ACS 160

Installation and Start-up Guide

CANopen Adapter Module
CFB-CAN

ABB

CANopen Adapter Module
CFB-CAN

Installation and Start-up Guide

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Safety Instructions

Overview

This chapter states the safety instructions that must be followed when installing and operating the CFB-CAN CANopen Adapter Module.

The material in this chapter must be studied before attempting any work on, or with, the unit.

Warnings and Notes

This manual distinguishes two sorts of safety instructions. Warnings are used to inform of conditions which can, if proper steps are not taken, lead to a serious fault condition, physical injury and death. Notes are used when the reader is required to pay special attention or when there is additional information available on the subject. Notes are less crucial than Warnings, but should not be disregarded.

Warnings

Readers are informed of situations that can result in serious physical injury and/or serious damage to equipment with the following symbols:

Dangerous Voltage Warning: warns of situations in which a high voltage can cause physical injury and/or damage equipment. The text next to this symbol describes ways to avoid the danger.

General Warning: warns of situations which can cause physical injury and/or damage equipment by means other than electrical. The text next to this symbol describes ways to avoid the danger.

Electrostatic Discharge Warning: warns of situations in which an electrostatic discharge can damage equipment. The text next to this symbol describes ways to avoid the danger.

Notes Readers are notified of the need for special attention or additional information available on the subject with the following symbols:

CAUTION! **Caution** aims to draw special attention to a particular issue.

Note: **Note** gives additional information or points out more information available on the subject.

General Safety Instructions

WARNING! All electrical installation and maintenance work on the drive should be carried out by qualified electricians.

The drive and adjoining equipment must be properly earthed.

Do not attempt any work on a powered drive. After switching off the mains, always allow the intermediate circuit capacitors 5 minutes to discharge before working on the frequency converter, the motor or the motor cable. It is good practice to check (with a voltage indicating instrument) that the drive is in fact discharged before beginning work.

The motor cable terminals of the drive are at a dangerously high voltage when mains power is applied, regardless of motor operation.

There can be dangerous voltages inside the drive from external control circuits even when the drive mains power is shut off. Exercise appropriate care when

working with the unit. Neglecting these instructions can cause physical injury and death.

WARNING! There are several automatic reset functions in the drive. If selected, they reset the unit and resume operation after a fault. These functions should not be selected if other equipment is not compatible with this kind of operation, or dangerous situations can be caused by such action.

More Warnings and Notes are printed at appropriate instances along the text.

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Chapter 1 – Introduction to This Guide

Intended Audience

The Guide is intended for the people who are responsible for commissioning and using a CFB-CAN CANopen Adapter Module with the ACS 160 drive. The reader is expected to have a basic knowledge of electrical fundamentals, electrical wiring practices, the drive, and the use of the drive control panel.

Before You Start

It is assumed that the drive is installed and ready to operate before starting the installation of the adapter module.

In addition to conventional installation tools, have the drive manuals available during the installation as they contain important information not included in this guide. The drive manuals are referred to at various points of this guide.

What This Guide Contains

This manual contains information on the wiring, configuration and use of the CFB-CAN module.

Safety Instructions are featured in the first few pages of this Guide. Safety Instructions describe the formats for various warnings and notations used within this Guide.

Chapter 2 – Overview contains a short description of the CANopen protocol and the CFB-CAN CANopen Adapter Module, a delivery checklist, and warranty information.

Chapter 3 – Installation contains wiring instructions.

Chapter 4 – Programming explains how to program the master station and the drive before the communication through the adapter module can be started.

Chapter 5 – Communication contains a description of how data is transmitted through the CFB-CAN module.

Chapter 6 – Status LEDs explains the status LED indications of the CFB-CAN module.

Appendix A contains information on EDS (Electronic Data Sheet) files.

Appendix B contains reference tables for decoding CAN error messages.

Appendix C contains Technical Data.

Appendix D contains a specification of the ambient conditions allowed during transportation, storage and use of the CFB-CAN module.

Terms and Abbreviations

CAN	Controller Area Network.
CFB-CAN CANopen Adapter Module	The CFB-CAN Adapter Module is one of the optional fieldbus adapter modules available for ACS 160 drives. The CFB-CAN is a device through which the drive is connected to a CANopen serial communication bus.
CiA	CAN in Automation International Users and Manufacturers Group.
CMS	CAN Message Specification; one of the service elements of the CAN Application Layer in the CAN Reference Model.
COB	Communication Object; a unit of transportation on a CAN network. Data is sent across a network inside a COB. The COB itself is part of the CAN message frame.
DBT	Distributor; one of the service elements of the CAN Application Layer in the CAN Reference Model. It is the responsibility of the Distributor to distribute COB IDs to the COBs that are used by a CMS.
EDS	Electronic Data Sheet; a node-specific ASCII-format file required when configuring the CAN network. The EDS file contains general information on the node and its dictionary objects (parameters). EDS files for ABB Drives are available through your local ABB representative. A sample listing of an EDS file can be found in Appendix A.
LMT	Layer Management; one of the service elements of the CAN Application Layer in the CAN Reference Model. It serves to configure parameters for each layer in the CAN Reference Model.

NMT	Network Management; one of the service elements of the CAN Application Layer in the CAN Reference Model. It performs initialisation, configuration and error handling on a CAN network.
Object Dictionary	A local storage of all Communication Objects recognised by a device.
OSI	Open Systems Interconnection.
Parameter	A parameter is an operating instruction for the drive. Parameters can be read and programmed with the drive control panel, or through the CFB-CAN Module.
PDO	Process Data Object; a type of COB. Used for transmitting time-critical data, such as control commands, references and actual values.
RO	Denotes read-only access.
RW	Denotes read/write access.
SDO	Service Data Object; a type of COB. Used for transmitting non-time-critical data, such as parameters.

Chapter 2 – Overview

Overview

This chapter contains a short description of the CANopen protocol and the CFB-CAN module, a delivery checklist, and warranty information.

CANopen

CANopen is a higher-layer protocol based on the CAN (Control Area Network) serial bus system and the CAL (CAN Application Layer). CANopen assumes that the hardware of the connected device has a CAN transceiver and a CAN controller as specified in ISO 11898.

The CANopen Communication Profile, CiA DS-301, includes both cyclic and event-driven communication, which makes it possible to reduce the bus load to minimum while still maintaining extremely short reaction times. High communication performance can be achieved at relatively low baud rates, thus reducing EMC problems and cable costs.

CANopen device profiles define both direct access to drive parameter and time-critical process data communication. The CFB-CAN fulfils CiA (CAN in Automation) standard DSP-402 (Drives and Motion Control), supporting the 'Manufacturer Specific' operating mode only.

The physical medium of CANopen is a differentially-driven two-wire bus line with common return according to ISO 11898. The maximum length of the bus is limited by the communication speed as follows:

Baud Rate	Max. Bus Length
1 Mbit/s	25 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m

Baud Rate	Max. Bus Length
125 kbit/s	500 m
50 kbit/s	1000 m
20 kbit/s	2500 m
10 kbit/s	5000 m

The maximum theoretical number of nodes is 127. However, in practice, the maximum number depends on the capabilities of the CAN transceivers used.

Further information can be obtained from the CAN in Automation International Users and Manufacturers Group (*www.can-cia.de).*

The CFB-CAN Module

The CFB-CAN CANopen Adapter Module is an optional device which enables the connection of an ACS 160 drive to a CANopen system.

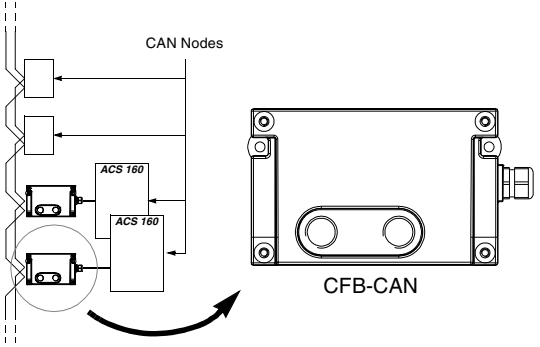


Figure 2-1 The construction of a CANopen network.

Through the CFB-CAN, it is possible to:

- Give control commands to the drive (Start, Stop, Run enable, etc.)
- Feed a motor speed reference to the drive
- Give a process actual value or a process reference to the PID controller of the drive
- Read status information and actual values from the drive
- Change drive parameter values
- Reset a drive fault.

The communication objects and functions supported by the CFB-CAN are discussed in Chapter 5.

The adapter module is mounted onto the side of the ACS 160 drive. See the *ACS 160 User's Manual* for more information.

Delivery Check

The option package of the CFB-CAN CANopen Adapter Module contains:

- CANopen Adapter Module, Type CFB-CAN
- 2 pcs M16×1.5 cable glands with O ring
- 2 pcs M4×12 mounting screws
- this manual, the *CFB-CAN Installation and Start-up Guide*.

Warranty and Liability Information

The warranty for your ABB drive and options covers manufacturing defects. The manufacturer carries no responsibility for damage due to transport or unpacking.

In no event and under no circumstances shall the manufacturer be liable for damages and failures due to misuse, abuse, improper installation, or abnormal conditions of temperature, dust, or corrosives, or failures due to operation above rated capacities. Nor shall the manufacturer ever be liable for consequential and incidental damages.

The period of manufacturer's warranty is 12 months, and not more than 18 months, from the date of delivery. Extended warranty may be available with certified start-up. Contact your local distributor for details.

Your local ABB Drives company or distributor may have a different warranty period, which is specified in their sales terms, conditions, and warranty terms.

If you have any questions concerning your ABB drive, contact your local distributor or ABB Drives office.

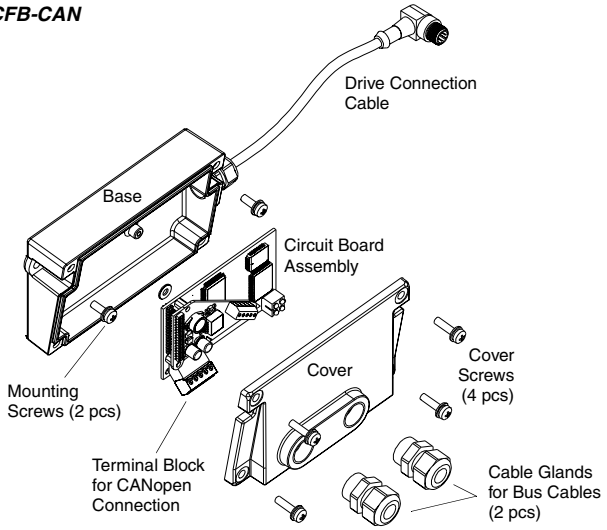
The technical data and specifications are valid at the time of printing. ABB reserves the right to subsequent alterations.

Chapter 3 – Installation

WARNING! Follow the safety instructions given in this Guide and in the *ACS 160 User's Manual.*

WARNING! The CFB-CAN contains components sensitive to electrostatic discharge (ESD). Wear an earthing wrist band when handling the circuit board assembly. Do not touch the boards unnecessarily.

Exploded View of the CFB-CAN



Mounting

The CFB-CAN is mounted onto the ACS 160 drive with two screws as shown in the *ACS 160 User's Manual.* This also provides the earthing of the module housing.

Drive Connection

The CFB-CAN uses the control panel connector of the drive. (However, leave the CFB-CAN disconnected at this point since the control panel is needed later for setting up the communication parameters.)

The CFB-CAN is powered through the drive control panel connector.

CANopen Connection

The CFB-CAN provides two cable entries for the incoming and outgoing bus cables. The cables are connected to a detachable terminal header, which enables the disconnection of the CFB-CAN without interrupting the data transfer to other devices.

If only one bus cable is connected, the unused cable entry should be plugged.

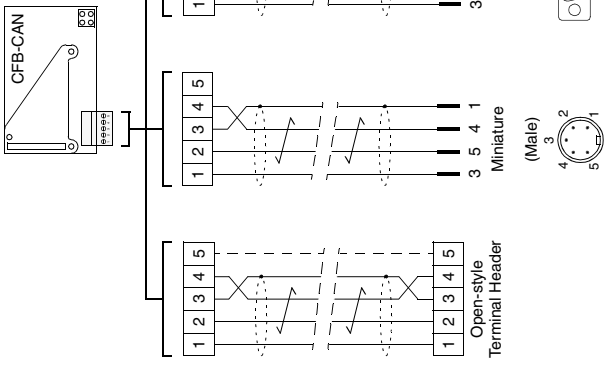
To connect the bus cables, follow this procedure:

1. Lead the bus cables to the space where the ACS 160 and the CFB-CAN are installed in. Arrange the bus cables as far away from any power cables as possible. Avoid parallel runs. Use grommets or cable glands at all cable lead-throughs for protection.
2. Remove the cover of the CFB-CAN module. Fasten the cable glands to the cover (if not done already).
3. Lead the bus cables through the cable glands and the cover. Loosen the clamping nuts of the cable glands if necessary.

4. Detach the terminal header from its receptacle on the circuit board assembly and make the connections.

Bus Connector Terminal Designations

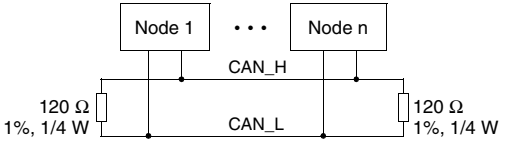
Terminal		Description
1	CAN_GND	CAN ground
2	CAN_L	CAN_L bus line (dominant low)
3	(CAN_SHLD)	Optional CAN shield
4	CAN_H	CAN_H bus line (dominant high)
5	(CAN_V+)	Optional CAN external power supply



5. Re-insert the terminal header into its receptacle.
6. Replace the cover of the CFB-CAN.
7. Tighten the clamping nuts of the cable glands.

CAN Bus Termination

The CAN bus line must be terminated with 120 ohm (approx.) resistors connected between the CAN_L and CAN_H wires at each end as shown below.



Chapter 4 – Programming

Overview

This chapter gives information on configuring the CAN controller and the drive for communication through the CFB-CAN CANopen Adapter Module.

Configuring the CAN Controller and Network

After the CFB-CAN module has been mechanically and electrically installed, the CAN controller and the drive must be prepared for communication with the module.

The CFB-CAN cannot communicate with the drive before it is configured for the CAN network. The CAN network is configured using a network installation tool; please refer to the tool's documentation.

EDS Files

EDS (Electronic Data Sheet) configuration files for ABB drives are available through your local ABB representative. A sample EDS file can be found in Appendix A.

Configuring the Drive

The communication between the drive and the CFB-CAN module is configured through drive parameters. As the control panel of the drive and the CFB-CAN share the same connector, the parameters must be set before detaching the panel and connecting the CFB-CAN.

The parameters that configure the CFB-CAN are listed in Table 4-1 below. The alternative selections for these parameters are discussed in more detail below the table.

Note: After making the necessary parameter changes, power down the drive, disconnect the control panel, connect the CFB-CAN, and power up the drive.

Table 4-1 The CFB-CAN configuration parameters.

No.	Description	Alternative Settings	Default
5101	Module Type	**0** None; **1** CFB-PDP; …; **5** CFB-CAN; …; **9** Other	**5** CFB-CAN
5102	Operating Mode	**1** Mandatory DS402 PDO Params. Activated; **0, 2, 3, 5…65536** Mandatory DS402 PDO Params. + ACS 160-specific PDO Params. Activated; **4** All PDO Params. Activated	**2** Mandatory DS402 PDO Parameters + ACS 160-specific PDO Parameters Activated
5103	Node ID	**1** to **127**	**1**
5104	Baudrate	**1** 10 kbit/s; **2** 20 kbit/s; **3** 50 kbit/s; **4** 125 kbit/s; **5** 250 kbit/s; **6** 500 kbit/s; **7** 800 kbit/s; **8** 1Mbit/s	**8** 1 Mbit/s
5105	PDO IN Word 0	**0** None; **1…9910** (ACS 160 Parameter No.)	**0** None
5106	PDO IN Word 1	**0** None; **1…9910** (ACS 160 Parameter No.)	**0** None
5107	PDO IN Word 2	**0** None; **1…9910** (ACS 160 Parameter No.)	**0** None
5108	PDO IN Word 3	**0** None; **1…9910** (ACS 160 Parameter No.)	**0** None
5109	PDO OUT Word 0	**0** None; **1…9910** (ACS 160 Parameter No.)	**0** None
5110	PDO OUT Word 1	**0** None; **1…9910** (ACS 160 Parameter No.)	**0** None
5111	PDO OUT Word 2	**0** None; **1…9910** (ACS 160 Parameter No.)	**0** None
5112	PDO OUT Word 3	**0** None; **1…9910** (ACS 160 Parameter No.)	**0** None

5101 Module Type	This parameter must be set to 5 by the user.
5102 Operating Mode	This parameter selects which PDO (Process Data Object) parameter sets are used.
5103 Node ID	Each device on the CAN link must have a unique node ID. This parameter is used to define a station number for the drive it is connected to.
5104 Baudrate	This parameter defines the transfer rate used on the CAN bus. The setting must be same for all devices on the link.
5105 PDO IN Word 0 … 5108 PDO IN Word 3	The CFB-CAN supports one transmit PDO (TPDO 36), the contents of which can be mapped to four target drive parameters using parameters 5105 … 5108. During Pre-Operational mode, the target parameters for TPDO 36 can also be selected from the fieldbus using object 5000h, subindexes 1…4. It is also possible to use the standard CANopen Communication Profile object 1A23h. For more information, see the *DS301 Communication Profile.*
5109 PDO OUT Word 0 … 5112 PDO OUT Word 3	The CFB-CAN supports one receive PDO (RPDO 36), the contents of which are taken from four source drive parameters selected with parameters 5109 … 5112. During Pre-Operational mode, the source parameters for RPDO 36 can also be selected from the fieldbus using object 5001h, subindexes 1…4. It is also possible to use the standard CANopen Communication Profile object 1623h. For more information, see the *DS301 Communication Profile.*

Other Parameters

Fieldbus Communication

Parameters 5204 COMM FAULT TIME and 5205 COMM FAULT FUNC define the action taken in the event of a communication error between the CFB-CAN module and the drive.

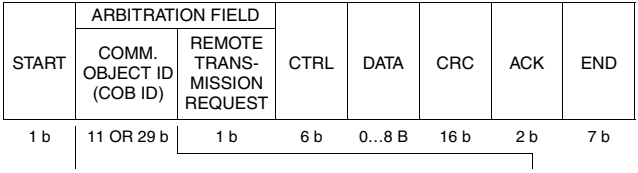
Control Locations and Actual Signal Selections

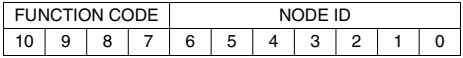
The ACS 160 drive can receive control signals from multiple sources (such as the digital and analogue inputs, the control panel, and a fieldbus adapter). The user can separately determine the source for each type of control information, and select which operating data is output as actual signals by the drive. Especially refer to parameter groups 10, 11, 15 and 16 in the *ACS 160 User's Manual* for information on the selection parameters.

Chapter 5 – Communication

Overview This chapter describes the communication on a CANopen network.

CAN Data Frame CAN employs data frames for transferring data between the host (controller) and the nodes on the bus. The following figure presents the structure of the data frame.





Communication Object	Function Code (Binary)	COB ID (Hex)	COB ID (Dec)
NMT	0000	0×00	0
SYNC	0001	0×80	128
TIME STAMP	0010	0×100	256
EMERGENCY	0001	0×81 … 0×FF	129 … 255
PDO 1 (tx)	0011	0×181 … 0×1FF	385 … 511
PDO 1 (rx)	0100	0×201 … 0×27F	513 … 639
PDO 2 (tx)	0101	0×281 … 0×2FF	641 … 767
PDO 2 (rx)	0110	0×301 … 0×37F	769 … 895
SDO (tx)	1011	0×581 … 0×5FF	1409 … 1535
SDO (rx)	1100	0×601 … 0×67F	1537 … 1663
NODEGUARD	1110	0×701 … 0×77F	1793 … 1919

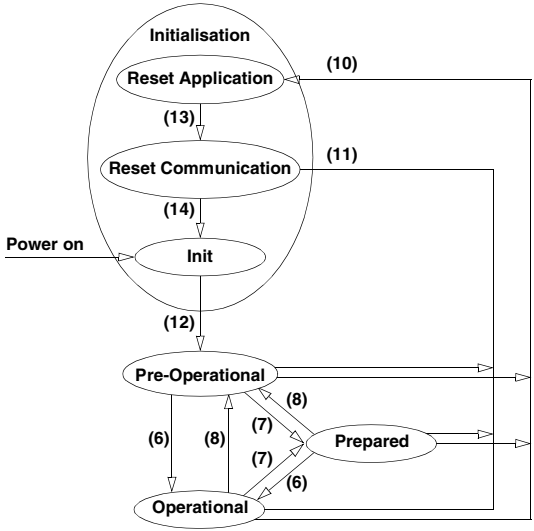
Communication Objects

Inside the CANopen data frame, different types of Communication Objects are used to convey the data. Process Data Objects (PDO) are used for transmitting time-critical process data (references, control commands, status information). Service Data Objects (SDO) are used for less time-critical data, e.g. parameters.

In addition, there are Special Function Objects and Network Management Objects.

CFB-CAN Boot-up Sequence

The CFB-CAN supports the boot-up sequence of a "Minimum Capability Device", as defined by the CANopen Communication Profile. The boot-up state diagram of the CFB-CAN is shown below.



(6) Start_Remote_Node indication
(7) Stop_Remote_Node indication
(8) Enter_Pre-Operational_State indication
(10) Reset_Node indication
(11) Reset_Communication indication
(12) After Initialisation is finished
(13) (14) After Reset is performed

The NMT commands used for controlling the node are:

Command	Name
001	Start_Remote_Node
002	Stop_Remote_Node
128	Enter_Pre-Operational_State
129	Reset_Node
130	Reset_Communication

Header	Byte	
	1	2
0000000000000010	NMT Command	Node ID

Note: If *Node ID* equals 0, all NMT slaves are addressed.

The node state indications are as follows:

Indication	State
4	Prepared
5	Operational
127	Pre-Operational

Process Data Objects (PDO)

Process Data Objects contain time-critical process data. Each PDO contains three 16-bit words.

The default COB IDs for PDOs are:

- PDO1 Rx (Master to Slave): 200h + Node ID
- PDO2 Rx (Master to Slave): 300h + Node ID
- PDO1 Tx (Slave to Master): 180h + Node ID
- PDO2 Tx (Slave to Master): 280h + Node ID.

The PDO transmission types are:

Transmission Type	PDO Transmission				
	Cyclic	Acyclic	Synchro-nous	Asynchro-nous	RTR only
0		+	+		
1 - 240	+		+		
241 - 251	Reserved				
252			+		+
253				+	
254				+	
255				+	

The transmission type of a PDO is defined in the PDO communication parameter index. See the CFB-CAN Object Dictionary (Communication Profile Area, Indexes 1400h [RPDO] and 1800h [TPDO] onwards) later in this chapter.

PDO1 Rx The contents of the PDO1 Rx object are as follows:

Master to Slave

Header	Byte	
	1	2
0100xxxxxxxryyyy	Control Word (6040h)	

0100 = COB ID Function code
xxxxxxx = Node ID
r = RTR (Remote Transmit Request) bit
yyyy = Data length

The drive switches between the states of the CANopen State Machine (shown further below) according to the bits of the Control Word.

Control Word

Bit	Description
0	Switch on
1	Disable voltage
2	Quick stop
3	Enable operation
4…6	(reserved)
7	Reset fault
8	Halt
9…15	(reserved)

PDO1 Tx The contents of the PDO1 Tx object are as follows:

Slave to Master

Header	Byte	
	1	2
0011xxxxxxxryyyy	Status Word (6041h)	

0011 = COB ID Function code
xxxxxxx = Node ID
r = RTR (Remote Transmit Request) bit
yyyy = Data length

The drive indicates its state in the CANopen State Machine (shown further below) with the bits of the Status Word.

Status Word

Bit	Description
0	Ready to switch on
1	Switched on
2	Operation enabled
3	Fault
4	Voltage disabled
5	Quick stop
6	Switch-on disabled
7	Warning
8	(reserved)
9	Remote
10	Target reached
11	Internal limit active
12, 13	(reserved)
14	External Control
15	Communication error between CFB-CAN and ACS 160

PDO2 Rx The contents of the PDO2 Rx object are as follows:

Master to Slave

Header	Byte		
	1	2	3
0110xxxxxxxryyyy	Control Word (6040h)		Modes of Operation

0110 = COB ID Function code
xxxxxxx = Node ID
r = RTR bit
yyyy = Data length

PDO2 Tx The contents of the PDO2 Tx object are as follows:

Slave to Master

Header	Byte		
	1	2	3
0101xxxxxxxryyyy	Status Word (6041h)		Modes of Operation Display

0101 = COB ID Function code
xxxxxxx = Node ID
r = RTR bit
yyyy = Data length

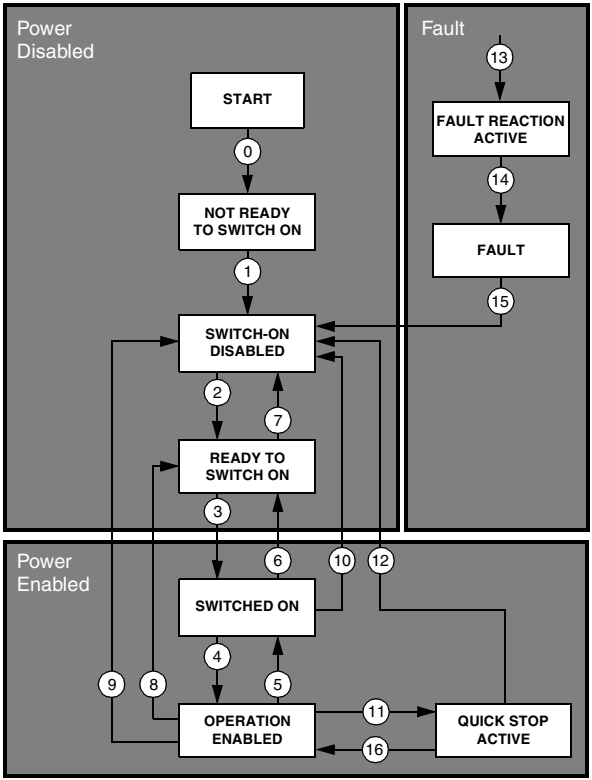
PDO2 Tx is transmitted on change of value.

CFB-CAN States The CFB-CAN module works according to the states and state transitions described below. The events that are able to trigger a transition between states are either internal actions or received in the Control Word.

The module has to be in the Operation Enable state in order to accept frequency and operation commands.

The numbers in the State Machine refer to the events table.

CFB-CAN
State Machine



State Transitions

The following state transitions are available in the CANopen drive profile. The number of the transition refers to the state machine above.

Transitions 0 and 1 are triggered at start-up. After all start-up tests have been performed the module will be in state 3.

No.	Name	Event
0	Start → Not Ready to Switch on	Reset
1	Not Ready to Switch on → Switch-on Disabled	Self-test and initialisation successful
2	Switch-on Disabled → Ready to Switch on	Shutdown command received
3	Ready to Switch on → Switched on	Switch-on command received
4	Switched on → Operation Enabled	Enable Operation command received
5	Operation Enabled → Switched on	Disable Operation command received
6	Switched on → Ready to Switch on	Shutdown command received
7	Ready to Switch on → Switch-on Disabled	Quick Stop command received
8	Operation Enabled → Ready to Switch on	Shutdown command received
9	Operation Enabled → Switch-on Disabled	Disable Voltage command received
10	Switched on → Switch-on Disabled	Disable Voltage or Quick Stop command received
11	Operation Enabled → Quick Stop Active	Quick Stop command received
12	Quick Stop Active → Switch-on Disabled	Quick stop completed or Disable Voltage command received
13	(any state) → Fault Reaction Active	Fatal drive fault has occurred
14	Fault Reaction Active → Fault	Fault action completed
15	Fault → Switch-on Disabled	Fault Reset command received
16	Quick Stop Active → Operation Enabled	Enable Operation command received

Control Word State Transition Bits

The following bits of the Control Word are used to trigger the state transitions listed above.

Command	Control Word Bit					Transitions
	Bit 7 Fault Reset	**Bit 3** Enable Operation	**Bit 2** Quick Stop	**Bit 1** Disable Voltage	**Bit 0** Switch on	
Shutdown	0	X	1	1	0	2, 6, 8
Switch on	0	X	1	1	1	3
Disable Voltage	0	X	X	0	X	7, 9, 10, 12
Quick Stop	0	X	0	1	X	7, 10, 11
Disable Operation	0	0	1	1	1	5
Enable Operation	0	1	1	1	1	4, 16
Fault Reset	0 → 1	X	X	X	X	15

Status Word State Bits

After a state transition is made, the following bits of the Status Word indicate the state of the module.

State	Status Word Bit					
	Bit 6 Switch-on Disabled	**Bit 5** Quick Stop	**Bit 3** Fault	**Bit 2** Operation Enabled	**Bit 1** Switched on	**Bit 0** Ready to Switch on
Not Ready to Switch on	0	X	0	0	0	0
Switch-on Disabled	1	X	0	0	0	0
Ready to Switch on	0	1	0	0	0	1
Switched on	0	1	0	0	1	1
Operation Enabled	0	1	0	1	1	1
Fault	0	X	1	1	1	1
Fault Reaction Active	0	X	1	1	1	1
Quick Stop Active	0	0	0	1	1	1

Service Data Objects (SDO)

Service Data Objects are mainly used to carry non-time-critical data, e.g. parameter values. SDOs provide access to the entries in the device Object Dictionary.

If 4 bytes or less data is to be transmitted, an 'expedited' SDO message can be used. Larger amounts of data can be segmented, i.e. split between several CAN messages.

The COB IDs for SDO communication are:

- Master to Slave: 600h + Node ID
- Slave to Master: 580h + Node ID.

Read:

Master to Slave

Header	Byte							
	1	2	3	4	5	6	7	8
1100xxxxxxx01000	Command	Object Index		Sub-index	Reserved			

xxxxxxx = Node ID

Write:

Master to Slave ('Expedited' message with max. 4 bytes of data)

Header	Byte							
	1	2	3	4	5	6	7	8
1100xxxxxxx01000	Command	Object Index		Sub-index	Data			

Master to Slave (Segmented message with over 4 bytes of data)
1st Frame

Header	Byte							
	1	2	3	4	5	6	7	8
1100xxxxxxx01000	Command	Object Index		Sub-index	Length			

All Subsequent Frames

Header	Byte							
	1	2	3	4	5	6	7	8
1100xxxxxxx01000	Command	Data						

The CFB-CAN Object Dictionary

The CFB-CAN Object Dictionary contains all Communication Objects. A listing of the Object Dictionary is given below.

The serial communication properties of the drive, as well as drive parameters, are detailed further in the drive documentation.

Communication Profile Area

<table>
<tr><th>Index (Hex)</th><th>Sub-index</th><th>Name</th><th>Type</th><th>Attri-bute</th><th>Information</th></tr>
<tr><td>1000</td><td>0</td><td>Device Type</td><td>Unsigned32</td><td>RO</td><td>Describes the type of device. Composed of two 16-bit fields (one for device profile, the other for additional information. The object value of the CFB-CAN is 0×10192, which corresponds to drive profile DSP-402 (0×192), and to additional information Frequency Converter (0×01).</td></tr>
<tr><td>1001</td><td>0</td><td>Error Register</td><td>Unsigned8</td><td>RO</td><td>Error register for the CFB-CAN.
Bit-encoded according to DS301/401.
Bit value 1 = Error occurred.
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>0</td><td>Generic error</td></tr>
<tr><td>1</td><td>Current</td></tr>
<tr><td>2</td><td>Voltage</td></tr>
<tr><td>3</td><td>Temperature</td></tr>
<tr><td>4</td><td>Communication error</td></tr>
<tr><td>5</td><td>Device profile specific</td></tr>
<tr><td>6</td><td>Reserved</td></tr>
<tr><td>7</td><td>Manufacturer specific</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Index (Hex)</th><th>Sub-index</th><th>Name</th><th>Type</th><th>Attri-bute</th><th>Information</th></tr>
<tr><td rowspan="4">1003</td><td>0</td><td>Pre-defined Error Field</td><td>Unsigned8</td><td>RW</td><td>Number of errors occurred and listed at subindexes 1 to A. Writing a zero here deletes the list.</td></tr>
<tr><td>1</td><td>Pre-defined Error Field</td><td>Unsigned32</td><td>RO</td><td rowspan="3">List of errors.
The most recent error is at subindex 1.
When a new error occurs, previous errors move down the list. Error numbers comprise a 16-bit error code (listed in Appendix B) and a 16-bit additional information field (0 with CFB-CAN). The error code is contained in the lower 2 bytes (LSB), the additional information in the upper 2 bytes (MSB).
Slave to Master
<table>
<tr><th rowspan="2">Header</th><th colspan="4">Byte</th></tr>
<tr><th>1 - 2</th><th>3</th><th>4 - 7</th><th>8</th></tr>
<tr><td>0001xxxxxx01000</td><td>Error code</td><td>Error reg.</td><td>Addit. info</td><td>Un-used</td></tr>
</table></td></tr>
<tr><td>•••</td><td>•••</td><td>•••</td><td>•••</td></tr>
<tr><td>A</td><td>Pre-defined Error Field</td><td>Unsigned32</td><td>RO</td></tr>
<tr><td>1005</td><td>0</td><td>COB ID SYNC Mes-sage</td><td>Unsigned32</td><td>RW</td><td>Identifier of the SYNC message.
The SYNC message controls the actions of PDOs that have the transmission type Syn-chronous.</td></tr>
<tr><td>1008</td><td>0</td><td>Manufacturer Device Name</td><td>Visible string</td><td>RO</td><td>Module name.
The constant string is CFB-CAN.</td></tr>
<tr><td>1009</td><td>0</td><td>Manufacturer Hardware Version</td><td>Visible string</td><td>RO</td><td>Version of module hardware.
The constant string is HW Vx.x where x.x = version number, e.g. 1.0.</td></tr>
<tr><td>100A</td><td>0</td><td>Manufacturer Software Ver-sion</td><td>Visible string</td><td>RO</td><td>Version of module software.
The constant string is SW Vx.x where x.x = version number, e.g. 1.0.</td></tr>
<tr><td>100B</td><td>0</td><td>Node ID</td><td>Unsigned32</td><td>RO</td><td>Actual Node ID.
This entry has the access attribute “read only” as it cannot be changed through an SDO service. However, it can be changed through CFB-CAN configuration parame-ters (see Chapter 4).</td></tr>
<tr><td>100C</td><td>0</td><td>Guard Time</td><td>Unsigned16</td><td>RW</td><td rowspan="2">Guard time (ms) × Life time factor = Life time for the Node Guarding Protocol.</td></tr>
<tr><td>100D</td><td>0</td><td>Life Time Fac-tor</td><td>Unsigned8</td><td>RW</td></tr>
<tr><td>100E</td><td>0</td><td>COB ID Guarding Pro-tocol</td><td>Unsigned32</td><td>RW</td><td>Describes the COB ID used for node guarding and life guarding.
Default: 700h + Node ID.</td></tr>
</table>

Index (Hex)	Sub-index	Name	Type	Attribute	Information
100F	0	Number of SDOs Supported	Unsigned32	RO	Composed of two fields which describe the number of Client SDOs and Server SDOs. MSB: Client SDOs (16 bits) — LSB: Server SDOs (16 bits)
1014	0	COB ID Emergency Message	Unsigned32	RW	Defines the COB ID of the Emergency Object (EMCY). Default: 80h + Node ID.
1400	0	1st Receive PDO Parameter	Unsigned8	RO	Number of entries.
	1	COB ID Used by PDO	Unsigned32	RW	Default: 200h + Node ID.
	2	Transmission Type	Unsigned8	RW	255 (asynchronous transmission).
	3	Inhibit Time	Unsigned16	RW	1 = 1 µs
1401	0	2nd Receive PDO Parameter	Unsigned8	RO	Number of entries.
	1	COB ID Used by PDO	Unsigned32	RW	Default: 300h + Node ID.
	2	Transmission Type	Unsigned8	RW	255 (asynchronous transmission).
	3	Inhibit Time	Unsigned16	RW	1 = 1 µs
1600	0	1st Receive PDO Mapping	Unsigned32	RW	Number of mapped application objects.
	1	1st Mapping Object	Unsigned32	RW	6040h (Control Word).
1601	0	2nd Receive PDO Mapping	Unsigned32	RW	Number of mapped application objects.
	1	1st Mapping Object	Unsigned32	RW	6040h (Control Word).
	2	2st Mapping Object	Unsigned32	RW	6060h (Modes of Operation).

Index (Hex)	Sub-index	Name	Type	Attribute	Information
1800	0	1st Transmit PDO Parameter	Unsigned8	RO	Number of entries.
	1	COB ID Used by PDO	Unsigned32	RW	Default: 180h + Node ID.
	2	Transmission Type	Unsigned8	RW	255 (asynchronous transmission).
	3	Inhibit Time	Unsigned16	RW	1 = 1 µs
1801	0	2nd Transmit PDO Parameter	Unsigned8	RO	Number of entries.
	1	COB ID Used by PDO	Unsigned32	RW	Default: 280h + Node ID.
	2	Transmission Type	Unsigned8	RW	255 (asynchronous transmission).
	3	Inhibit Time	Unsigned16	RW	1 = 1 µs
1A00	0	1st Transmit PDO Mapping	Unsigned32	RW	Number of mapped application objects.
	1	1st Mapping Object	Unsigned32	RW	6041h (Status Word).
1A01	0	2nd Transmit PDO Mapping	Unsigned32	RW	Number of mapped application objects.
	1	1st Mapping Object	Unsigned32	RW	6041h (Status Word).
	2	2nd Mapping Object	Unsigned32	RW	6061h (Modes of Operation Display).

Manufacturer-specific Profile Area

Index (Hex)	Sub-index	Name	Type	Attri-bute	Information
2000	0	SW Reset	Unsigned8	RW	Resets/reboots the module.
2200	0	Bus State	Unsigned8	RO	Bus state of the module. Values: 1 – Bus Running 2 – Bus Off/Error Passive 3 – Other Error
2300	0	Transmission Rate	Unsigned16	RW	The resolution for Process Data transmission for Transmission type 254. Specified with 6 ms resolution.
2800	0	Bus Off Control	Unsigned16	RW	After Bus Off/Error passive, this is the down time before bus re-initialisation in milliseconds.
3000	0	Module State	Unsigned8	RO	State if the module. Values: 0 – No bus connection 1 – Bus initialisation failed 2 – Prepared 3 – Pre-Operational 4 – Operational
4000	0	ACS 160 Par	Unsigned8	RO	Drive parameters. Subindex 0 indicates the ACS 160 parameter group number (first two digits of parameter number). Subindexes from 1 on correspond to parameter numbers in that group. Eg. ACS 160 parameter 1003 is represented as follows: Subindex 0: 4000h + Ah = 400Ah Subindex 3 Attempts to access a non-existent parameter causes a negative response.
… 4063	1…	ACS 160 Par	Unsigned16	RW RO	
5000	0	In Config	Unsigned8	RO	Alternative Transmit/Receive PDO mapping. See module configuration parameters 5105 to 5112 (Chapter 4).
	1…4	In Config 1…4	Unsigned16	RW	
5001	0	Out Config	Unsigned8	RO	
	1…4	Out Config 1…4	Unsigned16	RW	

Application Error Codes

The application error codes are a small subset of the error classes of the PROFIBUS specification (EN 50170). The codes are 4-byte values containing the *Error Class, Error Code,* and *Additional Code* (always 0 with CFB-CAN) fields.

Slave to Master

Header	Byte							
	1	2	3	4	5	6	7	8
1101xxxxxxx01000	Command	Object Index		Sub-index	Additional Code		Error Code	Error Class

Error Class	Error Code	Example
5 Service Error	**3** Parameter Inconsistent	Toggle bit not alternated.
	4 Illegal Parameter	Timeout value reached.
6 Access Error	**1** Object Access Unsupported	Attempt to write to a read-only parameter, or to read a write-only parameter.
	2 Object Non-existent	Object does not exist in Object Dictionary.
	6 Hardware Fault	Access failed because of a hardware error.
	7 Type Conflict	Data type does not match.
	9 Object Attribute Inconsistent	The subindex does not exist.
8 Other Error	**0**	User aborted transfer.

Additional Code	Meaning
0	No precise details for the reason for the error.
10h	Service parameter with an invalid value.
11h	Sub-index does not exist.
12h	Service parameter too long.
13h	Service parameter too short.
20h	Service cannot currently be executed
21h	…because of local control.
22h	…because of present device state.
30h	Value range of parameter exceeded.
31h	Value of parameter too high.
32h	Value of parameter too low.
36h	Maximum value smaller than minimum value.
40h	Incompatibility with other values.
41h	Data cannot be mapped to the PDO.
42h	PDO length exceeded.
43h	General parameter incompatibility.
47h	General internal incompatibility in the device.

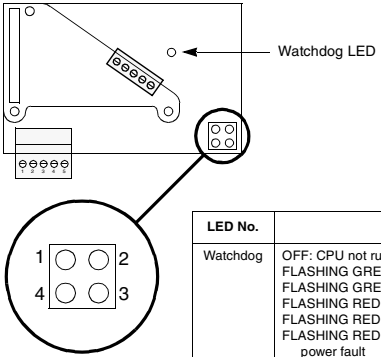
Standardised Device Profile Area

Index (Hex)	Sub-index	Name	Type	Attri-bute	Information
6040	0	Control Word	Unsigned16	RW	–
6041	0	Status Word	Unsigned16	RO	–
6042	0	Target Velocity	Integer16	RW	Required speed in rpm.
6043	0	Velocity Demand	Integer16	RO	Speed reference in rpm, provided by the ramp function.
6044	0	Control Effort	Integer16	RO	Output frequency of drive.
6046	0	Min/Max Value	Unsigned8	RO	Number of subindex.*
6046	1	Min Value	Unsigned32	RW	Minimum value.*
6046	2	Max Value	Unsigned32	RW	Maximum value.*
6048	0	Acceleration	Unsigned8	RO	Number of subindex.
6048	1	Acceleration (Delta Speed)	Unsigned32	RW	Acceleration Delta Speed value.
6048	2	Acceleration (Delta Time)	Unsigned16	RW	Acceleration Delta Time value. Fixed to 1 second.
6049	0	Deceleration	Unsigned8	RO	Number of subindex.
6049	1	Deceleration (Delta Speed)	Unsigned32	RW	Deceleration Delta Speed value.
6049	2	Deceleration (Delta Time)	Unsigned16	RW	Deceleration Delta Time value. Fixed to 1 second.
604A	0	Quickstop	Unsigned8	RO	Number of subindex.
604A	1	Quickstop (Delta Speed)	Unsigned32	RW	Quickstop Delta Speed value.
604A	2	Quickstop (Delta Time)	Unsigned16	RW	Quickstop Delta Time value.
6060	0	Modes of Operation	Integer8	WO	Sets mode of operation.
6061	0	Modes of Operation Display	Integer16	RO	Shows the current mode of operation.

*Note that changing the Max value may cause other parameters (for example, ramp times) to change since they use this value as a base for calculation. It is therefore recommended to set this parameter prior to other parameters.
Min/Max Value also sets the limits for the Status Word Limit bit to check against.

Status LEDs

There are five status LEDs on the printed board assembly of the CFB-CAN module.



LED No.	Description
Watchdog	OFF: CPU not running FLASHING GREEN (1 Hz): Initialised/Running FLASHING GREEN (2 Hz): Not initialised FLASHING RED (1 Hz): RAM check fault FLASHING RED (2 Hz): Flash check or fieldbus ASIC fault FLASHING RED (4 Hz): Drive initialisation failed or fieldbus power fault ORANGE: Firmware download enabled
1	Not used.
2	FLASHING GREEN (2 Hz): **Prepared** state FLASHING GREEN (1 Hz): **Pre-Operational** state GREEN: **Operational** state FLASHING RED: Bus initialisation failed
3	OFF: Module power off or module not initialised GREEN: Bus running FLASHING GREEN: Bus off/Error passive FLASHING RED: Other error
4	GREEN: Power on

Appendix A – EDS File Listing

Below is a sample EDS file listing. Due to space limitations, some repeated segments have been edited out. (Edits are marked •••.)

```
[FileInfo]
FileName=CACSx10a.eds
FileVersion=1
FileRevision=2
Description=EDS File For The ACS-160 Option
Board
CreationTime=02:30PM
CreationDate=12-01-99
CreatedBy=NN
ModificationTime=02:42PM
ModificationDate=15-02-2001
ModifiedBy=NN

[DeviceInfo]
VendorName=ABB Industry Oy, Drives
VendorNumber=3
ProductName=ACS160
ProductVersion=1
ProductRevision=1
BaudRate_10=1
BaudRate_20=1
BaudRate_50=1
BaudRate_100=0
BaudRate_125=1
BaudRate_250=1
BaudRate_500=1
BaudRate_800=1
BaudRate_1000=1
ProductNumber=1
SimpleBootUpSlave=1
SimpleBootUpMaster=0
ExtendedBootUpSlave=0
ExtendedBootUpMaster=0
Granularity=8
```

```
DynamicChannelsSupported=0x0

[Comments]
Lines=0x1
Line1=This is the EDS file for the ACS160 Option
Board

[MandatoryObjects]
SupportedObjects=2
1=0x1000
2=0x1001

[1000]
ParameterName=Device_Type
ObjectType=0x7
DataType=0x0007
LowLimit=0x00000000
HighLimit=0xFFFFFFFF
DefaultValue=0x10192
AccessType=ro
PDOMapping=0

[1001]
ParameterName=Error_Register
ObjectType=0x7
DataType=0x0005
LowLimit=0x00
HighLimit=0xFF
DefaultValue=0x00
AccessType=ro
PDOMapping=0

[OptionalObjects]
SupportedObjects=57
1=0x1003
2=0x1004
3=0x1005
•••
56=0x6060
57=0x6061

[1003]
SubNumber=2
ParameterName=Pre_Defined_Error_Field
ObjectType=0x8
DataType=0x0007
```

```
AccessType=rw
PDOMapping=0

[1003sub0]
ParameterName=Number of Errors
ObjectType=0x7
DataType=0x5
LowLimit=0x00000000
HighLimit=0xFF
DefaultValue=0x00000000
AccessType=RW
PDOMapping=0

[1003sub1]
ParameterName=Standard Error Field
ObjectType=0x7
DataType=0x0007
LowLimit=0x00000000
HighLimit=0xFFFFFFFF
DefaultValue=0x00000000
AccessType=RO
PDOMapping=0
```

• • •

```
[6060]
ParameterName=Modes_Of_Operation
ObjectType=0x7
DataType=0x0002
LowLimit=0x80
HighLimit=0x7F
AccessType=wo
PDOMapping=1

[6061]
ParameterName=Modes_Of_Operation_Display
ObjectType=0x7
DataType=0x0002
LowLimit=0x80
HighLimit=0x7F
AccessType=ro
PDOMapping=1

[ManufacturerObjects]
SupportedObjects=32
1=0x2000
```

```
2=0x2200
• • •
31=0x5000
32=0x5001

[2000]
ParameterName=Software_Reset
ObjectType=0x7
DataType=0x0009
DefaultValue=-----
AccessType=rw
PDOMapping=0

[2200]
ParameterName=Bus_State
ObjectType=0x7
DataType=0x0005
LowLimit=0x0
HighLimit=0xFF
DefaultValue=0x0
AccessType=ro
PDOMapping=1

• • •

[2300]
ParameterName=Transmission_Rate
ObjectType=0x7
DataType=0x0006
LowLimit=0x0
HighLimit=0xFFFF
DefaultValue=5
AccessType=rw
PDOMapping=0

• • •

[4001]
SubNumber=0x22
ParameterName=Group1Par
ObjectType=0x9
DataType=0x6

[4001sub0]
ParameterName=Number of Entries
```

```
ObjectType=0x7
DataType=0x5
LowLimit=0
HighLimit=0xFF
AccessType=RO
DefaultValue=0x25
PDOMapping=0

[4001sub2]
ParameterName=Speed
ObjectType=0x7
DataType=0x6
LowLimit=0
HighLimit=0xFFFF
AccessType=RO
DefaultValue=0
PDOMapping=1

[4001sub3]
ParameterName=Output_Freq
ObjectType=0x7
DataType=0x6
LowLimit=0
HighLimit=0xFFFF
AccessType=RO
DefaultValue=0
PDOMapping=1
```

• • •

```
[4001sub25]
ParameterName=MWh_Counter
ObjectType=0x7
DataType=0x6
LowLimit=0
HighLimit=0xFFFF
AccessType=RO
PDOMapping=1
```

• • •

```
[5001sub4]
ParameterName=ACS160_Out_Config_Parameter_4
ObjectType=0x7
DataType=0x6
LowLimit=0
```

```
HighLimit=0xFFFF
AccessType=RW
PDOMapping=0

[StandardDataTypes]
0x0001=0
0x0002=1
•••
0x0042=1

[DummyUsage]
Dummy0001=0
Dummy0002=0
Dummy0003=0
Dummy0004=0
Dummy0005=0
Dummy0006=0
Dummy0007=0

[Tools]
Items=0
```

Appendix B – CANopen Error Codes

This Appendix contains a cross-reference table for the ACS 160 drive. The table contains the CANopen error code (emergency number), and the corresponding drive fault code. The cause and corrective action for each error are given in the *ACS 160 User's Manual*.

CANopen Error Code	Corresponding ACS 160 Fault Code	CANopen Error Code	Corresponding ACS 160 Fault Code
0000h	No fault	5085h	25
1000h	20	5086h	26
2120h	15	5087h	27
2300h	1	5088h	28
2310h	5	5089h	29
2340h	4	5300h	10
3100h	16	6100h	CFB-CAN SW error
3120h	6	6320h	11
3210h	2	7081h	7
4210h	9	7082h	8
4310h	3	7110h	30
5081h	21	7120h	12 or 17
5082h	22	7510h	13
5083h	23	9000h	14
5084h	24		

Appendix C – Technical Data

CANopen Network

Size of Network: Max. 127 nodes

Medium: Screened, twisted pair CAN cable

- Termination: 120 Ω, 1/4 W, Metal Film

Topology: Multi-drop

Serial Communication Type: Asynchronous, half Duplex

Transfer Rate: 1 Mbit/s, 500 kbit/s, 250 kbit/s, 125 kbit/s, 100 kbit/s, 50 kbit/s, 20 kbit/s, or 10 kbit/s

Protocol: CANopen

Standards: CAN in Automation DS 301 *(Application Layer and Communication,* DSP 402 *(Device Profile: Drives and Motion Control),* ISO 11898 *(Controller Area Network [CAN] for High-Speed Communication)*

CFB-CAN

Enclosure: Cast aluminium, dimensions 124 × 79 × 42 mm (without cable glands)

Degree of Protection: IP65

Mounting: Onto ACS 160 drive

Settings: Via drive interface (control panel)

Connectors:

- One Phoenix Contact MC1,5/5-ST-3,81 (5-pole, cross-section 1.5 mm^2 max.) screw terminal block for fieldbus connection:

Terminal		Description
1	CAN_GND	CAN ground
2	CAN_L	CAN_L bus line (dominant low)
3	(CAN_SHLD)	Optional CAN shield
4	CAN_H	CAN_H bus line (dominant high)
5	(CAN_V+)	Optional CAN external power supply

General:

- All materials are UL/CSA approved
- Complies with EMC Standards EN 50081-2 and EN 50082-2

Appendix D – Ambient Conditions

Operation

The following conditions apply to stationary use of the module.

Installation Site Altitude: 0 to 2000 m above sea level. If the installation site is higher than 2000 m above sea level, please contact your local ABB representative for further information.

Temperature: -10 to +50 °C

Contamination Levels (IEC 721-3-3):
Chemical gases: Class 3C3
Solid particles: Class 3S3

Sinusoidal Vibration (IEC 721-3-3, 2nd Edition 1994-12):
Max 3 mm (2 to 9 Hz)
Max 10 m/s^2 (9 to 200 Hz)

Shock (IEC 721-3-3, 2nd Edition 1994-12):
Max 250 m/s^2, 6 ms

Storage and Transportation

The following conditions apply to storage and transportation of the module in the protective package.

Temperature: -40 to +70 °C

Contamination Levels (IEC 721-3-3):

Storage:	Chemical gases: Class 1C2 Solid particles: Class 1S3
Transportation:	Chemical gases: Class 2C2 Solid particles: Class 2S2

Shock (IEC 721-3-3, 2nd Edition 1994-12):
Max 300 m/s^2, 18 ms

CFB-CAN/EN
3BFE 64421140 R0125
EFFECTIVE: 01.06.2001

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