



# Operating Instructions

## MCA 124 EtherCAT

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# 1 Safety

## 1.1.1 Copyright, Limitation of Liability and Revision Rights

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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 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.

## 1.2 EtherCAT®

EtherCAT is a Ethernet based realtime communication, which allows a master to communicate to slave in a interval down to 30 microseconds. The size of the network is almost unlimited since up to 65535 devices can be connected. These factors do make EtherCAT to one of the fastest Ethernet based protocols in the marked.

The topology in EtherCAT can be made as line, tree or as star. This gives the user the flexibility to route the cabling in the most optimal way.

On the application level EtherCAT applies CANopen as the application layer. This incorporates the usages of PDO (Process data Objects) for control of the devices and SDO (Service Data Objects) for acyclic access to parameters of the devices.

More information on EtherCAT can be found on the EtherCAT technology groups homepage: [www.ethercat.org](http://www.ethercat.org).

**EtherCAT®** 

Illustration 1.1 EtherCAT® is Registered Trademark and Patented Technology, Licensed by Beckhoff Automation GmbH, Germany

## 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
- 8 Parameters
- 9 Application Examples
- 10 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*, provide the necessary information for getting the frequency converter up and running.
- The *VLT AutomationDrive Design Guide*, entails all technical information about the frequency converter design and applications including encoder, resolver, and relay options.
- The *VLT AutomationDrive Profibus Operating Instructions*, provide the information required for controlling, monitoring, and programming the frequency converter via a Profibus fieldbus.
- The *VLT AutomationDrive DeviceNet Operating Instructions*, provide the information required for controlling, monitoring, and programming the frequency converter via a DeviceNet fieldbus.
- The *VLT AutomationDrive MCT 10 Set-up Software Operating Instructions*, provide information for installation and use of the software on a PC.
- The *VLT AutomationDrive IP21/Type 1 Instruction*, provides information for installing the IP21/Type 1 option.
- The *VLT AutomationDrive 24 V DC Backup Instruction*, provides information for installing the 24 V DC Backup option.
- The *VLT AutomationDrive CanOpen Operating Instructions*.
- The *VLT AutomationDrive Modbus TCP Operating Instructions*.
- The *MCA 121 Ethernet/IP Operating Instructions*.
- The *MCA 120 PROFINET Operation Instruction*.

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

## 2.1.6 Abbreviations

| Abbreviation | Definition  |
|--------------|---|
| API          | Actual Packet Interval                            |
| CC           | Control Card                                      |
| CTW          | Control Word                                      |
| DCP          | Discovery and Configuration Protocol              |
| DHCP         | Dynamic Host Configuration Protocol Configuration |
| 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 Reference                    |
| 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                                       |

Table 2.1

### 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)

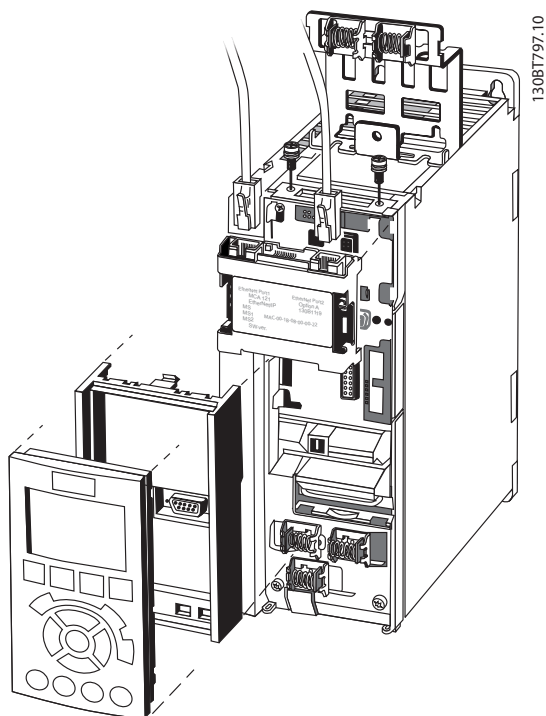


Illustration 3.1

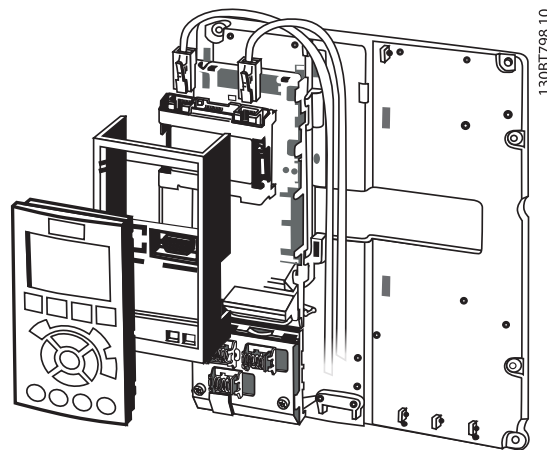


Illustration 3.2

**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      |

Table 3.2

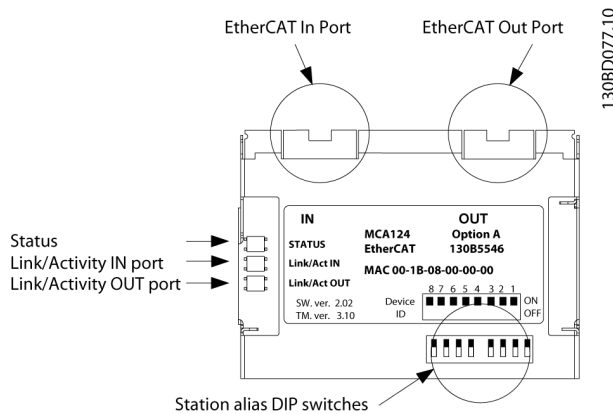


Illustration 3.3 Overview of the Option

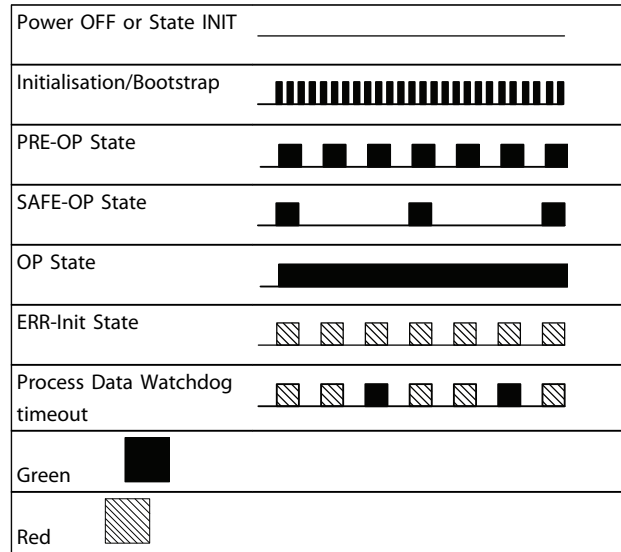


Table 3.3 Indication of Status LED

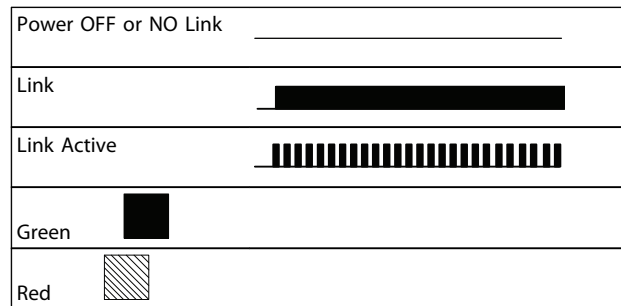


Table 3.4 Link/Act LED

### 3.1.5 Topology

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

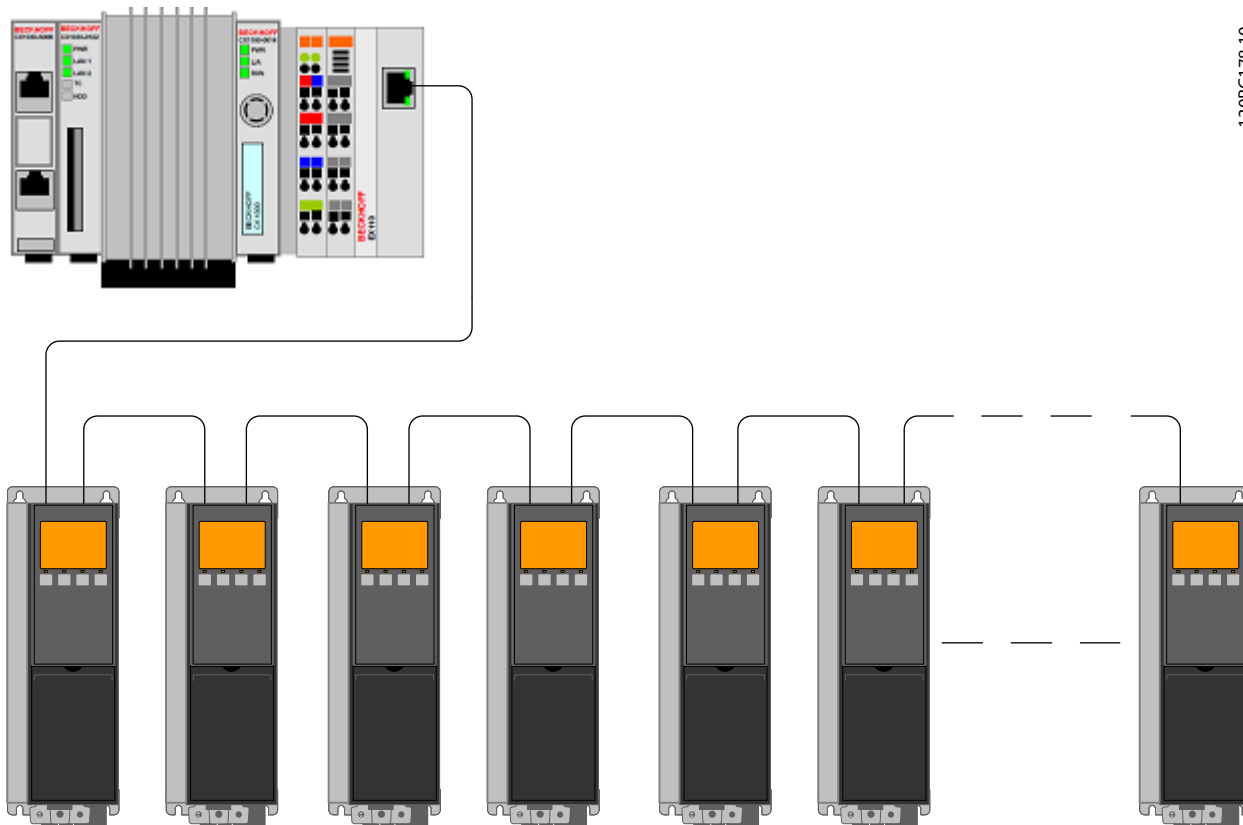
It is important in a EtherCAT system, that the connection is done correctly. EtherCAT options has to be connected so

that a OUT port always connects to a IN port on the next slave in the network. If this is not fulfilled the EtherCAT will go into error mode.

#### NOTE

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

3



130BC178.10

Illustration 3.4 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.

### 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 *VLT AutomationDrive series Design Guide*.

#### NOTE

The correct handling of the shield of the motor cable is vital for the overall performance of the system. If the rules are not followed it can lead to loss of the control and malfunction of the system.

#### 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°.

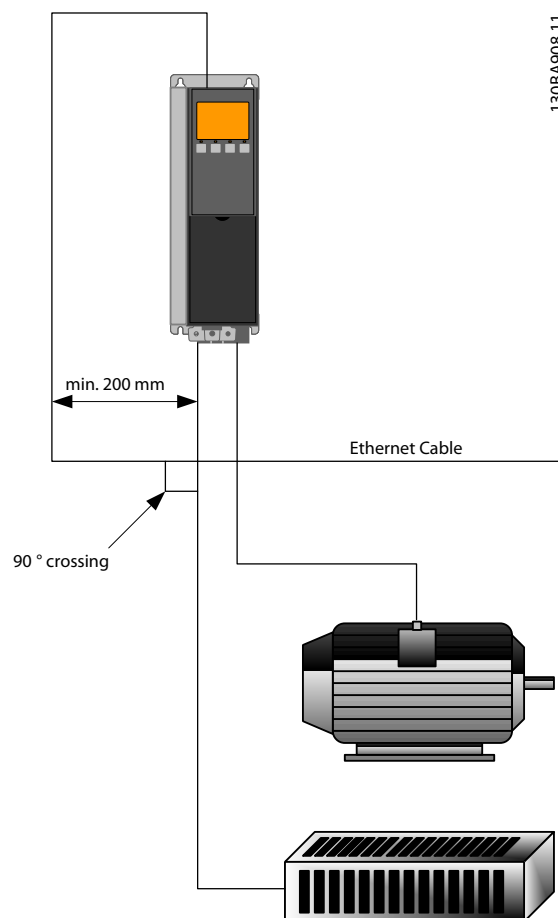


Illustration 3.5

## 4 How to Configure

### 4.1.1 IP Settings

All IP-related parameters are located in parameter group *12-0\* IP Settings*: 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 on] key 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 DS 402 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.

### 4.3 Configure the EtherCAT Network

All EtherCAT stations that are connected to the same bus network must have a unique station alias number. The station alias of the frequency converter can be selected via:

- Hardware switches
- 12-50 Configured Station Alias

- The TwinCAT under the EtherCAT⇒advance setting⇒ESC⇒E2PROM⇒Configured station alias setting

If 12-50 Configured Station Alias, can only be set if all address switches are set to ON or OFF.

#### 4.3.1.1 Setting the EtherCAT Station Alias using the Hardware Switches

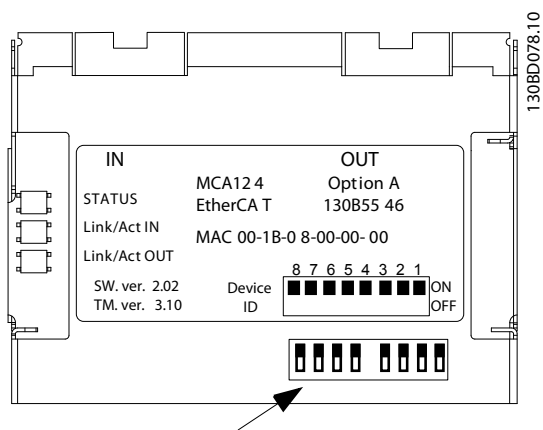
Using the hardware switches it is possible to select an address range from 1 to 254 according to *Table 4.1*:

| Switch        | 8    | 7   | 6   | 5   | 4   | 3   | 2   | 1   |
|---------------|------|-----|-----|-----|-----|-----|-----|-----|
| Address value | +128 | +64 | +32 | 16  | +8  | +4  | +2  | +1  |
| Address 5     | OFF  | OFF | OFF | OFF | OFF | ON  | OFF | ON  |
| Address 35    | OFF  | OFF | ON  | OFF | OFF | OFF | ON  | ON  |
| Address 82    | OFF  | ON  | OFF | ON  | OFF | OFF | ON  | OFF |
| Address 147   | ON   | OFF | OFF | ON  | OFF | OFF | ON  | ON  |

Table 4.1 Address Range

### NOTE

Switch off the power supply before changing the hardware switches. The address change will come into effect at the next power-up, and can be read in 12-50 Configured Station Alias. Note the location and sequence of the hardware switches as illustrated in *Illustration 4.1*.



Station alias DIP switches

Illustration 4.1

## 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/BusinessAreas/DrivesSolutions/EtherCAT/EtherCAT+files.htm>.

| Option version   | File                           |
|------------------|--------------------------------|
| 1.x, 2.x and 3.x | Danfoss_FC_series_ECAT_019.XML |

Table 5.1

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, 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. If an older version of the XML file is installed, this has to be erased. If the older versions are not erased it can lead to wrong identification of the Drive on the EtherCAT network. The XML file contains three entries, FC 300, FC 301 and FC 302. The FC 300 is the the entry for older EtherCAT drive version 1.02, Where the EtherCAT version 2.xx are handled via the entries FC 301 and FC 302.

### 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...*

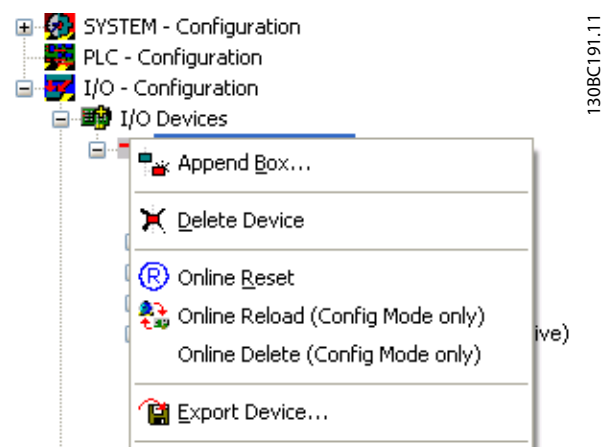


Illustration 5.1

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*.

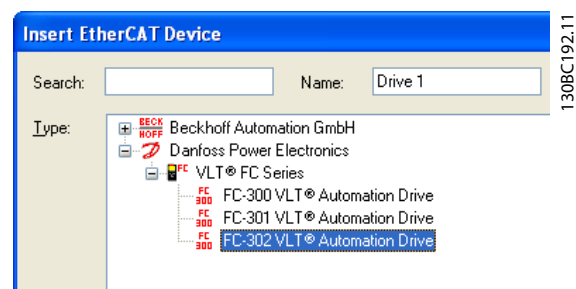


Illustration 5.2

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

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

5

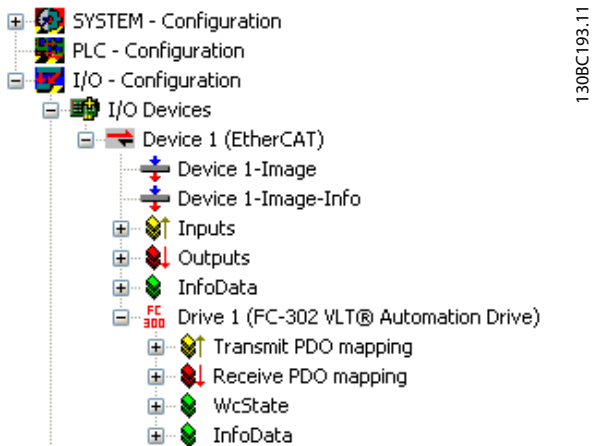


Illustration 5.3

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.

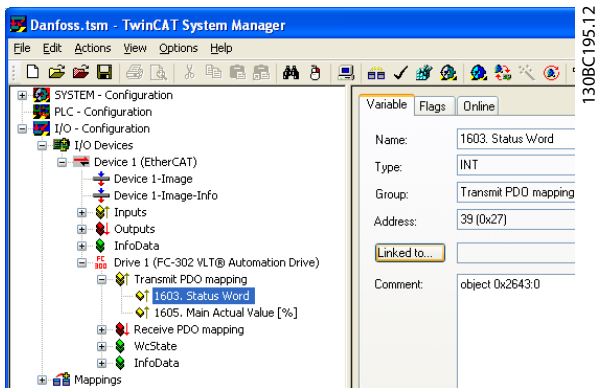


Illustration 5.4

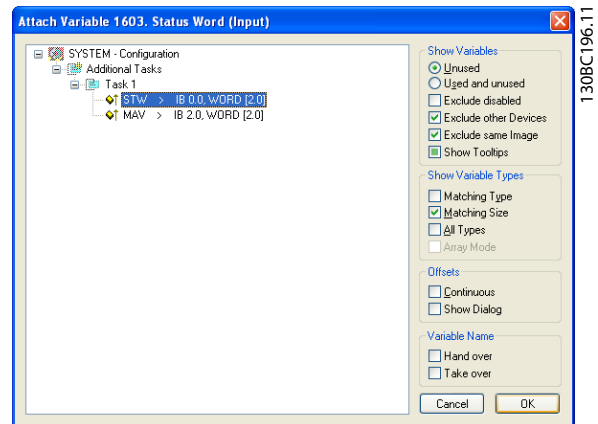


Illustration 5.5

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.

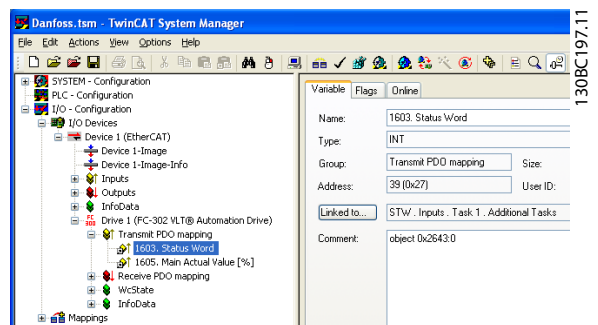


Illustration 5.6

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

## 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.

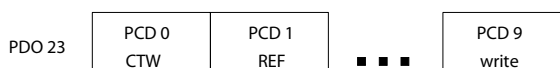
PDO 23 is pure process data objects for applications requiring no cyclic parameter access. The PLC sends out process control data, and the frequency converter then responds with a transmit PDO containing process status data. In the Danfoss EtherCAT interface all PDOs are free selectable. The first two 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)

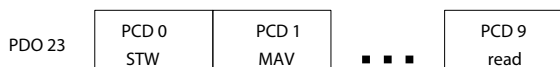


Illustration 6.1

130BC177:10

### 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).

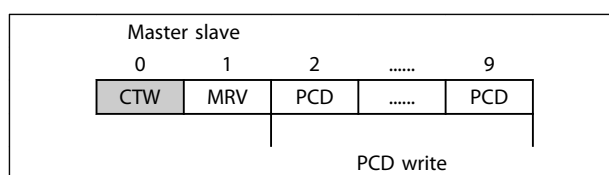


Table 6.1

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.

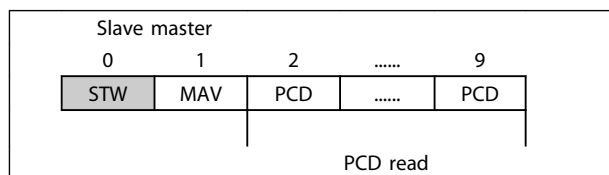


Table 6.2

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 *6.2.3 Reference Handling*).

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*.

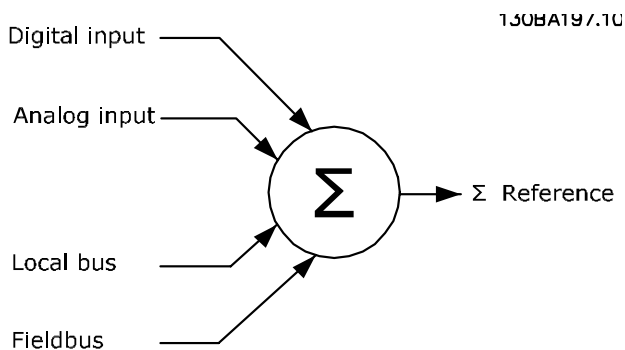


Illustration 6.2

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:

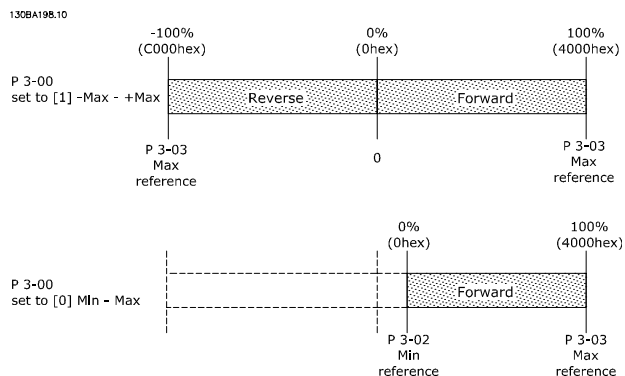


Illustration 6.3

#### 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 6.3.

| 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 6.3 Reference and MAV Formats

#### NOTE

Negative numbers are formed as a complement of two.

#### 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<br>100 RPM     |
| 25%     | 1000 hex<br>825 RPM  |
| 50%     | 2000 hex<br>1550 RPM |
| 75%     | 3000 hex<br>2275 RPM |
| 100%    | 4000 hex<br>3000 RPM |

Table 6.4

### 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* overrules the settings in 8-50 *Coasting Select* to 8-56 *Preset Reference Select*, and Terminal 37 *Coasting Stop (safe)* overrules 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 10 *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.

The desired control profile can also be controlled by object 6060 Modes of operation and readout by object 6061 Modes of operation display. Value -1 indicated FC profile. Value 2 indicates DS 402 Velocity mode. ESI (xml) file has default process data mapping for FC profile objects. If drive is to be run in DS 402 profile the DS 402 profile must be selected (e.g. by parameter 8-10 or object 6060) and the according process data shall be configured. The easy way to change the process data is to set the frequency converter in the desired control profile and then the press the "Load PDO info from device" button on the Process data tab in TwinCAT. This ensures that the objects for process data is matching the profile. In case of mismatch between the selected control profile and the process data objects, the drive will not enter state OPERATION but Error PRE-OP and issue an abort code. See Table 7.17.

6.4 DS 402 Control Profile and 6.5 Danfoss 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 (Parameter 8-10=DSP 402 profile)

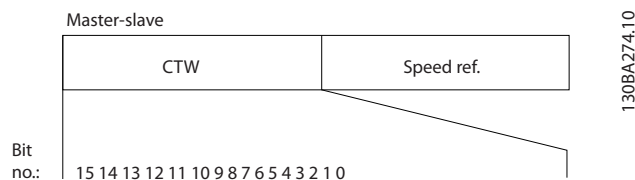


Illustration 6.4

| 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        |

Table 6.5

#### 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 06="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 6.6*:

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

**Table 6.6 Set-up Selection Table**

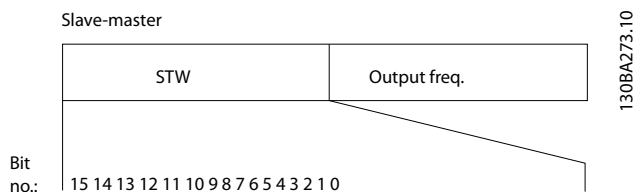
Bit 15, Forward/reversing

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



**Illustration 6.5**

| 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               |                    |

**Table 6.7**

**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.

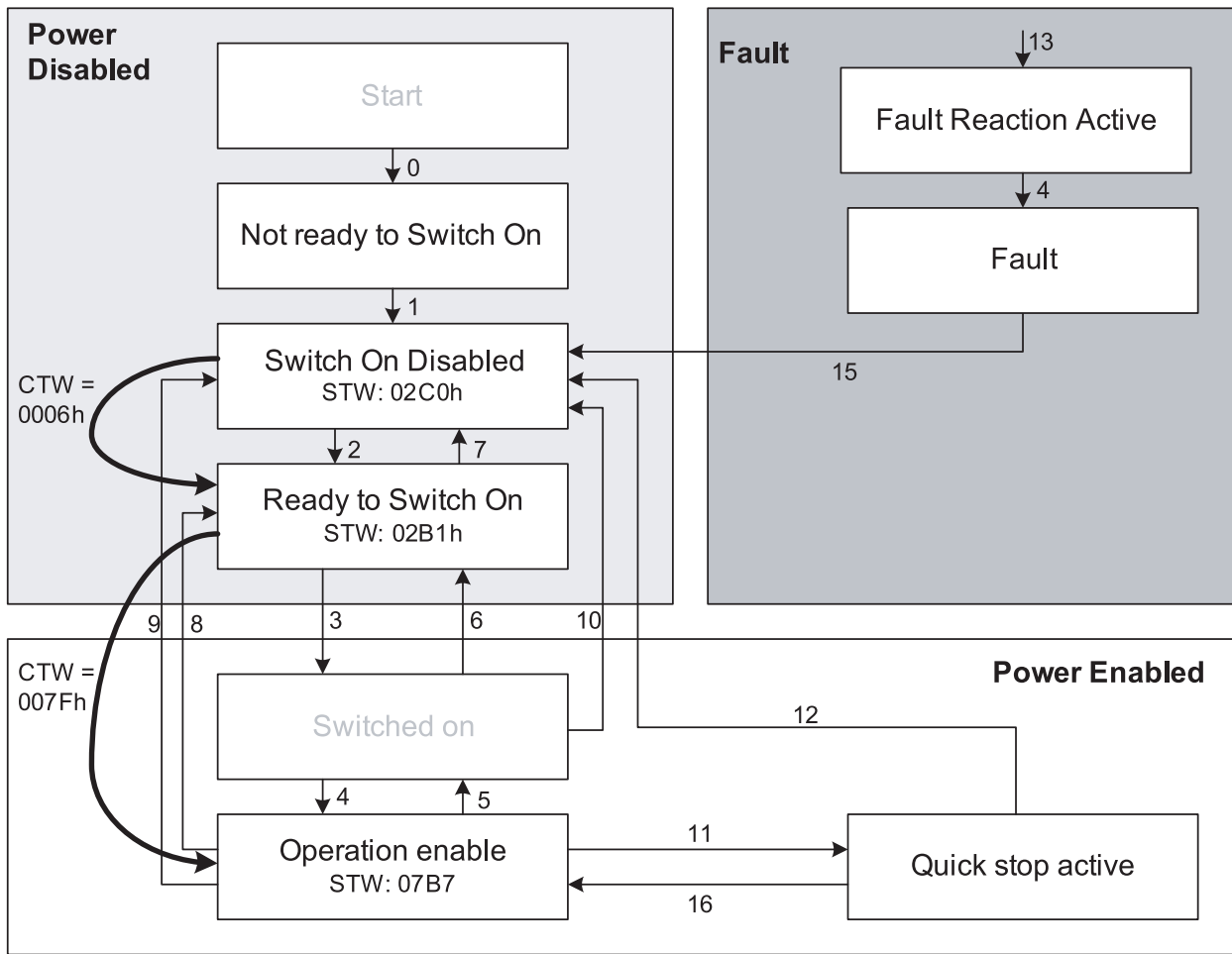
Bit 15, Danfoss reserved.

**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.

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Illustration 6.6 DSP 402 State Machine

## 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) | -            | -           | -   |

Table 6.8

## 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 [0] *FC##profile* . The control word is used to send commands from a master (PLC or PC) to a slave (frequency converter).

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

Table 6.9

#### 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 6.10*.

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

Table 6.10

##### 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 6.11:

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      |

Table 6.11

**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, frequency converter ready

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



Bit 02, Coasting stop

Bit 02="0" - the frequency converter has released the motor.

Bit 02="1" - the frequency converter can start the motor when a start command is given.

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

Table 6.12

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/tripplock

Bit 06="0" - the frequency converter is not in fault mode.

Bit 06="1" - the frequency converter is tripped, and locked.

Bit 07, No warning/warning

Bit 07="0" - there are no warnings.

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

Bit 08, Speed reference/speed = reference

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

Bit 08="1" - the present motor present speed matches the preset speed reference.

Bit 09, Local operation/bus control

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

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

Bit 10, Out of frequency limit

Bit 10="0" - the output frequency has reached the value in 4-11 *Motor Speed Low Limit [RPM]* or 4-13 *Motor Speed High Limit [RPM]*.

Bit 10="1" - the output frequency is within the defined limits.

Bit 11, No operation/in operation

Bit 11="0" - the motor is not running.

Bit 11="1" - the frequency converter has a start signal or the output frequency is greater than 0 Hz.

Bit 12, frequency converter OK/stopped, 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 Communication Profile Area

The section describes the general layout of the EtherCAT communication area which is supported. The process data objects are defined in this area.

### 7.2 1000-1FFF Communication Object Area

#### 7.2.1 1000 - 1FFF Communication Object Overview

| Index (hex) | Object (Symbolic Name) | Name                               | Type   | Read/Write |
|-------------|------------------------|------------------------------------|--|------------|
| 1000        | VAR                    | Device type                        | UNSIGNED32   | ro         |
| 1001        | VAR                    | Error register                     | UNSIGNED8  | ro         |
| 1002        | VAR                    | Manufacturer status register       | UNSIGNED32   | ro         |
| 1003        | ARRAY                  | Pre-defined error field            | UNSIGNED32   | ro         |
| 1008        | VAR                    | Manufacturer device name           | VISIBLE_STRING                                     | constant   |
| 1009        | VAR                    | Manufacturer hardware version      | VISIBLE_STRING                                     | constant   |
| 100A        | VAR                    | Manufacturer software version      | VISIBLE_STRING                                     | constant   |
| 1010        | ARRAY                  | Store parameters                   | UNSIGNED32   | rw         |
| 1011        | ARRAY                  | Restore default parameters         | UNSIGNED32   | rw         |
| 1018        | RECORD                 | Identity object                    | Identity (23h)                                     | ro         |
| 1100        | VAR                    | EtherCAT address                   | UNSIGNED16   | ro         |
| 1110        | ARRAY                  | Virtual MAC address                | UNSIGNED8  | ro         |
| 1111        | ARRAY                  | Virtual IP address info            | UNSIGNED8  | rw         |
| 1616        | ARRAY                  | Receive PDO parameter              | UNSIGNED32   | rw         |
| 1A16        | ARRAY                  | Transmit PDO parameter             | UNSIGNED32   | rw         |
| 1C00        | RECORD                 | Sync manager type                  | UNSIGNED8  | ro         |
| 1C12        | RECORD                 | RxPDO assign                       | UNSIGNED16   | rw         |
| 1C13        | RECORD                 | TxPDO assign                       | UNSIGNED16   | rw         |
| 2000-5FFF   |                        | Vendor specific area               | See 7.3.1 2000h-5FFFh Danfoss Specific Object Area |            |
| 6040        | VAR                    | Control word                       | UNSIGNED16   | rw         |
| 6041        | VAR                    | Status word                        | UNSIGNED16   | ro         |
| 6042        | VAR                    | VI_target_velocity                 | SIGNED16   | rw         |
| 6043        | VAR                    | VI_velocity_demand                 | SIGNED16   | ro         |
| 6044        | VAR                    | VI_actual_value                    | SIGNED16   | ro         |
| 6046        | ARRAY                  | VI_velocity_min_max_amount         | UNSIGNED32   | ro         |
| 6048        | RECORD                 | VI_velocity_acceleration           | See description                                    | ro         |
| 6049        | RECORD                 | VI_velocity_acceleration           | See description                                    | ro         |
| 604C        | ARRAY                  | VI dimension factor                | UNSIGNED32   | rw         |
| 6060        | VAR                    | Modes of operation                 | UNSIGNED8  | rw         |
| 6061        | VAR                    | Modes of operation display         | UNSIGNED8  | ro         |
| 6502        | VAR                    | Supported frequency converter mode | UNSIGNED32   | ro         |
| 6504        | VAR                    | Frequency converter manufacture    | VISIBLE_STRING                                     | ro         |

Table 7.1 Communication Object Overview

### 7.2.2 1000h Device Type

This object describes the type of device and its functionality. It is composed of a 16-bit field describing the device profile used, and a second 16-bit field providing additional information about optional functionality of the device.

| Additional Information |    |                                   |    | Device Profile Number |   |
|------------------------|----|-----------------------------------|----|-----------------------|---|
| Mode Bits              |    | Type Bits                         |    | Bits                  |   |
| 31..                   | 24 | 23..                              | 16 | 15..                  | 0 |
| 0                      |    | 1 (frequency converters, DS402)   |    | 402                   |   |
| 0                      |    | 1 (frequency converters, Danfoss) |    | -1                    |   |

**Table 7.2 1000h Device Type**

Device type will show 0x10192 when DS402 profile is selected in frequency converter, and 0 in case of FC profile.

### 7.2.3 1001h Error Register

This object is the error register of the device. Only bit 0 is supported. The other information of errors is read with object 603Fh.

| Bit | Meaning       |
|-----|---------------|
| 0   | Generic error |

**Table 7.3 1001h Error Register**

### 7.2.4 1002h Manufacturer Status Register

The contents of this object are manufacturer specific, and inform of the state of the frequency converter:

| Value | Meaning          |
|-------|------------------|
| 1     | Init             |
| 2     | Pre-operational  |
| 3     | Boot             |
| 4     | Safe-operational |
| 5     | Operational      |

**Table 7.4 1002h Manufacturer Status Register**

### 7.2.5 1003h Predefined Error Field

Holds the error on the frequency converter. Setting index 0 to 0 erases the field. Disabling the diagnosis trigger (FC p807) disables the display of values in this object (that is, they stay at 0).

| Index   | Meaning                 |
|---------|-------------------------|
| 1003h 0 | Number of stored errors |
| 1003h 1 | Current error           |

**Table 7.5 1003h Predefined Error Field**

The current error consist of two 16 bit word, where the most significant word holds the information if a warning or alarm is set.

|         |   |
|---------|---|
| Bit0    | 1, Alarmword 1 has an active Alarm (16-90 Alarm Word)   |
| Bit1    | 1, Alarmword 2 has an active Alarm (16-91 Alarm Word 2) |
| Bit2    | 0, Reserved   |
| Bit3    | 1, Warningword 1 has an active Warning (P 16-92)        |
| Bit4    | 1, Warningword 2 has an active Warning (P 16-93)        |
| Bit5-15 | 0, Reserved   |

**Table 7.6**

The least significant word reflects the following possible errors:

| Code (hex) | Meaning                                |
|------------|--|
| 0          | No fault                               |
| 1000       | General fault                          |
| 2130       | Short circuit                          |
| 2213       | Overcurr. during startup               |
| 2240       | Short to earth                         |
| 2310       | Continuous overcurrent                 |
| 2311       | Current inside the device, no. 1       |
| 3100       | Mains voltage                          |
| 3130       | Phase failure                          |
| 3210       | Overvoltage inside the device          |
| 3220       | undervoltage inside the device         |
| 3300       | Output voltage                         |
| 4210       | Exceed device temperature              |
| 4310       | Excess frequency converter temperature |
| 5110       | Low voltage power supply               |
| 5112       | +24 V power supply                     |
| 5210       | Measurement circuit                    |
| 6100       | Internal software fault                |
| 7110       | Brake chopper                          |
| 8100       | Communication                          |
| 8302       | Torque limiting                        |

**Table 7.7**

### 7.2.6 1008h Manufacturer Device Name

This object contains the device name as defined in 15-40 FC Type.

### 7.2.7 1009h Manufacturer Hardware Version

This object contains the Danfoss FC hardware version.

### 7.2.8 100Ah Manufacturer Software Version

This object contains the Danfoss software version as displayed in *15-49 SW ID Control Card*.

### 7.2.9 1010h Store Parameters

In the standard configuration, the contents of parameters written via fieldbus are stored in volatile memory, that is, the changed data will be lost after a power cycle. This index permits non-volatile storage of all frequency converter parameters which have been changed.

| Index, Sub-Index | Meaning   |
|------------------|---|
| 1010h 0          | Number sub-index supported                      |
| 1010h 1          | Save option parameters                          |
| 1010h 2          | Save communication option parameters            |
| 1010h 3          | Reserved  |
| 1010h 4          | Save edit setup                                 |
| 1010h 5          | Save frequency converter parameters/all set-ups |

**Table 7.8 1010h Store Parameters**

Writing the value “save” (0x65766c173) to sub-index 1 stores all frequency converter parameters of all set-ups into non-volatile memory, all other values are rejected. Sub-index 4 does the same for the Edit Set-up. This function is handled via *12-28 Store Data Values*.

### 7.2.10 1011h Restore Default Parameters

To restore factory default settings:

1. Write the value “load” to sub-index 1.
2. Initiate the next power cycle manually.
3. The default value is restored.

| Index, Sub-Index | Meaning                                    |
|------------------|--|
| 1011h 0          | Number of sub-index supported              |
| 1011h 1          | Restore all default parameters and restart |
| 1011h 2          | Restore communication related parameters   |

**Table 7.9 1011h Restore Default Parameters**

Writing the value “load” (0x64616F6C) stores all frequency converter parameters of all set-ups into non-volatile memory, all other values are rejected, and errors code 0x08000020 is returned. The frequency converter has to be power cycled before the changes get active. These objects execute an initialisation command in *14-22 Operation Mode*.

### 7.2.11 1018h Identity Object

This object contains general information about the device.

The Vendor ID (sub-index 1h) contains a unique value allocated to each manufacturer.

The manufacturer-specific Product code (sub-index 2h) identifies a specific device version.

The manufacturer-specific Revision number (sub-index 3h) consists of a major revision number and a minor revision number.

| Index, Sub-Index | Meaning   |
|------------------|---|
| 1018h 0          | Number of entries   |
| 1018h 1          | Vendor ID   |
| 1018h 2          | Product code  |
| 1018h 3          | Revision number (major revision number and minor revision number) |
| 1018h 4          | Serial number   |

**Table 7.10 1018h Identity Object**

### 7.2.12 1100h EtherCAT Address

This object contains the EtherCAT address of the device assigned by the master.

### 7.2.13 1110h Virtual MAC Address

This object contains the virtual MAC address for the EoE communication.

| Index, Sub-Index | Meaning                     |
|------------------|-----------------------------|
| 1110h 0          | Number sub-index supported  |
| 1110h 1          | Byte 0 of MAC address (LSB) |
| 1110h 2          | Byte 1 of MAC address       |
| 1110h 3          | Byte 2 of MAC address       |
| 1110h 4          | Byte 3 of MAC address       |
| 1110h 5          | Byte 4 of MAC address       |
| 1110h 6          | Byte 5 of MAC address (MSB) |

**Table 7.11 1110h Virtual MAC Address**

### 7.2.14 1111h Virtual IP Address Info

This object contains the virtual IP Info objects about IP addresses, gateways, DNS etc.

| Index, Sub-Index | Meaning                    | Data Type  |
|------------------|----------------------------|------------|
| 1111h 0          | Number sub-index supported | UNSIGNED8  |
| 1111h 1          | IP Address                 | UNSIGNED32 |
| 1111h 2          | Subnet Mask                | UNSIGNED32 |
| 1111h 3          | Default Gateway            | UNSIGNED32 |
| 1111h 4          | DNS Server                 | UNSIGNED32 |
| 1111h 5          | DNS Name                   | STRING     |

Table 7.12 1111h Virtual IP Address Info

For the DNS Name, the maximum string length is 97 characters, where the DNS Name consist of the host name and the DNS name separated by a “.”

### 7.2.15 1C00h Sync Manager Type

This object contains a list of all configured sync mangers and their types.

| Index, Sub-Index | Meaning   |
|------------------|---|
| 1C00h 0          | Number of entries   |
| 1C00h 1          | Sync-Manager Type Channel 1: Mailbox Write                |
| 1C00h 2          | Sync-Manager Type Channel 2: Mailbox Read                 |
| 1C00h 3          | Sync-Manager Type Channel 3: Process Data Write (Outputs) |
| 1C00h 4          | Sync-Manager Type Channel 4: Process Data Read (Inputs)   |

Table 7.13 1C00h Sync Manager Type

### 7.2.16 1C12h RxPDO Assignment

Sync manager 2 is used for process output data. Multiple RxPDOs can be mapped to this sync manager. Object 1C12h contains the list of all RxPDOs.

| Index, Sub-Index | Meaning            |
|------------------|--------------------|
| 1C00h 0          | Number of entries  |
| 1C00h 1          | RxPDO configurable |

Table 7.14 1C12h RxPDO Assignment

### 7.2.17 1C13h TxPDO Assignment

Sync manager 3 is used for process input data. Multiple RxPDOs can be mapped to this sync manager. Object 1C13h contains the list of all TxPDOs.

| Index, Sub-Index | Meaning            |
|------------------|--------------------|
| 1C00h 0          | Number of entries  |
| 1C00h 1          | RxPDO configurable |

Table 7.15 1C13h TxPDO Assignment

## 7.3 2000-5FFF Danfoss Specific Object Area

### 7.3.1 2000h-5FFFh Danfoss Specific Object Area

The area 2000h to 5FFFh holds the indexes for accessing the Danfoss FC parameters. All parameters in the frequency converter are linked to indexes in this area. The first index available is index 2001h. This index is linked to the frequency converters parameter 1 (language). The rest of the EtherCAT index follows the same rule, where the frequency converters parameter number plus 2000h gives the EtherCAT index. For example, the reading the running hours in *15-01 Running Hours*, is calculated by 2000h + parameter number in hex number = 2000h+5DD=index 25DDh. The xml file does only contain a subset of the frequency converters parameters. This subset has the indexes that are required for setting up the PDO communication. If a full list is required, the full list can be readout from the frequency converter. This list allows access to all parameters. This generates the correct information regarding option installed in the B and C slot. *Table 7.16* shows a few indexes and their mapping.

| Index | Parameter              |
|-------|------------------------|
| 2001h | 0-01 Language          |
| 2002h | 0-02 Motor Speed Unit  |
| 2003h | 0-03 Regional Settings |
| ..    |                        |
| 2078h | 1-20 Motor Power [kW]  |
| 2079h | 1-22 Motor Voltage     |
| ..    |                        |
| 24B1h | 12-01 IP Address       |
| 24B2h | 12-02 Subnet Mask      |

Table 7.16 2000h-5FFFh Vendor Specific Object Area

## 7.4 6000-Device profile Object Area

### 7.4.1 6000h-9FFFh Standardised Device Profile Area

The area 6000h to 9FFFh holds the indexes specified by the ETG (ETHERCAT user Group) for various device profiles. The Danfoss EtherCAT does support three profiles, FC

Profile, MCO and the DS 402 profile, velocity mode. The profile is selected via *8-10 Control Word Profile*, *Control Word Profile*, or via Index 6060h Modes of operation. The profile area has up to 13 indexes depending on the selection made in *8-10 Control Word Profile*.

Table 7.17 shows the support of indexes, depending on setting of *8-10 Control Word Profile* (Index 6060h)

| Index | Name                               | 8-10 Control Word Profile=FC Profile | 8-10 Control Word Profile=MCO | 8-10 Control Word Profile=DS 402 |
|-------|------------------------------------|--------------------------------------|-------------------------------|----------------------------------|
| 6040h | Control word                       | -                                    | -                             | √                                |
| 6041h | Status word                        | -                                    | -                             | √                                |
| 6042h | VI_target_velocity                 | -                                    | -                             | √                                |
| 6043h | VI_velocity_demand                 | -                                    | -                             | √                                |
| 6044h | VI_velocity_effort                 | -                                    | -                             | √                                |
| 6046h | VI_velocity_min_max_amount         | -                                    | -                             | √                                |
| 6048h | VI_velocity_acceleration           | -                                    | -                             | √                                |
| 6049h | VI_velocity_deceleration           | -                                    | -                             | √                                |
| 604Ch | VI dimension factor                | -                                    | -                             | √                                |
| 6060h | Modes of operation                 | √                                    | √                             | √                                |
| 6061h | Modes of operation display         | √                                    | √                             | √                                |
| 6502h | Supported frequency converter mode | √                                    | √                             | √                                |
| 6504h | Frequency converter manufacture    | √                                    | √                             | √                                |

Table 7.17 6000h-9FFFh Standardised Device Profile Area

#### 7.4.2 6040h Control Word

This object contains the control word in accordance with DS 402. The control word consists of 16 bit, these 16 bit are used for controlling the frequency converter (for example, start, stop, reset), The control word is described in *6.4 DS 402 Control Profile*.

#### 7.4.3 6041h Status Word

This object contains the Status word in accordance to DS 402. The status word consists of 16 bit. The 16 bits shows the state and status of the frequency converter (for example, running, ramping, on speed). The Status word is described in *6.4 DS 402 Control Profile*.

#### 7.4.4 6042h VI\_target\_velocity

The VI\_target\_velocity is the required velocity of the system. The velocity is in RPM, the value is scaled by the VI dimension factor 604Ch.

#### 7.4.5 6043h VI\_velocity\_demand

The VI\_velocity\_demand is the velocity of the system after the ramp controller. The velocity is in RPM, the value is scaled by the VI dimension factor 604Ch.

#### 7.4.6 6044h VI\_actual\_value

The VI\_actual\_value is the velocity at the motor shaft. The velocity is in RPM, and is obtained from *16-17 Speed [RPM]*.

#### 7.4.7 6046h VI\_velocity\_min\_max\_amount

The VI\_velocity\_min\_max\_amount is the minimum and maximum RPM at the motor shaft. The two values are obtained from *3-02 Minimum Reference* and *3-03 Maximum Reference*. The readout values in *3-02 Minimum Reference* and *3-03 Maximum Reference* will be truncated.

#### 7.4.8 6048h VI\_velocity\_acceleration

The VI\_velocity\_acceleration index specifies the slope of the acceleration ramp. It is generated as the quotient of the delta\_speed and delta\_time. The Delta time is stored in *3-41 Ramp 1 Ramp up Time*, and the Delta speed is store locally in the options non volatile memory. After a power down the delta speed will be generated from the frequency converter *1-25 Motor Nominal Speed*. This can give a different readout from the frequency converter, but the slope value is maintained.

| Index, Sub-Index | Meaning                       |
|------------------|-------------------------------|
| 1048h 0          | Number of sub-index supported |
| 1048h 1          | Delta speed                   |
| 1048h 2          | Delta time                    |

Table 7.18 6048h vl\_velocity\_acceleration

### 7.4.9 6049h vl\_velocity\_deceleration

The vl\_velocity\_deceleration index specifies the slope of the deceleration ramp. It is generated as the quotient of the delta\_speed and delta\_time. The Delta time is stored in *3-42 Ramp 1 Ramp Down Time*, and the Delta speed is stored locally in the options non volatile memory. After a power down the delta speed will be generate from the frequency converter *1-25 Motor Nominal Speed*. This can give a different readout from the frequency converter, but the slope value is maintained.

| Index, Sub-Index | Meaning                       |
|------------------|-------------------------------|
| 1049h 0          | Number of sub-index supported |
| 1049h 1          | Delta speed                   |
| 1049h 2          | Delta time                    |

Table 7.19 6049h vl\_velocity\_deceleration

### 7.4.10 604Ch vl\_dimension\_factor

The vl\_dimension\_factor configures the numerator and denominator of the factor. The vl\_dimension\_factor serves to include gearing in calculation or serves to scale specific units of the user. It influences the vl\_target\_velocity, vl\_velocity\_indexes.

| Index, Sub-Index | Meaning                       |
|------------------|-------------------------------|
| 104Ch 0          | Number of sub-index supported |
| 104Ch 1          | Numerator                     |
| 104Ch 2          | Denominator                   |

Table 7.20 604Ch vl\_dimension\_factor

### 7.4.11 6060h Modes of Operation

This index is used for selection the Danfoss FC profile, MCO profile or the DS 402 profile. The index links directly to *8-10 Control Word Profile*. If this value is changed while in operation, the option enters the "Error PREOP" state.

| Index, 6060h Value | Meaning  |
|--------------------|--|
| -2                 | MCO profile (only possible if MCO305 is mounted) |
| -1                 | FC Profile                                       |
| 2                  | DS 402 profile                                   |

Table 7.21 6060h Modes of Operation

### 7.4.12 6061h Modes of Operation Display

This index is used to display which mode the frequency converter is in. The mode can be changed via index 6060. The values are the same as used for index 6060.

| Index, 6061h Value | Meaning                   |
|--------------------|---------------------------|
| -1                 | Default display operation |

Table 7.22 6061h Modes of Operation Display

### 7.4.13 6502h Supported Frequency Converter Mode

This index informs the user of which operating mode the frequency converter is capable of. Bit 1 is set, indicating that the frequency converter can run DS 402 velocity mode, bit 16 FC profile and 17 indicates MCO profile.

### 7.4.14 6504h Frequency Converter Manufacturer

The data is coded as a string.

#### Emergency Object

This section describes the general layout of the EtherCAT emergency object. The emergency object is used to signal error states in the frequency converters to the master. The frequency converter can be programmed automatically to send the EMCY object if an alarm or warning is activated. The frequency converter resends the EMCY object if one of the alarms or warnings is removed.

#### Communication Object Overview

The EMCY object always consists of 8 bytes data, see *Table 7.23*:

| Byte 0    | Byte 1       | Byte 2                      | Byte 3   | Byte 4   | Byte 5   | Byte 6   | Byte 7   |
|-----------|--------------|-----------------------------|----------|----------|----------|----------|----------|
| EMCY code | Object 1001h | Vendor specific information |          |          |          |          |          |
|           |              | See <i>Table 7.27</i>       | Reserved | Reserved | Reserved | Reserved | Reserved |

Table 7.23 Communication Object Overview

This index does readout the name of the drive manufacturer. Data is coded as a string.

| Index, sub-index | Meaning                       |
|------------------|-------------------------------|
| 6504Ch 0         | Manufacturer "DANFOSS DRIVES" |

Table 7.24 6504h Drive Manufacturer (read only)

| Code (hex) | Meaning                                |
|------------|--|
| 0          | No fault                               |
| 1000       | General fault                          |
| 2130       | Short Circuit                          |
| 2213       | Overcurr. during startup               |
| 2240       | Short to earth                         |
| 2310       | Continuous overcurrent                 |
| 2311       | Current inside the device, No. 1       |
| 3100       | Mains voltage                          |
| 3130       | Phase failure                          |
| 3210       | Overvoltage inside the device          |
| 3220       | Undervoltage inside the device         |
| 3300       | Output voltage                         |
| 4210       | Exceed device temperature              |
| 4310       | Excess frequency converter temperature |
| 5110       | Low voltage power supply               |
| 5112       | +24 V Power supply                     |
| 5210       | Measurement circuit                    |
| 6100       | Internal software fault                |
| 7110       | Brake chopper                          |
| 8100       | Communication                          |
| 8302       | Torque limiting                        |

**Table 7.25 Byte 0 and 1**

|   |              |
|---|--------------|
| 0 | No errors    |
| 1 | Error active |

**Table 7.26 Byte 2**

|         |  |
|---------|--|
| Bit0    | 1, Alarmword 1 has an active Alarm ( <i>16-90 Alarm Word</i> )   |
| Bit1    | 1, Alarmword 2 has an active Alarm ( <i>16-91 Alarm Word 2</i> ) |
| Bit2    | 0, Reserved  |
| Bit3    | 1, Warningword 1 has an active Warning (P 16-92)                 |
| Bit4    | 1, Warningword 2 has an active Warning (P 16-93)                 |
| Bit5-15 | 0, Reserved  |

**Table 7.27 Byte 3**

|          |
|----------|
| Reserved |
|----------|

**Table 7.28 Byte 4 to byte 7**



## 8 Parameters

### 8.1 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> . Press [▲] or [▼] to change a character. Press [◀] and [▶] to move the cursor. When a character is highlighted by the cursor, it can be changed. Press [▲] or [▼] to change a character. A character can be inserted by placing the cursor between two characters and pressing [▲] or [▼]. |  |

| 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:      |  |
| [1]   | Freeze output  | Freezes output frequency until communication resumes.  |
| [2]   | Stop           | Stops with auto restart when communication resumes.  |
| [3]   | Jogging        | Runs the motor at JOG frequency until communication resumes.   |
| [4]   | Max. speed     | Runs the motor at maximum frequency until communication resumes.   |
| [5]   | Stop and trip  | Stops the motor, then resets the frequency converter to restart: via the fieldbus, via [Reset], or via a digital input.  |
| [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           |  |

### 8.2 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* [ 0.1 - 18000.0 s ]     | Enter the maximum time expected to pass between the reception of two consecutive telegrams. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in <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. |

#### 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 [7] <i>Set-up 1</i> , [8] <i>Set-up 2</i> , [9] <i>Set-up 3</i> or [10] <i>Set-up 4</i> . |
| [0]                          | Hold set-up | Retains the set-up selected in <i>8-04 Control Word Timeout Function</i> and displays a warning, until <i>8-06 Reset Control Timeout</i> toggles. Then the frequency converter resumes its original set-up.   |

| 8-05 End-of-Timeout Function |               |  |
|------------------------------|---------------|--|
| Option:                      | Function:     |  |
| [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 [0] Hold set-up has been selected in 8-05 End-of-Timeout Function. |              |   |
| Option:   | Function:    |   |
| [0] *   | Do not reset | Retains the set-up specified in 8-04 Control Word Timeout Function, following a control word time-out.  |
| [1]   | Do reset     | Returns the frequency converter to the original set-up following a control word time-out. The frequency converter performs the reset and then immediately reverts to the [0] Do not reset setting |

| 8-07 Diagnosis Trigger  |           |  |
|---|-----------|--|
| 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><b>NOTE</b></p> <p>The following is only valid for Profibus and EtherCAT.</p> <ul style="list-style-type: none"> <li>- [0] Disable: Do not send extended diagnosis/emergency data even if they appear in the frequency converter.</li> <li>- [1] Trigger on alarms: Send extended diagnosis/emergency data when one or more alarms appear in alarm 16-90 Alarm Word or 9-53 Profibus Warning Word.</li> <li>- [2] Trigger alarms/warn.: Send extended diagnosis/emergency data if one or more alarms or warnings appear in alarm 16-90 Alarm Word, 9-53 Profibus Warning Word, or warning 16-92 Warning Word.</li> </ul> <p>Enabling diagnosis can cause increased bus traffic. Not all fieldbus types support Diagnosis functions.</p> |
| [0] *   | Disable   |  |

| 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:           |  |
| [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:<br>16-10 Power [kW]<br>16-11 Power [hp]<br>16-12 Motor Voltage<br>16-14 Motor Current<br>16-16 Torque [Nm]<br>16-17 Speed [RPM]<br>16-22 Torque [%]<br>16-25 Torque [Nm] High |

| 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. If the parameter is changed while the frequency converter is in operation mode, the frequency converter goes to error state, and the control of the frequency converter is lost. |                 |  |
| 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 Control Profile. |
| [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. "0" indicates that the terminal is low "1" indicates that the terminal is high   |
| [11]                              | T19 DI status.      | The bit indicates the status of terminal 19. "0" indicates that the terminal is low "1" indicates that the terminal is high   |
| [12]                              | T27 DI status.      | The bit indicates the status of terminal 27. "0" indicates that the terminal is low "1" indicates that the terminal is high   |
| [13]                              | T29 DI status.      | The bit indicates the status of terminal 29. "0" indicates that the terminal is low "1" indicates that the terminal is high   |
| [14]                              | T32 DI status.      | The bit indicates the status of terminal 32. "0" indicates that the terminal is low "1" indicates that the terminal is high   |
| [15]                              | T33 DI status.      | The bit indicates the status of terminal 33. "0" indicates that the terminal is low "1" indicates that the terminal is high   |
| [16]                              | T37 DI status       | The bit indicates the status of terminal 37. 0" indicates T37 is low (safe stop) "1" indicates T37 is high (normal)   |
| [21]                              | Thermal warning     | The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor, or the thermistor.   |
| [30]                              | Brake fault (IGBT)  | Output is Logic '1' when the brake IGBT is short-circuited. Use this function to protect the frequency converter if there is a fault on the brake modules. Use the output/relay to cut out the main voltage from the frequency converter. |
| [40]                              | Out of ref. range   |   |
| [60]                              | Comtor 0            | See parameter group 13-1*. If Comtor 0 is evaluated as TRUE, the output goes high. Otherwise, it is low.  |
| [61]                              | Comtor 1            | See parameter group 13-1*. If Comtor 1 is evaluated as TRUE, the output goes high. Otherwise, it is low.  |
| [62]                              | Comtor 2            | See parameter group 13-1*. If Comtor 2 is evaluated as TRUE, the output goes high. Otherwise, it is low.  |
| [63]                              | Comtor 3            | See parameter group 13-1*. If Comtor 3 is evaluated as TRUE, the output goes high. Otherwise, it is low.  |
| [64]                              | Comtor 4            | See parameter group 13-1*. If Comtor 4 is evaluated as TRUE, the output goes high. Otherwise, it is low.  |
| [65]                              | Comtor 5            | See parameter group 13-1*. If Comtor 5 is evaluated as TRUE, the output goes high. Otherwise, it is low.  |

| 8-13 Configurable Status Word STW |                     |   |
|-----------------------------------|---------------------|---|
| Option:                           | Function:           |   |
| [70]                              | Logic Rule 0        | See parameter group 13-4*. 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.  |
| [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] <i>Set digital out A high</i> is executed. The output goes low whenever the Smart Logic Action [32] <i>Set digital out A low</i> 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] <i>Set digital out B high</i> is executed. The input goes low whenever the Smart Logic Action [33] <i>Set digital out B low</i> 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] <i>Set digital out C high</i> is executed. The input goes low whenever the Smart Logic Action [34] <i>Set digital out C low</i> 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] <i>Set digital out D high</i> is executed. The input goes low whenever the Smart Logic Action [35] <i>Set digital out D low</i> 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] <i>Set digital out E high</i> is executed. The input goes low whenever the Smart Logic Action [36] <i>Set digital out E low</i> 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] <i>Set digital out F high</i> is executed. The input goes low whenever the Smart Logic Action [37] <i>Set digital out F low</i> is executed.   |

| 8-14 Configurable Control Word CTW |           |  |
|------------------------------------|-----------|--|
| Option:                            | Function: |  |
| [0]                                | None      | Selection of control word bit 10 if it is active low or active high. |

| 8-14 Configurable Control Word CTW |                       |  |
|------------------------------------|-----------------------|--|
| Option:                            | Function:             |  |
| [1] *                              | Profile default       |  |
| [2]                                | CTW Valid, active low |  |
| [3]                                | Safe Option Reset     |  |
| [4]                                | PID error inverse     | When enabled, it inverts the resulting error from the process PID controller. Available only if "Configuration Mode" is set to "Surface Winder", "Extended PID Speed OL" or "Extended PID Speed CL".                               |
| [5]                                | PID reset I part      | When enabled, resets the I-part of the Process PID controller. Equivalent to 7-40 Process PID I-part Reset. Available only if "Configuration Mode" is set to "Surface Winder", "Extended PID Speed OL" or "Extended PID Speed CL". |
| [6]                                | PID enable            | When enabled, enables the extended process PID controller. Equivalent to 7-50 Process PID Extended PID. Available only if "Configuration Mode" is set "Extended PID Speed OL" or "Extended PID Speed CL".                          |

| 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.<br><b>NOTE</b><br>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. |  |

### 8.3 Parameter Group 12-\*\* Ethernet

#### 8.3.1 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:   |  |
| Size related* [0 - 0 ] | Read only. Displays the lease-time left for the current DHCP-assigned IP address. |  |

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

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

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

#### NOTE

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. |  |

## 8.3.2 12-1\* Ethernet Link Parameters

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

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

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

| 12-12 Auto Negotiation |           |   |
|------------------------|-----------|---|
| Option:                | Function: |   |
|                        |           | Configures Auto Negotiation of Ethernet link parameters, for each port: ON or OFF.      |
| [0]                    | Off       | Link Speed and Link Duplex can be configured in 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 12-12 Auto Negotiation is set to: ON, this parameter is read only and displays the actual link speed. If no link is present, "None" is displayed. |
| [0]              | None      |  |
| [1]              | 10 Mbps   |  |
| [2] *            | 100 Mbps  |  |

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

## 8.3.3 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 *                                 | [8 - 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 *                                | [8 - 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: |
| [0] *              | Off       |
| [1]                | On        |

### 8.3.4 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 first active after a power cycle. If the DIP switches all are set to ON or all to OFF, the display setting has priority over the DIP switch. Else the DIP switch settings has priority over the parameter. In this case the parameter will reflect the setting of the DIP switches. Changes to the DIP switch setting, will first be active after a power up. |

| 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 ] | <p>This parameter contains status information on the EtherCAT interface. Each of the 32 bits are linked to a status information of the EtherCAT interface.</p> <ul style="list-style-type: none"> <li>• Bit 0-7 contains info from ESC register 0x0130 (AL Status)</li> <li>• Bit 8-15 is reserved for future use</li> <li>• Bit 16-27 contains info from ESC register 0x0110 and 0x0111 (DL status)</li> <li>• Bit 28-31 is reserved for future use</li> </ul> <table border="1"> <thead> <tr> <th>Bit</th> <th>0</th> <th>1</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td></td> <td>Init State</td> <td>EtherCAT Statemachine state</td> </tr> </tbody> </table> | Bit        | 0                           | 1 | Meaning | 0 |  | Init State | EtherCAT Statemachine state |
| Bit                   | 0   | 1          | Meaning                     |   |         |   |  |            |                             |
| 0                     |   | Init State | EtherCAT Statemachine state |   |         |   |  |            |                             |

| 12-59 EtherCAT Status |  |  |                             |
|-----------------------|--|--|-----------------------------|
| Range:                | Function:                              |  |                             |
| Bit                   | 0                                      | 1  | Meaning                     |
| 1                     |  | Pre-OP                                   | EtherCAT Statemachine state |
| 2                     |  | Safe-OP                                  | EtherCAT Statemachine state |
| 3                     |  | Operational                              | EtherCAT Statemachine state |
| 4                     |  |  | Reserved                    |
| 5                     |  |  | Reserved                    |
| 6                     |  |  | Reserved                    |
| 7                     |  |  | Reserved                    |
| 8                     |  |  | Reserved                    |
| 9                     |  |  | Reserved                    |
| 10                    |  |  | Reserved                    |
| 11                    |  |  | Reserved                    |
| 12                    |  |  | Reserved                    |
| 13                    |  |  | Reserved                    |
| 14                    |  |  | Reserved                    |
| 15                    |  |  | Reserved                    |
| 16                    | EEPROM not loaded, PDI not operational | EEPROM loaded correctly, PDI operational | PDI Operational             |
| 17                    | Watchdog expired                       | Watchdog reloaded                        | PDI Watchdog Status         |
| 18                    | Deactivated for all ports              | Activated for all ports                  | Enhanced link detection     |
| 19                    |  |  | Reserved                    |
| 20                    | No link                                | Link detected                            | Physical link on Port 0     |
| 21                    | No link                                | Link detected                            | Physical link on Port 1     |
| 22                    |  |  | Reserved                    |
| 23                    |  |  | Reserved                    |
| 24                    | Open                                   | Closed                                   | Loop port 0                 |
| 25                    | No stable communication                | Communication established                | Communication on port 0     |
| 26                    | Open                                   | Closed                                   | Loop port 1                 |
| 27                    | No stable communication                | Communication established                | Communication on port 1     |
| 28                    |  |  | Reserved                    |
| 29                    |  |  | Reserved                    |
| 30                    |  |  | Reserved                    |

| 12-59 EtherCAT Status        |     |           |          |
|------------------------------|-----|-----------|----------|
| Range:                       |     | Function: |          |
|                              | Bit | 0         | 1        |
|                              | 31  |           | Reserved |
| Table 8.1 Bit Interpretation |     |           |          |

| 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. |

### 8.3.5 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. |
| [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. |

### 8.3.6 12-9\* Advanced Ethernet Settings

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

#### NOTE

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



**8.4 EtherCAT-specific Parameter List**

| Parameter                             | Default value         | Range                               | Conversion index | Data type          |
|---------------------------------------|-----------------------|-------------------------------------|------------------|--------------------|
| 8-01 Control Site                     | [0] Dig. & ctrl. word | [0-2]                               | -                | Uint8              |
| 8-02 Control Word Source              | [0] FC RS485          | [0-4]                               | -                | Uint8              |
| 8-03 Control Word Timeout Time        | 1                     | 0.1-18000                           | -1               | Uint32             |
| 8-04 Control Word Timeout Function    | [0] Off               | [0-10]                              | -                | Uint8              |
| 8-05 End-of-Timeout Function          | [0] Hold set-up       | [0-1]                               | -                | Uint8              |
| 8-06 Reset Control Word Timeout       | [0] Do not reset      | [0-1]                               | -                | Uint8              |
| 8-07 Diagnosis Trigger                | [0] Disable           | [0-3]                               | -                | Uint8              |
| 8-10 Control Word Profile             | [0] FC profile        | [0-x]                               | -                | Uint8              |
| 8-13 Configurable Status Word STW     |                       |                                     |                  |                    |
| 8-50 Coasting Select                  | [3] *Logic OR         | [0-3]                               | -                | Uint8              |
| 8-51 Quick Stop Select                | [3] *Logic OR         | [0-3]                               | -                | Uint8              |
| 8-52 DC Brake Select                  | [3] *Logic OR         | [0-3]                               | -                | Uint8              |
| 8-53 Start Select                     | [3] *Logic OR         | [0-3]                               | -                | Uint8              |
| 8-54 Reversing Select                 | [3] *Logic OR         | [0-3]                               | -                | Uint8              |
| 8-55 Set-up Select                    | [3] *Logic OR         | [0-3]                               | -                | Uint8              |
| 8-56 Preset Reference Select          | [3] *Logic OR         | [0-3]                               | -                | Uint8              |
| 8-90 Bus Jog 1 Speed                  | 100 rpm               | 0-4-13 Motor Speed High Limit [RPM] | 67               | Uint16             |
| 8-91 Bus Jog 2 Speed                  | 200 rpm               | 0-4-13 Motor Speed High Limit [RPM] | 67               | Uint16             |
| 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                     | [0] No Link           | [0-1]                               | -                | Unsigned 8         |
| 12-11 Link Duration                   | 00:00:00:00           | -                                   | -                | Time diff. w/ date |
| 12-12 Auto Negotiation                | [1] On                | [0-1]                               | -                | Unsigned 8         |
| 12-13 Link Speed                      | [0] None              | [0-2]                               | -                | Unsigned 8         |
| 12-14 Link Duplex                     | [1] Full Duplex       | [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                        |                  |                    |
| 12-28 Store Data Values               |                       |                                     |                  |                    |
| 12-29 Store Always                    | [0] Off               |                                     |                  |                    |
| 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                      | [0] Disable           | [0-1]                               | -                | Unsigned 8         |
| 12-81 HTTP Server                     | [0] Disable           | [0-1]                               | -                | Unsigned 8         |
| 12-82 SMTP Service                    | [0] Disable           | [0-1]                               | -                | Unsigned 8         |
| 12-89 Transparent Socket Channel Port | [0] Disable           | [0-1]                               | -                | Unsigned 8         |

| Parameter                | Default value | Range   | Conversion index | Data type   |
|--------------------------|---------------|---------|------------------|-------------|
| 12-90 Cable Diagnostic   | [0] Disable   | [0-1]   | -                | Unsigned 8  |
| 12-91 Auto Cross Over    | [0] Enable    | [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      |

**Table 8.2**

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

## 9 Application Examples

### 9.1 Example: 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. In the example the drive is set to FC profile in *8-10 Control Word Profile*. 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  |

Table 9.1

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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.

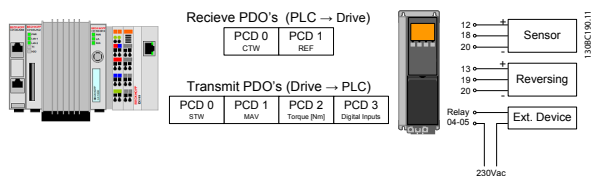


Illustration 9.1

Program the frequency converter as follows:

| Parameter                            | Setting  |
|--------------------------------------|--|
| 4-10 Motor Speed Direction           | [2] Both directions  |
| 5-10 Terminal 18 Digital Input       | [0] No operation   |
| 5-11 Terminal 19 Digital Input       | [10] Reversing   |
| 5-40 Function Relay                  | [36/37] Control word bit 11/12   |
| 8-03 Control Word Timeout Time       | 1 s  |
| 8-04 Control Word Timeout Function   | [2] Stop   |
| 8-10 Control Word Profile            | [0] FC Profile   |
| 8-50 Coasting Select                 | [1] Bus  |
| 8-51 Quick Stop Select               | [1] Bus  |
| 8-52 DC Brake Select                 | [1] Bus  |
| 8-53 Start Select                    | [1] Bus  |
| 8-54 Reversing Select                | [2] Logic AND  |
| 8-55 Set-up Select                   | [1] Bus  |
| 8-56 Preset Reference Select         | [1] Bus  |
| 12-21 Process Data Config Write      | [0] Sub index 16-80 Fieldbus CTW 1<br>[1] Sub index 16-85 FC Port CTW 1  |
| 12-22 Process Data Config Read       | [0] Sub index 16-03 Status Word<br>[1] Sub index 16-05 Main Actual Value [%]<br>[2] Sub index 16-16 Torque [Nm]<br>[3] Sub index 16-60 Digital Input |
| 12-23 Process Data Config Write Size | [0] Sub index 16<br>[1] Sub index 16   |
| 12-24 Process Data Config Read Size  | [0] Sub index 16<br>[1] Sub index 16<br>[2] Sub index 16<br>[3] Sub index 16   |

Table 9.2

## 9.2 Example: 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  | 0  | 1  | 0  | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|          |  | 0   |     |     |     | 4  |    |    |    | 7  |    |    |    | C  |    |    |    | 2  |    |    |    | 0  |    |   |   | 0 |   |   |   | 0 |   |   |   |   |

Table 9.3 Standard Telegram 1 Example

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

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

9

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

Function active

Function inactive

Table 9.4 Bit Functions



| 15-61 Option SW Version | XML File                          |
|-------------------------|-----------------------------------|
| 1.x                     | Danfoss_FC_series_ECACAT_001.XML  |
| 1.x or 2.x              | Danfoss_FC_series_ECACAT_0020.XML |

Table 10.3

### 10.1.3 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. If the drive is not in OP state Warning 34 will appear (60 s after power up or immediately if drive has been in OP).

### 10.1.4 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.

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

Table 10.4 [0] Digital input

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

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

Table 10.5 [1] Serial communication

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

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

Table 10.6 [2] Logic AND

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

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

Table 10.7 [3] Logic OR

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

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

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

Table 10.8 [0] Digital input

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

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

Table 10.9 [1] Serial communication

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

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

Table 10.10 [2] Logic AND

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

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

Table 10.11 [3] Logic OR

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

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

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

Table 10.12 [0] Digital input

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

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

Table 10.13 [1] Serial communication



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

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

Table 10.14 [2] Logic AND

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

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

Table 10.15 [3] Logic OR

### 10.1.5 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.

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

Table 10.16

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

Table 10.17

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

Table 10.18

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

Table 10.19

**NOTE**

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

## 10.1.6 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 [0] *FALSE* means no warning, while bit status [1] *TRUE* means warning. Any bit change in the warning word is notified by a change of bit 7 in the status word.

### Alarms

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

# 11 Warnings and Alarms

## 11.1 Status Messages

### 11.1.1 Warnings/Alarm Messages

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

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

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

**Three ways of resetting alarms:**

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

**NOTE**

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

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

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

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

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

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

### 11.1.2 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 |

| No. | Description                            | Warning | Alarm/Trip        | Alarm/Trip Lock | Parameter Reference                             |
|-----|--|---------|-------------------|-----------------|---|
| 22  | Hoist Mech. Brake                      |         |                   |                 |   |
| 23  | Internal Fan Fault                     | X       |                   |                 |   |
| 24  | External Fan Fault                     | X       |                   |                 | 14-53 Fan Monitor                               |
| 25  | Brake resistor short-circuited         | X       |                   |                 |   |
| 26  | Brake resistor power limit             | (X)     | (X)               |                 | 2-13 Brake Power Monitoring                     |
| 27  | Brake chopper short-circuited          | X       | X                 |                 |   |
| 28  | Brake check                            | (X)     | (X)               |                 | 2-15 Brake Check                                |
| 29  | Heatsink temp                          | X       | X                 | X               |   |
| 30  | Motor phase U missing                  | (X)     | (X)               | (X)             | 4-58 Missing Motor Phase Function               |
| 31  | Motor phase V missing                  | (X)     | (X)               | (X)             | 4-58 Missing Motor Phase Function               |
| 32  | Motor phase W missing                  | (X)     | (X)               | (X)             | 4-58 Missing Motor Phase Function               |
| 33  | Inrush Fault                           |         | X                 | X               |   |
| 34  | Fieldbus communication fault           | X       | X                 |                 |   |
| 36  | Mains failure                          | X       | X                 |                 |   |
| 38  | Internal Fault                         |         | X                 | X               |   |
| 39  | Heatsink sensor                        |         | X                 | X               |   |
| 40  | Overload of Digital Output Terminal 27 | (X)     |                   |                 | 5-00 Digital I/O Mode,<br>5-01 Terminal 27 Mode |
| 41  | Overload of Digital Output Terminal 29 | (X)     |                   |                 | 5-00 Digital I/O Mode,<br>5-02 Terminal 29 Mode |
| 42  | Overload of Digital Output On X30/6    | (X)     |                   |                 | 5-32 Term X30/6 Digi Out (MCB<br>101)           |
| 42  | Overload of Digital Output On X30/7    | (X)     |                   |                 | 5-33 Term X30/7 Digi Out (MCB<br>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<br>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) <sup>1)</sup> |                 | 5-19 Terminal 37 Safe Stop                      |
| 69  | Pwr. Card Temp                         |         | X                 | X               |   |
| 70  | Illegal FC configuration               |         |                   | X               |   |
| 71  | PTC 1 Safe Stop                        | X       | X <sup>1)</sup>   |                 | 5-19 Terminal 37 Safe Stop                      |
| 72  | Dangerous Failure                      |         |                   | X <sup>1)</sup> | 5-19 Terminal 37 Safe Stop                      |

| No.     | Description                                   | Warning | Alarm/Trip | Alarm/Trip Lock | Parameter Reference                   |
|---------|---|---------|------------|-----------------|---------------------------------------|
| 73      | Safe Stop Auto Restart                        |         |            |                 |                                       |
| 77      | Reduced power mode                            | X       |            |                 | 14-59 Actual Number of Inverter Units |
| 79      | Illegal PS config                             |         | X          | X               |                                       |
| 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 <i>Operating Instructions for MCO 305</i> |         |            |                 |                                       |
| 243     | Brake IGBT                                    | X       | X          |                 |                                       |
| 244     | Heatsink temp                                 | X       | X          | X               |                                       |
| 245     | Heatsink sensor                               |         | X          | X               |                                       |
| 246     | Pwr.card supply                               |         | X          | X               |                                       |
| 247     | Pwr.card temp                                 |         | X          | X               |                                       |
| 248     | Illegal PS config                             |         | X          | X               |                                       |
| 250     | New spare part                                |         |            | X               | 14-23 Typecode Setting                |
| 251     | New Type Code                                 |         | X          | X               |                                       |

**Table 11.1 Alarm/Warning Code List**

(X) Dependent on parameter

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

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

|             |                |
|-------------|----------------|
| Warning     | yellow         |
| Alarm       | flashing red   |
| Trip locked | yellow and red |

**Table 11.2 LED Indication**

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

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

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

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