



Programming Guide

CANopen[®]

VLT[®] Midi Drive FC 280



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1 Introduction

1.1 Purpose of the Manual

The *VLT® CANopen® Programming Guide* provides information about configuring the system, controlling the frequency converter, accessing parameters, programming, and troubleshooting.

The programming guide is intended for use by qualified personnel who are familiar with the VLT® frequency converter, with CANopen technology, and with the PC or PLC that is used as a master in the system.

Read the instructions before programming and follow the procedures in this manual.

CANopen® is a registered trademark for CAN IN AUTOMATION international users and manufacturers group e. V.

VLT® is a registered trademark.

1.2 Additional Resources

Additional documentation available for the product:

- *VLT® Midi Drive FC 280 Operating Guide* provides the necessary information for getting the frequency converter up and running.
- *VLT® Midi Drive FC 280 Design Guide* provides detailed information about capabilities and functionality to design motor control systems.
- *VLT® Midi Drive FC 280 Programming Guide* provides greater detail on working with parameters and many application examples.
- *VLT® CANopen Programming Guide* provides information about configuring the system, controlling the frequency converter, accessing parameters, programming, troubleshooting, and some typical application examples.
- *VLT® Midi Drive FC 280 Control Cassettes Installation Instruction* describes how to install a control cassette.

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

1.3 Document and Software Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome. *Table 1.1* shows the document version and the corresponding software version.

Edition	Remarks	Software version
MG07E1xx	New manual	1.1 or later

Table 1.1 Document and Software Version

1.4 Product Overview

This programming guide relates to the CANopen interface.

CANopen is a low-level network that standardizes communications between industrial devices (sensors, limit switches, motor controls) and high-level devices (controllers). CANopen follows the open systems interconnection (OSI) model and is based on CAN technology for media access control and physical signaling.

Configure CANopen systems to operate in a master/slave or a distributed control architecture using peer-to-peer communication. Up to 127 nodes in a multi-drop network topology are supported. Nodes can be removed or inserted without powering down the network.

Each node on the network has its own unique node ID to distinguish it on the network. The access control is based on the carrier sense multiple access/collision avoidance (CSMA/CA) principle, meaning that all nodes may have access to the network at the same time. When 2 nodes attempt to get control of the network bus simultaneously, the CAN protocol resolves the issue by arbitration. This allows to avoid collisions on the network.

CANopen defines device profiles for devices belonging to specific classes. For other devices, define a custom class to make it CANopen compatible. All of the above enhances the interchangeability and interoperability of the network.

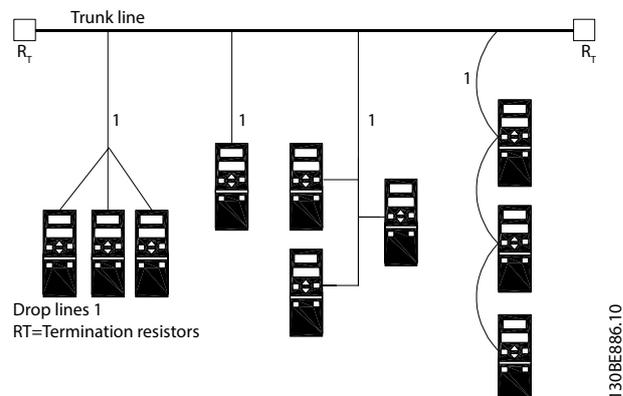


Illustration 1.1 Topology

1.5 Approvals and Certifications



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

1.6 Symbols, Abbreviations, and Conventions

Abbreviation	Definition
CAN	Controller area network
CIA	CAN in automation
COB	Communication object
COB-ID	Communication object identifier
CTW	Control word
EDS	Electronic datasheet
EMC	Electromagnetic compatibility
EMCY	Emergency message
I/O	Input/output
LCP	Local control panel
LED	Light emitting diode
LOP	Local operation pad
LSB	Least significant bit
MAV	Main actual value (actual output)
MRV	Main reference value
MSB	Most significant bit
NMT	Network management
N/A	Not applicable
OD	Object directory
PCD	Process data
PDO	Process data object
PLC	Programmable logic controller
PNU	Parameter number
REC	Receive error counter
RPDO	Receive process data object
RPM	Revolutions per minute; unit for the speed of a revolving motor
RTR	Remote transmission request frame
RX	Receive data
STW	Status word
SDO	Service data object
SYNC	Object for synchronization of process data
TEC	Transmit error counter
TPDO	Transmit process data object
TX	Transmit data

Table 1.2 Symbols and Abbreviations

Conventions

Numbered lists indicate procedures.

Bullet lists indicate other information and description of illustrations.

Italicized text indicates:

- Cross-reference.
- Link.
- Parameter name.
- Footnote.
- Parameter group.
- Parameter option.
- Alarms/warnings.

2 Safety

2.1 Safety Symbols

The following symbols are used in this guide:

⚠️ WARNING

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

⚠️ CAUTION

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

NOTICE

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

2.2 Qualified Personnel

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

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

2.3 Safety Precautions

⚠️ WARNING

HIGH VOLTAGE

Frequency converters contain high voltage when connected to AC mains input, DC supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

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

⚠️ WARNING

UNINTENDED START

When the frequency converter is connected to AC mains, DC supply, or load sharing, the motor may start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. The motor can start with an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up Software, or after a cleared fault condition.

To prevent unintended motor start:

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

⚠️ WARNING

DISCHARGE TIME

The frequency converter contains DC-link capacitors, which can remain charged even when the frequency converter is not powered. High voltage can be present even when the warning LED indicator lights are off. Failure to wait the specified time after power has been removed before performing service or repair work can result in death or serious injury.

- Stop the motor.
- Disconnect AC mains and remote DC-link supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters.
- Disconnect or lock PM motor.
- Wait for the capacitors to discharge fully. The minimum waiting time is specified in *Table 2.1*.
- Before performing any service or repair work, use an appropriate voltage measuring device to make sure that the capacitors are fully discharged.

Voltage [V]	Power range [kW (hp)]	Minimum waiting time (minutes)
200–240	0.37–3.7 (0.5–5)	4
380–480	0.37–7.5 (0.5–10)	4
	11–22 (15–30)	15

Table 2.1 Discharge Time

⚠ WARNING**LEAKAGE CURRENT HAZARD**

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

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

⚠ WARNING**EQUIPMENT HAZARD**

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

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

⚠ CAUTION**INTERNAL FAILURE HAZARD**

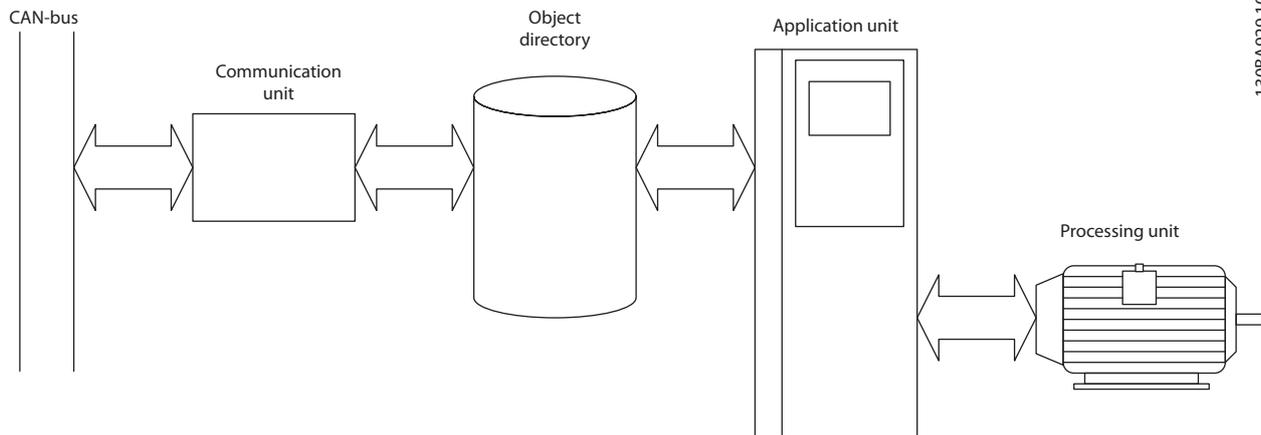
An internal failure in the frequency converter can result in serious injury when the frequency converter is not properly closed.

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

3 Configuration

3.1 Configure the CANopen Network

3.1.1 Object Model



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Illustration 3.1 Functional Principle of CANopen Nodes

All information accessible via the CAN bus is stored in the object directory (OD). The contents of the OD are organized in *Table 3.1*.

Object directory index range	Object type
0000h	Not used
0001h–025Fh	Data types
0260h–0FFFh	Reserved
1000h–1FFFh	Communication object area
2000h–5FFFh	Manufacturer-specific area
6000h–9FFFh	Standardized device profile area
A000h–FFFFh	Reserved

Table 3.1 Contents of the OD

For a complete overview of the objects supported in the OD, refer to *chapter 7 Object Directory*.

3.1.2 Communication in CANopen

In CANopen protocol, the communication is done via service data objects (SDOs), process data objects (PDOs), and network management (NMT).

PDOs are real-time process data with high priority. PDOs are only available if the node is in operational state.

SDOs are non-time-critical data and are used to configure the frequency converter. SDOs are only available if the node is in both operational and pre-operational state.

NMT functions monitor the network stability and include synchronization, detection of faults, and emergency message transmission.

COB identifiers (ID)

Each communication object has a unique identity (COB-ID) containing the function code and the node ID (node address), see *Illustration 3.2*.



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Illustration 3.2 COB-ID

Object	Function code (binary)	Resulting COB-ID	Communication parameter in OD
NMT	0000	0	-
SYNC	0001	125	(1005h)
Time stamp	0010	256	-
EMERGENCY	0001	129 (81h)–255 (FFh)	1014h
PDO1 (tx)	0011	385 (181h)–511 (1FFh)	1800h
PDO1 (rx)	0100	513 (201h)–639(27Fh)	1400h
PDO2 (tx)	0101	641 (281h)–767(2FFh)	1801h
PDO2 (rx)	0110	769 (301h)–895 (37Fh)	1401h
PDO3 (tx)	0111	897 (381h)–1023 (3FFh)	1802h
PDO3 (rx)	1000	1025 (401h)–1151 (47Fh)	1402h
PDO4 (tx)	1001	1153 (481h)–1279 (4FFh)	1803h
PDO4 (rx)	1010	1281 (501h)–1407 (57Fh)	1403h
SDO (tx)	1011	1409 (581h)–1535 (5FFh)	1200h - ...
SDO (rx)	1100	1537 (601h)–1663 (67Fh)	1200h - ...
NMT error control (node guarding)	1110	1793 (701h)–1919 (77Fh)	1016h, 1017h (100Eh)

Table 3.2 Communication Object

Transmit and receive is always seen from the point of view of a node:

- RX: Nodes receiving data (controller to node).
- TX: Nodes transmitting data (node to controller).

Example:

- COB-ID 383 stands for PDO3 transmit from node address 3.
- COB-ID 185 stands for PDO1 transmit from node address 5.
- COB-ID 604 stands for SDO receive to node address 4.

3.1.3 Controlling the Network

In each CANopen node, a state machine controls the different states of the node. After power-up, the node transmits a boot-up message with the COB-ID value 700h+node ID, and goes from initialization to pre-operational state.

In the pre-operational state, SDO communication is possible, but not PDO communication. The node must receive a start network command from an NMT master to enter the operational state. In operational state, both SDO and PDO communications are possible.

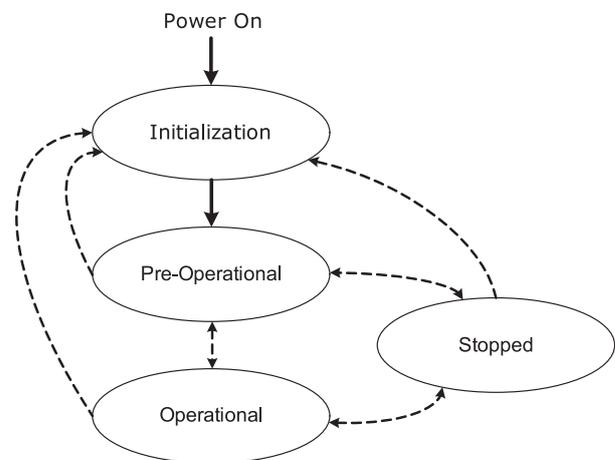
The NMT state of the node is shown with the green indicator light:

- Blinking: Pre-operational.
- On: Operational.
- Single flash: Stopped.

A node reset, or communication reset command from the NMT master puts the node to the initialization state. When the initialization is finished, the node enters pre-operational state automatically.

NOTICE

It may take several seconds to reset a frequency converter with the NMT node reset command. The reset time depends on the power size of the frequency converter. Greater power size may require a longer reset time.



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Illustration 3.3 Controlling the Network

3.1.4 Error Control

CANopen has 2 types of error control: Node guarding and heartbeat.

In node guarding, the NMT master sends a remote frame (RTR) signal cyclically with the following COB-ID: 700h +node ID.

The node replies with its actual status.

The frequency converter monitors the reception of the RTR frames, and the presence of the NMT master.

Configure the monitoring of the NMT master via the following OD:

- 100C: Guard time in [ms].
- 100D: Life time factor.

If the time equal to (guard time) x (life time factor) has expired, the action selected in *parameter 8-04 Control Word Timeout Function* is executed.

The frequency converter can also be configured as heartbeat producer via object 1017h (producer heartbeat time). The frequency converter continuously transmits heartbeats that can be monitored by, for example, an NMT master.

NOTICE

The CANopen control card does not support the heartbeat consumer function.

Emergency object (EMCY)

The emergency object communicates error states, and it is sent automatically if an alarm in the frequency converter occurs. If the alarm ceases, another emergency telegram is sent out with the content 0, indicating the end of the alarm state.

Configure the behavior of the EMCY object via *parameter 8-07 Diagnosis Trigger*.

OD 1014h contains the COB-ID of the node's EMCY message, the COB-ID value is set to 80h+node ID.

The EMCY always consists of 8 bytes with the full data as described in *Table 3.3*.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
EMCY code ¹⁾ (OD: 1003 [1])	OD: 1001h	Vendor-specific information					

Table 3.3 EMCY Consists of 8 Bytes with the Full Data

1) For more information on EMCY codes, refer to chapter 8 *Troubleshooting*.

Bit 0	1, alarm word 1 has an active alarm (parameter 16-90 Alarm Word).
Bit 1	1, alarm word 2 has an active alarm (parameter 16-91 Alarm Word 2).
Bit 2	1, alarm word 3 has an active alarm (parameter 16-97 Alarm Word 3).
Bit 3	1, warning word 1 has an active warning (parameter 16-92 Warning Word).
Bit 4	1, warning word 2 has an active warning (parameter 16-93 Warning Word 2).
Bit 5-7	0, reserved.

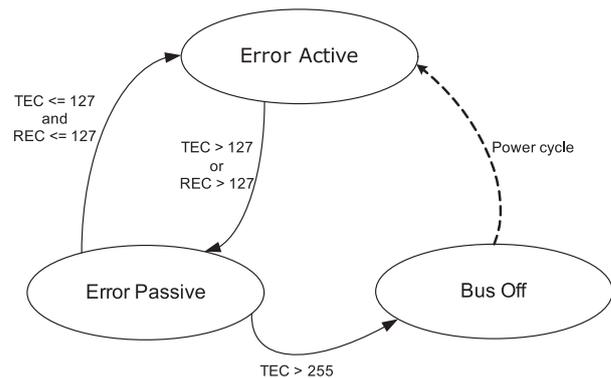
Table 3.4 Byte 3 Description

Bus error counters

The frequency converter contains 2 CAN bus error counters:

- *Parameter 10-05 Readout Transmit Error Counter (TEC).*
- *Parameter 10-06 Readout Receive Error Counter (REC).*

These counters determine the error-state of the CANopen node.



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Illustration 3.4 Bus Error Counters

TEC is incremented with 8 if a transmit error occurs, and decremented with 1 if a transmission is successful. REC is incremented with 1 if a receive error occurs or with 8 if the transmitting node is in error-active state, and decremented with 1 if a reception is successful.

In normal operation, the node is in error-active state. If TEC or REC exceeds the value 127, the node enters error-passive state. In error-passive state, the error flag is transmitted recessively. This means that an error-passive node, as a receiver, cannot block communication for other nodes. A node in the error-passive state has a lower-prioritized access to the bus.

If TEC exceeds 255 (248+8), the node enters the bus-off state.

In bus-off state, the Err indicator light turns solid red, and the frequency converter issues *warning 34, Fieldbus communication fault*.

Power cycle the frequency converter to cancel the bus-off state.

3.1.5 SDO Communication

All CANopen objects and frequency converter parameters can be accessed via service data objects (SDO). For a description of supported SDO abort codes, refer to *chapter 8 Troubleshooting*.

COB-ID		
Transmit SDO	1409 (581h)–1535 (5FFh)	580h+Node ID
Receive SDO	1537 (601h)–1663 (67Fh)	600h+Node ID

Table 3.5 COB-IDs for SDO Communication

COB-ID	CS	OD index	Subindex	Data
600+ID	See following text	01	20	00 00 00 00

Table 3.6 Structure of a SDO-message (Request)

The CS field contains the command and response specifiers. See *Table 3.7* and *Table 3.8*.

Command	CS
Write request 4 bytes	23h
Write request 2 bytes	2Bh
Write request 1 byte	2Fh
Read request (any)	40h

Table 3.7 Command

Response	CS
Write response (any)	60h
Read response 4 bytes	43h
Read response 2 bytes	4Bh
Read response 1 byte	4Fh
Error response	80h

Table 3.8 Response

Saving OD entries

In a standard configuration, all parameters and OD entries are stored in volatile (RAM) memory only. To store current network configuration in non-volatile memory, use OD with index 1010h.

To save parameters, write the value 65766173 (save) to the following subindex in OD: 1010h.

OD index	Subindex	Description
1010h	0	Number of entries.
	1	Save all communication parameters and frequency converter parameters.
	2	Save all communication parameters.
	3	Reserved.
	4	Save all frequency converter parameters (all set-ups).

Table 3.9 Saving OD Entries

Restoring OD entries

To restore factory defaults, use OD index 1011h.

To restore default parameters, write the value 64616F6C (load) to the following subindex in OD: 1011h.

OD index	Subindex	Description
1011h	0	Number of entries.
	1	Restore all communication parameters and frequency converter parameters ¹⁾ .
	2	Restore all communication parameters.
	3	Reserved.
	4	Restore all frequency converter parameters (all set-ups).

Table 3.10 Restoring OD Entries

1) Requires power cycle.

NOTICE

Frequency converter shows *alarm 80, Drive initialized after the restore*.

3.2 Configure the Master

3.2.1 EDS File

Electronic datasheet (EDS) files simplify the setting of most of the CANopen configurable parameters.

The EDS file contains:

- All supported communication-specific objects (OD range 1000h–1FFFh).
- A selected number of frequency converter parameters (OD range 2000h–5FFFh).
- DSP 402 profile objects (OD range 6000h–6FFFh).

Danfoss provides a generic English EDS file covering all voltage and power sizes for off-line configuration.

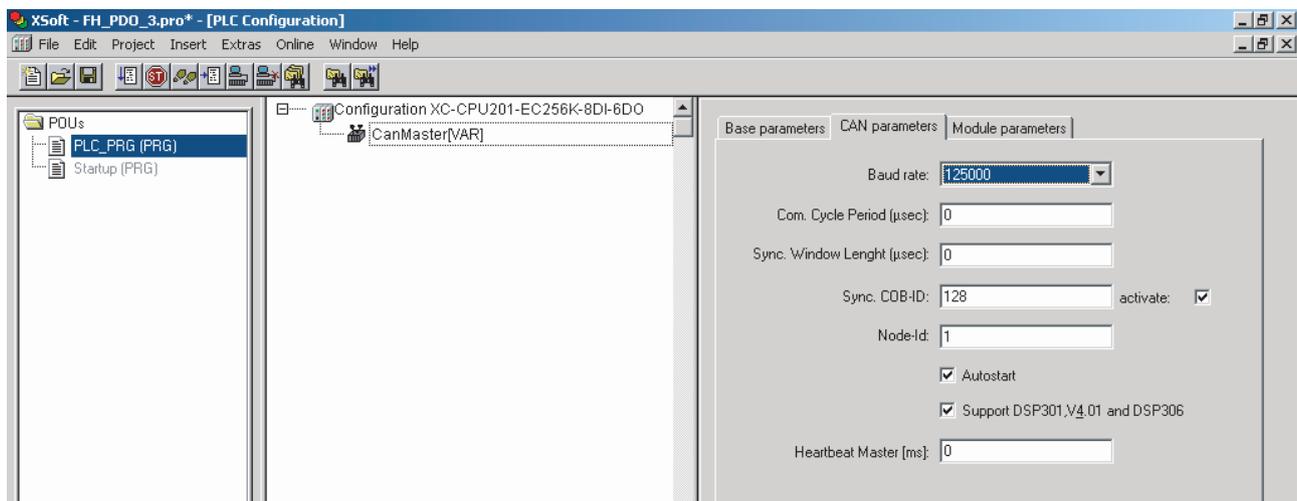
Download the EDS file from drives.danfoss.com/services/software-downloads/.

NOTICE

An EDS file does not contain all parameters, but a selected number of parameters with generic minimum, maximum, and default values.

3.2.2 Configuring the CANopen Master

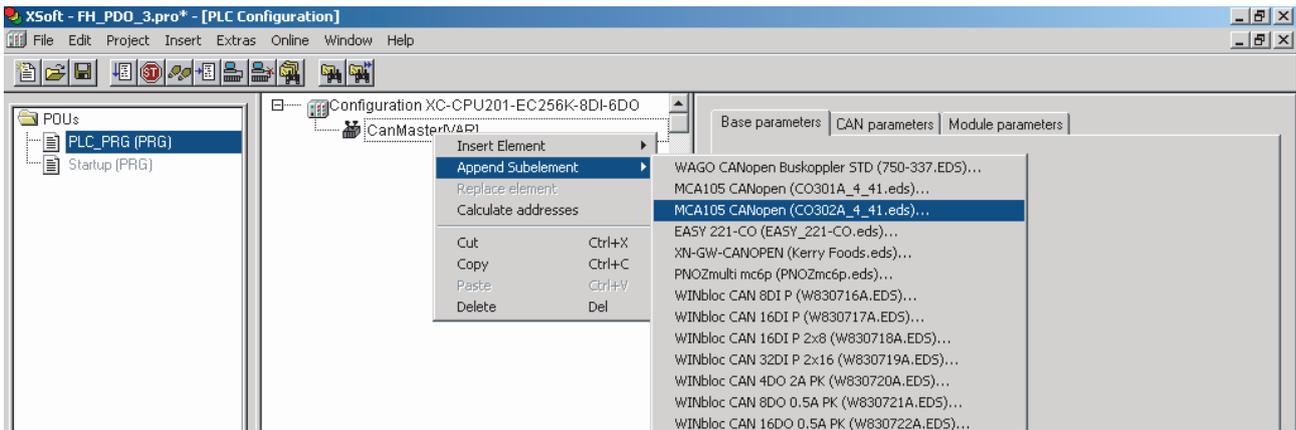
The example in this section shows how to set up the CANopen configuration on a Moeller XC-CPU201 PLC.



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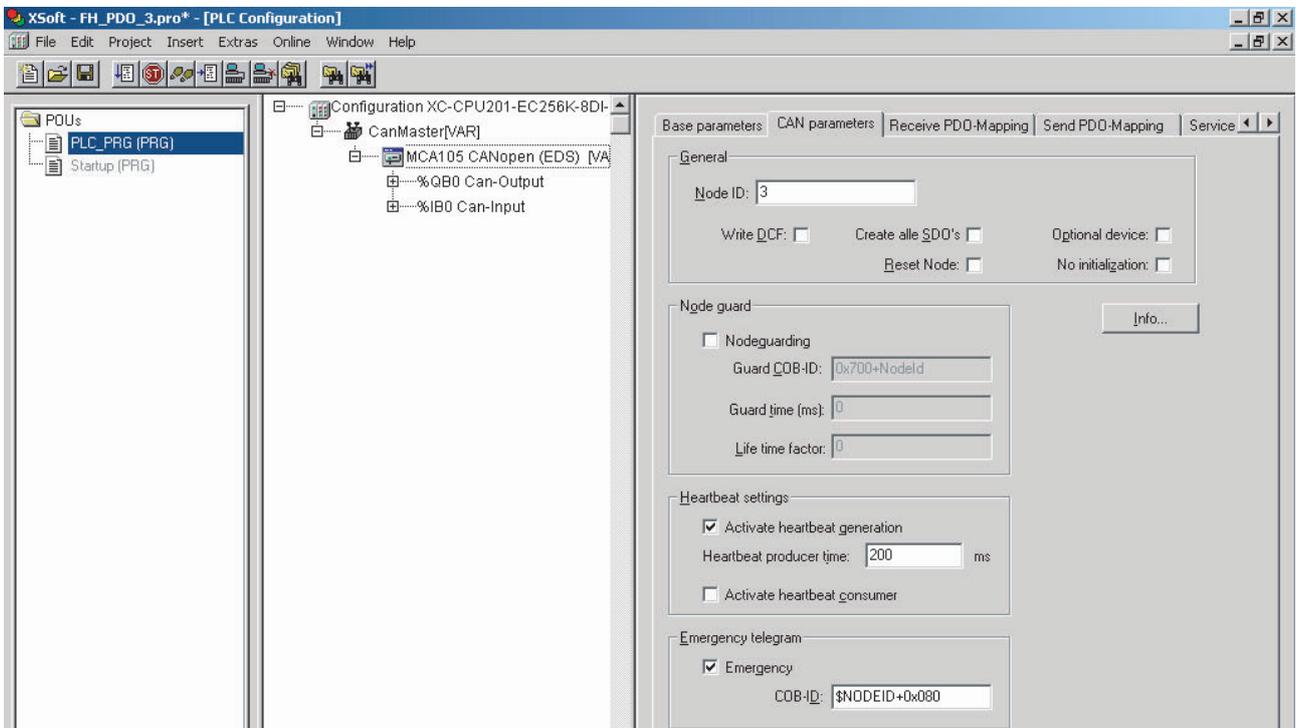
Illustration 3.5 Enter Baud Rate and Node-ID on the CanMaster (CANopen Scanner)

3



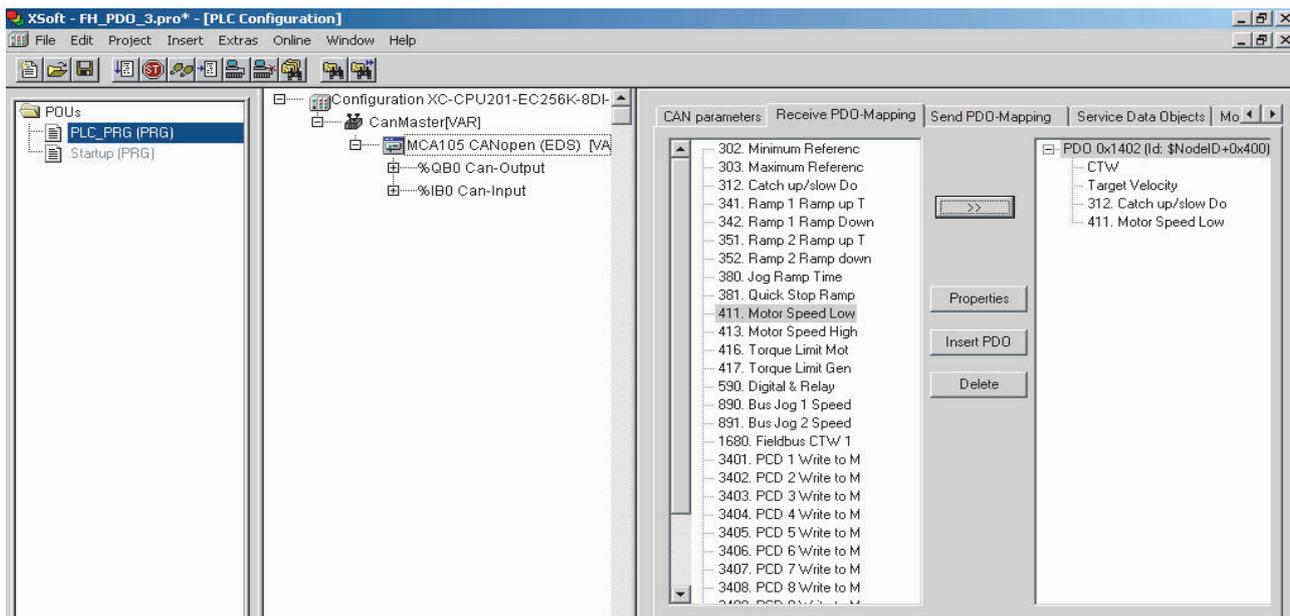
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Illustration 3.6 Right-click CanMaster and Append a CANopen Node from EDS File Library



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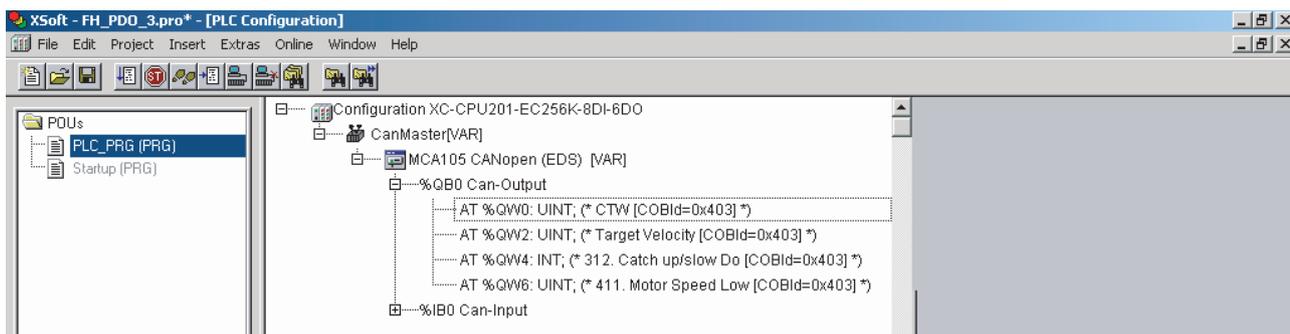
Illustration 3.7 Configure the CAN Parameters on the Node (Node-ID, Node-guarding, Heartbeat, and so on)



3

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Illustration 3.8 Configure Receive and Transmit PDO-mapping



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Illustration 3.9 PLC Memory Mapping

3.3 Configure the Frequency Converter

3.3.1 Frequency Converter Parameters

The following parameters are most important when configuring the frequency converter with a CANopen interface. Refer to *chapter 6 Parameters* for more details about each parameter.

Parameter 0-40 [Hand on] Key on LCP

Pressing the [Hand On] key (when the key is enabled) on the LCP disables the control of the frequency converter via the CANopen interface.

Parameter 8-02 Control Word Source

After initial power-up, the frequency converter automatically sets *parameter 8-02 Control Source* to [3] *Option A*, which means that the control word comes from the CANopen port.

Parameter 8-10 Control Word Profile

Select between the frequency converter profile and the DSP 402 profile for CANopen. Refer to *chapter 4 Control*.

Parameter 8-01 Control Site, parameter 8-50 Coasting Select – parameter 8-56 Preset Reference Select

Select how CANopen control commands gate with digital input commands of the control card.

Set *parameter 8-01 Control Site* to: [2] *Control word only* or [0] *Digital and ctrl. word*. For more information, refer to *chapter 4 Control*.

NOTICE

When *parameter 8-01 Control Site* is set to [2] *Control word only*, the settings in *parameter 8-50 Coasting Select – parameter 8-56 Preset Reference Select* are overruled.

Parameter 8-03 Control Word Timeout Time, parameter 8-04 Control Timeout Function

Enter the timeout time and select the timeout function. The reaction in the event of a bus timeout is set in these parameters:

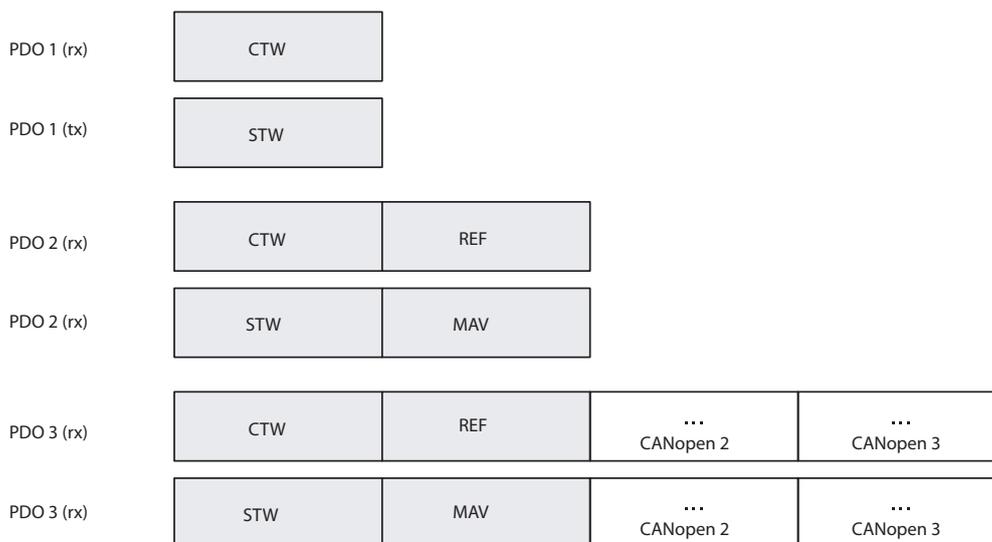
- *Parameter 10-01 Baud Rate Select*.
- *Parameter 10-02 Node ID*.

4 Control

4.1 PDO Communication

The real-time data transfer is performed by process data objects (PDO).

The PDOs correspond to entries in the device object dictionary and provide the interface to the application objects.



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Illustration 4.1 PDO Types

NOTICE

PDO type 1–3 are freely configurable.

All receive and transmit PDOs can be configured via the OD.

Map the process data:

- Receiving PDOs: OD 1600–1602.
- Transmitting PDOs: OD 1A00–1A02.

4.1.1 PDO Configuration

4

Index and name	Sub-index	Description	Value subindex 2	Transmission type
1400h 1 st receive PDO (RPDO 1)	0	Number of entries	1–240	SYNC
1401h 2 nd receive PDO (RPDO 2)	1	COB ID	254–255	COS
1402h 3 rd receive PDO (RPDO 3)	2	Transmission type	–	–
1600h 1 st receive PDO mapping (RPDO 1)	0	Number of entries	–	–
1601h 2 nd receive PDO mapping (RPDO 2)	1	1 st mapped object	–	–
1602h 3 rd receive PDO mapping (RPDO 3)	2	2 nd mapped object	–	–
	3	3 rd mapped object	–	–
	4	4 th mapped object	–	–
	5	5 th mapped object	–	–
	6	6 th mapped object	–	–
	7	7 th mapped object	–	–
	8	8 th mapped object	–	–
1800h 1 st transmit PDO (TPDO 1)	0	Number of entries	0	SYNC, non-cyclic
1801h 2 nd transmit PDO (TPDO 2)	1	COB ID	1–240	SYNC
1802h 3 rd transmit PDO (TPDO 3)	2	Transmission type	254–255	COS
	3	Inhibit time	–	–
	4	Reserved	–	–
	5	Event timer	–	–
1A00h 1 st transmit PDO mapping (TPDO 1)	0	Number of entries	–	–
1A01h 2 nd transmit PDO mapping (TPDO 2)	1	1 st mapped object	–	–
1A02h 3 rd transmit PDO mapping (TPDO 3)	2	2 nd mapped object	–	–
	3	3 rd mapped object	–	–
	4	4 th mapped object	–	–
	5	5 th mapped object	–	–
	6	6 th mapped object	–	–
	7	7 th mapped object	–	–
	8	8 th mapped object	–	–

Table 4.1 Receive PDO Configuration

4.1.2 PDO Transmission Modes

Subindex 2 contains the setting of the transmission mode.

The following PDO transmission modes are supported:

- Synchronous transmission.
- Asynchronous transmission.

4.1.3 PDO Triggering Modes

The CANopen communication profile has 2 message-triggering modes:

- Event driven.
- Remotely requested.

Event driven

An object-specific event triggers the message transmission. For synchronous PDOs, this is the expiration of the specified transmission period, synchronized by the reception of the SYNC object.

For acyclically transmitted synchronous PDOs and asynchronous PDOs, application-specific events specified in the device profile trigger the message transmission.

Remotely requested

A remote device can initiate the transmission of asynchronous PDOs.

Transmission type	PDO transmission				
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only
0	–	x	x	–	–
1–240	x	–	x	–	–
241–251	Reserved				
252	Not supported				
253					
254	–	–	–	x	–
255	–	–	–	x	–

Table 4.2 PDO Transmission

4.1.4 Inhibit Time

Subindex 3 contains the inhibit time.

This time defines a minimum interval for PDO transmission. The value is defined in multiples of 0.1 ms.

Default value is 300 (30 ms).

Minimum value is 0.

Maximum value is 32767 (3.2 s).

Data length is 2 bytes.

4.1.5 Event Timer

Subindex 5 contains the inhibit time for transmit PDOs.

If an event timer is configured for a TPDO (value not equal to 0), the elapsed timer causes the transmission of this TPDO.

The event timer can be configured in multiples of 1 ms. Default value is 0.

Maximum value is 32767 (32 s).

Data length is 2 bytes.

4.2 Control Profile

Select the control word profile in *parameter 8-10 Control Word Profile*.

4.3 DSP 402 Control Profile

4.3.1 Objects in DSP 402 Profile

Use the objects defined in DSP 402 profile to control the frequency converter. The CANopen control cassette supports the following objects in DSP 402 profile:

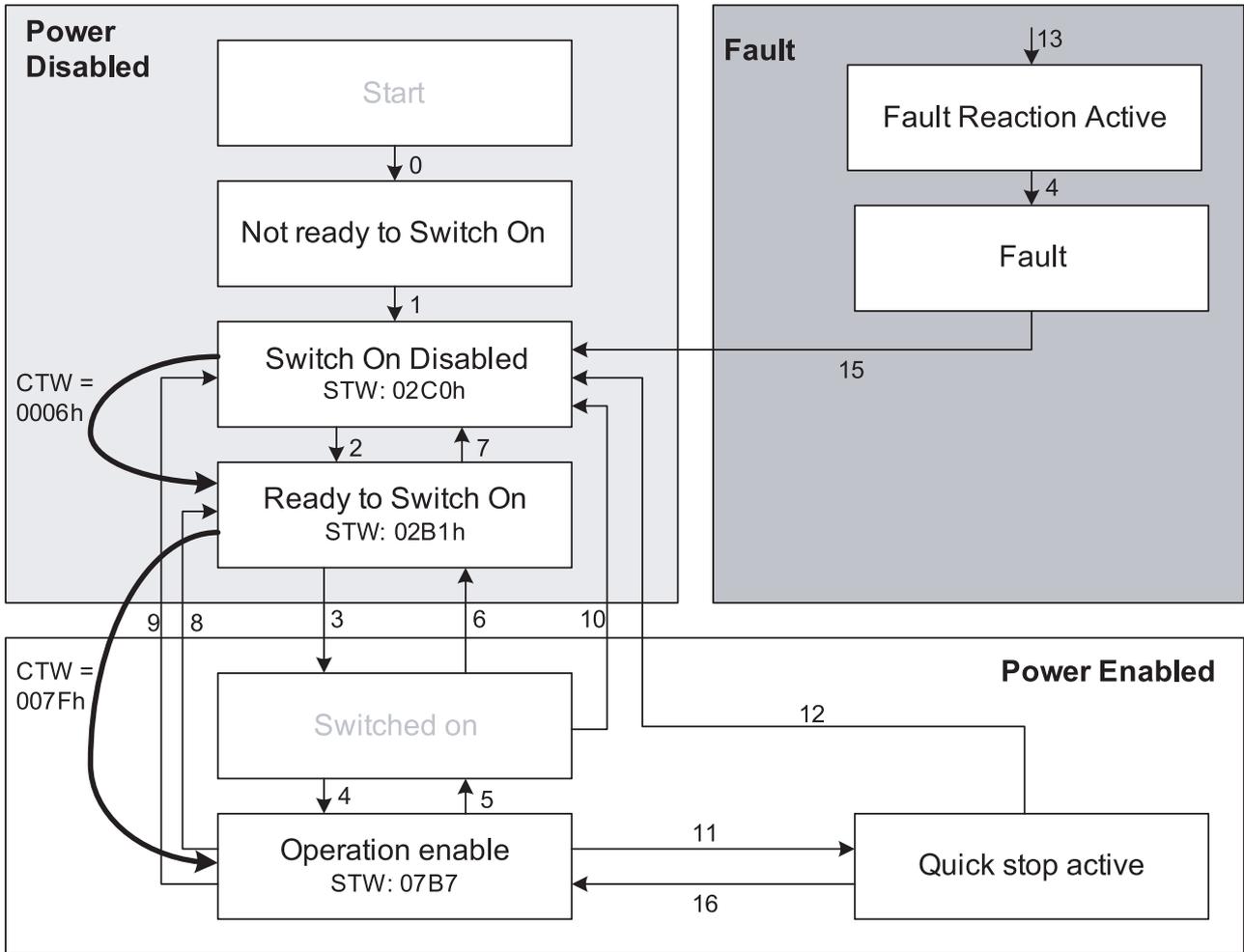
- Object 6040h: Control word.
- Object 6041h: Status word.
- Object 6042h: VI target velocity.
- Object 6042h: VI target velocity.
- Object 6043h: VI velocity demand.
- Object 6044h: VI control effort.
- Object 6046h: VI velocity minimum/maximum amount.
- Object 6048h: VI velocity acceleration.
- Object 6049h: VI velocity deceleration.
- Object 604Ah: VI velocity quick stop.
- Object 604Ch: VI dimension factor.
- Object 6502h: Supported frequency converter modes.

When *parameter 8-10 Control Word Profile* is set to [5] *CANopen DSP 402*:

- Use object 6040h as control word.
- Use object 6042h as reference.

4.3.2 DSP 402 State Transitions

4



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Illustration 4.2 DSP 402 State Machine

Transition	State	Control word	Status word	Action
–	Start condition	0000	0000	–
0	Start-up⇒Not ready to switch on	0000	0200	–
1	Not ready to switch on⇒Switch on disabled	0000, 0001	0240	–
2	Switch on disable⇒Ready to switched on	0006	0231	–
3	Ready to switch on⇒Switched on	0007	0233	–
4	Switched on⇒Operation enabled	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	The power section is switched off immediately, and the motor is free to rotate if unbraked.
9	Operation enable⇒Switch on disable	0001, 0000	0240	The power section is switched off immediately, and the motor is free to rotate if unbraked.
10	Switched on⇒Switched on disable	0001, 0000	0240	The power section is switched off immediately, and the motor is free to rotate if unbraked.
11	Operation enabled⇒Quick stop active	0002	0207	The motor ramps to 0 RPM with the programmed quick-ramp parameter.
12	Quick stop active⇒Switch on disabled	0001, 0000	0240	The power section is switched off immediately, and the motor is free to rotate if unbraked.
13	All states⇒Fault reaction active	xxxx	023F	–
14	Fault reaction active⇒Fault	xxxx	023F (0238 by InterBus)	–
15	Fault⇒Switch on disabled	0000	0240	–
16	Quick stop active⇒Operation enable (not supported)	–	–	–

Table 4.3 DSP 402 State Transitions

4.3.3 Control Word According to DSP 402 Profile (Object 6040h)

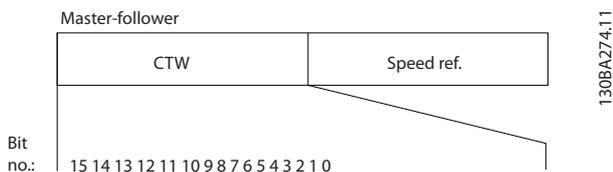


Illustration 4.3 Control Word

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	Set-up select (LSB)	
14	Set-up select (MSB)	
15	Forward	Reversing

Table 4.4 Control Bits

Explanation of the control bits:

Bit 00, Switch off/on

Bit 00 = 0: Execute transition 2, 6, or 8.
 Bit 00 = 1: Execute transition 3.

Bit 01, Disable/enable voltage

Bit 01 = 0: Execute transition 9, 10, or 12.
 Bit 01 = 1: Enable voltage.

Bit 02, Quick stop/run

Bit 02 = 0: Execute 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: Execute transition 7, 11, or quick stop.
 Bit 04 = 1: Enable 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 functions normally, and maintains the given reference.

Bit 06, Ramp stop/start

Bit 06 = 0: The frequency converter ramps the motor down to a stop.

Bit 01 = 1: A start command to the frequency converter is given.

Bit 07, No function/reset

Reset of trip.
 Bit 07 = 0: No reset.
 Bit 07 = 1: A trip is reset.

Bit 08, 09, and 10

Reserved for DSP 402.

Bit 11, Jog 1 OFF/ON

Activation of pre-programmed speed in *parameter 8-90 Bus Jog 1 Speed*.
 Jog 1 is only possible if bit 04 = 0, and bits 00-03 = 1.

Bit 12

Reserved for the frequency converter.

Bits 13/14, Selection of setup

Bits 13 and 14 are used for selecting among the 4 menu set-ups in accordance with *Table 4.5*.

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

Table 4.5 4 Menu Set-ups

Bit 15, Forward/reversing

Bit 15 = 0: No reversing.
 Bit 15 = 1: Reversing.

NOTICE

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

4.3.4 Status Word According to DSP402 Profile (Object 6041h)

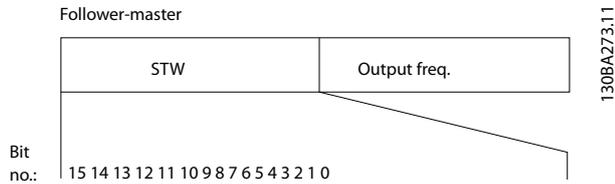


Illustration 4.4 Status Word

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	Speed ≠ reference	Speed = reference
09	Remote disabled	Remote enabled
10	Setpoint not reached	Setpoint reached
11	Speed limit not active	Speed limit active
12	Reserved	
13		
14		
15		

Table 4.6 Status Bits

Explanation of the status bits:

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

Bit 00 = 0: The state is less than ready to switch on.
 Bit 00 = 1: The state is at least equal to ready to switch on.

Bit 01, Switch off/switch on

Bit 01 = 0: The state is less than switched on.
 Bit 01 = 1: The state is at least equal to switched on.

Bit 02, Operation disable/operation enable

Bit 02 = 0: The state is less than operation enable.
 Bit 02 = 1: The state is at least equal to 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: The state is not switch on disable.
 Bit 06 = 1: The state is switch on disable.

Bit 07, No warning/warning

Bit 07 = 0: There is a no-warning situation.
 Bit 07 = 1: A warning has occurred.

Bit 08, Speed ≠ reference/speed = reference

Bit 08 = 0: The motor is running, but the current speed is different from the speed reference. This is the case when, for example, the speed is being ramped up or down.
 Bit 08 = 1: The current speed matches the speed reference.

Bit 09, Remote disable/remote enable

Bit 09 = 0: The frequency converter is stopped with the [Stop] key on the LCP, or [Local] is selected in *parameter 3-13 Reference Site*.
 Bit 09 = 1: It is possible to control the frequency converter via the serial port.

Bit 10, Setpoint not reached/setpoint reached

Bit 10 = 0: The actual motor speed is different from the speed reference. This is the case when, for example, the speed is being ramped up or down.
 Bit 10 = 1: The present motor speed equals the speed reference.

Bit 11, Speed limit not active/speed limit active

Bit 11 = 0: The output frequency is outside the range set in *parameter 4-11 Motor Speed Low Limit [RPM]/parameter 4-12 Motor Speed Low Limit [Hz]* or *parameter 4-13 Motor Speed High Limit [RPM]/parameter 4-14 Motor Speed High Limit [Hz]*.
 Bit 11 = 1: The output frequency is within the limits.

Bit 12

Reserved for DSP 402.

Bit 13

Reserved for DSP 402.

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 the output frequency is greater than 0 Hz.

Bit 15

Reserved for the frequency converter.

4.3.5 Reference Handling

In DSP 402 profile, the reference (object 6042h) is in RPM by default. To use a different unit, set the vl dimension factor (object 604Ch) to a value other than 1. Refer to the DSP 402 standard for details.

4.4 Danfoss FC Control Profile

4.4.1 Objects in FC Profile

In FC profile, DSP 402 profile objects (6000h to 6FFFh) cannot be used. When *parameter 8-10 Control Word Profile* is set to [0] FC Profile:

- Use object 2690h as control word, which is *parameter 16-80 Fieldbus CTW 1*.
- Use object 2692h as reference, which is *parameter 16-82 Fieldbus REF 1*.

4.4.2 Control Word according to FC Profile (Object 2690h)

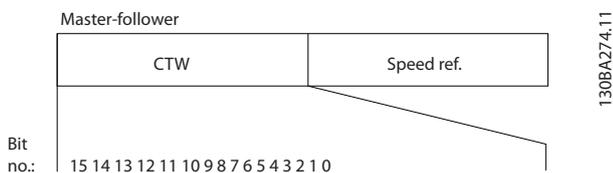


Illustration 4.5 Control Word

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 4.7 Control Bits

Explanation of the control bits

Bits 00/01

Use bits 00 and 01 to select between the 4 reference values, which are programmed in *parameter 3-10 Preset Reference* according to *Table 4.8*.

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

Table 4.8 Set-up

NOTICE

In *parameter 8-56 Preset Reference Select*, select how bit 00/01 gates with the corresponding function on the digital inputs.

Bit 02, DC brake

Bit 02 = 0: Apply DC brake and stop. The braking current and braking duration are set in *parameter 2-01 DC Brake Current* and *parameter 2-02 DC Braking Time*.

Bit 02 = 1: Perform ramping.

Bit 03, Coasting

Bit 03 = 0: The frequency converter releases the motor immediately (the output transistors are shut off), so that it coasts to a standstill.

Bit 03 = 1: Enables the frequency converter to start the motor, if the other starting conditions are fulfilled.

NOTICE

In *parameter 8-50 Coasting Select*, select how bit 03 gates with the corresponding function on a digital input.

Bit 04, Quick stop

Bit 04 = 0: The frequency converter ramps the motor speed down to a stop using *parameter 3-81 Quick Stop Ramp Time*.

Bit 05, Hold output frequency

Bit 05 = 0: Freezes the current output frequency (in Hz). The frozen output frequency can then be changed only with digital inputs (*parameter 5-10 Terminal 18 Digital Input* to *parameter 5-15 Terminal 33 Digital Input*) programmed to [21] Speed up and [22] Speed down.

NOTICE

If hold output frequency is active, the frequency converter can only be stopped by the following:

- Bit 03, Coasting.
- Bit 02, DC braking.
- A signal on a digital input (*parameter 5-10 Terminal 18 Digital Input* to *parameter 5-15 Terminal 33 Digital Input*) programmed to [5] DC-brake inverse, [2] Coast inverse, or [3] Coast and reset inverse.

Bit 06, Ramp stop/start

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

Bit 06 = 1: Allows the frequency converter to start the motor, if all other starting conditions are fulfilled.

In *parameter 8-53 Start Select*, select how bit 06 gates with the corresponding function on a digital input.

Bit 07, Reset

Bit 07 = 0: No reset.

Bit 07 = 1: Reset a trip. Reset is activated on the signal's leading edge, for example, when changing from logic 0 to logic 1.

Bit 08, Jog

Bit 08 = 1: The output frequency is determined by *parameter 3-19 Jog Speed [RPM]*.

Bit 09, Selection of ramp 1/2

Bit 09 = 0: Ramp 1 is active (*parameter 3-40 Ramp 1 Type to parameter 3-47 Ramp 1 S-ramp Ratio at Decel. Start*).

Bit 09 = 1: Ramp 2 is active (*parameter 3-50 Ramp 2 Type to parameter 3-57 Ramp 2 S-ramp Ratio at Decel. Start*).

Bit 10, Data not valid/data valid

This bit defines whether the control word is to be used or ignored.

Bit 10 = 0: The control word is ignored.

Bit 10 = 1: The control word is used.

This function is relevant, because the telegram always contains a control word, regardless of the type of telegram. For example, it is possible to turn off the control word if it should not be used when updating or reading parameters.

Bit 11, Relay 01

Bit 11 = 0: Relay 01 is not activated.

Bit 11 = 1: Relay 01 is activated, provided that control word bit 11 is selected in *parameter 5-40 Function Relay*.

Bit 12, Relay 04

Bit 12 = 0: Relay 04 is not activated.

Bit 12 = 1: Relay 04 is activated, provided control word bit 12 is selected in *parameter 5-40 Function Relay*.

Bit 13/14, Selection of set-up

Use bits 13 and 14 to select from the 4 menu set-ups according to *Table 4.9*.

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

Table 4.9 Selection of Set-up

The function is only available when *parameter 0-10 Active Set-up* is set to *[9] Multi set-ups*.

NOTICE

In *parameter 8-55 Set-up Select*, select how bit 13/14 gates with the corresponding function on digital inputs.

Bit 15, Reverse

Bit 15 = 0: No reversing.

Bit 15 = 1: Reversing.

NOTICE

By default, *parameter 8-54 Reversing Select* is set to *[0] Digital input*.

Bit 15 initiates reversing only when the parameter is set to *[1] Bus*, *[2] Logic AND*, or *[3] Logic OR*.

4.4.3 Status Word according to FC Profile (Object 2643h)

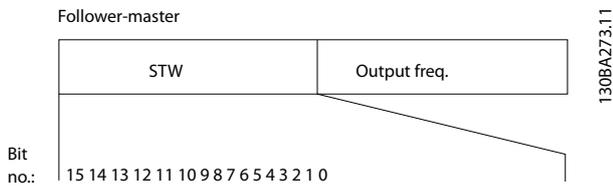


Illustration 4.6 Status Word

Bit	Bit value = 0	Bit value = 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	Trip lock
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, auto start
13	Voltage OK	Voltage exceeded
14	Torque OK	Torque exceeded
15	Timer OK	Timer exceeded

Table 4.10 Status Bits

Explanation of the status bits

Bit 00, Control not ready/ready

Bit 00 = 0: The frequency converter has tripped.
 Bit 00 = 1: The frequency converter controls are ready, but the power component is not necessarily receiving any power (if there is a 24 V external supply to controls).

Bit 01, Frequency converter ready

Bit 01 = 1: The frequency converter is ready for operation, but there is an active coasting command on a digital input or on serial communication.

Bit 02, Coasting stop

Bit 02 = 0: The frequency converter released the motor.
 Bit 02 = 1: The frequency converter can start the motor when it receives a start command.

Bit 03, No error/trip

Bit 03 = 0: The frequency converter is not in a fault mode.
 Bit 03 = 1: The frequency converter is tripped, and a reset signal is required to restart operation.

Bit 04, No error/error (no trip)

Bit 04 = 0: The frequency converter is not in a fault mode.
 Bit 04 = 1: There is a frequency converter error, but no trip.

Bit 05, Not used

Bit 05 is not used in the status word.

Bit 06, No error/triplock

Bit 06 = 0: The frequency converter is not in a 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 the speed is different from the speed reference. This is the case when, for example, the speed is being ramped up or down.
 Bit 08 = 1: The current speed matches the speed reference.

Bit 09, Local operation/bus control

Bit 09 = 0: [OFF/RESET] is pressed on the LCP, or *parameter 3-13 Reference Site* is set to [2] *Local*. 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 or serial communication.

Bit 10, Out of frequency limit

Bit 10 = 0: The output frequency has reached the value in *parameter 4-11 Motor Speed Low Limit [RPM]* or *parameter 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 received a start signal, or the output frequency is greater than 0 Hz.

Bit 12, Frequency converter OK/stopped, auto start

Bit 12 = 0: There is no temporary overtemperature on the inverter.
 Bit 12 = 1: The inverter stopped because of overtemperature, but the frequency converter did not trip and resumes operation once the overtemperature ceases.

Bit 13, Voltage OK/limit exceeded

Bit 13 = 0: There are no voltage warnings.
 Bit 13 = 1: The DC voltage in the DC link 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 *parameter 4-18 Current Limit*.
 Bit 14 = 1: The torque exceeds the limit in *parameter 4-18 Current Limit*.

Bit 15, Timer OK/limit exceeded

Bit 15 = 0: The timers for motor thermal protection and frequency converter thermal protection have not elapsed.
 Bit 15 = 1: 1 of the timers has elapsed.

4.4.4 Reference Handling

In the frequency converter profile, the reference is scaled as a normalized relative value in percent. The value is transmitted in hexadecimal:

- 0% = 0 hex.
- 100% = 4000 hex.
- -100% = C000 hex.

Depending on the setting in *parameter 3-00 Reference Range*, the reference is scaled from -maximum to +maximum or from minimum to maximum.

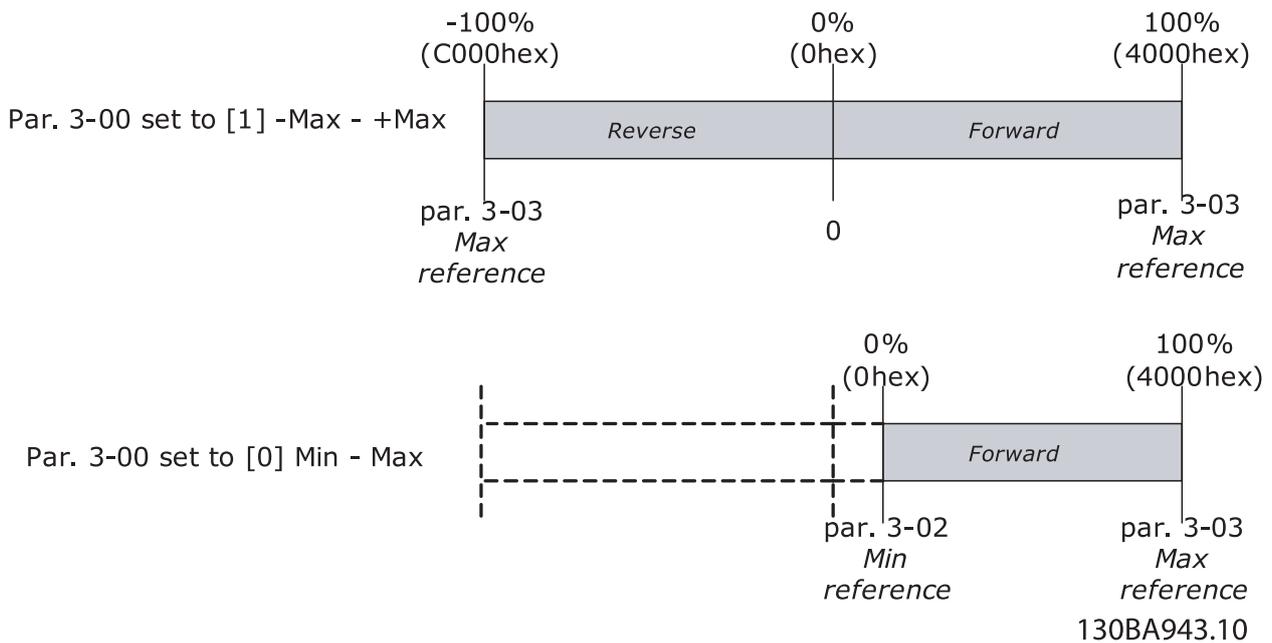


Illustration 4.7 Reference Handling

The actual reference in the frequency converter depends on the settings in the following parameters:

- *Parameter 1-23 Motor Frequency.*
- *Parameter 1-25 Motor Nominal Speed.*
- *Parameter 3-02 Minimum Reference.*
- *Parameter 3-03 Maximum Reference.*

All references provided to the frequency converter are added to the total reference value.

If a reference should be controlled by the fieldbus only, ensure that all other reference inputs are 0. This means that digital and analog input terminals should not be used for reference signals.

Maintain the default setting (0 %) for preset references in *parameter 3-10 Preset Reference*.

If the bus speed reference is negative, and the control word contains a run-reverse signal, the frequency converter runs clockwise (-x- gives +).

MAV is scaled in the same way as the reference.

5 Parameter Access

5.1 Danfoss Specific Objects (2000h-5FFFh)

All frequency converter parameters are accessible as OD entries:

OD index = frequency converter parameter + 2000h.

Frequency converter parameter	CANopen OD index
<i>Parameter 0-01 Language</i>	2001h
–	–
<i>Parameter 0-10 Active Set-up</i>	200Ah
<i>Parameter 0-11 Programming Set-up</i>	200Bh
–	–
<i>Parameter 1-00 Configuration Mode</i>	2064h
<i>Parameter 1-01 Motor Control Principle</i>	2065h
–	–
<i>Parameter 10-01 Baud Rate Select</i>	23E9h
–	–

Table 5.1 Converting Frequency Converter Parameters

Access the indexed parameters by accessing the appropriate subindex of the OD index.

6 Parameters

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

8-02 Control Source		
Option:	Function:	
		<p>NOTICE</p> <p>This parameter cannot be adjusted while the motor is running.</p> <p>Select the source of the control word.</p>
[0]	None	
[1]	FC Port	
[2]	FC USB	
[3]	Option A	

8-03 Control Word Timeout Time		
Range:	Function:	
1 s*	[0.1 - 18000 s]	Enter the maximum time expected to pass between the reception of 2 consecutive telegrams. If this time is exceeded, it indicates that the telegram communication has stopped. The function selected in <i>parameter 8-04 Control Word Timeout Function</i> is then carried out. A valid control word triggers the timeout counter.

8-04 Control Timeout Function		
Select the timeout function. The timeout function activates when the control word is not updated within the time period specified in <i>parameter 8-03 Control Word Timeout Time</i> .		
Option:	Function:	
[0] *	Off	Resumes control via fieldbus (fieldbus or standard), using the most recent control word.
[1]	Freeze output	Freezes output frequency until communication resumes.
[2]	Stop	Stops with auto restart when communication resumes.
[3]	Jogging	Runs the motor at jog frequency until communication resumes.
[4]	Max. speed	Runs the motor at maximum frequency until communication resumes.

8-04 Control Timeout Function		
Select the timeout function. The timeout function activates when the control word is not updated within the time period specified in <i>parameter 8-03 Control Word Timeout Time</i> .		
Option:	Function:	
[5]	Stop and trip	Stops the motor, then resets the frequency converter: <ul style="list-style-type: none"> Via the fieldbus. Via the [Reset] key. Via a digital input.

8-07 Diagnosis Trigger		
Option:	Function:	
		Select the frequency converter diagnosis function.
[0] *	Disable	Do not send extended diagnosis data even if alarms or warnings occur in the frequency converter.
[1]	Trigger on alarms	Send extended diagnosis data when 1 or more of the following alarms occur: <ul style="list-style-type: none"> <i>Parameter 16-90 Alarm Word</i>. <i>Parameter 16-91 Alarm Word 2</i>. <i>Parameter 16-97 Alarm Word 3</i>.
[2]	Trigger alarm/warn.	Send extended diagnosis data when 1 or more of the following alarms or warnings occur: <ul style="list-style-type: none"> <i>Parameter 16-90 Alarm Word</i>. <i>Parameter 16-91 Alarm Word 2</i>. <i>Parameter 16-92 Warning Word</i>. <i>Parameter 16-93 Warning Word 2</i>. <i>Parameter 16-97 Alarm Word 3</i>.

8-10 Control Word Profile		
Select the interpretation of the control and status words corresponding to the installed fieldbus. The LCP display shows only the options valid for the fieldbus.		
Option:	Function:	
[0] *	FC profile	
[7]	CANopen DSP 402	

8-14 Configurable Control Word CTW		
Array [15]		
Option:	Function:	
		This parameter is not valid in software versions earlier than 4.93.
[0]	None	The frequency converter ignores the information in this bit.

8-14 Configurable Control Word CTW		
Array [15]		
Option:		Function:
[1] *	Profile default	The functionality of the bit depends on the selection in <i>parameter 8-10 Control Word Profile</i> .
[2]	CTW Valid, active low	If set to 1, the frequency converter ignores the remaining bits of the control word.
[4]	PID error inverse	Inverts the resulting error from the process PID controller. Available only if <i>parameter 1-00 Configuration Mode</i> is set to [6] <i>Surface Winder</i> , [7] <i>Extended PID Speed OL</i> , or [8] <i>Extended PID Speed CL</i> .
[5]	PID reset I part	Resets the I-part of the process PID controller. Equivalent to <i>parameter 7-40 Process PID I-part Reset</i> . Available only if <i>parameter 1-00 Configuration Mode</i> is set to [6] <i>Surface Winder</i> , [7] <i>Extended PID Speed OL</i> , or [8] <i>Extended PID Speed CL</i> .
[6]	PID enable	Enables the extended process PID controller. Equivalent to <i>parameter 7-50 Process PID Extended PID</i> . Available only if <i>parameter 1-00 Configuration Mode</i> is set to [6] <i>Surface Winder</i> , [7] <i>Extended PID Speed OL</i> , or [8] <i>Extended PID Speed CL</i> .

8-50 Coasting Select		
Option:		Function:
		Select the trigger for the coasting function.
[0]	Digital input	A digital input triggers the coasting function.
[1]	Bus	A serial communication port or the fieldbus triggers the coasting function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the coasting function.
[3] *	Logic OR	The fieldbus/serial communication port or a digital input trigger the coasting function.

8-51 Quick Stop Select		
Select the trigger for the quick stop function.		
Option:		Function:
[0]	Digital input	
[1]	Bus	
[2]	Logic AND	
[3] *	Logic OR	

8-52 DC Brake Select		
Option:		Function:
		Select the trigger for the DC brake function.
[0]	Digital input	A digital input triggers the DC brake function.

8-52 DC Brake Select		
Option:		Function:
[1]	Bus	A serial communication port or the fieldbus triggers the DC brake function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the DC brake function.
[3] *	Logic OR	The fieldbus/serial communication port or a digital input trigger the DC brake function.

8-53 Start Select		
Option:		Function:
		Select the trigger for the start function.
[0]	Digital input	A digital input triggers the start function.
[1]	Bus	A serial communication port or the fieldbus triggers the start function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the start function.
[3] *	Logic OR	The fieldbus/serial communication port or a digital input trigger the start function.

8-54 Reversing Select		
Option:		Function:
		Select the trigger for the reversing function.
[0]	Digital input	A digital input triggers the reversing function.
[1]	Bus	A serial communication port or the fieldbus triggers the reversing function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the reversing function.
[3]	Logic OR	The fieldbus/serial communication port or a digital input trigger the reversing function.

8-55 Set-up Select		
Option:		Function:
		Select the trigger for the set-up selection.
[0]	Digital input	A digital input triggers the set-up selection.
[1]	Bus	A serial communication port or the fieldbus triggers the set-up selection.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the set-up selection.
[3] *	Logic OR	The fieldbus/serial communication port or a digital input trigger the set-up selection.

8-56 Preset Reference Select		
Option:	Function:	
		Select the trigger for the preset reference selection.
[0]	Digital input	A digital input triggers the preset reference selection.
[1]	Bus	A serial communication port or the fieldbus triggers the preset reference selection.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the preset reference selection.
[3] *	Logic OR	The fieldbus/serial communication port or a digital input trigger the preset reference selection.

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.	

10-01 Baud Rate Select		
Select the fieldbus transmission speed. The selection must correspond to the transmission speed of the master and the other fieldbus nodes.		
Option:	Function:	
[16]	10 Kbps	
[17]	20 Kbps	
[18]	50 Kbps	
[20] *	125 Kbps	
[21]	250 Kbps	
[22]	500 Kbps	
[23]	800 Kbps	
[24]	1000 Kbps	

10-02 Node ID		
Range:	Function:	
127* [1 - 127]	Select the station address. Every station connected to the same network must have an unambiguous address.	

10-05 Readout Transmit Error Counter		
Range:	Function:	
0* [0 - 255]	Shows the number of CAN control transmission errors since the last power-up.	

10-06 Readout Receive Error Counter		
Range:	Function:	
0* [0 - 255]	Shows the number of CAN control receipt errors since the last power-up.	

10-31 Store Data Values		
Use this parameter to store changed parameter values at power-down.		
Option:	Function:	
[0] * Off	Data values are not stored.	
[2]	Store all setups	Store parameter values of all set-ups. The selection returns to [0] Off after parameter values are stored in memory.
[3]	Store edit setup	Store parameter values of the edit set-up. The selection returns to [0] Off after parameter values are stored in memory.

10-33 Store Always		
Option:	Function:	
[0] * Off	Deactivates non-volatile storage of data.	
[1]	On	Stores the received parameter data in EEPROM non-volatile memory.

15-60 Option Mounted		
Array [8]		
Range:	Function:	
0* [0 - 30]	Shows the type of the installed option.	

16-84 Comm. Option STW		
Range:	Function:	
0* [0 - 65535]	Shows the status word of the extended fieldbus communication option. For more information, refer to the relevant fieldbus manual.	

16-90 Alarm Word		
Range:	Function:	
0* [0 - 4294967295]	Shows the alarm word sent via the serial communication port in hex code.	

16-91 Alarm Word 2		
Shows the alarm word 2 sent via the serial communication port in hex code.		
Range:	Function:	
0*	[0 - 0xFFFFFFFFUL]	

16-92 Warning Word		
Range:	Function:	
0* [0 - 4294967295]	Shows the warning word sent via the serial communication port in hex code.	

16-93 Warning Word 2		
Shows warning word 2 sent via the serial communication port in hex code.		
Range:	Function:	
0*	[0 - 0xFFFFFFFFFUL]	

16-97 Alarm Word 3		
Shows the alarm word 3 sent via the serial communication port in hex code.		
Range:	Function:	
0*	[0 - 0xFFFFFFFFFUL]	

6.1 Parameter List

Parameter number	Parameter description	Default value	4 set-up	Change during operation	Conversion index	Type
8-0* General Settings						
8-01	Control Site	[0] Digital and ctrl.word	All set-ups	TRUE	-	UInt8
8-02	Control Source	ExpressionLimit	All set-ups	TRUE	-	UInt8
8-03	Control Timeout Time	1 s	1 set-up	TRUE	-1	UInt16
8-04	Control Timeout Function	[0] Off	1 set-up	TRUE	-	UInt8
8-07	Diagnosis Trigger	[0] Disable	1 set-up	TRUE	-	UInt8
8-1* Ctrl. Word Settings						
8-10	Control Word Profile	[0] FC profile	All set-ups	TRUE	-	UInt8
8-14	Configurable Control Word CTW	[1] Profile default	All set-ups	TRUE	-	UInt8
8-5* Digital/Bus						
8-50	Coasting Select	[3] Logic OR	All set-ups	TRUE	-	UInt8
8-51	Quick Stop Select	[3] Logic OR	All set-ups	TRUE	-	UInt8
8-52	DC Brake Select	[3] Logic OR	All set-ups	TRUE	-	UInt8
8-53	Start Select	[3] Logic OR	All set-ups	TRUE	-	UInt8
8-54	Reversing Select	[3] Logic OR	All set-ups	TRUE	-	UInt8
8-55	Set-up Select	[3] Logic OR	All set-ups	TRUE	-	UInt8
8-56	Preset Reference Select	[3] Logic OR	All set-ups	TRUE	-	UInt8
8-9* Bus Feedback						
8-90	Bus Jog 1 Speed	100 RPM	All set-ups	TRUE	67	UInt16
8-91	Bus Jog 2 Speed	200 RPM	All set-ups	TRUE	67	UInt16
10-** CAN Fieldbus						
10-0* Common Settings						
10-01	Baud Rate Select	[20] 125 Kbps	1 set-up	TRUE	-	UInt8
10-02	Node ID	127 N/A	1 set-up	TRUE	0	UInt8
10-05	Readout Transmit Error Counter	0 N/A	All set-ups	TRUE	0	UInt8
10-06	Readout Receive Error Counter	0 N/A	All set-ups	TRUE	0	UInt8
10-3* Parameter Access						
10-31	Store Data Values	[0] Off	All set-ups	TRUE	-	uint8
10-33	Store Always	[0] Off	1 set-up	TRUE	-	UInt8
15-** Drive Information						
15-6* Option Ident						
15-60	Option Mounted	ExpressionLimit	All set-ups	FALSE	0	VisStr[30]
16-** Data Readouts						
16-8* Fieldbus & FC Port						
16-84	Comm. Option STW	0 N/A	1 set-up	TRUE	0	UInt16
16-9* Diagnosis Readouts						
16-90	Alarm Word	0 N/A	1 set-up	TRUE	0	UInt32
16-91	Alarm Word 2	0 N/A	1 set-up	TRUE	0	UInt32
16-92	Warning Word	0 N/A	1 set-up	TRUE	0	UInt32
16-93	Warning Word 2	0 N/A	1 set-up	TRUE	0	UInt32
16-97	Alarm Word 3	0 N/A	1 set-up	TRUE	0	UInt32

Table 6.1 Parameter List

6.1.1 Conversion Index

This number refers to a conversion figure used when writing or reading to parameters.

Conversion index	Conversion factor
100	1
67	1/60
6	1000000
5	100000
4	10000
3	1000
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001
-5	0.00001
-6	0.00001

Table 6.2 Conversion Index

7 Object Directory

7.1 Communication Profile Area (1000h-1FFFh)

This section describes the general layout of the supported CANopen communication area. The process data objects are defined in this area.

7.1.1 Communication Object Overview

OD index (hex)	Name	Type	Access
1000	Device type	UNSIGNED32	Read only
1001	Error register	UNSIGNED8	Read only
1005	COB-ID SYNC	UNSIGNED32	Read/write
1008	Manufacturer device name	VISIBLE_STRING	Read only
100A	Manufacturer software version	VISIBLE_STRING	Read only
100C	Guard time	UNSIGNED16	Read/write
100D	Life time factor	UNSIGNED8	Read/write
1010	Store parameters	UNSIGNED32	Read/write
1011	Restore default parameters	UNSIGNED32	Read/write
1014	COB-ID EMCY	UNSIGNED32	Read only
1017	Producer heartbeat time	UNSIGNED16	Read/write
1018	Identity object	Identity (23h)	Read only
1200	SDO server parameter	SDO parameter record	Read only
1400	1 st Receive PDO description	PDO communication parameter	Read/write
1401	2 nd Receive PDO description	PDO communication parameter	Read/write
1402	3 rd Receive PDO description	PDO communication parameter	Read/write
1600	1 st Receive PDO mapping	PDO Mapping	Read/write
1601	2 nd Receive PDO mapping	PDO Mapping	Read/write
1602	3 rd Receive PDO mapping	PDO Mapping	Read/write
1800	1 st Transmit PDO description	PDO communication parameter	Read/write
1801	2 nd Transmit PDO description	PDO communication parameter	Read/write

OD index (hex)	Name	Type	Access
1802	3 rd Transmit PDO description	PDO communication parameter	Read/write
1A00	1 st Transmit PDO mapping	PDO Mapping	Read/write
1A01	2 nd Transmit PDO mapping	PDO Mapping	Read/write
1A02	3 rd Transmit PDO mapping	PDO Mapping	Read/write

Table 7.1 Communication Object Overview

7.1.2 1000h Device Type

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

Additional information		Device profile number
Mode bits	Type bits	Bits
31... 24	23... 16	15... 0
0	1 (frequency converter)	402 (decimal)

Table 7.2 1000h Device Type

7.1.3 1001h Error Register

This object is the error register of the device. The device can map internal errors in this byte. This entry is mandatory for all devices, and is a part of the emergency object. Each bit of the error register is reserved for a specified group of errors (alarms). Only bit 0 is supported. More error information can be read with object 603Fh, error code.

Bit	Meaning
0	Generic error

Table 7.3 Content of Error Register

7.1.4 1005h COB-ID Sync Message Object

This index defines the COB-ID of the synchronization object (SYNC). It also defines whether the device generates the SYNC.

Bit	Value	Meaning
31 (MSB)	X	This bit is ignored
30	0 1	Device does not generate SYNC message. Device generates SYNC message (the frequency converter does not support this bit).
29	0 1	11-bit ID (CAN 2.0A) 29-bit ID (CAN 2.0B)
28–11	0 X	If bit 29=0: CAN ID uses bits 0–10. CAN ID does not use bits 11–28 and sets them to 0. If bit 29=1: CAN ID uses bits 28–11 for higher 18 bits and bits 10–0 for lower 11 bits.
10–0 (LSB)	X	Bits 10-0 of COB-ID.

Table 7.4 Structure of the SYNC COB-ID

Bits 29 and 30 must be static (not changeable). If a device is not able to generate SYNC messages, an attempt to set bit 30 generates an abort message (abort code: 0609 0030h).

Devices supporting only the standard CAN frame type either ignore attempts to change bit 29 or respond with an abort message (abort code: 0609 0030h).

The first transmission of SYNC object starts within 1 sync cycle after setting bit 30 to 1.

7.1.5 1008h Manufacturer Device Name

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

7.1.6 100Ah Manufacturer Software Version

This object contains the frequency converter software version from *parameter 15-49 SW ID Control Card*.

7.1.7 100Ch Guard Time

This object is used in node guarding, an error control service used in addition to the heartbeat mechanism to detect failure in the CAN network.

Node guarding provides the way to verify the availability of the master on the bus, which is necessary for the timeout functionality of the frequency converter.

This object contains the time between 2 master requests in ms.

7.1.8 100Dh Life Time Factor

This object contains the lifetime factor used in node guarding. This factor, multiplied by the value of 100Ch defines the time after which the node guarding function must poll the slave. If the slave does not receive a guard telegram within this time, the slave issues *warning 34, Fieldbus communication fault*.

7.1.9 1010h Store Parameters

In the standard configuration, the contents of parameters written via fieldbus are stored in volatile memory, and the changed data is lost after a power cycle. Use this object to store the changed frequency converter parameters in non-volatile memory.

Subindex	Meaning
0	Number of entries.
1	Save all communication parameters and frequency converter parameters.
2	Save all communication parameters.
3	Reserved
4	Save all frequency converter parameters (all set-ups).

Table 7.5 1010h Store Parameters

Writing the save value (0x65766c173) to subindex 1 saves all frequency converter parameters of all set-ups into non-volatile memory. Subindex 4 does the same for the edit set-up. This is done via *parameter 10-31 Store Data Values*.

7.1.10 1011h Restore Default Parameters

Use this object to set the frequency converter to factory default settings by writing the load value (0x64616F6C) to subindexes.

The parameters are set to default values after the next power cycle, which has to be initiated manually.

Subindex	Meaning
0	Number of entries.
1	Restore all communication parameters and frequency converter parameters.
2	Restore all communication parameters.
3	Reserved.
4	Restore all frequency converter parameters (all set-ups).

Table 7.6 1011h Restore Default Parameters

7.1.11 1014h COB ID Emergency Object

This object defines the COB-ID under which the emergency object (EMCY) is sent.

7.1.12 1017h Producer Heartbeat Time

The heartbeat acts as an error control service to detect a failure in the CAN network. A heartbeat producer cyclically transmits a message to the network. 1 or more devices in the network are aware of this heartbeat message. If the heartbeat cycle fails for the heartbeat producer, it informs the the local application about this event.

The producer heartbeat time defines the cycle time of the heartbeat. If this object is not used, its value is 0 by default.

7.1.13 1018h Identity Object

This object contains general information about the device. The vendor ID (subindex 1h) contains a unique value allocated to each manufacturer.

Subindex	Meaning
0	Number of entries.
1	Vendor ID (200008 dec.)

Table 7.7 1018h Identity Object

7.1.14 1020h Verify Configuration

This object contains the date and time of the downloaded configuration.

Subindex	Meaning
0	Number of entries.
1	Configuration date.
2	Configuration time.

Table 7.8 1020h Verify Configuration

8 Troubleshooting

8.1 Warnings and Alarms

NOTICE

Refer to *VLT® Midi Drive FC 280 Operating Guide* for an overview of warning and alarm types and for the full list of warnings and alarms.

The frequency converter display shows an alarm word, warning word, and CANopen warning word in hex format. When there is more than 1 warning or alarm, the sum of all warnings or alarms is shown. Alarm word, warning word, and CANopen warning word can also be shown using the bus in:

- *Parameter 16-90 Alarm Word.*
- *Parameter 16-91 Alarm Word 2.*
- *Parameter 16-92 Warning Word.*
- *Parameter 16-93 Warning Word 2.*
- *Parameter 16-97 Alarm Word 3.*

Bit (Hex)	Alarm word (<i>parameter 16-90 Alarm Word</i>)
00000001	Brake check
00000002	Power card overtemperature
00000004	Ground fault
00000008	Control card overtemperature
00000010	Control word timeout
00000020	Overcurrent
00000040	Torque limit
00000080	Motor thermistor overtemperature
00000100	Motor ETR overtemperature
00000200	Inverter overloaded
00000400	DC-link undervoltage
00000800	DC-link overvoltage
00001000	Short circuit
00002000	Inrush fault
00004000	Mains phase loss
00008000	AMA not OK
00010000	Live zero error
00020000	Internal fault
00040000	Brake overload
00080000	Motor phase U is missing
00100000	Motor phase V is missing
00200000	Motor phase W is missing
00400000	Fieldbus fault
00800000	24 V supply fault
01000000	Mains failure
02000000	1.8 V supply fault
04000000	Brake resistor short circuit
08000000	Brake chopper fault
10000000	Option change
20000000	Frequency converter initialized
40000000	Safe Torque Off
80000000	Mechanical brake low

Table 8.1 *Parameter 16-90 Alarm Word*

Bit (Hex)	Alarm word 2 (parameter 16-91 Alarm Word 2)
00000001	Service trip, read/write
00000002	Reserved
00000004	Service trip, typecode/sparepart
00000008	Reserved
00000010	Reserved
00000020	No flow
00000040	Dry pump
00000080	End of curve
00000100	Broken belt
00000200	Discharge high
00000400	Start failed
00000800	Speed limit
00001000	Reserved
00002000	Reserved
00004000	Reserved
00008000	Reserved
00010000	Reserved
00020000	KTY error
00040000	Fans error
00080000	ECB error
00100000	Reserved
00200000	Reserved
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	PTC thermistor
80000000	Dangerous failure

Table 8.2 Parameter 16-91 Alarm Word 2

Bit (Hex)	Warning word (parameter 16-92 Warning Word)
00000001	Brake check
00000002	Power card overtemperature
00000004	Ground fault
00000008	Control card overtemperature
00000010	Control word timeout
00000020	Overcurrent
00000040	Torque limit
00000080	Motor thermistor overtemperature
00000100	Motor ETR overtemperature
00000200	Inverter overloaded
00000400	DC-link undervoltage
00000800	DC-link overvoltage
00001000	DC-link voltage low
00002000	DC-link voltage high
00004000	Mains phase loss
00008000	No motor
00010000	Live zero error
00020000	10 V low
00040000	Brake resistor power low
00080000	Brake resistor short circuit
00100000	Brake chopper fault
00200000	Speed limit
00400000	Fieldbus communication fault
00800000	24 V supply fault
01000000	Mains failure
02000000	Current limit
04000000	Low temperature
08000000	Voltage limit
10000000	Encoder loss
20000000	Output frequency limit
40000000	Safe Torque Off
80000000	Extended status word

Table 8.3 Parameter 16-92 Warning Word

Bit (Hex)	Warning word 2 (parameter 16-93 Warning Word 2)
00000001	Start delayed
00000002	Stop delayed
00000004	Clock failure
00000008	Fire mode was active
00000010	Reserved
00000020	No flow
00000040	Dry pump
00000080	End of curve
00000100	Broken belt
00000200	Discharge high
00000400	Reserved
00000800	Reserved
00001000	Reserved
00002000	Reserved
00004000	Reserved
00008000	Reserved
00010000	Reserved
00020000	KTY error
00040000	Fans warning
00080000	ECB error
00100000	Reserved
00200000	Reserved
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	PTC thermistor
80000000	Reserved

Table 8.4 Parameter 16-93 Warning Word 2

8.2 Troubleshooting

8.2.1 Check 1: LED Status

The 2 indicator lights on the CANopen control card indicate the status of CANopen communication:

- The red indicator light (ERR) indicates error.
- The green indicator light (RUN) indicates running status.

The indicator light states comply with CiA303 part 3, version 1.4.0.

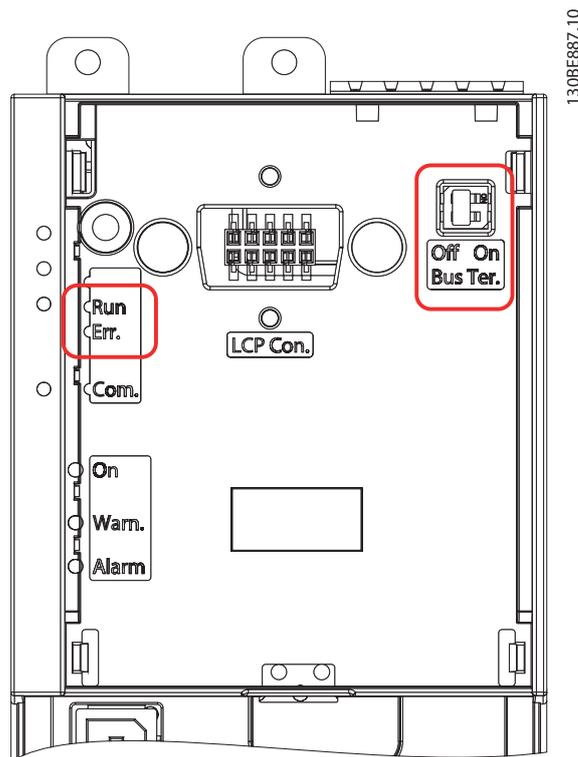


Illustration 8.1 Indicator Light Panel

State	Red indicator light	Status	Status
No error	 130BT249.10	Off	The device is in working condition.
Warning limit reached	 130BT250.10	Single flash	At least 1 of the error counters of the CAN controller has reached or exceeded the warning level.
Error control event	 130BT251.10	Double flash	A guard event (NMT-slave or NMT-master) or a heartbeat event has occurred.
Bus off	 130BT253.10	On	The device is in bus-off state.

Table 8.5 ERR Indicator Light

State	Green indicator light	Status
Stopped		Single flash Device in stopped state.
Pre-operational		Blinking Device in pre-operational state.
Operational		On Device in operational state.

Table 8.6 RUN Indicator Light

Indicator light flashing patterns

Each indicator light has the following flashing patterns:

- **Blinking:** The on and off pattern with a frequency of approximately 2.5 Hz. On for approximately 200 ms followed by off for approximately 200 ms.
- **Single flash:** 1 short flash (approximately 200 ms) followed by a long off phase (approximately 1000 ms).
- **Double flash:** A sequence of 2 short flashes (approximately 200 ms each), separated by an off phase (approximately 200 ms). This sequence is followed by a long off phase (approximately 1000 ms).

8.2.2 Check 2: Error Counters

Check the values of the TEC and REC in parameter 10-05 Readout Transmit Error Counter and parameter 10-06 Readout Receive Error Counter.

8.2.3 Check 3: Is the Cabling Correct?

Check that the cables are connected to the correct terminals.

Pin number	Terminal	Color	Name
1	–	–	Reserved
2	CAN_L	Blue	CAN LOW
3	Drain	(bare)	Shield
4	CAN_H	White	CAN HIGH
5	–	–	Reserved

Table 8.7 Cabling

8.2.4 Check 4: Is the Correct EDS File Installed?

Download the correct EDS file from www.danfoss.com/drives and drives.danfoss.com/services/software-downloads/.

8.2.5 Check 5: Is the bus connection terminated at both ends?

If the bus connection is not terminated at both ends, terminate the bus connection with termination resistors at the initial and final nodes. Termination is performed between terminal 2 (CAN_L) and 4 (CAN_H) with a resistor:

- 121 Ω.
- 1% metal film.
- ¼ W.

If the frequency converter with CANopen control cassette is at the end of the fieldbus line, turn on the CAN termination switch to activate the on-board termination resistor. In this case an external resistor is not required. To see the termination switch, refer to *Illustration 8.1*. By default, the switch is off.

8.2.6 SDO Abort Codes

Table 8.8 describes the error code when an SDO generates a failure.

Abort code	Description
0503 0000h	Toggle bit not alternated.
0504 0000h	SDO protocol timed out.
0504 0001h	Client/server command specifier not valid or unknown.
0504 0002h	Invalid block size (block mode only).
0504 0003h	Invalid sequence number (block mode only).
0504 0004h	CRC error (block mode only).
0504 0005h	Out of memory.
0601 0000h	Unsupported access to an object.
0601 0001h	Attempt to read a write-only object.
0601 0002h	Attempt to write a read-only object.
0602 0000h	Object does not exist in the object dictionary.
0604 0041h	Object cannot be mapped to the PDO.
0604 0042h	The number and length of the objects to be mapped would exceed PDO length.
0604 0043h	General parameter incompatibility reason.
0604 0047h	General internal incompatibility in the device.
0606 0000h	Access failed due to a hardware error.
0607 0010h	Data type does not match, length of service parameter does not match.
0607 0012h	Data type does not match, length of service parameter too high.
0607 0013h	Data type does not match, length of service parameter too low.
0609 0011h	Subindex does not exist.
0609 0030h	Value range of parameter exceeded (only for write access).
0609 0031h	Value of parameter written too high.
0609 0032h	Value of parameter written too low.
0609 0036h	Maximum value is less than minimum value.
0800 0000h	General error.
0800 0020h	Data cannot be transferred or stored to the application.
0800 0021h	Data cannot be transferred or stored to the application because of local control.
0800 0022h	Data cannot be transferred or stored to the application because of the present device state.
0800 0023h	Object dictionary dynamic generation fails or no object dictionary is present (for example, object dictionary is generated from file and generation fails because of a file error).

Table 8.8 SDO Abort Codes

8.2.7 EMCY Error Code

Code (hex)	Description
0	No fault.
1000	General fault.
2130	Short circuit.
2213	Overcurrent during start-up.
2240	Short to ground.
2310	Continuous overcurrent.
2311	Current inside the device.
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 supply.
5112	+24 V supply.
5210	Measurement circuit.
6100	Internal software fault.
7110	Brake chopper.
8100	Communication.
8110	CAN overrun (objects lost).
8120	CAN in error (passive mode).
8130	Life Guard error or heartbeat error.
8140	Recovered from bus off.
8150	Transmit COB-ID collision.
8210	PDO not processed due to length error.
8220	PDO length exceeded.
8302	Torque limiting.
FFxx	Vendor specific.

Table 8.9 EMCY Error Code

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