



Operating Instructions

MCA 124 EtherCAT

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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.

1.1.2 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.

1.1.3 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.

1.1.4 Warning against Unintended Start

1. The motor can be brought to a stop with bus commands while the frequency converter is connected to mains. If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.
2. While parameters are being changed, there is a risk that motor starts.
3. A motor that has been stopped can start if faults occur in the electronics of the frequency

1

converter, or if a temporary overload or a fault in the supply mains or the motor connection ceases.

⚠ WARNING**ELECTRICAL HAZARD**

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

2 Introduction

2.1.1 About this Manual

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

2 Introduction

3 How to Install

4 How to Configure

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

5 Configure the Master

6 How to Control the Frequency Converter

7 Parameters

8 Application Examples

9 Troubleshooting

Terminology:

In this manual several terms for Ethernet are used.

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

2.1.2 Assumptions

These operating instructions are under the conditions that the Danfoss EtherCAT option is used with a Danfoss FC 301/FC 302 frequency converter. The installed controller must support the interfaces described in this document. Strictly observe all the requirements stipulated in the controller and the frequency converter, along with all limitations herein.

2.1.3 Hardware

This manual relates to the EtherCAT option MCA 124, type no. 130B5546 (uncoated) and 130B5646 (conformal coated).

2.1.4 Background Knowledge

The Danfoss EtherCAT Option Card is designed to communicate with any system complying with the EtherCAT standard. 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 not the responsibility of Danfoss.

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

2.1.5 Available Literature

Available Literature for FC 301/FC 302

- The VLT AutomationDrive Operating Instructions, MG33AXYY, provide the necessary information for getting the frequency converter up and running.
- The VLT AutomationDrive Design Guide, MG33BXYY, entails all technical information about the frequency converter design and applications including encoder, resolver, and relay options.
- The VLT AutomationDrive Profibus Operating Instructions, MG33CXYY, provide the information required for controlling, monitoring, and programming the frequency converter via a Profibus fieldbus.
- The VLT AutomationDrive DeviceNet Operating Instructions, MG33DXYY, provide the information required for controlling, monitoring, and programming the drive via a DeviceNet fieldbus.
- The VLT AutomationDrive MCT 10 Set-up Software Operating Instructions, MG10RXYY, provide information for installation and use of the software on a PC.
- The VLT AutomationDrive IP21/Type 1 Instruction, MI33AXYY, provides information for installing the IP21/Type 1 option.
- The VLT AutomationDrive 24 V DC Backup Instruction, MI33BXYY, provides information for installing the 24 V DC Backup option.
- The VLT AutomationDrive CanOpen Operating Instructions, MG33JXYY.
- The VLT AutomationDrive Modbus TCP Operating Instructions, MG90PXYY.
- The MCA 121 Ethernet/IP Operating Instructions, MG90JXYY.
- The MCA 120 PROFINET Operation Instruction, MG90UXYY.

Danfoss Drives technical literature is also available online at <http://www.danfoss.com/BusinessAreas/DrivesSolutions/>.

2.1.6 Abbreviations

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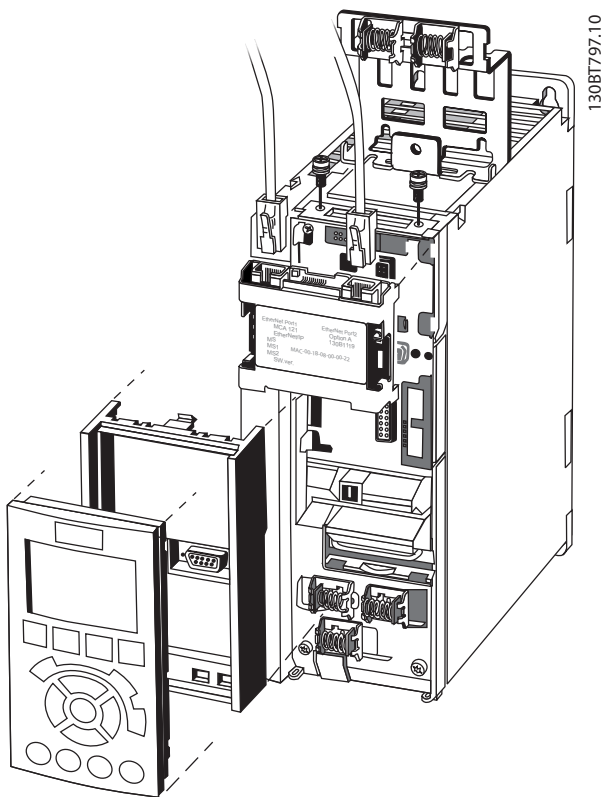
Abbreviation	Definition
API	Actual Packet Interval
CC	Control Card
CTW	Control Word
DCP	Discovery and Configuration Protocol
DHCP	Dynamic Host Configuration Protocol
EMC	Electromagnetic Compatibility
I/O	Input/Output
IP	Internet Protocol
PDO	Process Data Object
LCP	Local Control Panel
LED	Light Emitting 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)
SDO	Service Data Object
STW	Status Word

3 How to Install

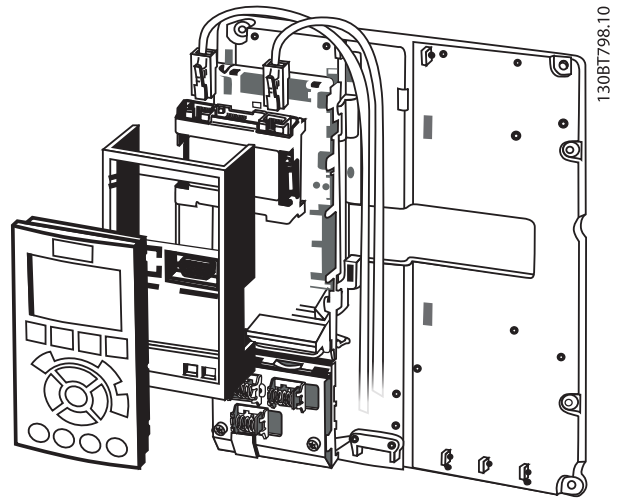
3.1.1 How to Install Option in Frequency Converter

Items required for installing a fieldbus option in the frequency converter:

- The fieldbus option
- Fieldbus option adaptor frame for the FC 300. This frame is deeper than the standard frame to allow space for the fieldbus option beneath
- Strain relief (only for A1 and A2 enclosures)



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Instructions:

1. Remove LCP panel from the FC 300.
2. Remove the frame located beneath and discard it.
3. Push the option into place. The Ethernet connectors must be facing upwards.
4. Remove both knock-outs on the fieldbus option adaptor frame.
5. Push the fieldbus option adaptor frame for the FC 300 into place.
6. Replace the LCP and attach cable.

NOTE

Do not strip and ground the Ethernet cable via the strain relief-plate! The grounding of screened Ethernet cable is done through the RJ-45 connector on the option.

NOTE

After installing the MCA 124 EtherCAT option, set 8-01 Control Site and 8-02 Control Word Source as follows:
 8-01 Control Site: [2] Control word only or [0] Digital and ctrl. word
 8-02 Control Word Source: [3] Option A

3.1.2 Network

It is of high importance that the media chosen for Ethernet data transmission are suitable. Usually CAT 5e and 6 cables are recommended for industrial applications. Both types are available as Unshielded Twisted Pair and Shielded Twisted Pair. Generally, shielded cables are recommended for use in industrial environments and with frequency converters. A maximum cable-length of 100 m is allowed between switches.

3.1.3 EtherCAT Cables

Cable Type	Specification
Ethernet standard	Standard Ethernet (in accordance with IEEE 802.3), 100Base-TX (FastEthernet)
Cable type	S/FTP (Screened Foiled Twisted Pair, ISO(IEC 11801 or EN 50173), CAT 5e
Damping	23.2 dB (at 100 MHz and 100 m each)
Crosstalk damping	24 dB (at 100 MHz and 100 m each)
Return loss	10 dB (100 m each)
Surge impedance	100 Ω

Table 3.1 Specification of EtherCAT Cables

3.1.4 LED Behaviour

The option has 3 bicolored LEDs that allow a fast and detailed diagnosis. The three LEDs are each linked to its unique part of the EtherCAT option:

LED Label	Description
Status	Module Status, reflects the activity on the EtherCAT slave
Link/Act In	Link/status In, reflects the activity on the IN port
Link/Act Out	Link/status In, reflects the activity on the OUT port

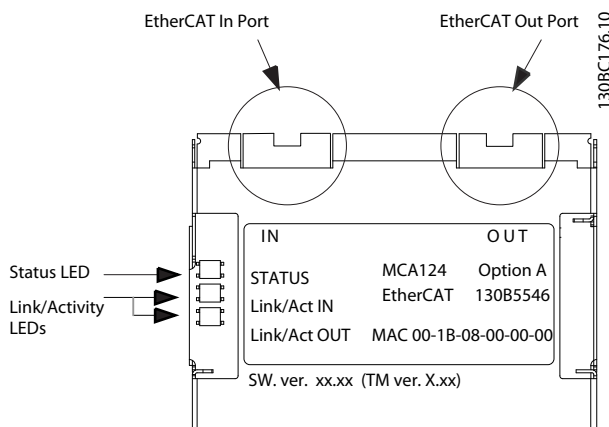


Illustration 3.1 Overview of the Option

Power OFF or State INIT	
PRE-OP State	
SAFE-OP State	
OP State	
ERR-Init State	
Link removed from In port	

Table 3.2 Indication of Status LED

Power OFF or NO Link	
Link	
Link Active	

Table 3.3 Link/Act LED



Green



Red

3

3.1.5 Topology

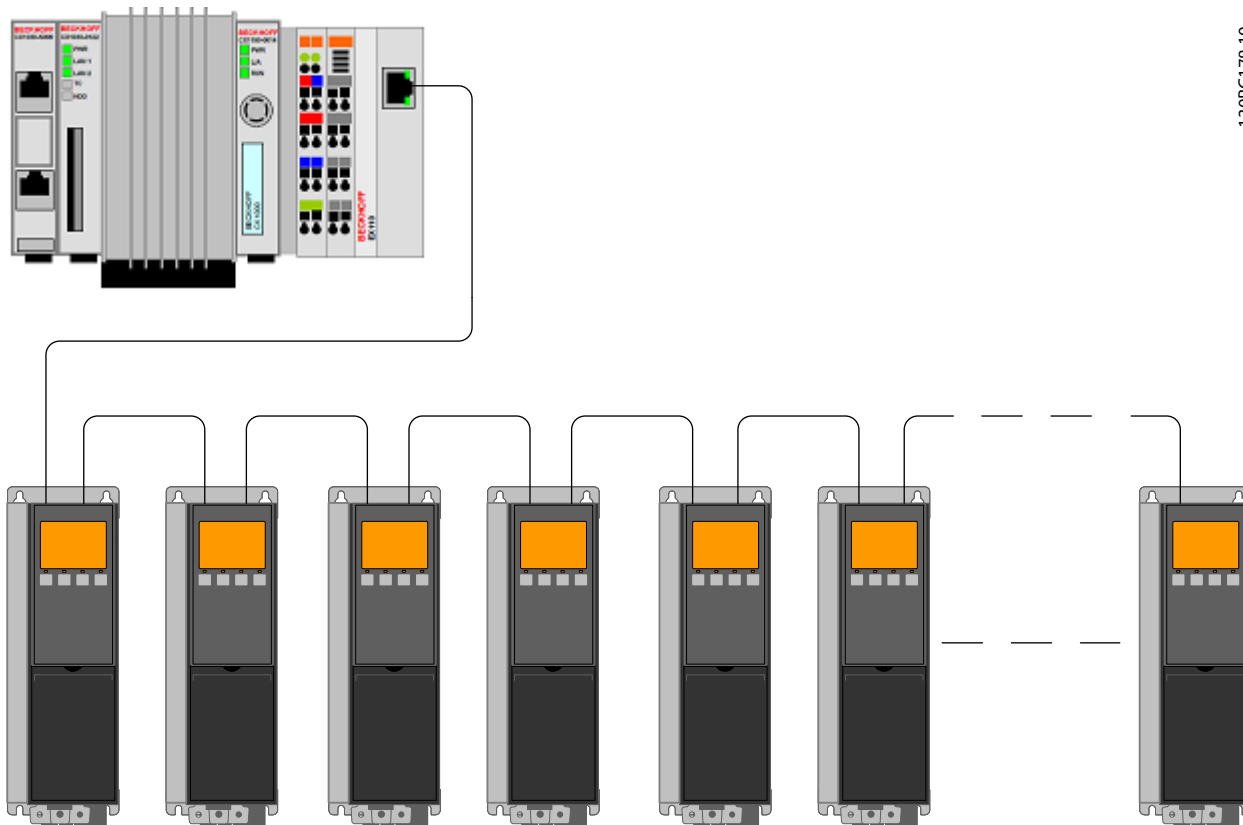
The EtherCAT module features a built-in EtherCAT slave controller, thus having two Ethernet RJ-45 connectors. This enables the possibility for connecting several EtherCAT options in a line topology.

The two ports are not equal, and it is therefore important that the top left port is connected to the OUT port of the

device. Take the same precautions to connect the right port (OUT port) to the IN port of the subsequent device.

NOTE

Do not connect any non-EtherCAT device to the last port as this causes malfunction of the complete EtherCAT network.

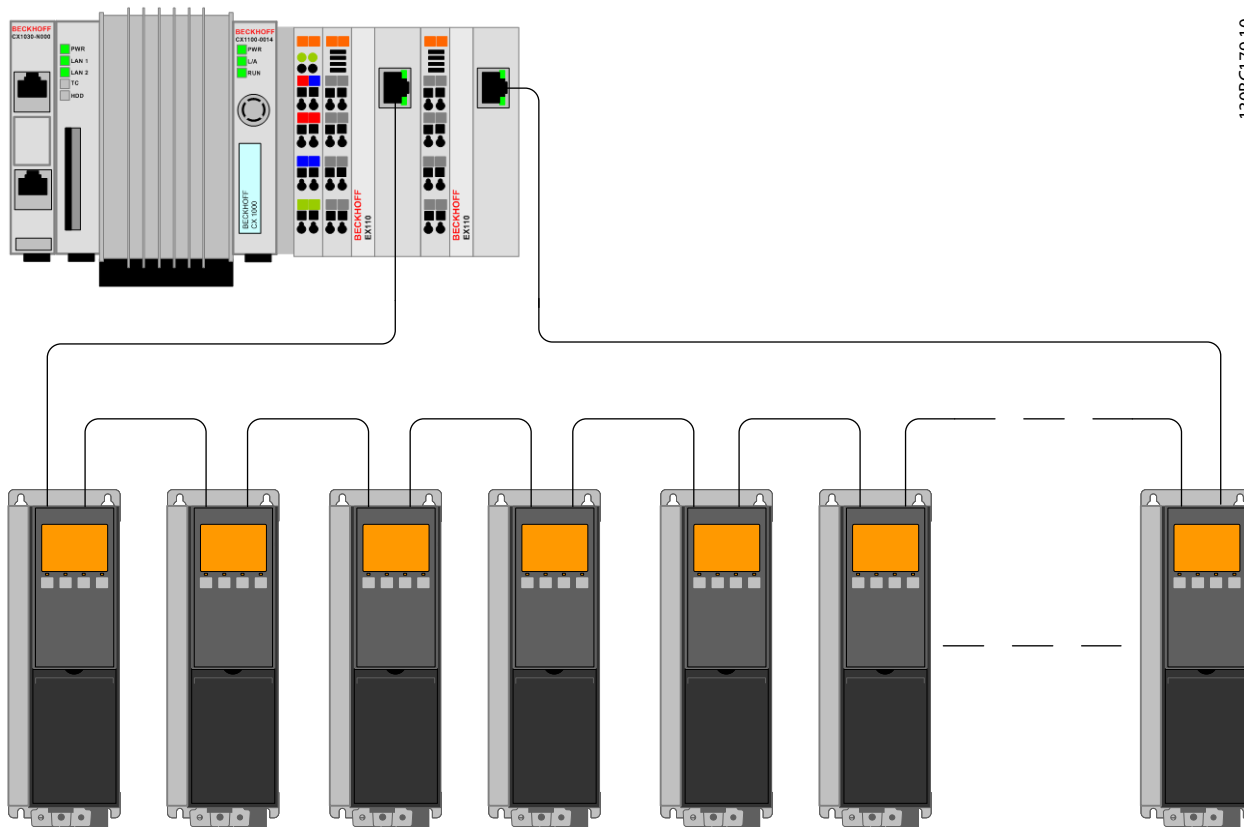


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Illustration 3.2 Line Topology

NOTE

In a line topology all frequency converters must be powered, either by mains or by their 24 V DC option cards, for the built-in EtherCAT slave controller to work. Mounting frequency converters of different power-sizes in a line topology can result in unwanted power-off behavior, while using control word timeout (8-02 Control Word Source to 8-06 Reset Control Word Timeout). Mount the frequency converters with the longest discharge time first in the line topology.



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Illustration 3.3 Ring/Redundant Line Topology

CAUTION

For this type of topology it is crucial that the PLC interfaces support redundancy mode. The EtherCAT option supports this mode, but it must be tested to validate the correct cooperation of control word timeout, and redundancy mode of the PLC.

3.1.6 EMC Precautions

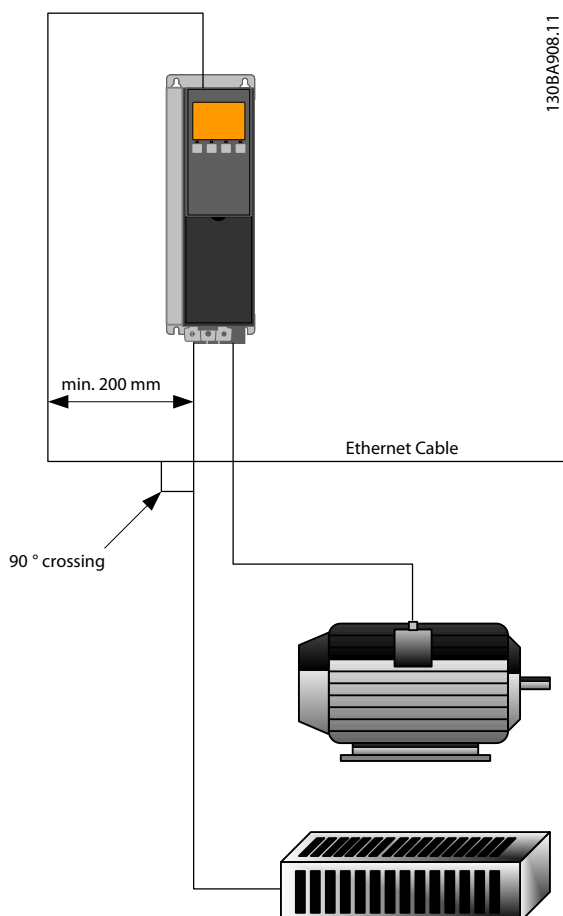
To achieve interference-free operation of the Ethernet, observe the following EMC precautions. Additional EMC information is available in the FC 300 series Design Guide, MG33BXYY.

3

NOTE

Always observe relevant national and local regulations, for example regarding protective earth connection.

The Ethernet communication cable must be kept away from motor and brake resistor cables to avoid coupling of high frequency noise between the cables. 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. When crossing is unavoidable, the Ethernet cable must cross motor and brake resistor cables at an angle of 90°.



4 How to Configure

4.1.1 IP Settings

All IP-related parameters are located in parameter group 12-0*: The parameters are all set to EtherCAT standard values, so no setting is needed.

The EtherCAT option offers several ways of IP address assignment.

4.1.2 Ethernet Link Parameters

Parameter group 12-1* holds Ethernet Link information:

12-10 Link Status

12-11 Link Duration

12-12 Auto Negotiation

12-13 Link Speed

12-14 Link Duplex

Each port has unique Ethernet Link Parameters.

12-10 Link Status and *12-11 Link Duration* displays information on the link status, per port.

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 broken, the counter is reset.

12-12 Auto Negotiation is a feature that enables two connected Ethernet devices to choose common transmission parameters, such as speed and duplex mode. In this process, the connected devices first share their capabilities and then choose 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 *12-12 Auto Negotiation* is set to OFF, link speed and duplex mode can be configured manually in *12-13 Link Speed* and *12-14 Auto Negotiation*.

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.

Half-duplex provides communication in both directions, but only in one direction at a time (not simultaneously).

Full-duplex allows for simultaneous communication in both directions.

4.2 Configure the Frequency Converter

4.2.1 VLT Parameters

Pay particular attention to the following parameters when configuring the frequency converter with an EtherCAT interface.

- *0-40 [Hand on] Key on LCP*. If the [Hand] button on the frequency converter is activated, control of the frequency converter via the EtherCAT interface is disabled.
- After an initial power up, the frequency converter automatically detects whether a fieldbus option is installed in slot A, and set *8-02 Control Word Source* to [Option A]. Adding, changing, or removing an option from an already commissioned frequency converter, does not change *8-02 Control Word Source*. However, it causes a Trip Mode, and the frequency converter displays an error.
- *8-10 Control Word Profile*. Choose between the Danfoss FC Profile and the DS402 profile
- *8-50 Coasting Select* to *8-56 Preset Reference Select*. Selection of how to gate EtherCAT control commands with digital input command of the control card.

NOTE

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

- *8-03 Control Word Timeout Time* to *8-05 End-of-Timeout Function*. The reaction in the event of a bus time-out is set via these parameters

5 Configure the Master

5.1 Import

5.1.1 Importing the XML File

To configure an EtherCAT Master, the configuration tool needs an XML file for each type of slave on the network. The XML file is a text file containing the necessary communications set-up data for a slave. Download the XML file for the FC 300 at <http://www.danfoss.com/drives>.

Option version	File
1.x	Danfoss_FC_series_ECAT_001.XML

The steps outlined in 5.2.1 *Setting up the Master* shows how to add a new device to the TwinCAT Tool. For tools from other vendors, please consult their relevant manuals.

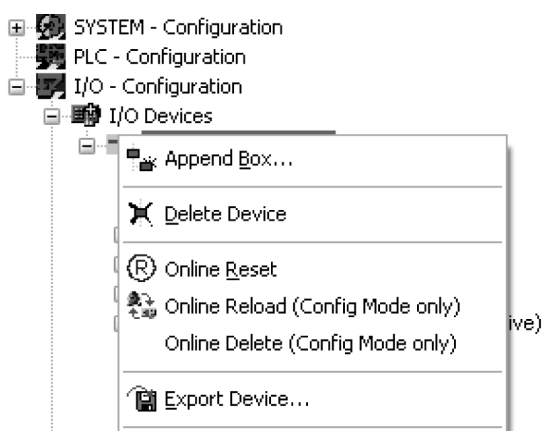
Copy the XML file from the Danfoss Web page to the location: C:\TwinCAT\Io\EtherCAT, and restart the TwinCAT System Manager. This will update the Device Description library of TwinCAT. The TwinCAT cache is first updated after a restart of the TwinCAT system.

5.2 Setting Up

5.2.1 Setting up the Master

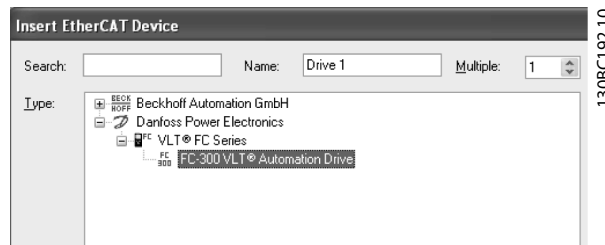
Inserting the Danfoss EtherCAT slave to the TwinCAT Master

1. Right click and select EtherCAT I/O master.
2. Select *Append Box...*

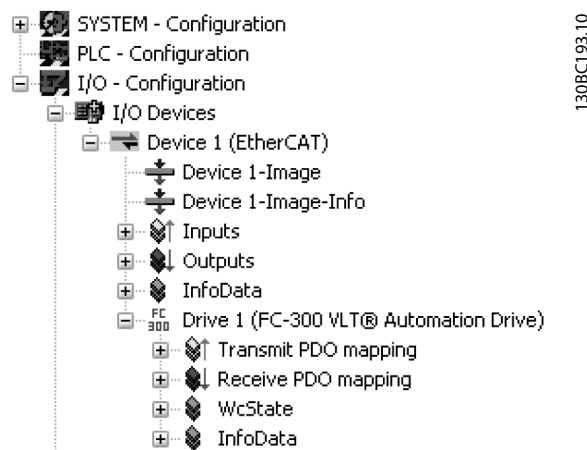


3. Select *Danfoss Power Electronics* in the *I/O Catalogue* of the *Insert EtherCAT Device* window.
4. Select *VLT FC Series*.

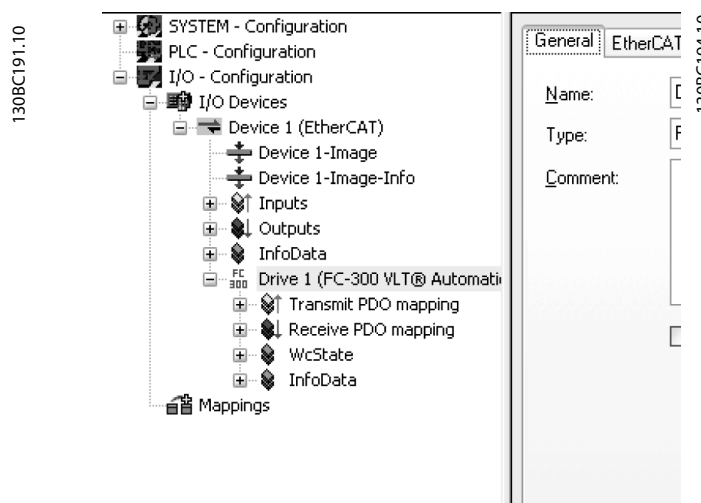
5. Select *FC-300 VLT AutomationDrive*.



Danfoss FC-300 is inserted into the EtherCAT master system.

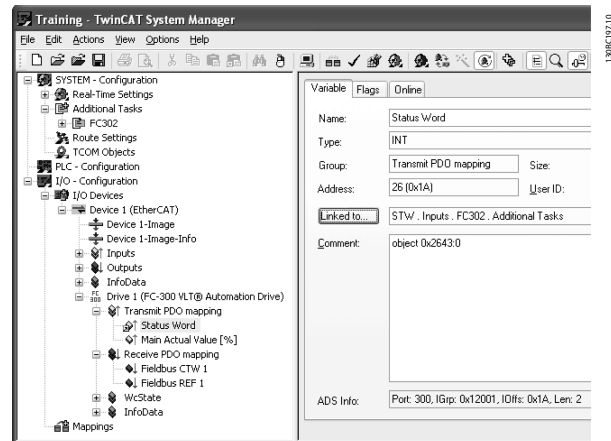
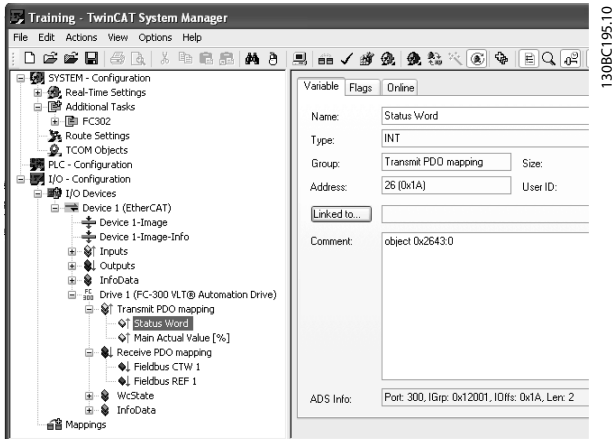


FC 300 VLT AutomationDrive is now the first slave in the master configuration.



To function properly, each of the four process data must be linked to variables inside the PLC. In this example, two transmit variables and two receive variables have been inserted in the PLC memory. To see a list of matching data

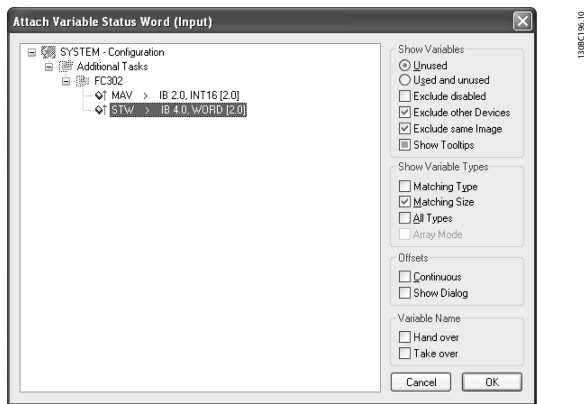
1. Select the variable.
2. Click the *Linked to...* button in the right window.



5

After a successfully integrating the frequency converter to the TwinCAT system, the frequency converter is now ready for operation.

In the following example, the status word is linked to the variable STW.



The status word is now linked to the variable STW in the PLC. Remaining variables must be mapped equally to the variables in the PLC.

6 How to Control the Frequency Converter

6.1 PDO Communication

The DS402 profile for frequency converters specifies a number of communication objects (SDOs). SDOs are suitable for data exchange between a process controller, for example a PLC, and frequency converters. Some SDOs are defined for cyclic data transfer, so that process data (PCD) can be transferred from the controller to the slave and vice versa. PDOs are used for cyclic data, a subset of the SDOs are PDO mappable.

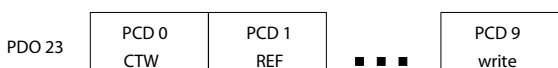
PDO 23 is pure process data objects for applications requiring no cyclic parameter access. The PLC sends out process control data, and the frequency converter then responds with a transmit PDO containing process status data. In the Danfoss EtherCAT interface all PDOs are free selectable. The first two words of the process data area (PCD 0 and PCD1) are set to a default value at factory, but can be changed.

Select the signals for transmission from the master to the frequency converter in *12-21 Process Data Config Write* (request from master to the frequency converter). Select the signals for transmission from the frequency converter to the master in (response: FC → master).

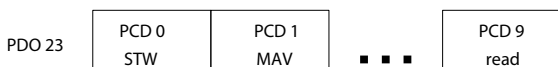
The EtherCAT option has only one PDO available - PDO 23. The PDO 23 is flexible in size, so that it can be adjusted to fit all needs (max. 10 PCDs). The selection is made in the master configuration, and is then automatically downloaded to the frequency converter during the transition from Init to Pre-Op. No manual setting of PPO types in the frequency converter is required.

Selection [1] *Standard telegram 1* is equivalent to PDO 23.

Receive PDOs (PLC → Drive)



Transmit PDOs (Drive → PLC)



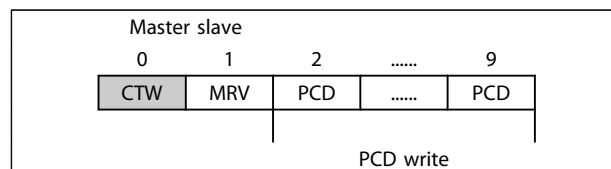
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6.2 Process Data

Use the process data part of the PDO for controlling and monitoring the frequency converter via the EtherCAT.

6.2.1 Process Control Data

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

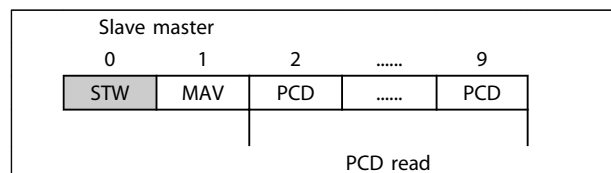


PCD 0 contains a 16-bit control word, where each bit controls a specific function of the frequency converter, see *6.3 Control Profile*. PCD 1 contains a 16-bit speed set point in percentage format. See *6.2.3 Reference Handling*.

The content of PCD 2 to PCD 9 is programmed in *12-21 Process Data Config Write* and *12-22 Process Data Config Read*.

6.2.2 Process Status Data

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



PCD 0 contains a 16-bit status word, where each bit contains information regarding a possible state of the frequency converter.

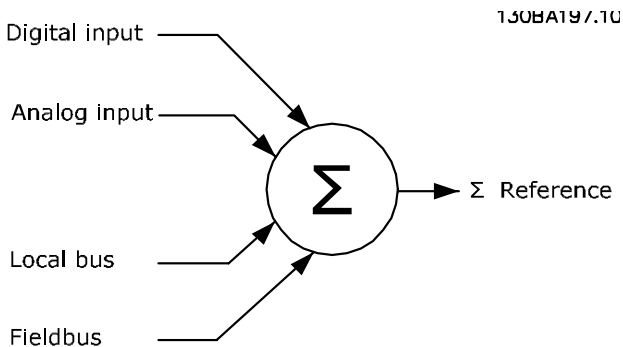
PCD 1 contains per default the value of the current speed of the frequency converter in percentage format (see).

The content of PCD 2 to PCD 9 is programmed in *12-22 Process Data Config Read*.

6.2.3 Reference Handling

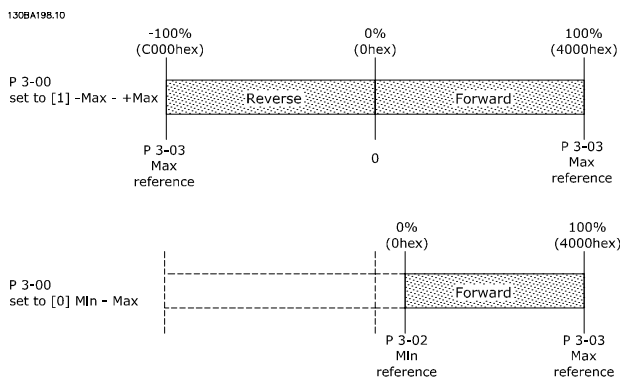
The reference handling in FC 301/FC 302 is an advanced mechanism that sums up references from different sources.

For more information on reference handling, refer to the FC 301/FC 302 Design Guide, MG33BXYY.



The reference, or speed set point (MRV, sent via EtherCAT), 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:



NOTE

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

The speed limit parameters in 4-11 Motor Speed Low Limit [RPM] to 4-14 Motor Speed High Limit [Hz] limits the actual frequency converter output. 4-19 Max Output Frequency sets the final speed limit.

The reference and the MAV have the format which appears from Table 6.1.

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 6.1 Reference and MAV Formats

NOTE

Negative numbers are formed as two's complement.

NOTE

The data type for MRV and MAV is 16-bit standardised value, which 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

6.2.4 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 %).

6.2.5 Influence of the Digital Input Terminals upon FC Control Mode

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*.

NOTE

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

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

CAUTION

To control the frequency converter via EtherCAT, set 8-50 *Coasting Select* to either [1] *Bus*, or to [2] *Logic AND*. Then set 8-01 *Control Site* to [0] *Digital and ctrl.word* or [2] *control word only*.

More detailed information and examples of logical relationship options are provided in 9 *Troubleshooting*.

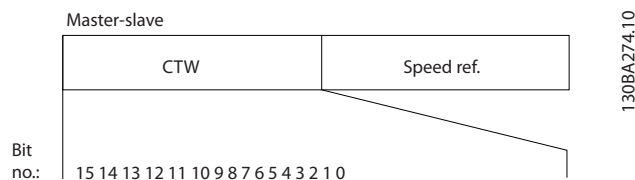
6.3 Control Profile

The frequency converter can be controlled according to the DS 402 profile, or the Danfoss FC profile. Select the desired control profile in 8-10 *Control Word Profile*. The choice of profile affects the control and status word only.

6.4 *DS 402 Control Profile* and 6.5 *FC Control Profile* provide a detailed description of control and status data.

6.4 DS 402 Control Profile

6.4.1 Control Word According to DSP 402 Profile (Par. 8-10 = DSP 402 profile)



Bit	Bit value = 0	Bit value = 1
00	Switch off	Switch on
01	Disable voltage	Enable voltage
02	Quick stop	Run
03	Disable operation	Enable operation
04	Disable ramp	Enable ramp
05	Freeze	Run enable
06	Ramp stop	Start
07	No function	Reset
08	Reserved	
09	Reserved	
10	Reserved	
11	Jog 1 OFF	Jog 1 ON
12	Reserved	
13	Setup select (LSB)	
14	Setup select (MSB)	
15	Forward	Reversing

Explanation of the Control Bits

Bit 00, Switch OFF/ON

Bits 00, Switch OFF/ON

Bit 00 = "0" - executes transition 2, 6 or 8.

Bit 00 = "1" - executes transition 3.

Bit 01, Disable/Enable Voltage

Bit 01 = "0" - executes transition 9, 10 or 12.

Bit 01 = "1" - enables voltage.

Bit 02, Quick stop/Run

Bit 02= "0" - executes transition 7, 10 or 11.

Bit 02 = "1" - quick stop not active.

Bit 03, Disable/enable Operation

Bit 03= "0" - executes transition 5.

Bit 03 = "1" - enables operation.

Bit 04, Quick-stop/ramp

Bit 04= "0" - executes transition 7 or 11, Quick stop.

Bit 04 = "1" - enables ramp.

Bit 05, Freeze output frequency/run enable

Bit 05 = "0" - the given output frequency is maintained even if the reference is changed.

Bit 05 = "1" - the frequency converter is again able to regulate, and the given reference is followed.

Bit 06, Ramp stop/start

Bit 06= "0" - the frequency converter controls the motor down to stop.

Bit 01 = "1" - gives a start command to the frequency converter.

Bit 07, No function/reset

Reset of trip.

Bit 07 = "0" - there is no reset.

Bit 07 = "1" - a trip is reset.

Bit 08, 09 and 10

DSP402 reserved.

Bit 11, Jog 1 OFF/ON

Activation of 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 12

Danfoss reserved.

Bits 13/14, Selection of Setup

Bits 13 and 14 are used for choosing among the four menu Set-ups in accordance with Table 6.2:

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

Table 6.2 Set-up Selection Table

Bit 15, Forward/reversing

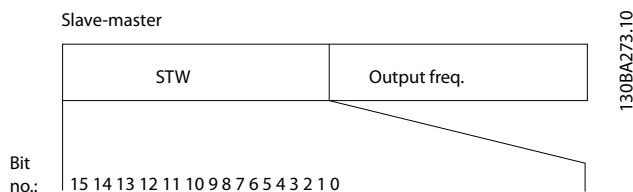
Bit 15 = "0" - no reversing.

Bit 15 = "1" - reversing.

NOTE

In factory setting reversing is set to [digital] in 8-54 Reversing Select.

6.4.2 Status Word According to DS 402 Profile



Bit	Bit value = 0	Bit value = 1
00	Not ready to switch ON	Ready to switch ON
01	Switched OFF	Switched ON
02	Operation disabled	Operation enabled
03	No malfunction	Malfunction
04	Voltage disabled	Voltage enabled
05	Quick stop	Run
06	Switch on disable	Switch on enable
07	No warning	Warning
08	Reserved	
09	Remote disabled	Remote enabled
10	Set point not reached	Set point reached
11	Speed limit not active	Speed limit active
12	Reserved	
13	Reserved	
14	Not running	Running
15	Reserved	

Explanation of the Status Bits

Bit 00, Not ready to switch on/Ready to switch on

Bit 00 = "0" - state less than "Ready to switch on".

Bit 00 = "1" - state at least = "Ready to Switch on".

Bit 01, Switch off/Switch on

Bit 00 = "0" - state less than "Switched on".

Bit 00 = "1" - state at least = "Switched on".

Bit 02, Operation disable/Operation enable

Bit 00 = "0" - state less than "Operation enable".

Bit 00 = "1" - state at least = "Operation enable".

Bit 03, No fault/trip

Bit 03 = "0" - the frequency converter is not in a fault condition.

Bit 03 = "1" - the frequency converter has tripped and needs a reset signal to run.

Bit 04, Voltage disable/Voltage enable

Bit 04 = "0" - control word bit 01 = "1".

Bit 04 = "1" - control word bit 01 = "0".

Bit 05, Quick stop/Run

Bit 05 = "0" - control word bit 02 = "1".

Bit 05 = "1" - control word bit 02 = "0".

Bit 06, Start enable/Start disable

Bit 06 = "0" - state is not "Switch on disable".

Bit 06 = "1" - state = "Switch on enable".

Bit 07, No warning/Warning

Bit 07 = "0" - no warning situation.

Bit 07 = "1" - a warning has occurred.

Bit 08, Danfoss reserved

Bit 09, Remote disable/Remote enable

Bit 09 = "0" - the frequency converter has been stopped with the stop key on the LCP, or [Local] has been selected in 3-13 Reference Site.

Bit 09 = "1" - it is possible to control the frequency converter via the serial port.

Bit 10, Set point not reached/Set point reached

Bit 10 = "0" - the actual motor speed is different from the speed reference set. This situation can occur while the speed is ramped up/down during start/stop.

Bit 10 = "1" - the present motor speed equals the speed reference set.

Bit 11, Speed limit not active/speed limit active

Bit 11 = "0" - the output frequency is out of the range set in parameters 4-11/4-12 *Motor Speed low Limit RPM/Hz* or parameters 4-13/4-14 *Motor Speed high Limit RPM/Hz*.

Bit 11 = "1" - the output frequency is within the mentioned range.

Bit 12, DSP 402 reserved

Bit 13, DSP 402 reserved

Bit 14, Running/Not running

Bit 14 = "0" - the motor is not running.

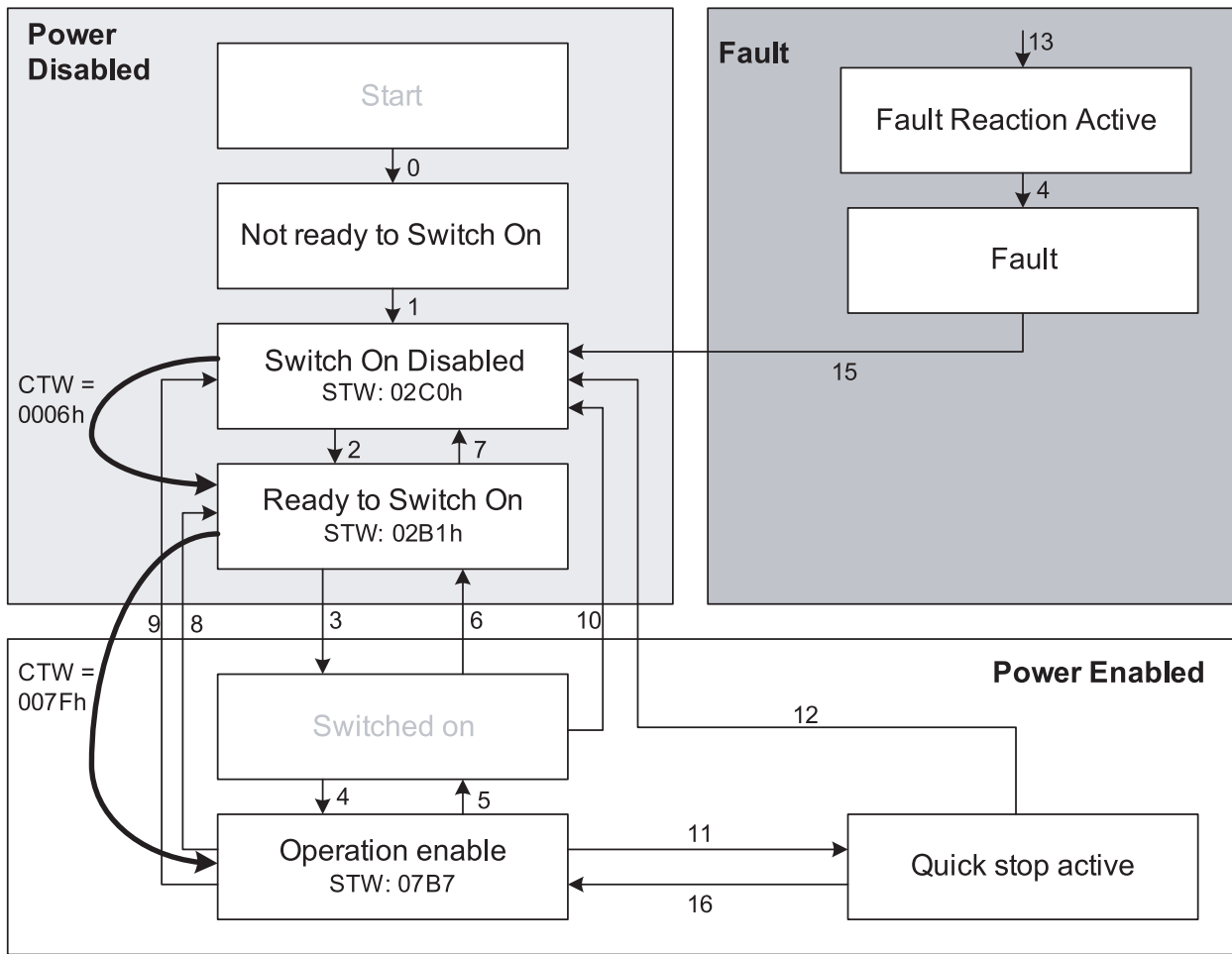
Bit 14 = "1" - the frequency converter has a valid start signal or that the output frequency is greater than 0 Hz.

Bit 15, Danfoss reserved

8-10 Control Profile

Option:	Function:	
[0] *	FC profile	
[7]	CANopen DSP 402	

FC Profile is the default control profile for the frequency converter, whereas *CANopen DSP 402* is the CiA standardized control profile, featuring the special DSP 402 transition state machine.



6

Illustration 6.1 DSP 402 State Machine

130BA924.10

6.4.3 DSP 402 State Transitions

Transition	State	Control word	Status word	Action
-	Start condition	0000	0000	-
0	Start-up⇒ Not ready to switch on	0000	0200	-
1	Switch On Disabled ⇒ Switch On Disabled	0000, 0001	0240	-
2	Not Ready to Switch On ⇒ Switched On	0006	0231	-
3	Ready to Switch On ⇒ Switched On	0007	0233	-
4	Switched On ⇒ Ready to Switch On	000F	0237	-
5	Operation Enabled ⇒ Switched On	0007	0233	Motor ramps to 0 RPM with programmed ramp down parameter.
6	Switched On ⇒ Ready to Switch On	0006	0231	-
7	Ready to Switch On ⇒ Switch On Disable	0001, 0000	0240	-
8	Operation Enable ⇒ Ready to Switch On	0006	0231	If the motor is not braked, and the power section is switched off immediately, the motor is free to rotate.
9	Operation Enable ⇒ Switch On Disable	0001, 0000	0240	If the motor is not braked, and the power section is switched off immediately, the motor is free to rotate.
10	Switched On ⇒ Switched On Disable	0001, 0000	0240	If the motor is not braked, and the power section is switched off immediately, the motor is free to rotate.
11	Operation Enabled ⇒ Quick Stop Active	0002	0207	Motor ramps to 0 RPM with programmed quick ramp parameter.
11	Operation Enabled ⇒ Quick Stop Active	0003	0217	Motor ramps to 0 RPM with programmed quick ramp parameter.
12	Quick Stop Active ⇒ Switch On Disabled	0001, 0000	0240	If the motor is not braked, and the power section is switched off immediately, the motor is free to rotate.
13	All states ⇒ Fault Reaction Active	xxxx	023F	-
14	Fault Reaction Active ⇒ Fault	xxxx	023F	-
15	Fault ⇒ Switch On Disabled	0000	0240	-
16	Quick Stop Active ⇒ Operation Enable (not supported)	-	-	-

6.5 Danfoss FC Control Profile

6.5.1 Control Word according to FC Profile (CTW)

To select Danfoss FC protocol in the control word, *8-10 Control Word Profile* must be set to Danfoss FC protocol [0]. 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

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 6.3*:

NOTE

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	<i>3-10 Preset Reference</i> [0]
0	1	2	<i>3-10 Preset Reference</i> [1]
1	0	3	<i>3-10 Preset Reference</i> [2]
1	1	4	<i>3-10 Preset Reference</i> [3]

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.

NOTE

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.

NOTE

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.

NOTE

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 you do not wish 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 6.3:

The function is only possible when Multi-Set-ups 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

NOTE

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.

6.5.2 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 for an example of a status word telegram using PPO type 3.

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 external 24 V supply to controls).

Bit 01, Drive 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	Bit = 0	Bit = 1
00	Control not ready	Control ready
01	Drive not ready	Drive 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	Drive OK	Stopped, autostart
13	Voltage OK	Voltage exceeded
14	Torque OK	Torque exceeded
15	Timer OK	Timer exceeded

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, Drive OK/stopped, autostart

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 Parameters

7.1 Parameter Group 0-** Operation/Display

0-37 Display Text 1		
Range:	Function:	
0 * [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 <i>0-20 Display Line 1.1 Small</i> , <i>0-21 Display Line 1.2 Small</i> , <i>0-22 Display Line 1.3 Small</i> , <i>0-23 Display Line 2 Large</i> or <i>0-24 Display Line 3 Large</i> . Use the [▲] or [▼] buttons on the LCP to change a character. Use the [◀] and [▶] buttons to move the cursor. When a character is highlighted by the cursor, it can be changed. Use the [▲] or [▼] buttons on the LCP to change a character. A character can be inserted by placing the cursor between two characters and pressing [▲] or [▼].	

7.2 Parameter Group 8-** Communication and Option

8-01 Control Site		
Option:	Function:	
	The setting in this parameter overrides the settings in <i>8-50 Coasting Select</i> to <i>8-56 Preset Reference Select</i> .	
[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.

8-03 Control Word Timeout Time		
Range:	Function:	
1.0 s*	[Application dependant]	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 <i>8-04 Control Word Timeout Function</i> is then carried out. A valid control word triggers the time-out counter.

8-04 Control Word 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 <i>8-03 Control Word Timeout Time</i> .		
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 the reset button on the LCP, or via a digital input.
[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, <i>8-05 End-of-Timeout Function</i> 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] <i>Select setup 1</i>
[9]	Select setup 3	See [7] <i>Select setup 1</i>
[10]	Select setup 4	See [7] <i>Select setup 1</i>
[26]	Trip	

NOTE

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 <i>8-04 Control Word Timeout Function</i> is set to [Set-up 1-4].
[0]	Hold set-up	Retains the set-up selected in <i>8-04 Control Word Timeout Function</i> and displays a warning,

8-05 End-of-Timeout Function		
Option:	Function:	
		until 8-06 <i>Reset Control Timeout</i> 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 Word Timeout		
This parameter is active only when <i>Hold set-up</i> [0] has been selected in 8-05 <i>End-of-Timeout Function</i> .		
Option:	Function:	
[0] *	Do not reset	Retains the set-up specified in 8-04 <i>Control Word Timeout Function</i> , 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 <i>Do not reset</i> [0] setting

8-07 Diagnosis Trigger		
This parameter enables and controls the frequency converter diagnosis/Emergency function. In Profibus, it expands the diagnosis data to 24 byte. In EtherCAT, it activates the transmission of the Emergency object. The Emergency object consists of 8 byte of data, where byte 3 indicates an active alarm or warning. Bit 0 = 1 Alarmword 1 has an active Alarm. Bit 1 = 1 Alarmword 2 has an active Alarm. Bit 2, reserved, Bit 3 = 1 Warningword 1 has an active warning. Bit 4 = 1 Warningword 2 has an active warning. Bits 5-7, reserved.		
Option:	Function:	
	<p>NOTE The following is only valid for Profibus and EtherCAT.</p> <ul style="list-style-type: none"> - <i>Disable</i> [0]: Do not send extended diagnosis/emergency data even if they appear in the frequency converter. - <i>Trigger on alarms</i> [1]: Send extended diagnosis/emergency data when one or more alarms appear in alarm 16-90 <i>Alarm Word</i> or 9-53 <i>Profibus Warning Word</i>. - <i>Trigger alarms/warn.</i> [2]: Send extended diagnosis/emergency data if one or more alarms or warnings appear in alarm 16-90 <i>Alarm Word</i>, 9-53 <i>Profibus Warning Word</i>, or warning 16-92 <i>Warning Word</i>. 	

8-07 Diagnosis Trigger		
This parameter enables and controls the frequency converter diagnosis/Emergency function. In Profibus, it expands the diagnosis data to 24 byte. In EtherCAT, it activates the transmission of the Emergency object. The Emergency object consists of 8 byte of data, where byte 3 indicates an active alarm or warning. Bit 0 = 1 Alarmword 1 has an active Alarm. Bit 1 = 1 Alarmword 2 has an active Alarm. Bit 2, reserved, Bit 3 = 1 Warningword 1 has an active warning. Bit 4 = 1 Warningword 2 has an active warning. Bits 5-7, reserved.		
Option:	Function:	
		Enabling diagnosis can cause increased bus traffic. Not all fieldbus types support Diagnosis functions.
[0] *	Disable	
[1]	Trigger on alarms	
[2]	Trigger alarm/warn.	

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 <i>Power [kW]</i> 16-11 <i>Power [hp]</i> 16-12 <i>Motor Voltage</i> 16-14 <i>Motor Current</i> 16-16 <i>Torque [Nm]</i> 16-17 <i>Speed [RPM]</i> 16-22 <i>Torque [%]</i> 16-25 <i>Torque [Nm] High</i>

8-10 Control Word 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 are visible in the LCP display.		
Option:	Function:	
[0] *	FC Profile	
[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 <i>Control Profile</i> .
[2]	Alarm 68 Only	Only set in case of an Alarm 68.

8-13 Configurable Status Word STW

Option:	Function:
[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 ^{*1} .
[11] T19 DI status.	The bit indicates the status of terminal 19 ^{*1} .
[12] T27 DI status.	The bit indicates the status of terminal 27 ^{*1} .
[13] T29 DI status.	The bit indicates the status of terminal 29 ^{*1} .
[14] T32 DI status.	The bit indicates the status of terminal 32 ^{*1} .
[15] T33 DI status.	The bit indicates the status of terminal 33 ^{*1} .
[16] T37 DI status	The bit indicates the status of terminal 37 ^{*2} .
[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*. If Comparator 0 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[61] Comparator 1	See parameter group 13-1*. If Comparator 1 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[62] Comparator 2	See parameter group 13-1*. If Comparator 2 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[63] Comparator 3	See parameter group 13-1*. If Comparator 3 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[64] Comparator 4	See parameter group 13-1*. If Comparator 4 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[65] Comparator 5	See parameter group 13-1*. If Comparator 5 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[70] Logic Rule 0	See parameter group 13-4*. 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*. If Logic Rule 1 is evaluated as TRUE, the output goes high. Otherwise, it is low.

8-13 Configurable Status Word STW

Option:	Function:
[72] Logic Rule 2	See parameter group 13-4*. 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*. 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*. 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*. If Logic Rule 5 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[80] SL Digital Output A	See 13-52 <i>SL Controller Action</i> . The output goes high whenever the Smart Logic Action [38] Set dig. out. A high is executed. The output goes low whenever the Smart Logic Action [32] Set dig. out. A low is executed.
[81] SL Digital Output B	See 13-52 <i>SL Controller Action</i> . The input goes high whenever the Smart Logic Action [39] Set dig. out. A high is executed. The input goes low whenever the Smart Logic Action [33] Set dig. out. A low is executed. [
[82] SL Digital Output C	See 13-52 <i>SL Controller Action</i> . The input goes high whenever the Smart Logic Action [40] Set dig. out. A high is executed. The input goes low whenever the Smart Logic Action [34] Set dig. out. A low is executed.
[83] SL Digital Output D	See 13-52 <i>SL Controller Action</i> . The input goes high whenever the Smart Logic Action [41] Set dig. out. A high is executed. The input goes low whenever the Smart Logic Action [35] Set dig. out. A low is executed.
[84] SL Digital Output E	See 13-52 <i>SL Controller Action</i> . The input goes high whenever the Smart Logic Action [42] Set dig. out. A high is executed. The input goes low whenever the Smart Logic Action [36] Set dig. out. A low is executed.
[85] SL Digital Output F	See 13-52 <i>SL Controller Action</i> . The input goes high whenever the Smart Logic Action [43] Set dig. out. A high is executed. The input goes low whenever the Smart Logic Action [37] Set dig. out. A low is executed. *1: "0" indicates that the terminal is low "1" indicates that the terminal is high *1: "0" indicates T37 is low (safe stop) "1" indicates T37 is high (normal)

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	

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. NOTE Only selection [0] Digital input is available when 1-10 Motor Construction is set to [1] PM non-salient SPM.
[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.

8-53 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.

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.	

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

7.3 Parameter Group 12-** Ethernet

7.3.1 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 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.

12-01 IP Address		
Range:	Function:	
0 * [0 - 2147483647]	Configure the IP address of the option. Read-only if 12-00 IP Address Assignment set to DHCP or BOOTP.	

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

12-03 Default Gateway		
Range:	Function:	
0 * [0 - 2147483647]	Configure the IP default gateway of the option. Read-only if 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:	
Application dependent*	[Application dependant]	

12-07 Domain Name		
Range:	Function:	
0 [0 - 2147483647]	Domain name of the attached network. Can be automatically assigned when using DHCP.	

12-08 Host Name		
Range:	Function:	
0 [0 - 2147483647]	Logical (given) name of option.	

NOTE

Note that the display of the frequency converter only shows the first 19 characters, but the remaining characters are stored in the frequency converter.

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

7.3.2 12-1* Ethernet Link Parameters

12-1* Ethernet Link parameters		
Option:	Function:	
		Applies for whole parameter group.
[0]	Port 1	
[1]	Port 2	

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:	
Application dependent*	[Application dependant]	

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 12-13 Link Speed and 12-14 Link Duplex.
[1] *	On	

NOTE

It is recommended to set *12-12 Auto Negotiation* to [0] Off for the EtherCAT option and for the connected port. This setting ensures that the connected ports are set to an optimized Link Speed with Link Duplex setting. If only one of the ports in a link is set to *Auto Negotiation ON*, the ports can switch to half duplex, which results in poor network performance. Most switches today have Auto negotiation set, but it can then take longer to establish a connection.

12-13 Link Speed		
Option:	Function:	
		Forces the link speed for each port in 10 Mbps or 100 Mbps. If <i>12-12 Auto Negotiation</i> 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	

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

7.3.3 12-2* Process Data

12-20 Control Instance		
Range:	Function:	
[None, 20, 21, 100, 101, 103]	Read only. Displays the connection to the master. In EtherNET/IP: If no CIP connection is present, "None" is displayed. In EtherCAT: If no connection is active "None" is displayed, else it displays the active PDO.	

12-21 Process Data Config Write		
Range:	Function:	
[[0 - 9] PCD read 0 - 9]	Configuration of readable process data.	

NOTE

For configuration of 2-word (32-bit) parameter read/write, use two consecutive arrays in *12-21 Process Data Config Write* and *12-22 Process Data Config Read*.

12-22 Process Data Config Read		
Range:	Function:	
[[0 - 9] PCD read 0 - 9]	Configuration of readable process data.	

12-23 Process Data Config Write Size		
Range:	Function:	
16*	[1 - 32]	Sets the number of bits being sent from the frequency converter as process data. The setting counts from right (LSB). The value 1 means that only the least significant bit of the signal is transferred from the frequency converter.

12-24 Process Data Config Read Size		
Range:	Function:	
16*	[1 - 32]	Sets the number of bits being sent to the frequency converter as process data. The setting counts from right (LSB). The value 1 means that only the least significant bit of the signal is transferred to the frequency converter. The preceding bits are set to zero.

12-28 Store Data Values		
Option:	Function:	
[0] *	Off	
[1]	Store all setups	
[2]	Store all setups	

12-29 Store Always		
Option:	Function:	
		Activates function that always stores received parameter data in non-volatile memory (EEPROM).
[0] *	Off	
[1]	On	

7.3.4 12-5* EtherCAT

12-50 Configured Station Alias		
Range:	Function:	
0*	[0 - 65535]	This parameter shows the configured EtherCAT station alias for the frequency converter. Changes are active after a power cycle.

12-51 Configured Station Address		
Range:	Function:	
0*	[0 - 65535]	This parameter shows the configured station address. The parameter can only be set by the master at power up.

12-59 EtherCAT Status		
Range:	Function:	
0*	[0 - 4294967295]	This parameter contains status information on the EtherCAT interface. Each of the 32 bits are linked to a status information of the EtherCAT interface.

Bit	Meaning	0/1
0	Link Status port 1	Disconnected/Connected

1	Link Status port 2	Disconnected/Connected
2	Link speed port 1	0/10 Mbps/100 Mbps
3	Link speed port 2	0/10 Mbps/100 Mbps
4	Link Duplex port 1	Half/Full
5	Link Duplex port 2	Half/Full
6	Auto Negotiation Port 1	Disabled/Enabled
7	Auto Negotiation Port 2	Disabled/Enabled
8	Auto Crossover Port 1	Straight/Crossed
9	Auto Crossover Port 2	Straight/Crossed
10	Duplicate IP	Disabled/Enabled
11	Valid IP Address	Disabled/Enabled
12	Station Address Given	Disabled/Enabled
13	Wrong Tx Config	No/Yes
14	Wrong Rx Config	No/Yes
15	TxPDO1 Disabled	Disabled/Enabled
16	RxPDO1 Disabled	Disabled/Enabled
17	TxPDO6	Disabled/Enabled
18	RxPDO6	Disabled/Enabled
19	Reserved	
20	Reserved	
21	Reserved	
22	Reserved	
23	TxPDO23	Disabled/Enabled
24	RxPDO23	Disabled/Enabled
25		
26		
27	Warning 34	Not active/Active
28	State	
29	State	
30	State	
31	State	

7

7.3.5 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	Disables the built-in HTTP (web) server.
[1]	Enabled	Enables the built-in HTTP (web) server.

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

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

12-89 Transparent Socket Channel Port		
Range:	Function:	
Size related*	[0 - 0.]	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.

7.3.6 12-9* Advanced Ethernet Settings

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

NOTE

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.

12-93 Cable Error Length		
Range:	Function:	
0*	[0 - 65535]	If Cable Diagnostics is enabled in <i>12-90 Cable Diagnostic</i> , 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 no errors detected.

7.4 EtherCAT-specific Parameter List

Parameter	Default value	Range	Conversion index	Data type
8-01 Control Site	Dig. & ctrl. word [0]	[0 - 2]	-	UInt8
8-02 Control Word Source	FC RS485 [0]	[0 - 4]	-	UInt8
8-03 Control Word Timeout Time	1	0.1-18000	-1	UInt32
8-04 Control Word Timeout Function	Off [0]	[0 - 10]	-	UInt8
8-05 End-of-Timeout Function	Hold set-up [0]	[0 - 1]	-	UInt8
8-06 Reset Control Word Timeout	Do not reset [0]	[0 - 1]	-	UInt8
8-07 Diagnosis Trigger	Disable [0]	[0 - 3]	-	UInt8
8-10 Control Word Profile	FC profile [0]	[0 - x]	-	UInt8
8-13 Configurable Status Word STW				
8-50 Coasting Select	*Logic OR [3]	[0 - 3]	-	UInt8
8-51 Quick Stop Select	*Logic OR [3]	[0 - 3]	-	UInt8
8-52 DC Brake Select	*Logic OR [3]	[0 - 3]	-	UInt8
8-53 Start Select	*Logic OR [3]	[0 - 3]	-	UInt8
8-54 Reversing Select	*Logic OR [3]	[0 - 3]	-	UInt8
8-55 Set-up Select	*Logic OR [3]	[0 - 3]	-	UInt8
8-56 Preset Reference Select	*Logic OR [3]	[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
12-00 IP Address Assignment	0.0.0.0	-	-	Unsigned 8
12-01 IP Address	0.0.0.0	-	-	Unsigned 32
12-02 Subnet Mask	0.0.0.0	-	-	Unsigned 32
12-03 Default Gateway	0.0.0.0	-	-	Unsigned 32
12-04 DHCP Server	0.0.0.0	-	-	Unsigned 32
12-05 Lease Expires	0	-	-	Unsigned 32
12-06 Name Servers	0.0.0.0	-	-	Unsigned 32
12-07 Domain Name		-	-	String
12-08 Host Name		-	-	String
12-09 Physical Address	00:1B:08:00:00:00	-	-	Visible string 17
12-10 Link Status	No Link [0]	[0 - 1]	-	Unsigned 8
12-11 Link Duration	00:00:00:00	-	-	Time diff. w/ date
12-12 Auto Negotiation	On [1]	[0 - 1]	-	Unsigned 8
12-13 Link Speed	None [0]	[0 - 2]	-	Unsigned 8
12-14 Link Duplex	Full Duplex [1]	[0 - 1]	-	Unsigned 8[
12-20 Control Instance	Application Dependent	0 - 255		
12-21 Process Data Config Write	Application Dependent			
12-22 Process Data Config Read	16	1 - 32		
12-23 Process Data Config Write Size	16	1 - 32		
12-24 Process Data Config Read Size	0	0 - 4294967295		
12-27 Primary Master	Off [0]			
12-28 Store Data Values				
12-29 Store Always	Off [0]			
12-50 Configured Station Alias	0	-	-	Unsigned 16
12-51 Configured Station Address	0	-	-	Unsigned 16
12-59 EtherCAT Status	0	-	-	Unsigned 32
12-80 FTP Server	Disable [0]	[0 - 1]	-	Unsigned 8
12-81 HTTP Server	Disable [0]	[0 - 1]	-	Unsigned 8

Parameter	Default value	Range	Conversion index	Data type
12-82 SMTP Service	Disable [0]	[0 - 1]	-	Unsigned 8
12-89 Transparent Socket Channel Port	Disable [0]	[0 - 1]	-	Unsigned 8
12-90 Cable Diagnostic	Disable [0]	[0 - 1]	-	Unsigned 8
12-91 Auto Cross Over	Enable [0]	[0 - 1]	-	Unsigned 8
12-93 Cable Error Length	0	0 - 200	0	Unsigned 16
12-98 Interface Counters	0	0 - 65535	-	Unsigned 16
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

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

8 Application Examples

8.1 E.g.: Process Data with PDO 23

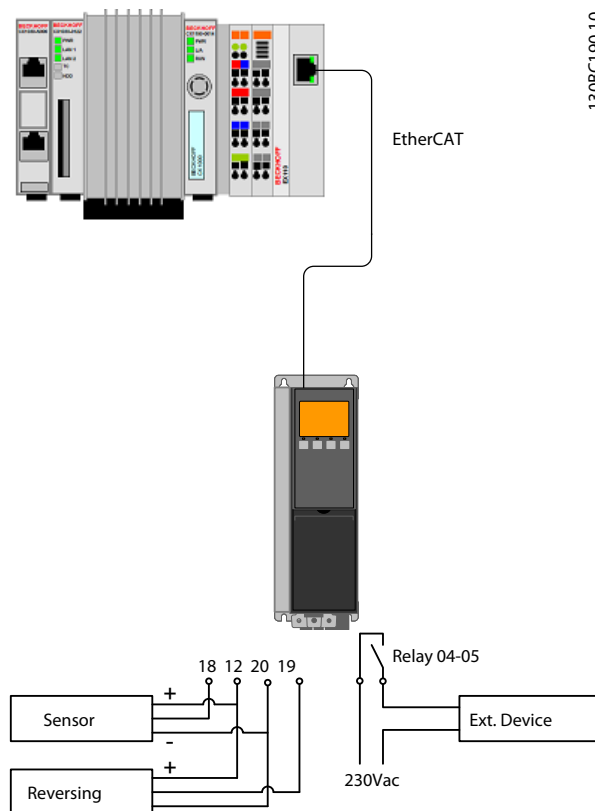
This example shows how to work with PDO 23, which consists of Control Word/Status Word and Reference/Main Actual Value. The PDO contains up to ten objects, which can be programmed to monitor process signals:

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

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 EtherCAT cable is broken, the master has a system failure, or the PLC is in stop mode.



Program the frequency converter as follows:

Parameter	Setting
4-10 Motor Speed Direction	Both directions [2]
5-10 Terminal 18 Digital Input	No operation [0]
5-11 Terminal 19 Digital Input	Reversing [10]
5-40 Function Relay	Control word bit 11/12 [36/37]
8-03 Control Word Timeout Time	1 sec
8-04 Control Word Timeout Function	Stop [2]
8-10 Control Word Profile	FC Profile [0]
8-50 Coasting Select	Bus [1]
8-51 Quick Stop Select	Bus [1]
8-52 DC Brake Select	Bus [1]
8-53 Start Select	Bus [1]
8-54 Reversing Select	Logic AND [2]
8-55 Set-up Select	Bus [1]
8-56 Preset Reference Select	Bus [1]
12-21 Process Data Config Write	Sub index [0] 16-80 Fieldbus CTW 1 Sub index [1] 16-85 FC Port CTW 1
12-22 Process Data Config Read	Sub index [0] 16-03 Status Word Sub index [1] 16-05 Main Actual Value [%] Sub index [2] 16-16 Torque [Nm] Sub index [3] 16-60 Digital Input

8.2 E.g.: Simple Control Word, Reference, Status Word and Main Actual Value

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

example to demonstrate the full range of modules. All the values shown are arbitrary, and are provided for demonstration purposes only.

The control word telegram is sent from the PLC to the frequency converter. Standard Telegram 1 is used in the

		PCD																															
		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 8.1 Standard Telegram 1 Example

Table 8.1 indicates the bits contained within the control word, and how they are presented as process data in Standard Telegram 1 for this example.

Table 8.2 indicates which bit functions, and which corresponding bit values are active for this example.

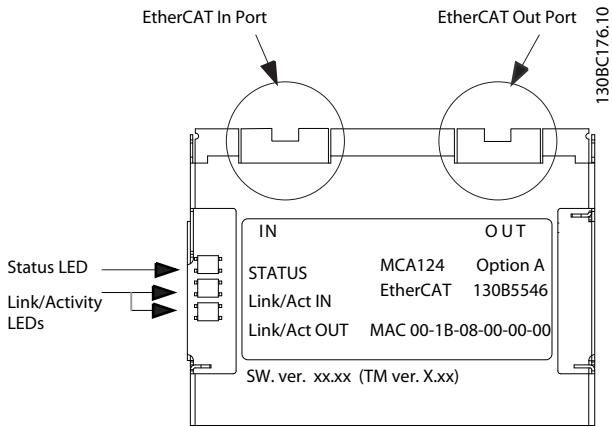


Bit	Bit value = 0	Bit value = 1	Bit value	
00	Reference value	External selection lsb	0	C
01	Reference value	External selection msb	0	
02	DC brake	Ramp	1	
03	Coasting	Enable	1	
04	Quick stop	Ramp	1	7
05	Freeze output	Ramp enable	1	
06	Ramp stop	Start	1	
07	No function	Reset	0	
08	No function	Jog	0	4
09	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	<input type="checkbox"/>			
Function inactive	<input type="checkbox"/>			

Table 8.2 Bit Functions

9 Troubleshooting

9.1.1 LED Status



Power OFF or State INIT	_____
PRE-OP State	■ ■ ■ ■ ■ ■ ■ ■
SAFE-OP State	■ _____ ■ _____ ■
OP State	████████████████████
ERR-Init State	▨ ▨ ▨ ▨ ▨ ▨ ▨ ▨
Link removed from In port	▨ ▨ ■ ▨ ▨ ■ ▨

Table 9.1 Indication of Status LED

Power OFF or NO Link	_____
Link	████████████████████
Link Active	

Table 9.2 Link/Act LED

-
- Green
- ▨
- Red

9

9.1.2 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?

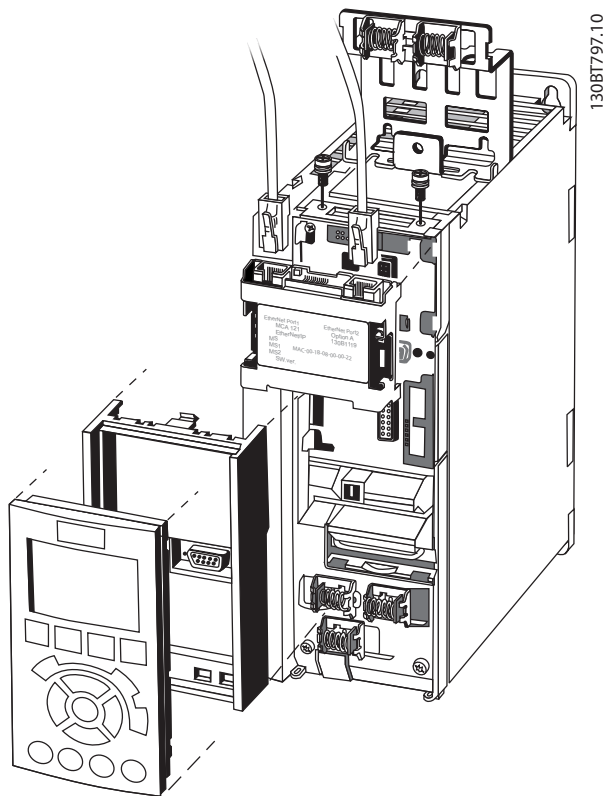
Check that the cable is mounted correctly. Check if the corresponding Network LED shows link activity. Link/Act

Check 2: Does the hardware configuration match?

Check that the Station Alias in the master matches the value in *12-50 Configured Station Alias*

Check 3: Is the correct XML file installed?

Download the correct XML file from [http:// www.danfoss.com/BusinessAreas/DrivesSolutions/](http://www.danfoss.com/BusinessAreas/DrivesSolutions/).



15-61 Option SW Version	XML File
1.x	Danfoss_FC_series_ECACAT_001.XML

9.1.3 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.

9.1.4 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*.

The following tables 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*, *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.

NOTE

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

Digital input [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

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

Serial communication [1]		
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

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

Logic AND [2]		
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

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

Logic AND [2]		
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

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

Logic OR [3]		
Terminal	Bit 02/03/04	Function
0	0	Stop/Anti-clockwise
0	1	Start/Clockwise
1	0	Start/Clockwise
1	1	Start/Clockwise

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

Logic OR [3]		
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

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.

Digital input [0]				
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

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

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

Digital input [0]		
Terminal	Bit 06/15	Function
0	0	Stop/Anti-clockwise
0	1	Stop/Anti-clockwise
1	0	Start/Clockwise
1	1	Start/Clockwise

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

Serial communication [1]		
Terminal	Bit 02/03/04	Function
0	0	Stop/Anti-clockwise
0	1	Start/Clockwise
1	0	Stop/Anti-clockwise
1	1	Start/Clockwise

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

Serial communication [1]				
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

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

Logic OR [3]				
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

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

Logic AND [2]				
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

9.1.5 Alarm and Warning Words

Alarm word, Warning word, and EtherCAT warning word are shown in the display in Hex format. If there is more than one warning or alarm, a sum of all warnings or alarms is shown. Alarm word, warning word, and EtherCAT warning word can also be displayed using the serial bus in *16-90 Alarm Word*, *16-92 Warning Word*, and *12-59 EtherCAT Status*.

FC 301/FC 302			
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

FC 301/FC 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)	-

FC 301/FC 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

FC 301/FC 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

NOTE

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

9.1.6 Warning and Alarm Messages

There is a clear distinction between alarms and warnings. When there is an alarm, the frequency converter enters 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, on the other hand, may come when a warning condition appears, then disappear when conditions return to normal, without interfering with the process.

Warnings

A single bit within a warning word represents warnings within the frequency converter. Bit status FALSE [0] means no warning, while bit status TRUE [1] 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 FALSE [0] means no fault, while bit status TRUE [1] means fault.

10 Warnings and Alarms

10.1 Status Messages

10.1.1 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 using the [Reset] control button on the LCP
- Via a digital input with the “Reset” function
- Via serial communication/optional fieldbus

NOTE

After a manual reset using [Reset] on the LCP, the [Auto On] button 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 10.1*).

10.1.2 Alarm List

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts 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)		8-04 Control Word Timeout Function
22	Hoist Mech. Brake				

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 above 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 and alarm are marked against a code in *Table 10.1*, this means that either a warning occurs before an alarm, or that you can 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.

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
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 10.1 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 digital input (Parameter group 5-1* [1]). 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.

LED indication	
Warning	yellow
Alarm	flashing red
Trip locked	yellow and red

Alarm Word Extended Status Word							
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 10.2 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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