.5.3 PROFIdrive State - Transition Diagram

In the PROFIdrive Control profile, the control bits 0 to 3 perform the basic start-up/power down functions, whereas the control bits 4-15 perform application-oriented control.

Illustration 6.3 shows the basic state-transition diagram, where control bits 0 to 3 control the transitions, and the corresponding status bit indicates the actual state. The black bullets indicate the priority of the control signals, where fewer bullets indicate lower priority, and more bullets indicate higher priority.

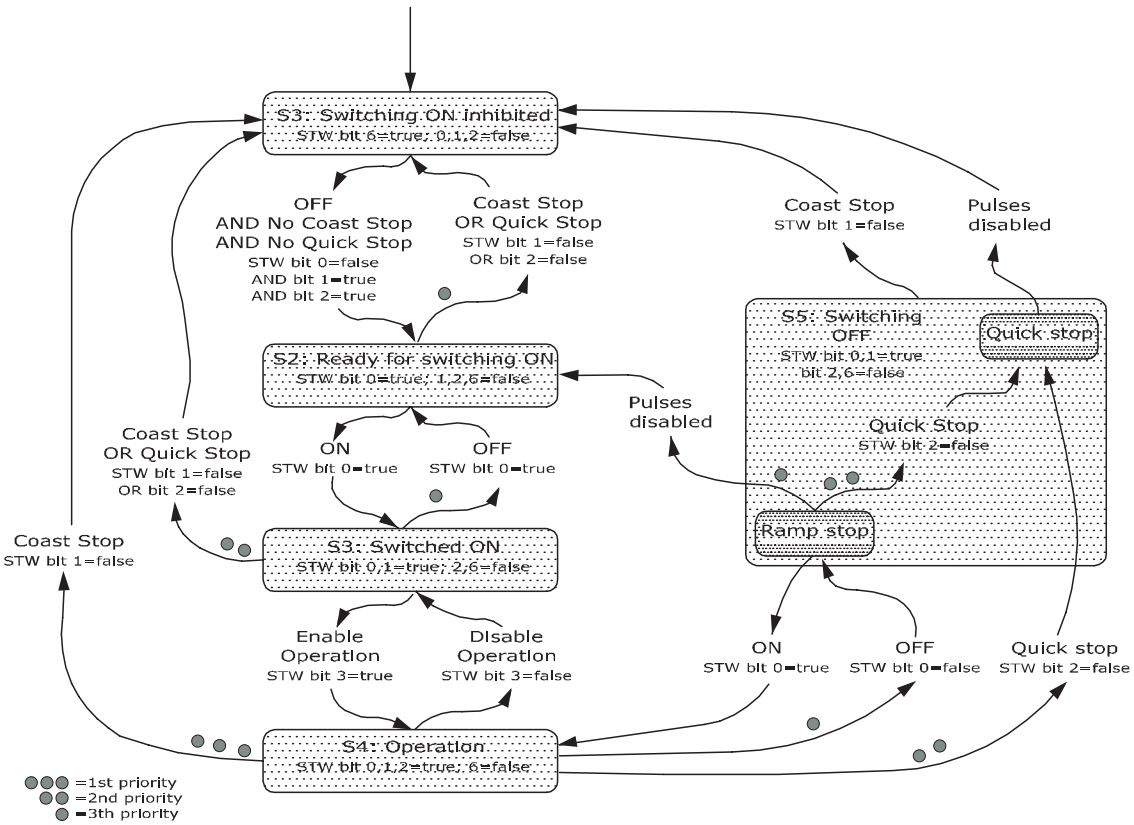

Illustration 6.3 PROFIdrive State Transition Diagram

6.6 Danfoss FC Control Profile

6.6.1 Control Word according to FC Profile (CTW)

To select Danfoss FC protocol in the control word, *parameter 8-10 Control Profile* must be set to *[0] frequency converter profile*. The control word is used to send commands from a master (PLC or PC) to a slave (frequency converter).

Bit	Bit value=0	Bit value=1
00	Reference value	external selection lsb
01	Reference value	external selection msb
02	DC brake	Ramp
03	Coasting	No coasting
04	Quick stop	Ramp
05	Hold output frequency	Use ramp
06	Ramp stop	Start
07	No function	Reset
08	No function	Jog
09	Ramp 1	Ramp 2
10	Data invalid	Data valid
11	No function	Relay 01 active
12	No function	Relay 04 active
13	Parameter set-up	selection lsb
14	Parameter set-up	selection msb
15	No function	Reverse

Table 6.16 Bit Values for FC Control Word

Explanation of the control bits

Bits 00/01 Reference value

Bits 00 and 01 are used to choose between the four reference values, which are pre-programmed in *3-10 Preset Reference* according to *Table 6.17*.

NOTICE

In *8-56 Preset Reference Select* a selection is made to define how Bit 00/01 gates with the corresponding function on the digital inputs.

Bit 01	Bit 00	Programmed ref. value	Parameter
0	0	1	[0] *3-10 Preset Reference*
0	1	2	[1] *3-10 Preset Reference*
1	0	3	[2] *3-10 Preset Reference*
1	1	4	[3] *3-10 Preset Reference*

Table 6.17 Programmed Reference Values for Bits

Bit 02, DC brake

Bit 02="0" - leads to DC braking and stop. Braking current and duration are set in *2-01 DC Brake Current* and *2-02 DC Braking Time*.

Bit 02="1" - leads to ramping.

Bit 03, Coasting

Bit 03="0" - causes the frequency converter to immediately coast the motor to a standstill.

Bit 03="1" - enables the frequency converter to start the motor if the other starting conditions have been fulfilled.

NOTICE

In *8-50 Coasting Select* a selection is made to define how Bit 03 gates with the corresponding function on a digital input.

Bit 04, Quick stop

Bit 04="0" - causes a quick stop, ramping the motor speed down to stop via *3-81 Quick Stop Ramp Time*.

Bit 04="1" - the frequency converter ramps the motor speed down to stop via *3-81 Quick Stop Ramp Time*.

Bit 05, Hold output frequency

Bit 05="0" - causes the present output frequency (in Hz) to freeze. The frozen output frequency can only be changed with the digital inputs (*5-10 Terminal 18 Digital Input* to *5-15 Terminal 33 Digital Input*) programmed to *Speed up* and *Speed down*.

Bit 05="1" - use ramp.

NOTICE

If *Freeze output* is active, stop the frequency converter with

- **Bit 03 Coasting stop**
- **Bit 02 DC braking**
- **Digital input (*5-10 Terminal 18 Digital Input* to *5-15 Terminal 33 Digital Input*) programmed to *DC braking*, *Coasting stop*, or *Reset and coasting stop*.**

Bit 06, Ramp stop/start

Bit 06="0" - causes a stop, in which the motor speed is ramped down to stop via the selected *ramp down* parameter.

Bit 06="1" - permits the frequency converter to start the motor, if the other starting conditions have been fulfilled.

NOTICE

In *8-53 Start Select* a selection is made to define how Bit 06 Ramp stop/start gates with the corresponding function on a digital input.

Bit 07, Reset

Bit 07="0" - does not cause a reset.

Bit 07="1" - causes the reset of a trip. Reset is activated on the signals leading edge, that is, when changing from logic "0" to logic "1".

Bit 08, Jog

Bit 08="0" - no function.

Bit 08="1" - *3-19 Jog Speed [RPM]* determines the output frequency.

Bit 09, Selection of ramp 1/2
Bit 09="0" - ramp 1 is active (*3-40 Ramp 1 Type* to *3-47 Ramp 1 S-ramp Ratio at Decel. Start*).
Bit 09="1" - ramp 2 (*3-50 Ramp 2 Type* to *3-57 Ramp 2 S-ramp Ratio at Decel. Start*) is active.

Bit 10, Data not valid/Data valid
Is used to tell the frequency converter whether it should use or ignore the control word.
Bit 10="0" - the control word is ignored.
Bit 10="1" - the control word is used. This function is relevant, because the control word is always contained in the telegram, regardless of which type of telegram is used. Thus, it is possible to turn off the control word, if it is not wished to use it when updating or reading parameters.

Bit 11, Relay 01
Bit 11="0" - relay 01 not activated.
Bit 11="1" - relay 01 activated, provided Control word bit 11 has been chosen in *5-40 Function Relay*.

Bit 12, Relay 04
Bit 12="0" - relay 04 has not been activated.
Bit 12="1" - relay 04 has been activated, provided *Control word bit 12* has been chosen in *5-40 Function Relay*.

Bit 13/14, Selection of set-up
Bits 13 and 14 are used to choose from the four menu set-ups according to *Table 6.18*:

The function is only possible when *[9] Multi-Set-up* is selected in *0-10 Active Set-up*.

Set-up	Bit 14	Bit 13
1	0	0
2	0	1
3	1	0
4	1	1

Table 6.18 Selection of Set-up

NOTICE

In *8-55 Set-up Select* a selection is made to define how Bit 13/14 gates with the corresponding function on the digital inputs.

Bit 15 Reverse
Bit 15="0" - no reversing.
Bit 15="1" - reversing.

6.6.2 Status Word according to FC Profile (STW)

The status word is used to inform the master (for example, a PC) of the operation mode of the slave (frequency converter).

Refer to *chapter 9 Application Examples* for an example of a status word telegram using PPO type 3.

Bit	Bit=0	Bit=1
00	Control not ready	Control ready
01	Frequency converter not ready	Frequency converter ready
02	Coasting	Enable
03	No error	Trip
04	No error	Error (no trip)
05	Reserved	-
06	No error	Triplock
07	No warning	Warning
08	Speed reference	Speed=reference
09	Local operation	Bus control
10	Out of frequency limit	Frequency limit ok
11	No operation	In operation
12	Frequency converter OK	Stopped, autostart
13	Voltage OK	Voltage exceeded
14	Torque OK	Torque exceeded
15	Timer OK	Timer exceeded

Table 6.19 Definition of Status Bits

Explanation of the status bits
Bit 00, Control not ready/ready
Bit 00="0" - the frequency converter has tripped.
Bit 00="1" - the frequency converter controls are ready, but the power component is not necessarily receiving any power supply (in case of 24 V external supply to controls).

Bit 01, frequency converter ready
Bit 01="0" - the frequency converter is not ready for operation.
Bit 01="1" - the frequency converter is ready for operation, but there is an active coasting command via the digital inputs or via serial communication.

Bit 02, Coasting stop
Bit 02="0" - the frequency converter has released the motor.
Bit 02="1" - the frequency converter can start the motor when a start command is given.

Bit 03, No error/trip
Bit 03="0" - the frequency converter is not in fault mode.
Bit 03="1" - the frequency converter is tripped, and that a reset signal is required to re-establish operation.

Bit 04, No error/error (no trip)
Bit 04="0" - the frequency converter is not in fault mode.
Bit 04="1" - there is a frequency converter error but no trip.

Bit 05, Not used
Bit 05 is not used in the status word.

Bit 06, No error/triplock
Bit 06="0" - the frequency converter is not in fault mode.
Bit 06="1" - the frequency converter is tripped, and locked.

Bit 07, No warning/warning
Bit 07="0" - there are no warnings.
Bit 07="1" - a warning has occurred.

Bit 08, Speed reference/speed = reference
Bit 08="0" - the motor is running, but that the present speed is different from the preset speed reference. It could, for example, be the case while the speed is being ramped up/down during start/stop.
Bit 08="1" - the present motor present speed matches the preset speed reference.

Bit 09, Local operation/bus control
Bit 09="0" - [Stop/Reset] is activated on the control unit, or that *Local control* in *3-13 Reference Site* is selected. It is not possible to control the frequency converter via serial communication.
Bit 09="1" - it is possible to control the frequency converter via the fieldbus/serial communication.

Bit 10, Out of frequency limit
Bit 10="0" - the output frequency has reached the value in *4-11 Motor Speed Low Limit [RPM]* or *4-13 Motor Speed High Limit [RPM]*.
Bit 10="1" - the output frequency is within the defined limits.

Bit 11, No operation/in operation
Bit 11="0" - the motor is not running.
Bit 11="1" - the frequency converter has a start signal or the output frequency is greater than 0 Hz.

Bit 12, frequency converter OK/stopped, auto start
Bit 12="0" - there is no temporary over temperature on the frequency converter.
Bit 12="1" - the frequency converter has stopped because of over temperature, but the unit has not tripped and resumes operation once the over temperature stops.

Bit 13, Voltage OK/limit exceeded
Bit 13="0" - there are no voltage warnings.
Bit 13="1" - the DC voltage in the frequency converters intermediate circuit is too low or too high.

Bit 14, Torque OK/limit exceeded
Bit 14="0" - the motor current is lower than the torque limit selected in *4-16 Torque Limit Motor Mode* or *4-17 Torque Limit Generator Mode*.
Bit 14="1" - the torque limits in *4-16 Torque Limit Motor Mode* and *4-17 Torque Limit Generator Mode* have been exceeded.

Bit 15, Timer OK/limit exceeded
Bit 15="0" - the timers for motor thermal protection and VLT thermal protection, respectively, have not exceeded 100%.
Bit 15="1" - one of the timers has exceeded 100%.

7 PROFINET Acyclic Communication

PROFINET offers additional to the cyclical data communication, a cyclical communication. This feature is possible by an IO controller (for example, PLC), as well as an IO Supervisor (for example, PC Tool).

Cyclical communication means that data transfer takes place all the time with a certain update rate. This is the known function normally used for quick update of I/O Process Data. A-cyclical communication means a one time event, mainly used for Read/Write on parameters from Process controllers, PC-based tools, or monitoring systems.

7.1 Features of an IO Controller System

Cyclical data exchange.

A-cyclical read/write on parameters.

The a-cyclical connection is fixed and cannot be changed during operation.

In general an IO controller is used as Process controller, responsible for commands, speed reference, status of the application and so on (PLC or PC-based controller.)

The IO controller, a-cyclical connection might be used for general parameter access in the slaves.

7.2 Features of an IO-Supervisor System

Initiate/Abort a-cyclical connection.

A-cyclical read/write on parameters.

The a-cyclical connection can be established dynamically (Initiate) or removed (Abort) even though an IO controller is active on the network.

The a-cyclical connection is typically used for configuration or commissioning tools for easy access to each parameter in any slave in the system.

7.3 Addressing Scheme

The structure of a PROFINET IO Device is shown in *Illustration 7.1*.

An IO device consists of a number of physical or virtual slots. Slot 0 is always present, and represents the basic unit. Each slot contains a number of data blocks addressed by an index.

The master must address a variable in the slave as follows: /Slave address/Slot #/Index #

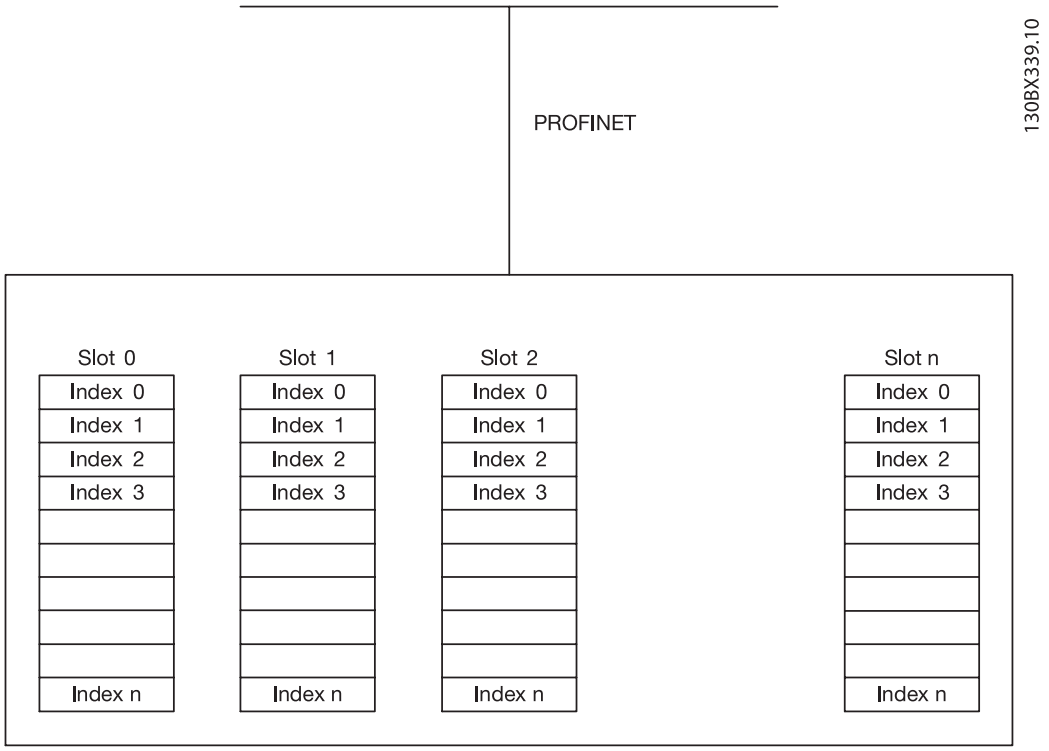

Illustration 7.1 PROFINET IO Device Structure

7.4 Acyclic Read/Write Request Sequence

A Read or Write service on a frequency converter parameter takes place as illustrated in *Illustration 7.2*.

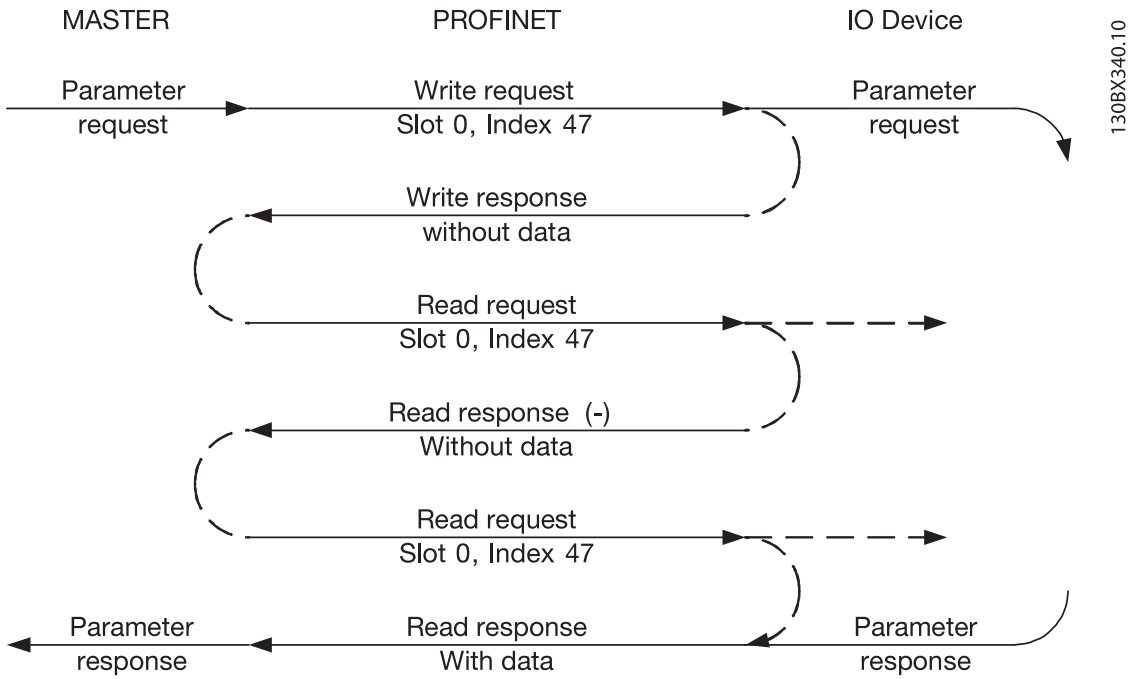

Illustration 7.2 Acyclic Read/Write Request Sequence

A Read or Write on a frequency converter parameter must be initiated by an acyclic write service on slot 0, index 47. If this Write request is valid, a positive write response without data is returned from the frequency converter immediately. If not, a negative write response is returned from the frequency converter.

The frequency converter now interprets the "Profidrive parameter channel" part of the Data Unit, and start to perform this command internal in the frequency converter.

As the next step, the master sends a Read request. If the frequency converter is still busy performing the internal parameter request, a negative response without data is returned from the frequency converter. This request is repeated by the master, until the frequency converter has the response data ready for the frequency converter parameter request.

The following example shows the details of the telegrams needed for the Read/Write service.

7.5 Data Structure in the Acyclic Telegrams

The data structure for a write/read parameter request, consists of three main blocks:

- Header block
- Parameter block
- Data block

Arrange according to *Table 7.1*:

Word number		
1 Header	Request #	Request ID
2 Header	Axis	# Param.
3 (Param. 1)	Attribute	# elements
4 (Param. 1)	Parameter number	
5 (Param. 1)	Subindex number	
6 (Param. 2)	Attribute	# elements
7 (Param. 2)	Parameter number	
8 (Param. 2)	Subindex number	
9 (Param. 3)	Attribute	# elements
10 (Param. 3)	Parameter number	
11 (Param. 3)	Subindex number	
....		
N (Data Param. 1)	Format	# elements
N+1 (Data Param. 1)	Data	Data

Word number		
N (Data Param. 2)	Format	# elements
N+1 (Data Param. 2)	Data	Data
N (Data Param. 3)	Format	# elements
N+1 (Data Param. 3)	Data	Data
N+1 (Data Param. 3)	Data	Data
N+1 (Data Param. 3)	Data	Data

Table 7.1 Request Telegram

7.6 Header

Request number
Request # is used by the Master to handle the response from the IO device. The IO device mirrors this number in its response.

Request ID
1=request parameter 2=change parameter

Axis
Always leave this to 0 (zero). Only used in multi axis system.

Number of parameters
Number of parameters to read or write.

7.7 Parameter Block

The following 5 values have to be provided for each parameter to read.

Attribute
Attribute to be read
10=Value
20=Description
30=Text

Number of elements
The number of elements to read, if parameter is indexed.

Attribute
Attribute to be read.

Parameter number
The number of the parameter to read.

Subindex
Pointer to the index.

7.8 Data Block

The Data block is only needed for write commands. For each parameter to write this information has to be set-up.

Format
The format of the information to write,
2: Integer 8
3: Integer 16
4: Integer 32
5: Unsigned 8
6: Unsigned 16
7: Unsigned 32
9: Visible string
33: Normalised value 2 bytes
35: Bit sequence of 16 Boolean variables
54: Time difference without date
For the individual frequency converter series, the programming guide contains a table with parameter number, format, and other relevant information and will not be further explained in this manual.

Number of elements
The number of elements to read if parameter is indexed.

Data
The actual value to transfer. The amount of data has to be exactly the size requested in the parameter block. If the size differs, the request generates an error.

On a successful transmission of a request command, the master can read the response from the frequency converter. The response does look very much like the request command. The response only consists of 2 blocks, the header and the data block.

1 Header	Request #	Request ID
2 Header	Axis	# Param.
3 (Data Param. 1)	Format	Error code
4 (Data Param. 1)	Data	Data
5 (Data Param. 2)	Format	Error code
6 (Data Param. 2)	Data	Data
7 (Data Param. 3)	Format	Error code
8 (Data Param. 3)	Data	Data
9 (Data Param. 3)	Data	Data
10 (Data Param. 3)	Data	Data

Table 7.2 Response Telegram

7.9 Header

Request number
Request # is used by the Master to handle the response from the IO device. The IO device does mirror this number in its response.

Request ID
1=request parameter
2=change parameter

Axis
Always leave this to 0 (zero).
Only used in multi axis system.

Number of parameters
Number of parameters transferred.

7.10 Data Block

The Datablock is only needed for write commands. For each parameter to write, this information has to be set-up.

Format
See *Table 7.2*.

Error code
If the IO device does discover an error during the execution of the command, it sets the error code to the following values:

0x00	unknown parameter
0x01	parameter is read-only
0x02	value out of range due to max/min value
0x03	wrong subindex
0x04	parameter is no array
0x05	wrong datatype (wrong data length)
0x06	it is not allowed to set this parameter (only reset)
0x07	descriptive element is read-only
0x09	no description available (only value)
0x0b	process control not possible
0x0f	no text array available (only value)
0x11	not possible in current state
0x14	value out of range due to drive state/configuration
0x15	reply too long (more than 240 bytes)
0x16	wrong parameter address (unknown or unsupported value for attribute, element, parameter number or subindex or illegal combination
0x17	illegal format (for writing)
0x18	value amount not consistent
0x65	wrong axis : action not possible with this axis
0x66	unknown service request
0x67	this service is not possible with multi parameter access
0x68	parameter value can not be read from bus

Table 7.3 Error Code

NOTICE

All values if Hex numbers.

Data
The actual value to transfer. The amount of data has to be exactly the size requested in the parameter block. If the size differs, the request generates an error.

8 Parameters

8.1 Parameter Group 0-** Operation/Display

0-37 Display Text 1		
Range:		**Function:**
Size related*	[0 - 0]	In this parameter it is possible to write an individual text string for display in the LCP or to be read via serial communication. If to be displayed permanently select Display Text 1 in *0-20 Display Line 1.1 Small*, *0-21 Display Line 1.2 Small*, *0-22 Display Line 1.3 Small*, *0-23 Display Line 2 Large* or *0-24 Display Line 3 Large*. Parameter 0-37 is linked to Parameter 12-08 Host Name. Changing Parameter 12-08 will change Parameter 0-37 - but not in the other direction.

8.2 Parameter Group 8-** Communication and Option

8-01 Control Site		
Option:		**Function:**
		The setting in this parameter overrides the settings in *parameter 8-50 Coasting Select* to *8-56 Preset Reference Select*.
[0]	Digital and ctrl.word	Control by using both digital input and control word.
[1]	Digital only	Control by using digital inputs only.
[2]	Controlword only	Control by using control word only.

8-02 Control Source		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** Select the source of the control word: one of 2 serial interfaces or 4 installed options. During initial power-up, the frequency converter automatically sets this parameter to *[3] Option A*, if it detects a valid fieldbus option installed in slot A. If the option is removed, the frequency converter detects a change in the configuration, sets *parameter 8-02 Control Source* back to default setting RS-485, and the frequency converter trips. If an option is installed after initial power-up, the setting of *parameter 8-02 Control Source* does not change, but the frequency converter trips and displays: Alarm 67 *Option Changed*.

8-02 Control Source		
Option:		**Function:**
		When retrofitting a bus option into a frequency converter that did not have a bus option installed to begin with, take an ACTIVE decision to move the control to Bus based. This is done for safety reasons to avoid an accidental change.
[0]	None	
[1]	FC Port	
[2]	USB Port	
[3]	Option A	
[4]	Option B	
[5]	Option C0	
[6]	Option C1	
[30]	External Can	

8-03 Control Timeout Time		
Range:		**Function:**
Size related*	[1 - 18000 s]	Enter the maximum time expected to pass between the reception of two consecutive telegrams. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in *parameter 8-04 Control Timeout Function*is then carried out. A valid control word triggers the time-out counter.

8-04 Control Timeout Function		
Select the time-out function. The time-out function activates when the control word fails to be updated within the time period specified in *parameter 8-03 Control Timeout Time*.		
Option:		**Function:**
[0]	Off	Resumes control via serial bus (fieldbus or standard) using the most recent control word.
[1]	Freeze output	Freezes output frequency until communication resumes.
[2]	Stop	Stops with auto restart when communication resumes.
[3]	Jogging	Runs the motor at JOG frequency until communication resumes.
[4]	Max. speed	Runs the motor at maximum frequency until communication resumes.
[5]	Stop and trip	Stops the motor, then resets the frequency converter to restart: via the fieldbus, via [Reset], or via a digital input.

8-04 Control Timeout Function

Select the time-out function. The time-out function activates when the control word fails to be updated within the time period specified in *parameter 8-03 Control Timeout Time*.

Option:		Function:
[7]	Select setup 1	Changes the set-up upon reestablishment of communication following a control word time-out. If communication resumes after a time-out, *parameter 8-05 End-of-Timeout Function* defines whether to resume the set-up used before the time-out, or to retain the set-up endorsed by the time-out function.
[8]	Select setup 2	See *[7] Select setup 1*
[9]	Select setup 3	See *[7] Select setup 1*
[10]	Select setup 4	See *[7] Select setup 1*
[20]	N2 Override Release	

NOTICE

To change the set-up after a time-out, the following configuration is required:
Set *0-10 Active Set-up* to *[9] Multi set-up* and select the relevant link in *0-12 This Set-up Linked to*.

8-05 End-of-Timeout Function

Option:		Function:
		Select the action after receiving a valid control word following a time-out. This parameter is active only when *8-04 Control Timeout Function* is set to *[7] Set-up 1*, *[8] Set-up 2*, *[9] Set-up 3* or *[10] Set-up 4*.
[0]	Hold set-up	Retains the set-up selected in *8-04 Control Timeout Function* and displays a warning, until *8-06 Reset Control Timeout* toggles. Then the frequency converter resumes its original set-up.
[1]	Resume set-up	Resumes the set-up active before the time-out.

8-06 Reset Control Timeout

This parameter is active only when *[0] Hold set-up* has been selected in *parameter 8-05 End-of-Timeout Function*.

Option:		Function:
[0]	Do not reset	Retains the set-up specified in *parameter 8-04 Control Timeout Function*, following a control word time-out.
[1]	Do reset	Returns the frequency converter to the original set-up following a control word time-out. The frequency converter performs the reset and then immediately reverts to the *[0] Do not reset* setting

8-07 Diagnosis Trigger

Option:		Function:
		Enables and controls the drive diagnosis function.
[0]	Disable	Extended diagnosis data are not sent even if they appear in the frequency converter.
[1]	Trigger on alarms	Extended diagnosis data are sent when one or more alarms appear.
[2]	Trigger alarm/warn.	Extended diagnosis data are sent if one or more alarms/warnings appear.

8-08 Readout Filtering

If the speed feedback value readouts on fieldbus are fluctuating, this function is used. Select filtered, if the function is required. A power-cycle is required for changes to take effect.

Option:		Function:
[0]	Motor Data Std-Filt.	Select *[0]* for normal bus readouts.
[1]	Motor Data LP-Filter	Select *[1]* for filtered bus readouts of the following parameters: *16-10 Input Power [kW]* *16-11 Input Power [hp]* *16-12 Motor Voltage* *16-14 Motor current* *16-16 Torque [Nm]* *16-17 Speed [RPM]* *16-22 Torque [%]* *16-25 Torque [Nm] High*

8-10 Control Profile

Select the interpretation of the control and status words corresponding to the installed fieldbus. Only the selections valid for the fieldbus installed in slot A will be visible in the LCP display.
For guidelines in selection of *[0] Frequency converter profile* and *[1] PROFIdrive profile* refer to the *design guide* of the related product.
For additional guidelines in the selection of *[1] PROFIdrive profile*, *[5] ODVA* and *[7] CANopen DSP 402*, see *Operating Instructions* for the installed fieldbus.

Option:		Function:
[0]	FC profile	
[1]	PROFIdrive profile	
[5]	ODVA	
[7]	CANopen DSP 402	

8-13 Configurable Status Word STW

Option:		Function:
		This parameter enables configuration of bits 12–15 in the status word.
[0]	No function	
[1] *	Profile Default	Function corresponds to the profile default selected in *8-10 Control Profile*.

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8-13 Configurable Status Word STW		
Option:		**Function:**
[2]	Alarm 68 Only	Only set in case of an Alarm 68.
[3]	Trip excl. Alarm 68	Set in case of a trip, except if Alarm 68 executes the trip.
[10]	T18 DI status.	The bit indicates the status of terminal 18. "0" indicates that the terminal is low "1" indicates that the terminal is high
[11]	T19 DI status.	The bit indicates the status of terminal 19. "0" indicates that the terminal is low "1" indicates that the terminal is high
[12]	T27 DI status.	The bit indicates the status of terminal 27. "0" indicates that the terminal is low "1" indicates that the terminal is high
[13]	T29 DI status.	The bit indicates the status of terminal 29. "0" indicates that the terminal is low "1" indicates that the terminal is high
[14]	T32 DI status.	The bit indicates the status of terminal 32. "0" indicates that the terminal is low "1" indicates that the terminal is high
[15]	T33 DI status.	The bit indicates the status of terminal 33. "0" indicates that the terminal is low "1" indicates that the terminal is high
[16]	T37 DI status	The bit indicates the status of terminal 37. "0" indicates T37 is low (safe stop) "1" indicates T37 is high (normal)
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor, or the thermistor.
[30]	Brake fault (IGBT)	Output is Logic '1' when the brake IGBT is short-circuited. Use this function to protect the frequency converter if there is a fault on the brake modules. Use the output/ relay to cut out the main voltage from the frequency converter.
[40]	Out of ref. range	
[60]	Comparator 0	See parameter group *13-1* Comparators*. If Comparator 0 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[61]	Comparator 1	See parameter group *13-1* Comparators*. If Comparator 1 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[62]	Comparator 2	See parameter group *13-1* Comparators*. If Comparator 2 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[63]	Comparator 3	See parameter group *13-1* Comparators*. If Comparator 3 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[64]	Comparator 4	See parameter group *13-1* Comparators*. If Comparator 4 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[65]	Comparator 5	See parameter group *13-1* Comparators*. If Comparator 5 is evaluated as TRUE, the output goes high. Otherwise, it is low.

8-13 Configurable Status Word STW		
Option:		**Function:**
[70]	Logic Rule 0	See parameter group *13-4* Logic Rules*. If Logic Rule 0 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[71]	Logic Rule 1	See parameter group *13-4* Logic Rules*. If Logic Rule 1 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[72]	Logic Rule 2	See parameter group *13-4* Logic Rules*. If Logic Rule 2 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[73]	Logic Rule 3	See parameter group *13-4* Logic Rules*. If Logic Rule 3 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[74]	Logic Rule 4	See parameter group *13-4* Logic Rules*. If Logic Rule 4 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[75]	Logic Rule 5	See parameter group *13-4* Logic Rules*. If Logic Rule 5 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[80]	SL Digital Output A	See *13-52 SL Controller Action*. The output goes high whenever the Smart Logic Action *[38] Set digital out A high* is executed. The output goes low whenever the Smart Logic Action *[32] Set digital out A low* is executed.
[81]	SL Digital Output B	See *13-52 SL Controller Action*. The input goes high whenever the Smart Logic Action *[39] Set digital out B high* is executed. The input goes low whenever the Smart Logic Action *[33] Set digital out B low* is executed.
[82]	SL Digital Output C	See *13-52 SL Controller Action*. The input goes high whenever the Smart Logic Action *[40] Set digital out C high* is executed. The input goes low whenever the Smart Logic Action *[34] Set digital out C low* is executed.
[83]	SL Digital Output D	See *13-52 SL Controller Action*. The input goes high whenever the Smart Logic Action *[41] Set digital out D high* is executed. The input goes low whenever the Smart Logic Action *[35] Set digital out D low* is executed.
[84]	SL Digital Output E	See *13-52 SL Controller Action*. The input goes high whenever the Smart Logic Action *[42] Set digital out E high* is executed. The input goes low whenever the Smart Logic Action *[36] Set digital out E low* is executed.
[85]	SL Digital Output F	See *13-52 SL Controller Action*. The input goes high whenever the Smart Logic Action *[43] Set digital out F high* is executed. The input goes low whenever the Smart Logic Action *[37] Set digital out F low* is executed.

8-14 Configurable Control Word CTW

Option:		Function:
		Selection of control word bit 10 if it is active low or active high.
[0]	None	
[1] *	Profile default	
[2]	CTW Valid, active low	
[3]	Safe Option Reset	
[4]	PID error inverse	
[5]	PID reset I part	
[6]	PID enable	

8-19 Product Code

Range:		Function:
Size related*	[0 - 2147483647]	Select [0] to readout the actual fieldbus product code according to the mounted fieldbus option. Select [1] to readout the actual Vendor ID.

8-50 Coasting Select

Option:		Function:
		Select control of the coasting function via the terminals (digital input) and/or via the bus.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activates Start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-51 Quick Stop Select

Select control of the Quick Stop function via the terminals (digital input) and/or via the bus.

Option:		Function:
[0]	Digital input	
[1]	Bus	
[2]	Logic AND	
[3] *	Logic OR	

8-52 DC Brake Select

Option:		Function:
		Select control of the DC brake via the terminals (digital input) and/or via the fieldbus. **NOTICE** **Only selection *[0] Digital input* is available when *1-10 Motor Construction* is set to *[1] PM non-salient SPM*.**

8-52 DC Brake Select

Option:		Function:
[0]	Digital input	Activates Start command via a digital input.

8-53 Start Select

Option:		Function:
		Select control of the frequency converter start function via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates start command via a digital input.
[1]	Bus	Activates start command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activates start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-54 Reversing Select

Option:		Function:
[0]	Digital input	Select control of the frequency converter reverse function via the terminals (digital input) and/or via the fieldbus.
[1]	Bus	Activates the Reverse command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates the Reverse command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activates the Reverse command via the fieldbus/serial communication port OR via one of the digital inputs.

8-55 Set-up Select

Option:		Function:
		Select control of the frequency converter set-up selection via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates the set-up selection via a digital input.
[1]	Bus	Activates the set-up selection via the serial communication port or fieldbus option.
[2]	Logic AND	Activates the set-up selection via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activate the set-up selection via the fieldbus/serial communication port OR via one of the digital inputs.

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8-90 Bus Jog 1 Speed		
Range:		**Function:**
100 RPM*	[0 - par. 4-13 RPM]	Enter the jog speed. Activate this fixed jog speed via the serial port or fieldbus option.

8-91 Bus Jog 2 Speed		
Range:		**Function:**
200 RPM*	[0 - par. 4-13 RPM]	Enter the jog speed. Activate this fixed jog speed via the serial port or fieldbus option.

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8.3 Parameter Group 9-** PROFIdrive

9-15 PCD Write Configuration

Array [10]

Option:		Function:
		Select the parameters to be assigned to PCD 3 to 10 of the telegrams. The number of available PCDs depends on the telegram type. The values in PCD 3 to 10 will then be written to the selected parameters as data values. Alternatively, specify a standard Profibus telegram in *9-22 Telegram Selection*.

9-16 PCD Read Configuration

Array [10]

Option:		Function:
		Select the parameters to be assigned to PCD 3 to 10 of the telegrams. The number of available PCDs depends on the telegram type. PCDs 3 to 10 contain the actual data values of the selected parameters. For standard Profibus telegram, see *9-22 Telegram Selection*.

9-22 Telegram Selection

Option:		Function:
		Select a standard Profibus telegram configuration for the frequency converter, as an alternative to using the freely configurable telegrams in *9-15 PCD Write Configuration* and *9-16 PCD Read Configuration*.
[1]	Standard telegram 1	
[101]	PPO 1	
[102]	PPO 2	
[103]	PPO 3	
[104]	PPO 4	
[105]	PPO 5	
[106]	PPO 6	
[107]	PPO 7	
[108]	PPO 8	

9-23 Parameters for Signals

Array [1000]
Read only

Option:		Function:
		This parameter contains a list of signals available for selection in *9-15 PCD Write Configuration* and *9-16 PCD Read Configuration*.
[0]	None	
[302]	Minimum Reference	
[303]	Maximum Reference	
[341]	Ramp 1 Ramp Up Time	
[342]	Ramp 1 Ramp Down Time	

9-23 Parameters for Signals

Array [1000]
Read only

Option:		Function:
[351]	Ramp 2 Ramp Up Time	
[352]	Ramp 2 Ramp Down Time	
[380]	Jog Ramp Time	
[381]	Quick Stop Ramp Time	
[382]	Starting Ramp Up Time	
[411]	Motor Speed Low Limit [RPM]	
[413]	Motor Speed High Limit [RPM]	
[416]	Torque Limit Motor Mode	
[417]	Torque Limit Generator Mode	
[590]	Digital & Relay Bus Control	
[593]	Pulse Out #27 Bus Control	
[595]	Pulse Out #29 Bus Control	
[597]	Pulse Out #X30/6 Bus Control	
[653]	Terminal 42 Output Bus Control	
[663]	Terminal X30/8 Output Bus Control	
[890]	Bus Jog 1 Speed	
[891]	Bus Jog 2 Speed	
[894]	Bus Feedback 1	
[895]	Bus Feedback 2	
[896]	Bus Feedback 3	
[1500]	Operating hours	
[1501]	Running Hours	
[1502]	Input kWh Counter	
[1600]	Control Word	
[1601]	Reference [Unit]	
[1602]	Reference [%]	
[1603]	Status Word	
[1605]	Main Actual Value [%]	
[1609]	Custom Readout	
[1610]	Input Power [kW]	
[1611]	Input Power [hp]	
[1612]	Motor Voltage	
[1613]	Frequency	
[1614]	Motor current	
[1615]	Frequency [%]	
[1616]	Torque [Nm]	
[1617]	Speed [RPM]	
[1618]	Motor Thermal	
[1622]	Torque [%]	
[1630]	DC Link Voltage	
[1632]	Brake Energy /s	
[1633]	Brake Energy /2 min	
[1634]	Heatsink Temp.	
[1635]	Inverter Thermal	
[1638]	SL Controller State	
[1639]	Control Card Temp.	
[1650]	External Reference	
[1652]	Feedback[Unit]	
[1653]	Digi Pot Reference	
[1654]	Feedback 1 [Unit]	

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9-23 Parameters for Signals

Array [1000]
Read only

Option:		Function:
[1655]	Feedback 2 [Unit]	
[1656]	Feedback 3 [Unit]	
[1660]	Digital Input	
[1661]	Terminal 53 Switch Setting	
[1662]	Analog Input 53	
[1663]	Terminal 54 Switch Setting	
[1664]	Analog Input 54	
[1665]	Analog Output 42 [mA]	
[1666]	Digital Output [bin]	
[1667]	Pulse Input #29 [Hz]	
[1668]	Pulse Input #33 [Hz]	
[1669]	Pulse Output #27 [Hz]	
[1670]	Pulse Output #29 [Hz]	
[1671]	Relay Output [bin]	
[1672]	Counter A	
[1673]	Counter B	
[1675]	Analog In X30/11	
[1676]	Analog In X30/12	
[1677]	Analog Out X30/8 [mA]	
[1680]	Fieldbus CTW 1	
[1682]	Fieldbus REF 1	
[1684]	Comm. Option STW	
[1685]	FC Port CTW 1	
[1690]	Alarm Word	
[1691]	Alarm Word 2	
[1692]	Warning Word	
[1693]	Warning Word 2	
[1694]	Ext. Status Word	
[1695]	Ext. Status Word 2	
[1696]	Maintenance Word	
[1840]	Analog Input X49/1	
[1841]	Analog Input X49/3	
[1842]	Analog Input X49/5	
[1843]	Analog Out X49/7	
[1844]	Analog Out X49/9	
[1845]	Analog Out X49/11	
[1846]	X49 Digital Output [bin]	
[2013]	Minimum Reference/Feedb.	
[2014]	Maximum Reference/Feedb.	
[2021]	Setpoint 1	
[2022]	Setpoint 2	
[2023]	Setpoint 3	
[3644]	Terminal X49/7 Bus Control	
[3654]	Terminal X49/9 Bus Control	
[3664]	Terminal X49/11 Bus Control	

9-27 Parameter Edit

Option:		Function:
		Parameters can be edited via PROFINET, the standard RS-485 interface, or the LCP.
[0]	Disabled	Disables editing via PROFINET.
[1]	Enabled	Enables editing via PROFINET.

9-28 Process Control

Option:		Function:
		Process control (setting of Control Word, speed reference, and process data) is possible via either PROFINET or standard fieldbus but not both simultaneously. Local control is always possible via the LCP. Control via process control is possible via either terminals or fieldbus depending on the settings in *parameter 8-50 Coasting Select* to *8-56 Preset Reference Select*.
[0]	Disable	Disables process control via PROFINET, and enables process control via standard fieldbus or PROFINET IO-Supervisor.
[1]	Enable cyclic master	Enables process control via IO Controller, and disables process control via standard fieldbus or PROFINET IO-Supervisor..

9-53 Profibus Warning Word

Range:		Function:
0 *	[0 - 65535]	This parameter displays PROFINET communication warnings.

Read only

Bit	Condition when bit is active
0	Connection with IO Controller is not ok
1	Reserved for status of connection with second IO Controller
2	Not used
3	Clear data command received
4	Actual value is not updated
5	No Link on both port
6	Not used
7	Initializing of PROFINET is not ok
8	Drive is tripped
9	Internal CAN error
10	Wrong configuration data from IO Controller
11	Not used
12	Internal error occurred
13	Not configured
14	Timeout active
15	Warning 34 active

Table 8.1 PROFINET Communication Warnings

9-65 Profile Number		
Range:		**Function:**
0 *	[0 - 0]	This parameter contains the profile identification. Byte 1 contains the profile number and byte 2 the version number of the profile.

NOTICE

This parameter is not visible via LCP.

9-70 Programming Set-up		
Option:		**Function:**
		Select the set-up to be edited.
[0]	Factory setup	Uses default data. This option can be used as a data source to return the other set-ups to a known state.
[1]	Set-up 1	Edits Set-up 1.
[2]	Set-up 2	Edits Set-up 2.
[3]	Set-up 3	Edits Set-up 3.
[4]	Set-up 4	Edits Set-up 4.
[9]	Active Set-up	Follows the active set-up selected in *0-10 Active Set-up*.

This parameter is unique for LCP and fieldbuses. See *0-11 Programming Set-up*.

9-71 Profibus Save Data Values		
Option:		**Function:**
		Parameter values changed via PROFINET are not automatically stored in non-volatile memory. Use this parameter to activate a function that stores parameter values in the EEPROM non-volatile memory, so changed parameter values will be retained at power-down.
[0]	Off	Deactivates the non-volatile storage function.
[1]	Store all setups	Stores all parameter values for all set-ups in the non-volatile memory. The selection returns to *[0] Off* when all parameter values have been stored.
[2]	Store all setups	Stores all parameter values for all set-ups in the non-volatile memory. The selection returns to *[0] Off* when all parameter values have been stored.

9-72 ProfibusDriveReset		
Option:		**Function:**
[0]	No action	
[1]	Power-on reset	Resets frequency converter upon power-up, as for power-cycle.
[3]	Comm option reset	Resets the PROFINET option only, the PROFINET option goes through a power-up sequence. When reset, the frequency converter disappears from the fieldbus, which may cause a communication error from the master.

9-80 Defined Parameters (1)		
Array [116]		
No LCP access		
Read only		
Range:		**Function:**
0 *	[0 - 9999]	This parameter displays a list of all the defined frequency converter parameters available for PROFINET.

9-81 Defined Parameters (2)		
Array [116]		
No LCP access		
Read only		
Range:		**Function:**
0 *	[0 - 9999]	This parameter displays a list of all the defined frequency converter parameters available for PROFINET.

9-82 Defined Parameters (3)		
Array [116]		
No LCP access		
Read only		
Range:		**Function:**
0 *	[0 - 9999]	This parameter displays a list of all the defined frequency converter parameters available for PROFINET.

9-83 Defined Parameters (4)		
Array [116]		
No LCP access		
Read only		
Range:		**Function:**
0 *	[0 - 9999]	This parameter displays a list of all the defined frequency converter parameters available for PROFINET.

9-84 Defined Parameters (5)		
Array [115]		
No LCP access		
Read only		
Range:		**Function:**
0 *	[0 - 9999]	This parameter displays a list of all the defined frequency converter parameters available for PROFINET.

9-90 Changed Parameters (1)		
Array [116]		
No LCP access		
Read only		
Range:		**Function:**
0 *	[0 - 9999]	This parameter displays a list of all the frequency converter parameters deviating from default setting.

9-91 Changed Parameters (2)

Array [116]
No LCP access
Read only

Range:		Function:
0 *	[0 - 9999]	This parameter displays a list of all the frequency converter parameters deviating from default setting.

9-92 Changed Parameters (3)

Array [116]
No LCP access
Read only

Range:		Function:
0 *	[0 - 9999]	This parameter displays a list of all the frequency converter parameters deviating from default setting.

9-94 Changed Parameters (5)

Array [116]
No LCP Address
Read only

Range:		Function:
0 *	[0 - 9999]	This parameter displays a list of all the frequency converter parameters deviating from default setting.

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8.4 Parameter Group 12-** Ethernet

8.4.1 12-0* IP Settings

12-00 IP Address Assignment		
Option:		**Function:**
		Selects the IP Address assignment method.
[0]	MANUAL	IP-address can be set in *parameter 12-01 IP Address* IP Address.
[1]	DHCP	IP-address is assigned via DHCP server.
[2]	BOOTP	IP-address is assigned via BOOTP server.
[10]	DCP	DCP Assigned via the DCP protocol.
[20]	From node ID	

12-01 IP Address		
Range:		**Function:**
0*	[0 - 2147483647]	Configure the IP address of the option. Read-only if *parameter 12-00 IP Address Assignment* set to DHCP or BOOTP. In POWERLINK the IP address follows the *12-60 Node ID* last byte and the first part is fixed to 192.168.100 (Node ID).

12-02 Subnet Mask		
Range:		**Function:**
0*	[0 - 4244635647]	Configure the IP subnet mask of the option. Read-only if *parameter 12-00 IP Address Assignment* set to DHCP or BOOTP. In POWERLINK it is fixed to 255.255.255.0.

12-03 Default Gateway		
Range:		**Function:**
0*	[0 - 2147483647]	Configure the IP default gateway of the option. Read-only if *parameter 12-00 IP Address Assignment* set to DHCP or BOOTP. In a non-routed network this address is set to the IP address of the IO Device

12-04 DHCP Server		
Range:		**Function:**
0*	[0 - 2147483647]	Read only. Displays the IP address of the found DHCP or BOOTP server.

12-05 Lease Expires		
Range:		**Function:**
Size related*	[0 - 0]	Read only. Displays the lease-time left for the current DHCP-assigned IP address.

12-06 Name Servers		
Range:		**Function:**
0*	[0 - 2147483647]	IP addresses of Domain Name Servers. Can be automatically assigned when using DHCP.

12-07 Domain Name		
Range:		**Function:**
0	[0 - 48]	Domain name of the attached network. Can be automatically assigned when using DHCP network.

12-08 Host Name		
Range:		**Function:**
0*	[0 - 48]	Logical (given) name of option.

NOTICE

The display of the frequency converter only shows the first 19 characters, but the remaining characters are stored in the frequency converter. If Hardware switches are different from all ON or all OFF, the switches has priority.

12-09 Physical Address		
Range:		**Function:**
0*	[0 - 17]	Read only. Displays the Physical (MAC) address of the option.

8.4.2 12-1* Ethernet Link Parameters

Applies for whole parameter group.

Index [0] is used for Port 1 and Index [1] is used for Port 2. For EtherCAT, Index [0] is for In Port and Index [1] is for Out port.

12-10 Link Status		
Option:		**Function:**
		Read only. Displays the link status of the Ethernet ports.
[0] *	No Link	
[1]	Link	

12-11 Link Duration		
Range:		**Function:**
Size related*	[0 - 0]	Read only. Displays the duration of the present link on each port in dd:hh:mm:ss.

12-12 Auto Negotiation		
Option:		**Function:**
		Configures Auto Negotiation of Ethernet link parameters, for each port: ON or OFF.
[0]	Off	*Link Speed* and *Link Duplex* can be configured in *parameter 12-13 Link Speed* and *12-14 Link Duplex*.
[1] *	On	

NOTICE

In POWERLINK this parameter is fixed to OFF setting.

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12-13 Link Speed		
Option:		**Function:**
		Forces the link speed for each port in 10 Mbps or 100 Mbps. If *parameter 12-12 Auto Negotiation* is set to: ON, this parameter is read only and displays the actual link speed. If no link is present, "None" is displayed.
[0] *	None	
[1]	10 Mbps	
[2]	100 Mbps	

NOTICE

In POWERLINK this parameter is locked to 100 Mbs.

12-14 Link Duplex		
Option:		**Function:**
		Forces the duplex for each port to Full or Half duplex. If *12-12 Auto Negotiation* is set to: [ON], this parameter is read only.
[0]	Half Duplex	
[1]	Full Duplex	

NOTICE

In POWERLINK this parameter is locked to half duplex.

8.4.3 12-8* Other Ethernet Services

12-80 FTP Server		
Option:		**Function:**
[0] *	Disabled	Disables the built-in FTP server.
[1]	Enabled	Enables the built-in FTP server.

12-81 HTTP Server		
Option:		**Function:**
[0] *	Disabled	
[1]	Enabled	Enables the built-in HTTP (web) server.

12-82 SMTP Service		
Option:		**Function:**
[0] *	Disabled	
[1]	Enabled	Enables the SMTP (e-mail) service on the option.

12-89 Transparent Socket Channel Port		
Range:		**Function:**
Size related*	[0 - 65535]	Configures the TCP port number for the transparent socket channel. This configuration enables FC telegrams to be sent transparently on Ethernet via TCP. Default value is 4000, 0 means disabled. The MCT 10 Set-up Software uses this port.

8.4.4 12-9* Advanced Ethernet Settings

12-90 Cable Diagnostic		
Option:		**Function:**
		Enables/disables advanced Cable diagnosis function. If enabled, the distance to cable errors can be read out in *parameter 12-93 Cable Error Length*. The parameter resumes to the default setting of Disable after the diagnostics have finished.
[0] *	Disabled	
[1]	Enabled	

NOTICE

The cable diagnostics function is only issued on ports where there is no link (see *12-10 Link Status*, *Link Status*)

12-91 Auto Cross Over		
Option:		**Function:**
[0]	Disabled	Disables the auto cross-over function.
[1] *	Enabled	Enables the auto cross-over function.

12-92 IGMP Snooping		
Option:		**Function:**
		This prevents flooding of the Ethernet protocol stack by only forwarding multicast packets to ports that are member of the multicast group. In PROFINET this function is disabled.
[0]	Disabled	Disables the IGMP snooping function.
[1] *	Enabled	Enables the IGMP snooping function.

12-93 Cable Error Length		
Range:		**Function:**
0*	[0 - 65535]	If Cable Diagnostics is enabled in *12-90 Cable Diagnostic*, the built-in switch is possible via Time Domain Reflectometry (TDR). This measurement technique detects common cabling problems such as open circuits, short circuits, and impedance mismatches or breaks in transmission cables. The distance from the option to the error is displayed in meters with an accuracy of ±2 m. The value 0 means that no errors detected.

12-94 Broadcast Storm Protection		
Range:		**Function:**
-1 %*	[-1 - 20 %]	The built-in switch is capable of protecting the switch system from receiving too many broadcast packages, which can use up network resources. The value indicates a percentage of the total bandwidth that is allowed for broadcast messages. Example:

12-94 Broadcast Storm Protection		
Range:		**Function:**
		The "OFF" means that the filter is disabled - all broadcast messages passes through. The value "0%" means that no broadcast messages passes through. A value of "10%" means that 10% of the total bandwidth is allowed for broadcast messages, if the amount of broadcast messages increases above the 10% threshold, they will be blocked.
-1 %*	[-1 - 20 %]	

12-95 Broadcast Storm Filter		
Option:		**Function:**
		Applies to *parameter 12-94 Broadcast Storm Protection*; if the Broadcast Storm Protection should also include Multicast telegrams.
[0] *	Broadcast only	
[1]	Broadcast & Multicast	

12-96 Port Config		
Enables/disables port-mirroring function. For troubleshooting with a network analyzer tool.		
Option:		**Function:**
[0]	Normal	No port-mirroring
[1]	Mirror Port 1 to 2	All network traffic on port 1 will be mirrored to port 2.
[2]	Mirror Port 2 to 1	All network traffic on port 2 will be mirrored to port 1.
[10]	Port 1 disabled	
[11]	Port 2 disabled	
[254]	Mirror Int. Port to 1	
[255]	Mirror Int. Port to 2	

12-98 Interface Counters		
Range:		**Function:**
4000*	[0 - 4294967295]	Read only. Advanced Interface counters, from built-in switch, can be used for low-level troubleshooting, The parameter shows a sum of port 1+port 2.

12-99 Media Counters		
Range:		**Function:**
0*	[0 - 4294967295]	Read only. Advanced Interface counters, from built-in switch, can be used for low-level troubleshooting, The parameter shows a sum of port 1+port 2.

8.5 PROFINET-specific Parameter List

Parameter	Default value	Range	Conversion index	Data type
8-01 Control Site	[0] Dig. & ctrl. word	[0-2]	-	Uint8
Parameter 8-02 Control Source	[0] FC RS485	[0-4]	-	Uint8
Parameter 8-03 Control Timeout Time	1	0.1-18000	-1	Uint32
Parameter 8-04 Control Timeout Function	[0] Off	[0-10]	-	Uint8
8-05 End-of-Timeout Function	[0] Hold set-up	[0-1]	-	Uint8
Parameter 8-06 Reset Control Timeout	[0] Do not reset	[0-1]	-	Uint8
Parameter 8-07 Diagnosis Trigger	[0] Disable	[0-3]	-	Uint8
Parameter 8-10 Control Profile	[0] FC profile	[0-x]	-	Uint8
8-13 Configurable Status Word STW				
8-50 Coasting Select	[3] *Logic OR	[0-3]	-	Uint8
Parameter 8-51 Quick Stop Select	[3] *Logic OR	[0-3]	-	Uint8
8-52 DC Brake Select	[3] *Logic OR	[0-3]	-	Uint8
8-53 Start Select	[3] *Logic OR	[0-3]	-	Uint8
Parameter 8-54 Reversing Select	[3] *Logic OR	[0-3]	-	Uint8
8-55 Set-up Select	[3] *Logic OR	[0-3]	-	Uint8
8-56 Preset Reference Select	[3] *Logic OR	[0-3]	-	Uint8
8-90 Bus Jog 1 Speed	100 rpm	0-*4-13 Motor Speed High Limit [RPM]*	67	Uint16
8-91 Bus Jog 2 Speed	200 rpm	0-*4-13 Motor Speed High Limit [RPM]*	67	Uint16
9-15 PCD Write Configuration	-	-	-	Uint16
9-16 PCD Read Configuration	-	-	-	Uint16
Parameter 9-22 Telegram Selection	-	[0-108]	-	Uint8
Parameter 9-23 Parameters for Signals	-	0-573	-	Uint16
Parameter 9-27 Parameter Edit	[1] Enabled	[0-1]	-	Uint16
9-28 Process Control	[1] Enable cyclic master	[0-1]	-	Uint16
9-44 Fault Message Counter	0	[0-8]	0	Uint16
9-45 Fault Code	0	-	-	Uint16
9-47 Fault Number	0	-	-	Uint16
9-52 Fault Situation Counter	0	0-1000	0	Uint16
9-53 Profibus Warning Word	0	16 bits	0	V2
9-64 Device Identification	0	[0-10]	0	Uint16
9-65 Profile Number	0	8 bits	0	Uint8
Parameter 9-70 Programming Set-up	[9] Active set-up	[0-9]	-	Uint8
Parameter 9-71 Profibus Save Data Values	[0] Off	[0-2]	-	Uint8
9-72 ProfibusDriveReset	[0] No action	[0-2]	-	Uint8
9-80 Defined Parameters (1)	-	0-115	0	Uint16
9-81 Defined Parameters (2)		0-115	0	Uint16
9-82 Defined Parameters (3)	-	0-115	0	Uint16
9-83 Defined Parameters (4)	-	0-115	0	Uint16
9-90 Changed Parameters (1)	-	0-115	0	Uint16
9-91 Changed Parameters (2)	-	0-115	0	Uint16
9-92 Changed Parameters (3)	-	0-115	0	Uint16
9-93 Changed Parameters (4)	-	0-115	0	Uint16
12-00 IP Address Assignment	0.0.0.0	0-255	-	Unsigned 8
12-01 IP Address	0.0.0.0	0-255	-	Oct. string 4
Parameter 12-02 Subnet Mask	0.0.0.0	0-255	-	Oct. string 4
12-03 Default Gateway	0.0.0.0	0-255	-	Oct. string 4-

Parameter	Default value	Range	Conver-sion index	Data type
12-04 DHCP Server	0.0.0.0	0-255	-	Oct. string 4
Parameter 12-05 Lease Expires	00:00:00:00	-	-	Time diff. w/ date
Parameter 12-06 Name Servers	0.0.0.0	0-255	-	Oct. string 4
Parameter 12-07 Domain Name	-	max. 19 ch.	-	Visible string 48
12-08 Host Name	-	max. 19 ch.	-	Visible string 48
Parameter 12-09 Physical Address	00:1B:08:00:00:00	-	-	Visible string 17
12-10 Link Status	[0] No Link	[0-1]	-	Unsigned 8
Parameter 12-11 Link Duration	00:00:00:00	-	-	Time diff. w/ date
12-12 Auto Negotiation	[1] On	[0-1]	-	Unsigned 8
12-13 Link Speed	[0] None	[0-2]	-	Unsigned 8
Parameter 12-14 Link Duplex	[1] Full Duplex	[0-1]	-	Unsigned 8[
12-80 FTP Server	[0] Disable	[0–1]	-	Unsigned 8
12-81 HTTP Server	[0] Disable	[0–1]	-	Unsigned 8
12-82 SMTP Service	[0] Disable	[0–1]	-	Unsigned 8
12-89 Transparent Socket Channel Port	[0] Disable	[0–1]	-	Unsigned 8
Parameter 12-90 Cable Diagnostic	[0] Disable	[0-1]	-	Unsigned 8
12-91 Auto Cross Over	[0] Enable	[0-1]	-	Unsigned 8
12-92 IGMP Snooping	[0] Enable	[0-1]	-	Unsigned 8
Parameter 12-93 Cable Error Length	0	0-200	0	Unsigned 16
Parameter 12-94 Broadcast Storm Protection	0	Off–20%	-	Unsigned 16
Parameter 12-95 Broadcast Storm Filter	[1] Enable	[0-31]	-	Unsigned 8
Parameter 12-98 Interface Counters	0	03-365535	-	Unsigned 16
Parameter 12-99 Media Counters	0	0-65535	-	Unsigned 16
16-84 Comm. Option STW	0	0-FFFF	0	V2
16-90 Alarm Word	0	0-FFFF	0	Uint32
16-92 Warning Word	0	0-FFFF	0	Uint32

Table 8.2

Refer to the relevant Operating Instructions for a comprehensive parameter list.

8.6 Object and Data Types Supported

8.6.1 Parameter Description

PROFINET has a number of describing attributes.

8.6.2 Size Attribute

The size index and the conversion index for each parameter can be taken from the parameter list in the respective Operating Instructions.

Physical unit	Size index	Measuring unit	Designation	Conversion index	Conversion factor
	0	No dimension			
Time	4	second	s	0	1
				-1	0.1
				-2	0.01
		millisecond	ms	-3	0.001
		minute	min	70	60
		hour	h	74	3600
		day	d	77	86400
Energy	8	watthour	Wh	0	1
		kilowatthour	kWh	3	1000
		megawatthour	MWh	6	10^6
Power	9	milliwatt	mW	-3	0.001
		watt	W	0	1
		kilowatt	kW	3	1000
		megawatt	MW	6	10^6
Rotation	11	rotation per minute	RPM	67	1
Torque	16	newtonmetre	Nm	0	1
		kilonewtonmetre	kNm	3	1000
Temperature	17	degree Celsius	°C	0	1
Voltage	21	millivolt	mV	-3	0.001
		volt	V	0	1
		kilovolt	kV	3	1000
Current	22	milliampere	mA	-3	0.001
		ampere	A	0	1
		kiloampere	kA	3	1000
Resistance	23	milliohm	mOhm	-3	0.001
		ohm	Ohm	0	1
		kiloohm	kOhm	3	1000
Ratio	24	per cent	%	0	1
Relative change	27	per cent	%	0	1
Frequency	28	hertz	Hz	0	1
		kilohertz	kHz	3	1000
		megahertz	MHz	6	10^6
		gigahertz	GHz	9	10^9

Table 8.3 Size Index and Conversion Index

8.6.3 Object and Data Types Supported

Data type	Short name	Description
3	I2	Integer 16
4	I4	Integer 32
5	-	Unsigned 8
6	O2	Unsigned 16
7	O4	Unsigned 32
9	-	Visible string
10	-	Byte string
33	N2	Standardized value (16 bit)
35	V2	Bit sequence
54	-	Time difference without date indication

Table 8.4 Data Types Supported

9 Application Examples

9.1 Example: Process Data with PPO Type 6

This example shows how to work with PPO type 6, which consists of Control Word/Status Word and Reference/Main Actual Value. The PPO also has two additional words, which can be programmed to monitor process signals, see *Table 9.1*:

	0		1		2		3	
	CTW		**MRV**		**PCD [2]**		**PCD**	
From Controller	04	7C	20	00	00	00	00	00
	STW		**MAV**		**PCD [2]**		**PCD [3]**	
From frequency converter	0F	07	20	00	3F	A6	00	08
Byte #	1	2	3	4	5	6	7	8

Table 9.1 PCD

The application requires monitoring of the motor torque and digital input, so PCD 2 is set up to read the current motor torque. PCD 3 is set up to monitor the state of an external sensor via the process signal digital input. The sensor is connected to digital input 18.

An external device is also controlled via control word bit 11 and the built-in relay of the frequency converter. Reversing is permitted only when the reversing bit 15 in the control word and the digital input 19 are set to high.

For safety reasons the frequency converter stops the motor if the PROFINET cable is broken, the master has a system failure, or the PLC is in stop mode.

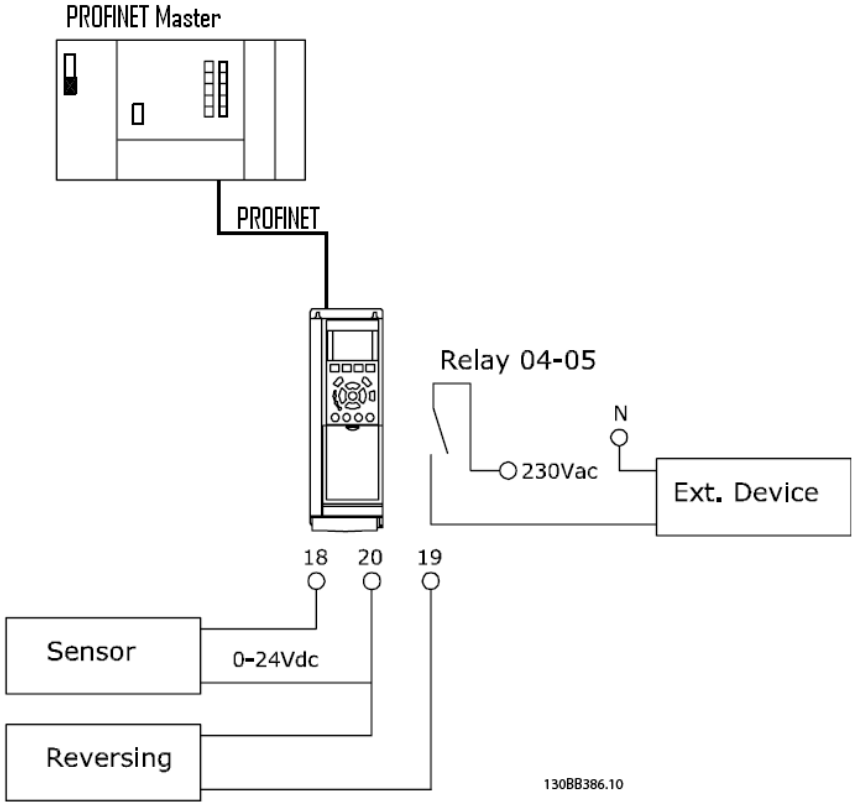


Illustration 9.1

Program the frequency converter as shown in *Table 9.2*:

Parameter	Setting
4-10 Motor Speed Direction	[2] Both directions
5-10 Terminal 18 Digital Input	[0] No operation
5-11 Terminal 19 Digital Input	[10] Reversing
5-40 Function Relay	[36/37] Control word bit 11/12
Parameter 8-03 Control Timeout Time	1 s
Parameter 8-04 Control Timeout Function	[2] Stop
Parameter 8-10 Control Profile	[0] FC Profile
8-50 Coasting Select	[1] Bus
Parameter 8-51 Quick Stop Select	[1] Bus
8-52 DC Brake Select	[1] Bus
8-53 Start Select	[1] Bus
Parameter 8-54 Reversing Select	[2] Logic AND
8-55 Set-up Select	[1] Bus
8-56 Preset Reference Select	[1] Bus
9-16 PCD Read Configuration	[2] Sub index *16-16 Torque [Nm]* [3] Sub indes *16-60 Digital Input*

Table 9.2

9.2 Example: Control Word Telegram using Standard Telegram 1/PPO3

This example shows how the control word telegram relates to the controller and the frequency converter, using FC Control Profile.

The control word telegram is sent from the PLC to the frequency converter. Standard Telegram 1 is used in the example in order to demonstrate the full range of modules. All the values shown are arbitrary, and are provided for the purposes of demonstration only.

	0		1		2		3																							
	CTW		MRV		PCD		PCD																							
	04	7C	20	00																										
PQW:	256		258		260		262																							
	CTW		MRV																											
Bit no.:	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	0	0	1	0	0	0	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	0				4				7				C				2				0				0				0			

Table 9.3 PCD

Table 9.3 indicates the bits contained within the control word, and how they are presented as process data in Standard Telegram 1 for this example.

Table 9.4 indicates which bit functions, and which corresponding bit values are active for this example.

Bit	Bit value=0	Bit value=1	Bit value	
00	Reference value	External selection lsb	0	**C**
01	Reference value	External selection msb	0	
02	DC brake	Ramp	1	
03	Coasting	Enable	1	
04	Quick stop	Ramp	1	**7**
05	Freeze output	Ramp enable	1	
06	Ramp stop	Start	1	
07	No function	Reset	0	
08	No function	Jog	0	**4**
09	Ramp 1	Ramp 2	0	
10	Data not valid	Valid	1	
11	No function	Relay 01 active	0	
12	No function	Relay 02 active	0	**0**
13	Parameter set-up	Selection lsb	0	
14	Parameter set-up	Selection msb	0	
15	No function	Reversing	0	
Function active				
Function inactive				

Table 9.4 Control Word Telegram using Standard Telegram 1/PPO3

9.3 Example: Status Word Telegram using Standard Telegram 1/PPO3

This example shows how the control word telegram relates to the PLC and the frequency converter, using FC Control Profile.

The control word telegram is sent from the frequency converter to the controller. Standard Telegram 1 is used in the example to demonstrate the full range of modules. All the values shown are arbitrary, and are provided for demonstration purposes only.

	0		1		2		3	
	STW		MAV		PCD		PCD	
	0F	07	20	00				
PIW:	256		258		260		262	
	STW		MAV					

Bit no.:	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	0	0	1	0	0	0	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	0				F				0				7				2				0				0				0			

Table 9.5 PCD

Table 9.5 indicates the bits contained within the status word, and how they are presented as process data in Standard Telegram 1 for this example.

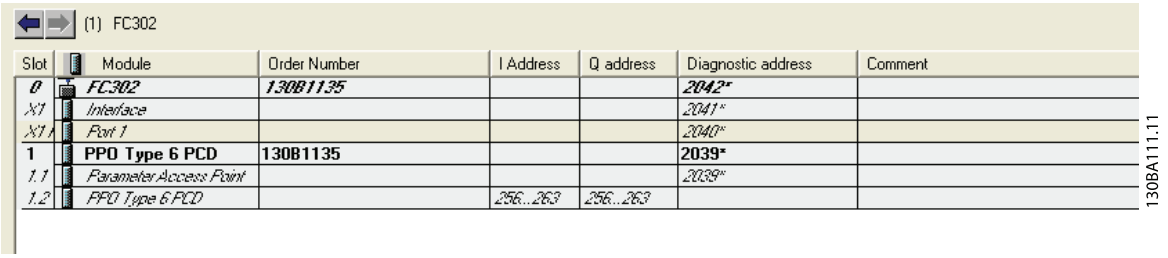
Table 9.6 indicates which bit functions, and which corresponding bit values are active for this example.

Bit	Bit value=0	Bit value=1	Bit value	
00	Control not ready	Control ready	1	**7**
01	Drive not ready	Drive ready	1	
02	Coasting	Enable	1	
03	No error	Trip	0	
04	No error	Error (no trip)	0	**0**
05	Reserved	-	0	
06	No error	Triplock	0	
07	No warning	Warning	0	
08	Speed reference	Speed#=#reference	1	**F**
09	Local operation	Bus control	1	
10	Outside frequency range	Within frequency range	1	
11	No operation	In operation	1	
12	Drive ok	Stopped, autostart	0	**0**
13	Voltage ok	Voltage exceeded	0	
14	Torque ok	Torque exceeded	0	
15	Timers ok	Timers exceeded	0	
Function active				
Function inactive				

Table 9.6 Status Word Telegram using Standard Telegram 1/PPO3

9.4 Example: PLC Programming

In this example PPO type 6 is placed in the following Input/Output address:



Input address	256-257	258-259	260-261	262-263		Output address	256-257	258-259	260-261	262-263
Set-up	Status word	MAV	Motor torque	Digital input		Set-up	Control word	Reference	Not used	Not used

Illustration 9.2 PPO Type 6 Placed in the Input/Output Address

This network sends a start command (047C Hex) and a reference (2000 Hex) of 50% to the frequency converter.

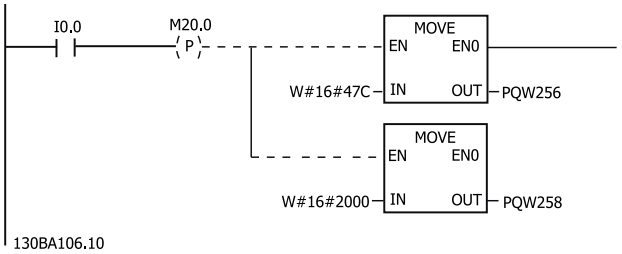


Illustration 9.3 Network Sends Start Command and Reference

This network reads the motor torque from the frequency converter. A new reference is sent to the frequency converter because the Motor Torque (86.0%) is higher than the compared value.

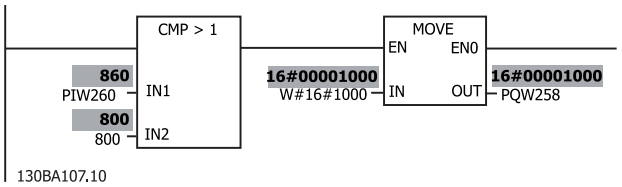


Illustration 9.4 Network Reads the Motor Torque

This network reads the status on the digital inputs from the frequency converter. If digital input 18 is On, it stops the frequency converter.

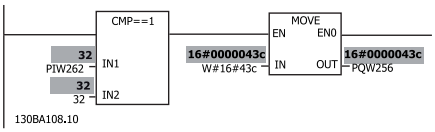


Illustration 9.5 Network Reads the Status on the Digital Inputs

This network reverses the motor when digital input 19 is ON, because *parameter 8-54 Reversing Select* is programmed to Logic AND.

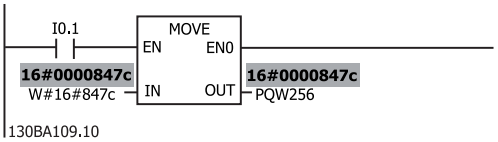


Illustration 9.6 Network Reverses the Motor

This network activates relay 02.

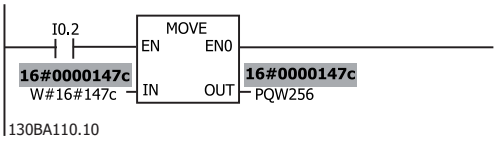


Illustration 9.7 Network Activates Relay 02

10 Troubleshooting

10.1 LED Status

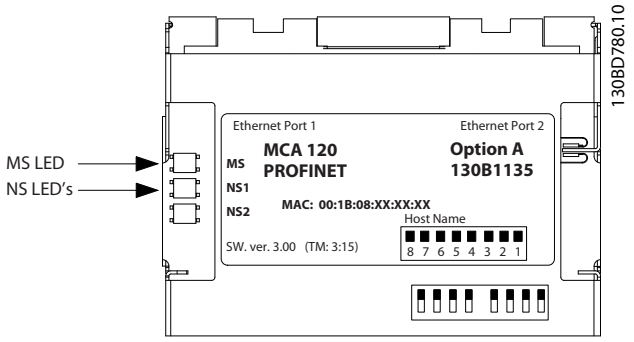


Illustration 10.1 LED

Status	Tri-colour LED	
No IP Address assigned	Off	
No Communication to PROFINET module. Module is waiting for configuration telegram from Controller.	Green:	
IO AR established	Green:	
Supervisor AR established, No IO AR.	Green:	
Internal Error	Red:	
Wink	Yellow:	

Table 10.1 MS: Module Status

Network Status

Phases	Status	Tri-colour LED	
Power Off	No Power or No Link on the corresponding port	Off	
Power On	IP Address Conflict	Red:	
	Waiting for configuration	Green:	
Running	In Data Exchange Mode	Green:	
	Wrong Configuration	Red:	
Data exchange	No increment in "In Octets" counter of corresponding port in last 60 s	Yellow:	

Table 10.2 Indication on Network Status LED

10.2 No Communication with the Frequency Converter

If there is no communication with the frequency converter, proceed with the following checks:

Check 1: Is the cabling correct?
Check that the cable is mounted correctly. Check if the corresponding Network LED shows link activity. NS1 or NS2

Check 2: Does the hardware config match?
Check that the Hardware config match the value in *12-08 Host Name*

Check 3: Is the correct GSD file installed?
Download the correct GSD file from *http:// www.danfoss.com/BusinessAreas/DrivesSolutions/*.

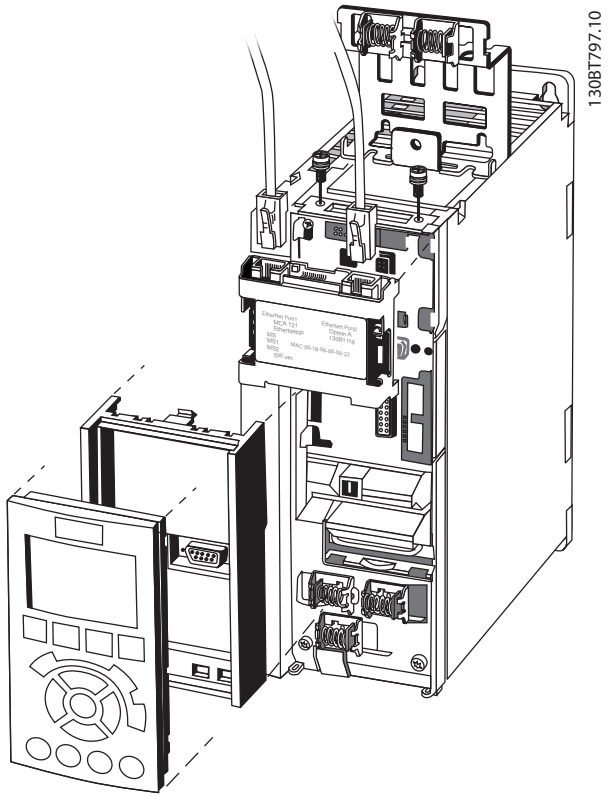


Illustration 10.2 Remove LCP and Plastic Cradle

If there is no communication with the frequency converter, control the cable in the VLT® AutomationDrive. In the FCD 302, control the cable for the control card.

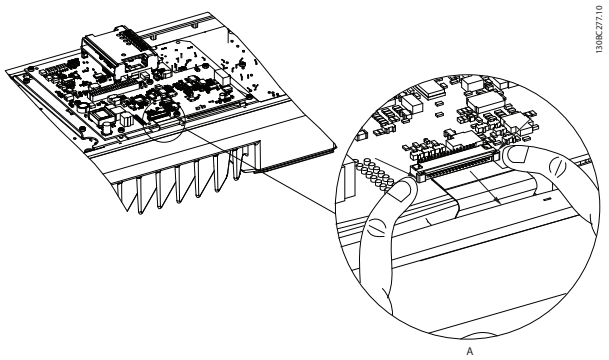


Illustration 10.3 Control the Cable

15-61 Option SW Version	GSDML file
FC 100/200/300 1.x or 2.x	GSDML-V2.2-Danfoss-FC-20090620
3.x	GSDML-V2.3-Danfoss-FC-20131010
FCD 302	GSDML-V2.2-Danfoss-FCD-2011XXXXX

Table 10.3 GSDML File

10.3 Warning 34 Appears even though Communication is Established

If the master is in stop mode, Warning 34 appears. Check that the master is in run mode. If the frequency converter is not in operational state, Warning 34 will appear (60 s after power up or immediately if the frequency converter has been in operational state).

10.4 Frequency Converter Does Not Respond to Control Signals

Check 1: Is the Control word valid?
If bit 10=0 in the Control word, the frequency converter does not accept the Control word.

Check 2: Is the relationship between bits in the Control word and the terminal I/Os correct?
Check the logical relationship in the frequency converter.

Define the desired logical relationship in *8-50 Coasting Select* to *8-56 Preset Reference Select* according to the following range of options. Select the FC control mode, digital input and/or serial communication, using *8-50 Coasting Select* to *8-56 Preset Reference Select*.

If *8-01 Control Site* is set to digital only, then the frequency converter will not react on commands send via the control word.

Table 10.4 to *Table 10.11* show a coast command's effect upon the frequency converter for the full range of *8-50 Coasting Select* settings.

The effect of control mode upon the function of *8-50 Coasting Select*, *parameter 8-51 Quick Stop Select*, and *8-52 DC Brake Select* is as follows:

If *[0] Digital input* is selected, the terminals control the Coast and DC Brake functions.

NOTICE

Coasting, Quick Stop, and DC brake functions are active for logic 0.

Terminal	Bit 02/03/04	Function
0	0	Coast/DC brake/Q-Stop
0	1	Coast/DC brake/Q-Stop
1	0	No Coast/DC brake/Q-Stop
1	1	No Coast/DC brake/Q-Stop

Table 10.4 [0] Digital Input

If *[1] Serial communication* is selected, commands are activated only when given via serial communication.

Terminal	Bit 02/03/04	Function
0	0	Coast/DC brake/Q-Stop
0	1	No Coast/DC brake/Q-Stop
1	0	Coast/DC brake/Q-Stop
1	1	No Coast/DC brake/Q-Stop

Table 10.5 [1] Serial Communication

If *[2] Logic AND* is selected, both signals must be activated to perform the function.

Terminal	Bit 02/03/04	Function
0	0	Coast/DC brake/Q-Stop
0	1	No Coast/DC brake/Q-Stop
1	0	No Coast/DC brake/Q-Stop
1	1	No Coast/DC brake/Q-Stop

Table 10.6 [2] Logic AND

If *[3] Logic OR* is selected, activation of one signal activates the function.

Terminal	Bit 02/03/04	Function
0	0	Coast/DC brake/Q-Stop
0	1	Coast/DC brake/Q-Stop
1	0	Coast/DC brake/Q-Stop
1	1	No Coast/DC brake/Q-Stop

Table 10.7 [3] Logic OR

The effect of control mode upon the function of *8-53 Start Select* and *parameter 8-54 Reversing Select*:

If *[0] Digital input* is selected, the terminals control the start and reversing functions

Terminal	Bit 06/15	Function
0	0	Stop/Anti-clockwise
0	1	Stop/Anti-clockwise
1	0	Start/Clockwise
1	1	Start/Clockwise

Table 10.8 [0] Digital input

If *[1] Serial communication* is selected, commands are activated only when given via serial communication.

Terminal	Bit 02/03/04	Function
0	0	Stop/Anti-clockwise
0	1	Start/Clockwise
1	0	Stop/Anti-clockwise
1	1	Start/Clockwise

Table 10.9 [1] Serial Communication

If *[2] Logic AND* is selected, both signals must be activated to perform the function.

Terminal	Bit 02/03/04	Function
0	0	Stop/Anti-clockwise
0	1	Stop/Anti-clockwise
1	0	Stop/Anti-clockwise
1	1	Start/Clockwise

Table 10.10 [2] Logic AND

If *[3] Logic OR* is selected, activation of one signal activates the function.

Terminal	Bit 02/03/04	Function
0	0	Stop/Anti-clockwise
0	1	Start/Clockwise
1	0	Start/Clockwise
1	1	Start/Clockwise

Table 10.11 [3] Logic OR

The effect of control mode upon the function of *8-55 Set-up Select* and *8-56 Preset Reference Select*:

If *[0] Digital input* is selected, the terminals control the set-up and preset reference functions.

Terminal		Bit 00/01, 13/14		Function
Msb	Lsb	Msb	Lsb	Preset ref. Set-up no.
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	2
0	1	0	1	2
0	1	1	0	2
0	1	1	1	2
1	0	0	0	3
1	0	0	1	3
1	0	1	0	3
1	0	1	1	3
1	1	0	0	4
1	1	0	1	4
1	1	1	0	4
1	1	1	1	4

Table 10.12 [0] Digital Input

If *[1] Serial communication* is selected, commands are activated only when given via serial communication.

Terminal		Bit 00/01, 13/14		Function
Msb	Lsb	Msb	Lsb	Preset ref. Set-up no.
0	0	0	0	1
0	0	0	1	2
0	0	1	0	3
0	0	1	1	4
0	1	0	0	1
0	1	0	1	2
0	1	1	0	3
0	1	1	1	4
1	0	0	0	1
1	0	0	1	2
1	0	1	0	3
1	0	1	1	4
1	1	0	0	1
1	1	0	1	2
1	1	1	0	3
1	1	1	1	4

Table 10.13 [1] Serial Communication

If *[2] Logic AND* is selected, both signals must be activated to perform the function.

Terminal		Bit 00/01, 13/14		Function
Msb	Lsb	Msb	Lsb	Preset ref. Set-up no.
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	2
0	1	1	0	1
0	1	1	1	2
1	0	0	0	1
1	0	0	1	1
1	0	1	0	3
1	0	1	1	3
1	1	0	0	1
1	1	0	1	2
1	1	1	0	3
1	1	1	1	4

Table 10.14 [2] Logic AND

If *[3] Logic OR* is selected, activation of one signal activates the function.

Terminal		Bit 00/01, 13/14		Function
Msb	Lsb	Msb	Lsb	Preset ref, Set-up no.
0	0	0	0	1
0	0	0	1	2
0	0	1	0	3
0	0	1	1	4
0	1	0	0	2
0	1	0	1	2
0	1	1	0	4
0	1	1	1	4
1	0	0	0	3
1	0	0	1	4
1	0	1	0	3
1	0	1	1	4
1	1	0	0	4
1	1	0	1	4
1	1	1	0	4

Table 10.15 [3] Logic OR

10.5 Alarm and Warning Words

PROFINET alarm words and warning words are shown on the display in Hex format. If there is more than one warning or alarm, a sum of all warnings or alarms will be shown. Alarm word, warning word, and, PROFINET warning word can also be displayed using the serial bus in *16-90 Alarm Word*, *16-92 Warning Word* and *9-53 Profibus Warning Word*.

Bit (Hex)	Unit diagnose bit	Alarm word (*16-90 Alarm Word*)	Alarm no.
00000001	48	Brake check	28
00000002	49	Power card over temperature	29
00000004	50	Earth fault	14
00000008	51	Control card over temperature	65
00000010	52	Control word timeout	18
00000020	53	Over current	13
00000040	54	Torque limit	12
00000080	55	Motor thermistor over temp.	11
00000100	40	Motor ETR over temperature	10
00000200	41	Inverter overloaded	9
00000400	42	DC link under voltage	8
00000800	43	DC link over voltage	7
00001000	44	Short circuit	16
00002000	45	Inrush fault	33
00004000	46	Mains phase loss	4
00008000	47	AMA not OK	50
00010000	32	Live zero error	2
00020000	33	Internal fault	38
00040000	34	Brake overload	26
00080000	35	Motor phase U is missing	30
00100000	36	Motor phase V is missing	31
00200000	37	Motor phase W is missing	32
00400000	38	Fieldbus comm. fault	34
00800000	39	24 V supply fault	47
01000000	24	Mains failure	36
02000000	25	1.8 V supply fault	48
04000000	26	Brake resistor short circuit	25
08000000	27	Brake chopper fault	27
10000000	28	Option change	67
20000000	29	Drive initialisation	80
40000000	30	Safe stop	68
80000000	31	Mechanical brake low	63

Table 10.16 FC 102/FC 202/FC 301/FC 302/FCD 302

Bit (Hex)	Unit diagnose bit	Warning word (*16-92 Warning Word*)	Alarm no.
00000001	112	Brake check	28
00000002	113	Power card over temperature	29
00000004	114	Earth fault	14
00000008	115	Control card	65
00000010	116	Control word timeout	18
00000020	117	Over current	13
00000040	118	Torque limit	12
00000080	119	Motor thermistor over temp.	11
00000100	104	Motor ETR over temperature	10
00000200	105	Inverter overloaded	9
00000400	106	DC link under voltage	8
00000800	107	DC link over voltage	7
00001000	108	DC link voltage low	6
00002000	109	DC link voltage high	5
00004000	110	Mains phase loss	4
00008000	111	No motor	3
00010000	96	Live zero error	2
00020000	97	10 V low	1
00040000	98	Brake overload	26
00080000	99	Brake resistor short circuit	25
00100000	100	Brake chopper fault	27
00200000	101	Speed limit	49
00400000	102	Fieldbus comm. fault	34
00800000	103	24 V supply fault	47
01000000	88	Mains failure	36
02000000	89	Current limit	59
04000000	90	Low temperature	66
08000000	91	Voltage limit	64
10000000	92	Encoder loss	61
20000000	93	Output frequency limit	62
40000000	94	Unused	-
80000000	95	Warning word 2 (ext. stat. word)	-

Table 10.17 FC 102/FC 202/FC 301/FC 302/FCD 302

Bit (Hex)	Unit diagnose bit	PROFIBUS warning word (*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	Baudrate 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 10.18 FC 102/FC 202/FC 301/FC 302/FCD 302

Bit (Hex)	Comm. option STW (*16-84 Comm. Option STW*)
00000001	parameterization ok
00000002	configuration ok
00000004	clearmode active
00000008	baudrate search
00000010	waiting for parameterization
00000020	waiting for configuration
00000040	in data exchange
00000080	not used
00000100	not used
00000200	not used
00000400	not used
00000800	MCL2/1 connected
00001000	MCL2/2 connected
00002000	MCL2/3 connected
00004000	data transport active
00008000	not used

Table 10.19 FC 102/FC 202/FC 301/FC 302/FCD 302

NOTICE

***16-84 Comm. Option STW* is not part of extended diagnosis.**

10.6 Warning and Alarm Messages

There is a clear distinction between alarms and warnings. An alarm make the frequency converter enter a fault condition. After the cause for the alarm has been cleared, the master will have to acknowledge the alarm message before the frequency converter can start operating again. A warning condition triggers a warning which disappears when condition returns to normal, without interfering with the process.

Warnings
A single bit within a warning word represents warnings within the frequency converter. Bit status *[0] False* means no warning, while bit status *[1] True* means warning. Any bit change in the warning word is notified by a change of bit 7 in the status word.

Alarms
Following an alarm message, the frequency converter enters fault condition. When the fault has been removed and the controller has acknowledged the alarm message by setting bit 7 in the control word, the frequency converter resumes operation. A single bit within an alarm word represents alarms within the frequency converter. Bit status *[0] False* means no fault, while bit status *[1] True* means fault.

11 Warnings and Alarms

11.1 Status Messages

11.1.1 Warnings/Alarm Messages

The LEDs on the LCP signals a warning or an alarm. A code in the display is also shown.

A warning remains active until its cause is no longer present. Under certain circumstances, operation of the motor can still be continued. Warning messages are not necessarily critical.

An alarm makes the frequency converter trip. Alarms must be reset to restart operation once their cause has been rectified.

Three ways of resetting alarms

- By pressing [Reset]
- Via a digital input with the "Reset" function
- Via serial communication/optional fieldbus

NOTICE

After a manual reset pressing [Reset], the [Auto On] key must be pressed to restart the motor.

If an alarm cannot be reset, the reason could be that its cause has not been rectified, or the alarm is trip-locked (see also *Table 11.1*).

Alarms that are trip-locked offer additional protection, meaning that the mains supply must be switched off before the alarm can be reset. After being switched back on, the frequency converter is no longer blocked and can be reset as described, once the cause has been rectified.

Alarms that are not trip-locked can also be reset using the automatic reset function in *14-20 Reset Mode* (Warning: automatic wake-up is possible!)

If a warning or alarm is marked against a code in *Table 11.1*, this means that either a warning occurs before an alarm, or that it is possible to specify whether it is a warning or an alarm that is displayed for a given fault.

This is possible, for instance, in *1-90 Motor Thermal Protection*. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash. Once the problem has been rectified, only the alarm continues flashing until the frequency converter is reset.

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11.1.2 Alarm List

No.	Description	Warning	Alarm/trip	Alarm/trip lock	Parameter reference
1	10 V low	X			
2	Live zero error	(X)	(X)		*6-01 Live Zero Timeout Function*
3	No motor	(X)			*1-80 Function at Stop*
4	Mains phase loss	(X)	(X)	(X)	*14-12 Function at Mains Imbalance*
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC over-voltage	X	X		
8	DC under voltage	X	X		
9	Inverter overloaded	X	X		
10	Motor ETR over temperature	(X)	(X)		*1-90 Motor Thermal Protection*
11	Motor thermistor over temperature	(X)	(X)		*1-90 Motor Thermal Protection*
12	Torque limit	X	X		
13	Over Current	X	X	X	
14	Earth Fault	X	X	X	
15	Hardware mismatch		X	X	
16	Short Circuit		X	X	
17	Control word time-out	(X)	(X)		*Parameter 8-04 Control Timeout Function*

No.	Description	Warning	Alarm/trip	Alarm/trip lock	Parameter reference
22	Hoist Mech. Brake				
23	Internal Fan Fault	X			
24	External Fan Fault	X			*14-53 Fan Monitor*
25	Brake resistor short-circuited	X			
26	Brake resistor power limit	(X)	(X)		*2-13 Brake Power Monitoring*
27	Brake chopper short-circuited	X	X		
28	Brake check	(X)	(X)		*2-15 Brake Check*
29	Heatsink temp	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	*4-58 Missing Motor Phase Function*
31	Motor phase V missing	(X)	(X)	(X)	*4-58 Missing Motor Phase Function*
32	Motor phase W missing	(X)	(X)	(X)	*4-58 Missing Motor Phase Function*
33	Inrush Fault		X	X	
34	Fieldbus communication fault	X	X		
36	Mains failure	X	X		
38	Internal Fault		X	X	
39	Heatsink sensor		X	X	
40	Overload of Digital Output Terminal 27	(X)			*5-00 Digital I/O Mode*, *5-01 Terminal 27 Mode*
41	Overload of Digital Output Terminal 29	(X)			*5-00 Digital I/O Mode*, *5-02 Terminal 29 Mode*
42	Overload of Digital Output On X30/6	(X)			*5-32 Term X30/6 Digi Out (MCB 101)*
42	Overload of Digital Output On X30/7	(X)			*5-33 Term X30/7 Digi Out (MCB 101)*
46	Pwr. card supply		X	X	
47	24 V supply low	X	X	X	
48	1.8 V supply low		X	X	
49	Speed limit	X			
50	AMA calibration failed		X		
51	AMA check U_{nom} and I_{nom}		X		
52	AMA low I_{nom}		X		
53	AMA motor too big		X		
54	AMA motor too small		X		
55	AMA parameter out of range		X		
56	AMA interrupted by user		X		
57	AMA time-out		X		
58	AMA internal fault	X	X		
59	Current limit	X			
61	Tracking Error	(X)	(X)		*4-30 Motor Feedback Loss Function*
62	Output Frequency at Maximum Limit	X			
63	Mechanical Brake Low		(X)		*2-20 Release Brake Current*
64	Voltage Limit	X			
65	Control Board Over-temperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Configuration has Changed		X		
68	Safe Stop	(X)	(X)[1)]		*5-19 Terminal 37 Safe Stop*
69	Pwr. Card Temp		X	X	
70	Illegal FC configuration			X	
71	PTC 1 Safe Stop	X	X[1)]		*5-19 Terminal 37 Safe Stop*
72	Dangerous Failure			X[1)]	*5-19 Terminal 37 Safe Stop*
73	Safe Stop Auto Restart				
77	Reduced power mode	X			*14-59 Actual Number of Inverter Units*
79	Illegal PS config		X	X	

No.	Description	Warning	Alarm/trip	Alarm/trip lock	Parameter reference
80	Drive Initialized to Default Value		X		
81	CSIV corrupt				
82	CSIV parameter error				
85	Profibus/Profisafe Error				
90	Encoder Loss	(X)	(X)		*17-61 Feedback Signal Monitoring*
91	Analogue input 54 wrong settings			X	S202
100-199	See *Operating Instructions for MCO 305*				
243	Brake IGBT	X	X		
244	Heatsink temp	X	X	X	
245	Heatsink sensor		X	X	
246	Pwr.card supply		X	X	
247	Pwr.card temp		X	X	
248	Illegal PS config		X	X	
250	New spare part			X	*14-23 Typecode Setting*
251	New Type Code		X	X	

Table 11.1 Alarm/Warning Code List

(X) Dependent on parameter

1) Cannot be Auto reset via 14-20 Reset Mode

A trip is the action when an alarm has appeared. The trip coasts the motor and can be reset by pressing [Reset] or by making a reset by a *[1] digital input* (Parameter group *5-1* Digital I/O Mode*). The event that caused an alarm cannot damage the frequency converter or cause dangerous conditions. A trip lock is an action when an alarm occurs, that can damage the frequency converter or connected parts. A Trip Lock situation can only be reset by a power cycling.

Warning	yellow
Alarm	flashing red
Trip locked	yellow and red

Table 11.2 LED Indication

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Bit	Hex	Dec	Alarm word	Alarm word 2	Warning word	Warning word 2	Extended status word
0	00000001	1	Brake Check	ServiceTrip, Read/Write	Brake Check		Ramping
1	00000002	2	Pwr. Card Temp	ServiceTrip, (reserved)	Pwr. Card Temp		AMA Running
2	00000004	4	Earth Fault	ServiceTrip, Typecode/ Sparepart	Earth Fault		Start CW/CCW
3	00000008	8	Ctrl.Card Temp	ServiceTrip, (reserved)	Ctrl.Card Temp		Slow Down
4	00000010	16	Ctrl. Word TO	ServiceTrip, (reserved)	Ctrl. Word TO		Catch Up
5	00000020	32	Over Current		Over Current		Feedback High
6	00000040	64	Torque Limit		Torque Limit		Feedback Low
7	00000080	128	Motor Th Over		Motor Th Over		Output Current High
8	00000100	256	Motor ETR Over		Motor ETR Over		Output Current Low
9	00000200	512	Inverter Overld.		Inverter Overld.		Output Freq High
10	00000400	1024	DC under Volt		DC under Volt		Output Freq Low
11	00000800	2048	DC over Volt		DC over Volt		Brake Check OK
12	00001000	4096	Short Circuit		DC Voltage Low		Braking Max
13	00002000	8192	Inrush Fault		DC Voltage High		Braking
14	00004000	16384	Mains ph. Loss		Mains ph. Loss		Out of Speed Range
15	00008000	32768	AMA Not OK		No Motor		OVC Active
16	00010000	65536	Live Zero Error		Live Zero Error		AC Brake
17	00020000	131072	Internal Fault	KTY error	10V Low	KTY Warn	Password Timelock
18	00040000	262144	Brake Overload	Fans error	Brake Overload	Fans Warn	Password Protection
19	00080000	524288	U phase Loss	ECB error	Brake Resistor	ECB Warn	
20	00100000	1048576	V phase Loss		Brake IGBT		
21	00200000	2097152	W phase Loss		Speed Limit		
22	00400000	4194304	Fieldbus Fault		Fieldbus Fault		Unused
23	00800000	8388608	24 V Supply Low		24V Supply Low		Unused
24	01000000	16777216	Mains Failure		Mains Failure		Unused
25	02000000	33554432	1.8 V Supply Low		Current Limit		Unused
26	04000000	67108864	Brake Resistor		Low Temp		Unused
27	08000000	134217728	Brake IGBT		Voltage Limit		Unused
28	10000000	268435456	Option Change		Encoder loss		Unused
29	20000000	536870912	Drive Initialized		Output freq. lim.		Unused
30	40000000	1073741824	Safe Stop (A68)	PTC 1 Safe Stop (A71)	Safe Stop (W68)	PTC 1 Safe Stop (W71)	Unused
31	80000000	2147483648	Mech. brake low	Dangerous Failure (A72)	Extended Status Word		Unused

Table 11.3 Description of Alarm Word, Warning Word and Extended Status Word

The alarm words, warning words and extended status words can be read out via serial bus or optional fieldbus for diagnose. See also *16-94 Ext. Status Word*.

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