OsiSense XCC

CANopen Multi-Turn Absolute Encoder

User Manual

Original instructions

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Telemecanique Sensors

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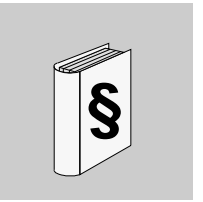
Safety Information



Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

CAUTION

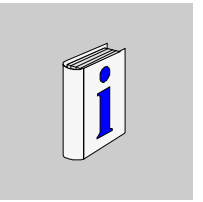
CAUTION, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** equipment damage.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book



At a Glance

Document Scope

This manual explains how to install and configure the absolute rotary encoder with CANopen interface connected on a bus.

Related Documents

Title of Documentation	Reference Number
Instruction sheet	W9 1690020

You can download these technical publications and other technical information from our website at www.schneider-electric.com.

User Comments

We welcome your comments about this document. You can reach us by e-mail at techcomm@schneider-electric.com.

Introduction

1

Overview

The purpose of this section is to provide general information about the encoder described in this documentation.

References of the CANopen encoders:

Description	Reference
CANopen encoder with a solid shaft	XCC 3510PS84CBN
CANopen encoder with a hollow shaft	XCC 3515CS84CBN

What's in this Chapter?

This chapter contains the following topics:

Introduction

Principle

This manual explains how to install and configure the absolute rotary encoder with CANopen interface. The products are fully compliant with standard DS406 and are CiA certified.

Multi-Turn Absolute Rotary Encoders

Absolute rotary encoders identify all the points of a movement by means of a single digital signal. Due to their capacity to give a single, exact position value to all linear and angular positions, absolute rotary encoders have become one of the most important links between the mechanical system and the control system.

The basic principle behind a rotary encoder is the optical sampling of a transparent code disk fixed on the rotating shaft.

Resolution:

Type	Value	No. of bits
Maximum no. of steps per revolution	8192	13
Maximum no. of detectable revolutions	4096	12
Maximum resolution (no. of steps)	33554432	25

The CANopen bus interface on the absolute rotary encoders authorizes speeds of up to 1 MBaud (cable length: 30 m for a maximum speed of 1 MBaud, 5000 m for a maximum speed of 10 kBaud).

The encoder connection base provides access to three rotary switches for configuring the address and transmission speed. It also incorporates two LEDs that provide assistance with diagnostics. The encoder acts as a T-junction with two M12 connectors for the BUS IN and BUS OUT signals.

General CANopen Information

The CANopen system is used in industrial applications. It is a multiple access system (maximum: 127 participants), which means that all devices can access the bus (the CANopen system manages anticollision). In simple terms, each node checks whether the bus is free, and if it is, the user can send messages. If two nodes try to access the bus at the same time, the node with the higher priority level (lowest ID number) has permission to send its message. The nodes with the lower priority level must stop transferring their data and start a new transmission after a given time.

Data communication is carried out via messages. These messages consist of 1 COB-ID (object identifier) followed by a maximum of 8 bytes of data. The COB-ID consists of a function code and a node number.

The node number corresponds to the network address of the device. It is unique on a bus. The function code varies according to the type of message being sent:

- Management messages (LMT, NMT)
- Messaging and service (SDOs)
- Data exchange (PDOs)
- Predefined messages (synchronization, emergency messages)

The value of the COB-ID sets the priority level of the message.

The absolute rotary encoders support the following communication modes:

- Client-server mode: data is only transmitted at the request of the client (PLC).
- Cyclic mode: data is transmitted cyclically (at regular, adjustable intervals) on the bus.
- Synchronous mode: data is transmitted after receipt of a synchronization message (SYNC).
- Status change mode: data is transmitted as soon as it has been modified.

The absolute rotary encoder complies with the class 2 encoder profile (DS 406 in which the characteristics of rotary encoders with CANopen interface are defined). This profile incorporates numerous parameters (direction of rotation, resolution, etc.) as well as useful operating and diagnostic data to be transferred. The encoder also has manufacturer-specific functions. Various software tools for configuration and parameter-setting are available from different suppliers. The encoders are easy to program using the EDS (electronic data sheet) configuration file, which can be downloaded from www.schneider-electric.com.

NOTE: More extensive information on the CANopen technology (functionality, manufacturer, products), encoder standards and profiles are available from the CiA:

CAN In Automation (CiA)

International Users and Manufacturers Group e.V.

Am Weichselgarten 26

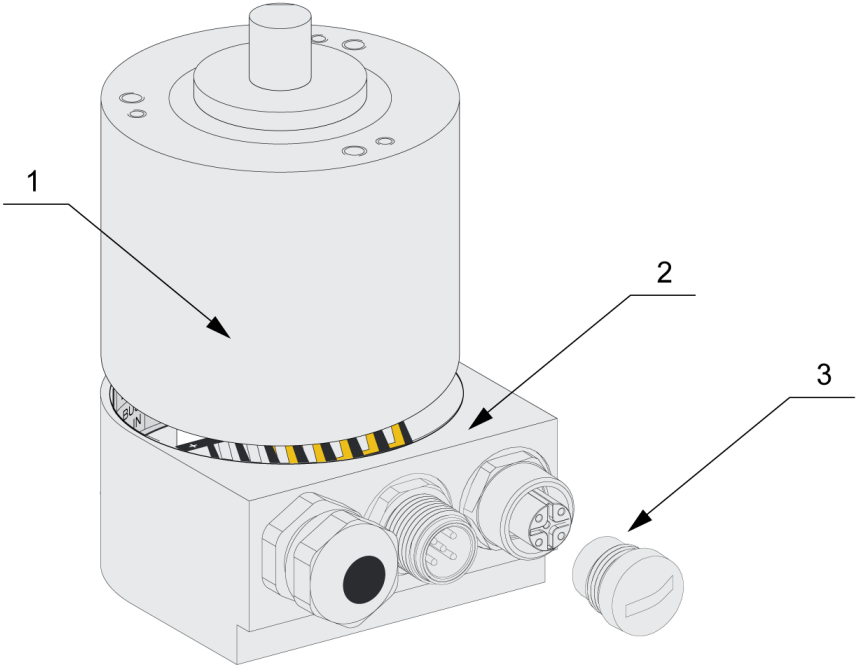
D-91058 Erlangen Germany

www.can-cia.org

General Presentation

Description

The absolute rotary encoder with CANopen interface looks like this:



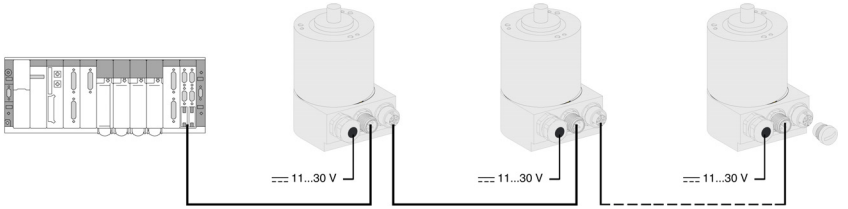
Encoder elements:

No.	Description
1	Encoder body
2	Connection base
3	Sealing plug

The encoder body connects to the base via a 15-pin SUB-D connector.

Networking

The absolute rotary encoder interface is based on the CANopen standard. The CANopen master is generally a PLC, to which the encoders are attached via M12 connectors. The power to the encoders is supplied directly via the PG9 on each base:



Bus Architecture

The maximum number of stations on the bus is 127 with addresses from 1 to 89.

The following speeds are available: 10, 20, 50, 125, 250, 500, 800, 1000 kBaud.

The cable length is limited by the transmission speed due to bit-by-bit arbitration:

Speed (kBaud)	**1000**	**800**	**500**	**250**
Max. length (m)	12	30	100	250
Max. length (ft)	39.37	98.43	328.08	820.21

The values in the table are theoretical, given for information purposes only, and will vary according to the environment and the number of slaves on the bus.

⚠ CAUTION

UNINTENDED EQUIPMENT OPERATION

- Warranty invalidated if dismantled.
- Handle with care.
- In environments subject to interference, it is advisable to connect the encoder to ground, using one of the fixing screws.

Failure to follow these instructions can result in injury or equipment damage.

Installation

2

Overview

The absolute encoder is connected to a connection base by means of a 15-pin SUB-D connector. The base can be removed from the encoder by undoing two screws located on the side of the base. The bus and the power supply are routed into the base via M12 connectors and a PG9 cable gland respectively and are connected to the terminals.

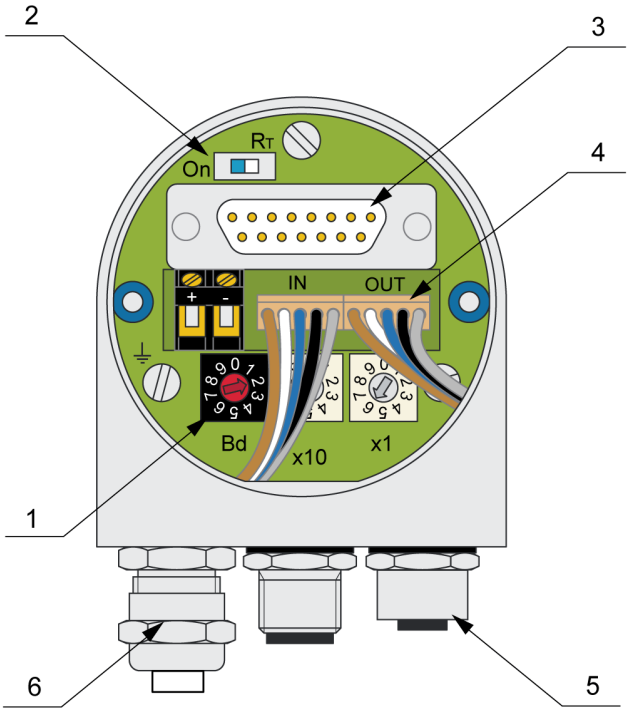
What's in this Chapter?

This chapter contains the following topics:

Connection Base

Description

Unscrew the encoder base to access the encoder settings:



Elements that can be accessed in the base:

No.	Description	Application
1	Rotary switches	Transmission speed and node number
2	Switch	Enables the line terminator
3	15-pin female SUB-D	Base/encoder connection
4	Terminals	BUS IN, BUS OUT and power supply
5	2 x M12 A-coded connectors	Cable/base connection (BUS IN, BUS OUT)
6	PG9 cable glands	Cable/base connection (for 24 VDC power supply cable, ∅ 4...8 mm)

⚠ DANGER

RISK OF ELECTROCUTION

- Switch off the power supply before working on this device.
- Check that the rotating machine is immobilized before working on this device.
- Close the cover correctly after configuration or wiring the microswitch.

Failure to follow these instructions will result in death or serious injury.

Transmission Speed

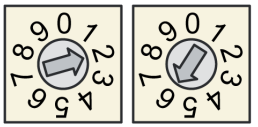
The baud rate is set using the rotary switch on the base.

The following baud rates are possible:

Speed (kBaud)	Position of encoder rotary switch
10	0
20	1
50	2
125	3
250	4
500	5
800	6
1000	7
Reserved	8
Default (250)	9

Node Address

The rotary switches located in the base are used to set the encoder network address (node number):



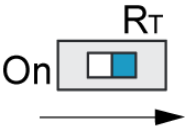
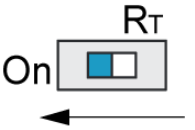
The switch marked (x1) is used to set the units and the switch marked (x10) is used to set the tens. The possible addresses are between 1 and 89, and any one address can only be used once in the network.

NOTE: Address 0 is reserved (NMT).

NOTE: Addresses 90...99 are reserved and must not be used.

Line Terminator

If the encoder is connected at one end of the bus line, the line terminator must be enabled (set the switch to the "ON" position).

Encoder location on the bus	Switch position
Encoder in the middle of the bus	
Encoder at the end of the bus	

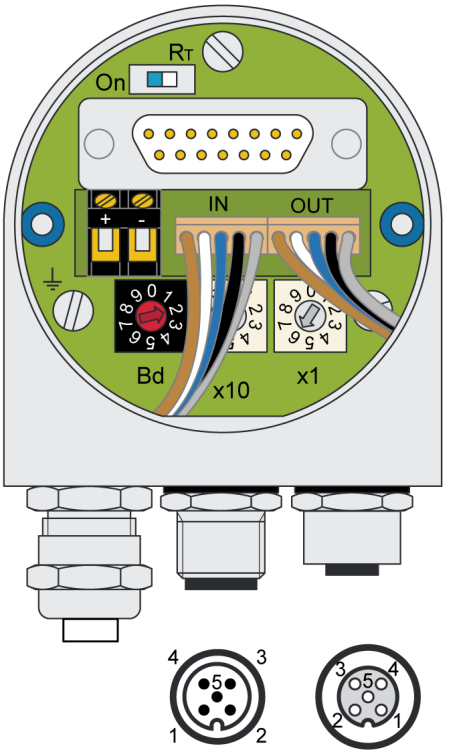
NOTE: If the line terminator is set to "ON", the "BUS OUT" terminals *Wiring the Bus and the Power Supply, page 19* shall be disconnected.

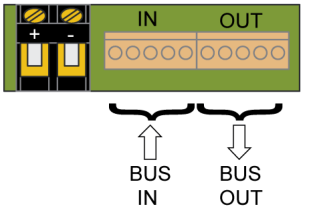
The base must be connected to the encoder for the bus to be wired correctly. If the encoder has to be changed during operation, a separate line terminator must be used.

Wiring the Bus and the Power Supply

Description

Remove the base to access the encoder wiring:





Description of the terminals:

Terminals	Pin	Description
-	-	Supply voltage 0 V
+	+	Supply voltage 24 V
BUS IN	1	CAN_SHLD
	2	(CAN_V+)
	3	CAN_GND
	4	CAN_H
	5	CAN_L

Terminals	Pin	Description
BUS OUT	1	CAN_SHLD
	2	(CAN_V+)
	3	CAN_GND
	4	CAN_H
	5	CAN_L

⚠ DANGER

RISK OF ELECTROCUTION

- Switch off the power supply before working on this device.
- Check that the rotating machine is immobilized before working on this device.
- Close the cover correctly after configuration or wiring the microswitch.

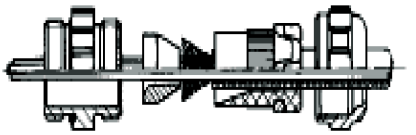
Failure to follow these instructions will result in death or serious injury.

Wiring the Encoder

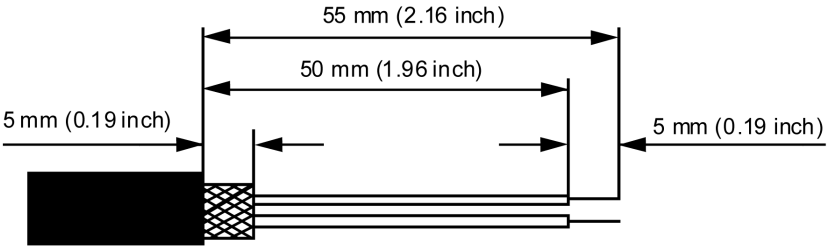
Connecting the Power Supply to the Connection Base

To supply the encoder via the PG9, connect the base using the following procedure:

Step	Action
1	Remove the screw, the seal gasket and the cable gland collar.
2	Prepare the cable as shown in the diagram below.
3	Place the screw and the seal gasket on the cable.
4	Fit the collar under the shielding.
5	Insert the cable assembly in the cable gland and tighten the screw.



Wiring diagram:



Connecting the base to the bus

To connect the encoder to the bus, simply connect the network cable to the female M12 connector (see *Connection Base, page 16*).

NOTE: Shielded cables should be used for data transmission to avoid problems with electromagnetic interference. The shielding must be connected to ground at both ends of the cable.

NOTE: The encoder must be connected to the bus before being powered on.

Accessories

List of accessories

The list of available accessories is as follows:

Description		Type
Reducing ring *	0.59 in to 0.55 in	XCC R358RDL14
Reducing ring *	0.59 in to 0.47 in	XCC R358RDL12
Reducing ring *	0.59 in to 0.39 in	XCC R358RDL10
Reducing ring *	0.59 in to 0.31 in	XCC R358RDL08
Reducing ring *	0.59 in to 0.24 in	XCC R358RDL06

* Only for hollow shafts

Assembly instructions

Encoder with output shaft:

Connect the encoder shaft to the revolving shaft using an XCC RA coupling.

Encoder with hollow shaft:

Position the encoder, fix it on the revolving shaft using the loop clamp, with or without the reducing ring. Then attach the flexible kit to a fixed support.

Do not tighten the fixing ring if the driving shaft and the bushing are missing from the encoder.

Installation Precautions

Precautions

The following points must be respected:

- Do not knock over the encoder and do not expose it to excessive vibration. The encoder is a precision device.
- Do not open the encoder casing (this does not mean that the connection base cannot be removed).
- The encoder shaft must be connected to the shaft to measure with appropriate coupling. This coupling is used to dampen vibrations and compensate for any imbalance at the encoder shaft, and also to prevent any significant unauthorized force. Schneider-Electric offers appropriate couplings.
- Schneider-Electric absolute encoders are robust, but when used in difficult environmental conditions they must still be protected appropriately. The encoder must not be used as a handle or a step.
- Only qualified personnel can commission and operate these encoders. Such personnel are authorized to commission, connect to ground and identify the devices, systems and circuits in accordance with current safety standards.
- No electrical modifications should be made to the encoder.
- Route the connection cable from the bus to the encoder, ensuring it is a sufficient distance or completely separate from the power supply cables and associated electromagnetic interference. Use fully shielded cables to obtain reliable data transfer and ensure correct grounding.
- In environments subject to interference, it is advisable to connect the encoder to ground.

⚠ DANGER

RISK OF ELECTROCUTION

- Switch off the power supply before working on this device.
- Check that the rotating machine is immobilized before working on this device.
- Close the cover correctly after configuration or wiring the microswitch.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Check the electrical connections to avoid short-circuits and voltage peaks.
- Check the connections before use and when carrying out maintenance operations.
- Comply with the recommendations for use.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

CAUTION

LOSS OF PROTECTION LEVEL IP

Close the cover correctly after configuration or wiring the microswitch.

Failure to follow these instructions can result in equipment damage.

Characteristics

3

Encoder Characteristics

Mechanical characteristics

The mechanical characteristics are as follows:

Shaft type		∅ 10 h8 *(0.39 in h8)* ∅ 15 F7 *(0.59 in F7)*
Maximum rotation speed		6000 rpm
Moment of inertia		30 g.cm^2
Torque		0.3 N.cm
Maximum load	Radial	11 daN

Electrical characteristics

The electrical characteristics are as follows

Supply voltage	⎓ 11...30 V. Max. ripple: 500 mV
No-load current consumption	100 mA
Frequency	800 kHz

Environmental characteristics

The environmental characteristics are as follows:

Conformity		CE
Ambient air temperature	Operation	-40...+85°C *(-40...+185°F)*
	Storage	-40...+85°C *(-40...+185°F)*
Degree of protection		IP 64
Vibration resistance		10 g (f = 10...2000 Hz), acc. to IEC 60068-2-6
Shock resistance		100 g (6 ms, 1/2 sine wave) acc. to IEC 60068-2-27

Withstand to electromagnetic disturbance	Electrostatic discharges	Acc. to IEC 61000-4-2: level 2, 4 kV air; 2 kV contact.
	Radiated electromagnetic fields (electromagnetic waves)	Acc. to IEC 61000-4-3: level 3, 10 V/m
	Fast transients (On/Off interference)	Acc. to IEC 61000-4-4: level 3, 2 kV (1 kV for the I/O)
	Impulse voltage	Acc. to 61000-4-5: level 1: 500 V
Materials	Base	Aluminum
	Cover	Aluminum
	Shaft	Stainless steel
	Bearings	Steel balls 6000ZZ1 (solid shaft) - 6803ZZ (hollow shaft)

Configuration

4

Overview

The purpose of this chapter is to describe the configuration parameters of the absolute encoder with a CANopen interface.

What's in this Chapter?

This chapter contains the following sections:

4.1 Configuration

Presentation

This subsection describes how to configure a CANopen absolute encoder.

What's in this Section?

This section contains the following topics:

Encoder Configuration/EDS File

General

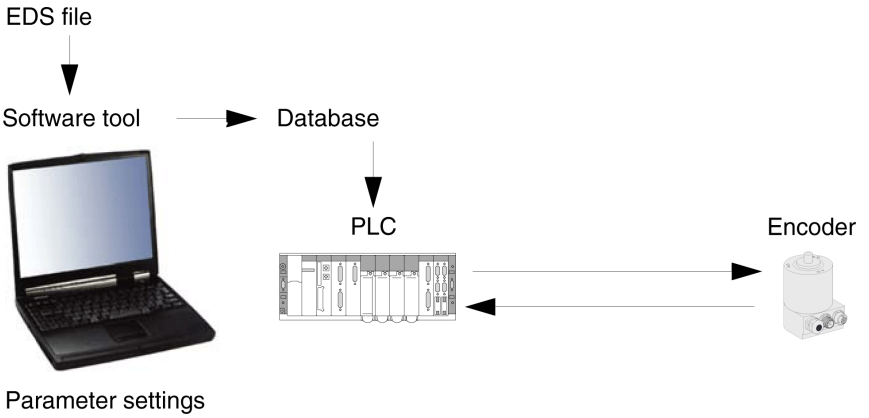
The absolute encoder with CANopen interface can be configured to suit the user's requirements. The EDS file corresponding to the encoder must be loaded in the software tool used for the configuration of the CANopen network. The user can then access the parameters and functions of the encoder.

Configuration

Download the EDS file and its 3 associated image files from "www.Schneider-Electric.com":

- **TEXCC35CBN_0101E.EDS**
- **TEXCC35CBN_0101E_R.dib**
- **TEXCC35CBN_0101E_S.dib**
- **TEXCC35CBN_0101E_D.dib**

The system is configured as shown in the diagram below:



CANopen Data Transmission

Data Transmission

Data is transmitted in a CANopen network in the form of messages. These messages consist of a COB-ID and 8 bytes of data, as shown in the following table:

COB-ID	Command	Index		Sub-index	Service data/Process data			
11 Bits	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Low	High		LSB	->	->	MSB

COB-ID

The 11-bit COB-ID is made up as follows:

10	9	8	7	6	5	4	3	2	1	0		
Function code				Node number								
X	X	X	X	X	X	X	X	X	X	X		X Free choice

The COB-ID only determines the message object. It consists of a function code, which identifies the message class, and the node number, which is the address of the absolute encoder. The node number is set using the two rotary switches located on the base (*Node Address, page 18*).

The following function codes are available (rx and tx as viewed by the master):

Object	FC (binary)	COB-ID result	Hex.	Priority class*
NMT	0000	0		0
SYNC	0001	128	80	0
Emergency	0010	129 - 255	81 - FF	0, 1
PDO (tx)	0011	385 - 511	181 - 1FF	1, 2
PDO (rx)	0100	513 - 639	201 - 27F	2
PDO (tx)	0101	641 - 767	281 - 2FF	2, 3
PDO (rx)	0110	769 - 895	301 - 37F	3, 4
SDO (tx)	1011	1409 - 1535	581 - 5FF	6
SDO (rx)	1100	1537 - 1663	601 - 67F	6, 7

* Priority: 0 = maximum priority, 7 = minimum priority

FC = Function code

Command Byte

The Command byte determines the type of message sent via the CAN network. A byte includes three types of message:

- Parameter settings: these are used to send parameter data to the encoder (node) for its configuration.
- Request: these are used by the master to read the parameters recorded in a node.
- Alarm: these are sent to the master by the rotary encoder if a message that has been sent cannot be processed correctly.

The description of the commands is as follows:

Command	Function	Message	Description
22 h	Master -> Encoder	Request	Parameter to the encoder
60 h	Encoder -> Master	Confirmation	Parameter received
40 h	Master -> Encoder	Request	Request for parameter
43 h, 4B h, 4F h (*)	Encoder -> Master	Response	Parameter to the master
80 h	Alarm	Response	Transmission error

(*) The value of this Command byte depends on the data length of the required parameter:

Command	Data length	Data length
43 h	4 bytes	Unsigned 32
4B h	2 bytes	Unsigned 16
4F h	1 byte	Unsigned 8

Index/Sub-Index

Data is transmitted solely using objects referenced by an index. The objects are simple or compound type. In this case, the index associated with the object will have several sub-indexes. The number of sub-indexes is specified in sub-index 0, and can be from 1 to 254. Each object is described in a structure called the object dictionary.

The organization of a standard object dictionary is shown in the following table:

Index (hex)	Object
0000	Not used
0001-001F	Static data types
0020-003F	Complex data types
0040-005F	Manufacturer-specific data types
0060-0FFF	Reserved
1000-1FFF	Communication area (see *Communication Objects 1000h to 1FFFh (DS 301), page 52*)
2000-5FFF	Manufacturer-specific area (see *Manufacturer Specific Objects 2000h to 5FFFh, page 73*)
6000-9FFF	Device profile-specific area (see *Encoder Specific Objects 6000h to 9FFFh (DS 406), page 74*)
A000-FFFF	Reserved

Operational Mode

Principle

The absolute rotary encoder accesses the CAN network four seconds after power-up in pre-operational mode:

FC	NN	Command	S/P data	Description
1110 b	XXXXXXX	-	-	Bootup message

It is recommended that the parameters are entered when the encoder is in pre-operational mode. Pre-operational mode entails reduced activity on the network, which simplifies the checking of the accuracy of the sent/received SDOs. It is not possible to send or receive PDOs in pre-operational mode.

Reinitialization of the Absolute Rotary Encoder

If a node is not operating correctly, it is advisable to carry out a reinitialization.

FC	NN	Command	S/P data	Description
0000 b	NODE-ID d	81 h	-	NMT-Réinitialisation, NODE-ID
0000 b	0 d	82 h	-	NMT-Reinitialization, all nodes

NODE-ID: node number

After reinitialization, the absolute rotary encoder accesses the bus in pre-operational mode.

Mode: Pre-operational

To set a node to pre-operational mode, the master must send the following message:

FC	NN	Command	S/P data	Description
0000 b	NODE-ID d	80 h	-	NMT-Pre-operational, NODE-ID

NODE-ID: node number

Mode: START

For 1 or all nodes to switch to operational mode, the master sends the following message:

FC	NN	Command	S/P data	Description
0000 b	0 d	01 h	-	NMT-start, all nodes.
0000 b	NODE-ID d	01 h	-	NMT-start, NODE-ID

NODE-ID: node number

It is possible to set all nodes (NN=0) or a single node (NN=NODE-ID) to operational mode.

Mode: STOP

For 1 or all nodes to exit operational mode, the master sends the following message:

FC	NN	Command	S/P data	Description
0000 b	0 d	02 h	-	NMT-stop, all nodes.
0000 b	NODE-ID d	02 h	-	NMT-stop, NODE-ID

NODE-ID: node number

Transmission of the Current Position

The process value is sent on the CAN network with the following message:

COB-ID	Process value			
11 Bits	Byte 0	Byte 1	Byte 2	Byte 3
	2^7 to 2^0	2^{15} to 2^8	2^{23} to 2^{16}	2^{31} to 2^{24}

The COB-ID contains the node number and the corresponding PDO(tx). By default, the process value that is sent uses function code PDO(tx)0011 and, in response to the SYNC message, uses function code PDO(tx)0101.

4.2 Software tools

Presentation

The encoders described in this document are CANopen certified with the DS 406 V3.2 profile. They are compatible with other CANopen certified products.

The encoders described in this section are configured using the following software:

Setting the network parameters	SyCon configuration tool version ≥ 2.9
PLC programming	Unity Pro version ≥ 4.0

Please refer to the software documentation for the minimum PC configuration used.

What's in this Section?

This section contains the following topics:

Setting the Network Parameters (SyCon)

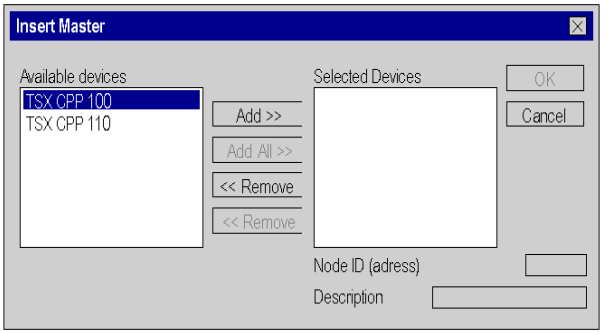
Description of SyCon

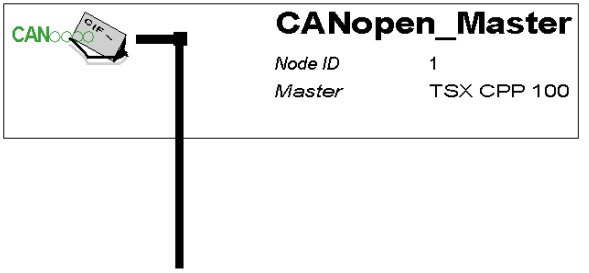
The configuration tool (SyCon) is used to draw a diagram of a network using a graphic representation of the nodes on the network. SyCon is then used to generate the complete configuration of the network that has been drawn.

It provides access to the various configuration parameters and the communication parameters.

Declaration of the master

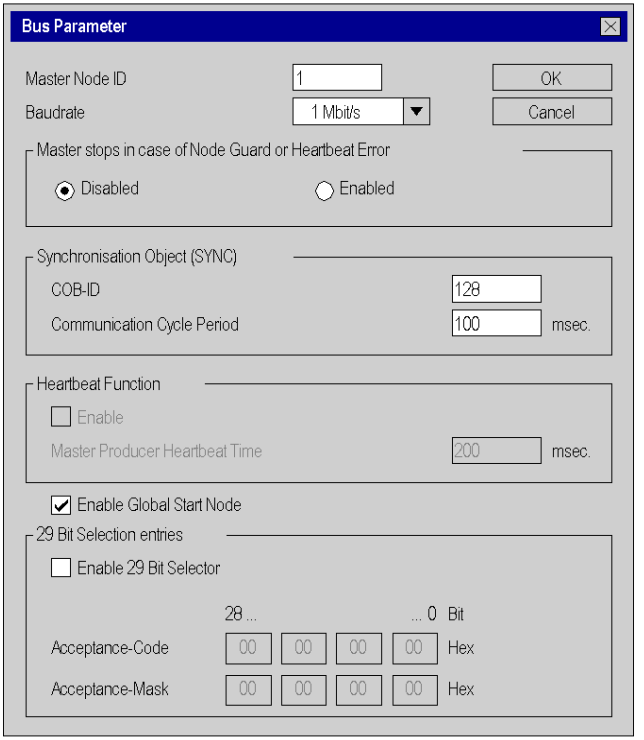
Within the UNITY programming software, launch the SyCon network tool and follow the steps below:

Steps	Actions
1	In the menu, select the command **File** → **New**. **Result:** A bus selection screen appears.
2	Select **CANopen** then confirm by clicking **Ok**. **Result:** A blank architecture will appear on the screen.
3	In the menu, click on **File** → **Copy EDS**.
4	In the menu, select the command **Insert** → **Master**. **Result:** The following screen appears: 

Steps	Actions
5	Select **TSX CPP 100**. Click on **Add**. Enter a name, which represents the master device, in the **Description** field. Note: The name should contain neither spaces nor letters with accents and should consist of no more than 32 letters. Confirm by clicking **OK**. **Result:** The following architecture appears: 

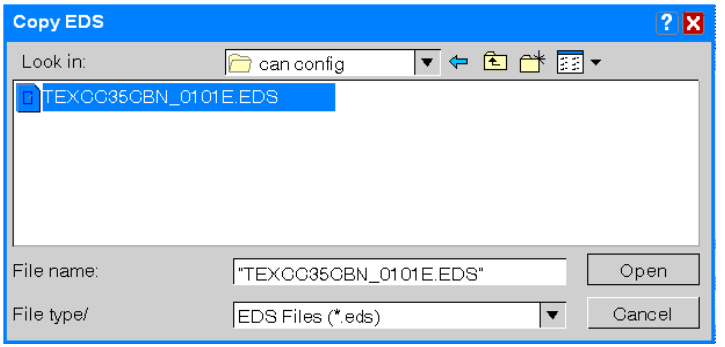
CANopen bus configuration

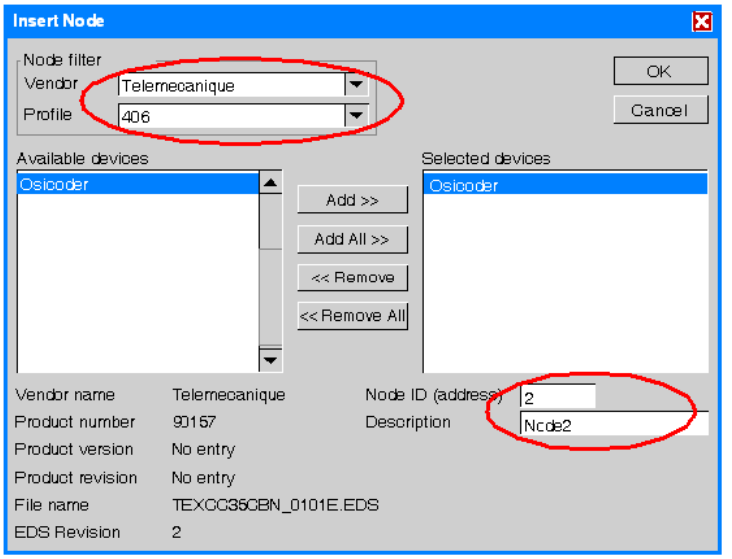
The table below shows the various steps for configuring the CANopen bus:

Steps	Actions
1	In the menu, select the command **Parameters** → **Bus Parameters**. **Result:** The following screen appears: 
2	Configure: • The speed • The COB-ID SYNC value (default value) • The Period duration.
3	Select **Disabled** in **Master stops in case of Node Guard or Heartbeat error**.
4	Select **Enable Global Start Node**.
5	Confirm by clicking **OK**.

Adding an encoder

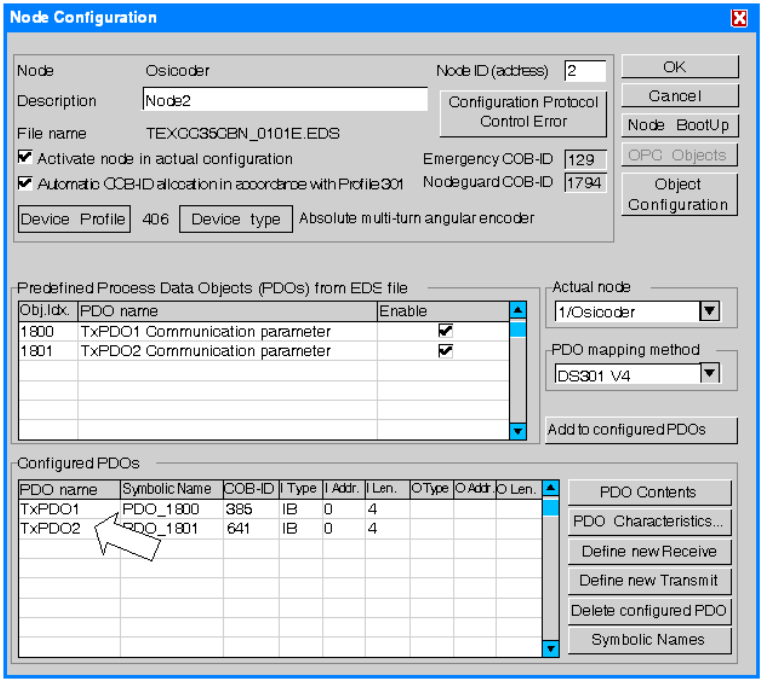
The following table gives the various steps for adding an encoder:

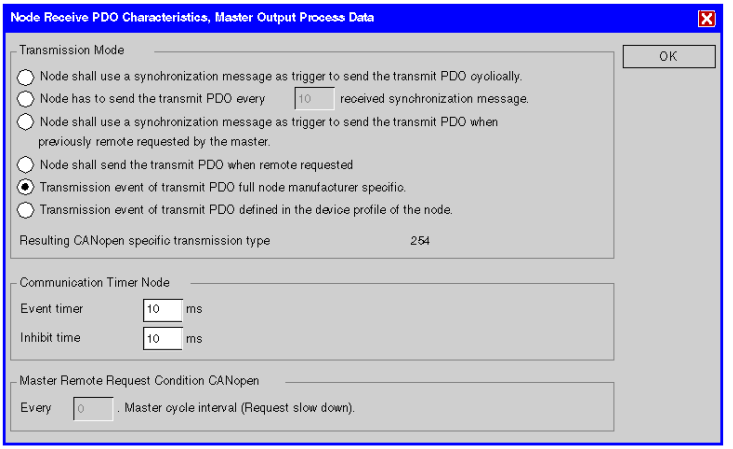
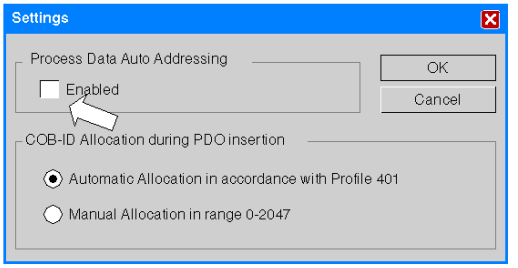
Steps	Actions
1	In the menu, click on **File** → **Copy EDS**. Select the encoder's EDS file: 
2	Click on **Open**. **Result:** A confirmation window appears.
3	Click on **Yes** to import the 3 associated image files. Note: If the image files are in the same directory as the EDS file, they are found automatically. **Result:** An information window appears. Click on **OK**
4	In the menu, click on **Insert** → **Node**. **Result:** A cursor appears.

Steps	Actions
5	Place the cursor on the bus outside the frame around the master. **Result:** A window appears: 
6	In the window: • Select the manufacturer • Select the profile (DS406) • Enter the address of the encoder node (see *Node Address, page 18*) • Enter the name of the node • Click on **OK** **Result:** The encoder is added in the architecture.

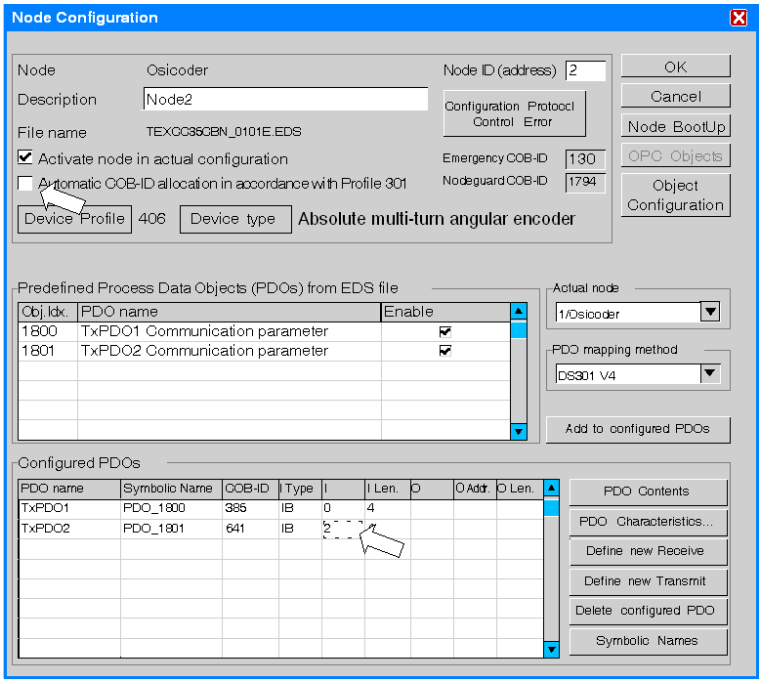
Setting the PDO Parameters

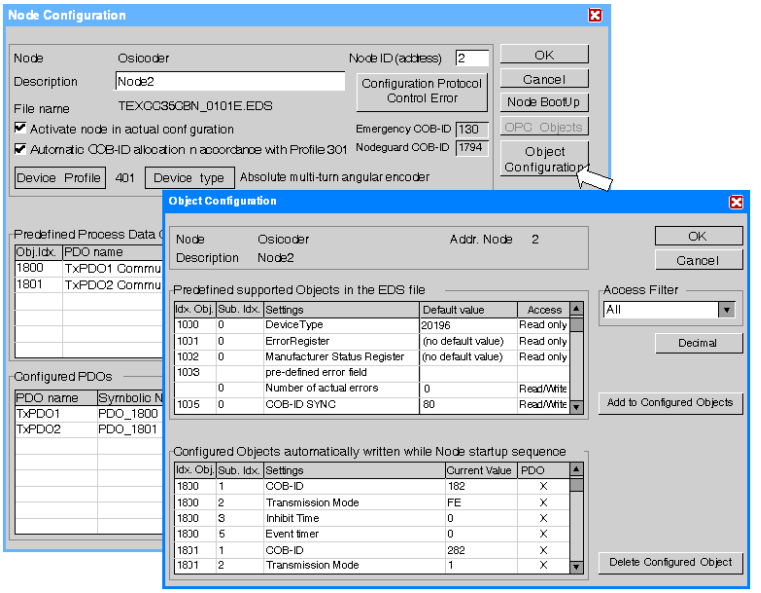
Follow the steps below:

Step	Action
1	Double-click on the image of the encoder to be configured. **Result:** The configuration window appears.
2	Select a configured PDO and click on **PDO Characteristics**: 

Step	Action
3	Select the required transmission mode: 
4	Click on **OK**
5	If you want to define the addresses of the activated PDOs manually: ● Select the master ● Click on **Parameters** → **Global Configuration** ● Deselect **Auto Addressing** ● Click on **OK** Illustration:  Otherwise, go directly to step 6.

Step	Action
6	Enter the required values in the **Addr. I** boxes next to the activated PDO.

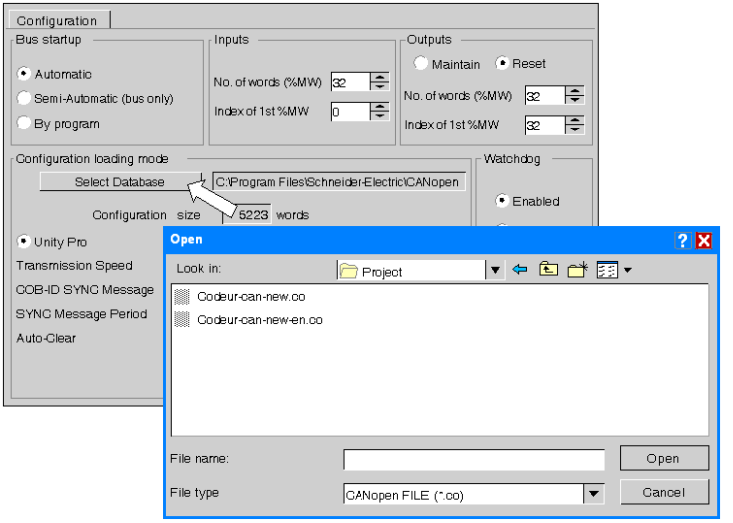


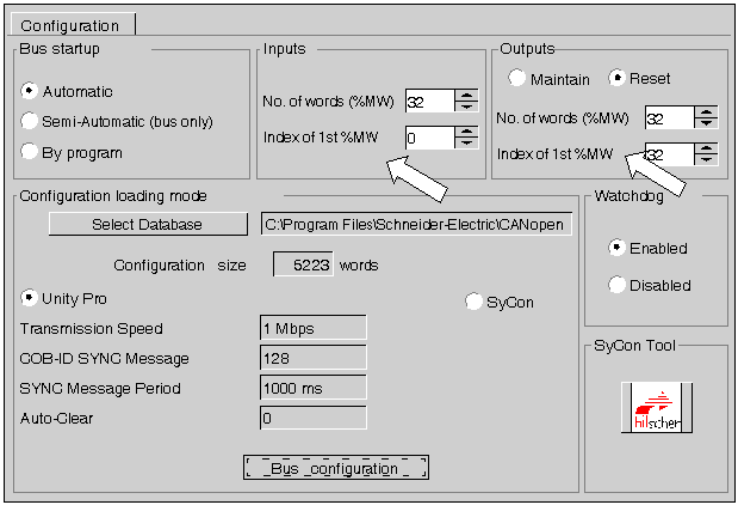
Step	Action
7	Click on **Object Configuration**:  This window is used to configure the default values of the configured objects that will be sent to the encoder the next time the node is powered up. For further information on the various objects see, see *CANopen Object Dictionary, page 51*.
8	Select the objects to be sent to the device, click on the **Add to Configured Objects** button and click on **OK**.
9	Go to **File** → **Save**: a *.CO configuration file is created. which contains the complete network architecture and the initial configuration of each node. This file is used by PLC programming software (eg: UNITY, etc.).

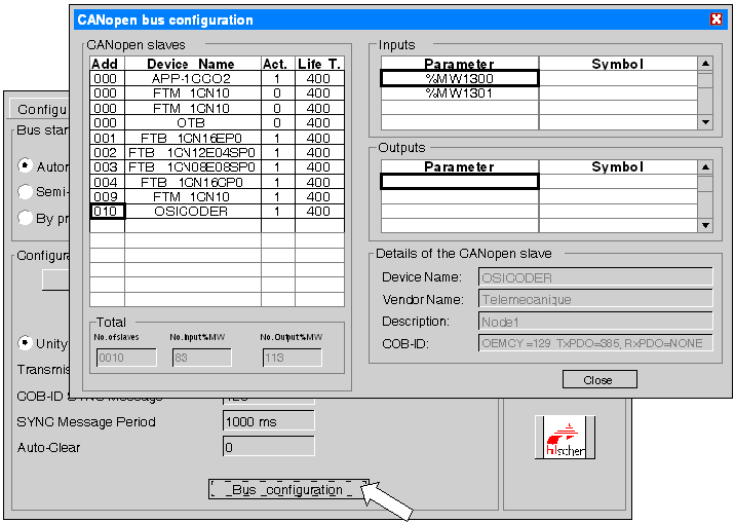
Integration and Use under Unity

Configuration

Follow the steps below:

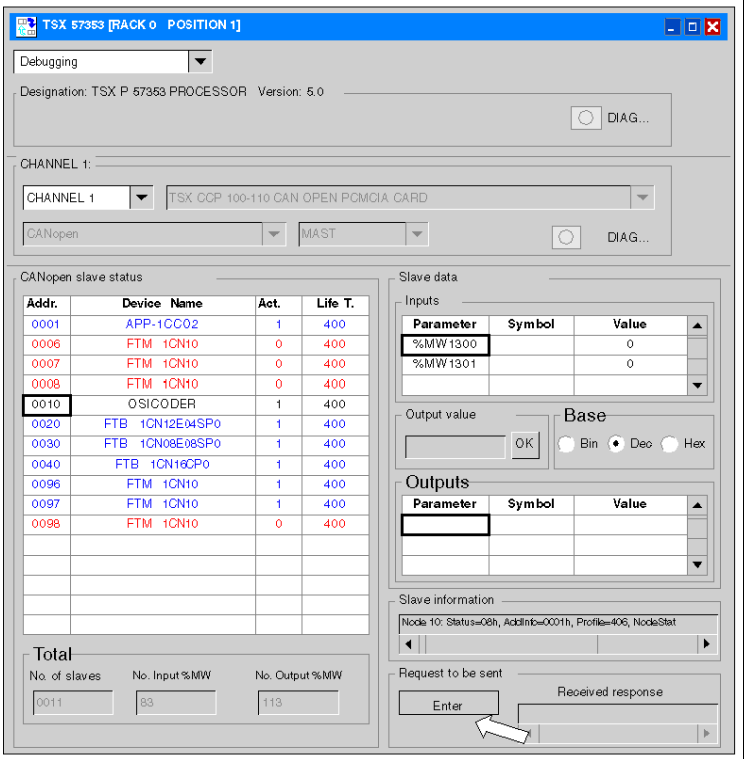
Steps	Actions
1	In the master configuration window, click on **Select Database** and choose the configuration file of the network generated with SyCon: 

Steps	Actions
2	Complete the fields in the "Input" (input data exchange area) and "Output" (output data exchange area) boxes: 

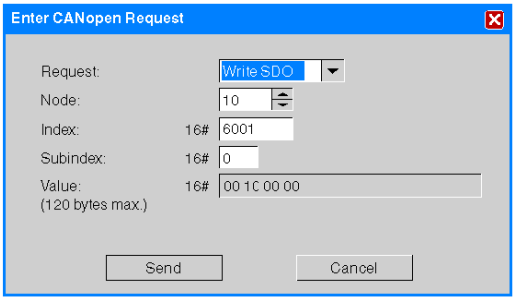
Steps	Actions
3	Click on the "Bus Configuration" button:  The bus configuration window is used to display the exact address of the data associated with the devices. The start address of each PDO is defined by the start address of the exchange area configured using Unity, to which the PDO offset defined using SyCon is added.
4	Execute the required SDO requests (either from the debug screen, or via the program).

SDO Request from the Debug Screen

Follow the steps below:

Step	Action
1	Click on the "Enter request" button at the bottom right of the debug screen: 

Step	Action

2	• Complete the fields:
	  • Request: "Write SDO" or "Read SDO"
	  • Node: Address of the device on the CANopen network
	  • Index: Index of the object to be read or written
	  • Subindex: Sub-index of the object to be read or written
	  • Value: Entry area for the data to be sent, for write only
	• Click on "Send".
	For further details on the various objects, see *CANopen Object Dictionary, page 51*.
	The example below shows setting the number of points per revolution to 4096:
	 
	The value "00 10 00 00" corresponds to the number 1000 in hexadecimal format, and thus to 4096 in decimal format.

3	After a "Read SDO" request, the value obtained can be read in the "Received response" area at the bottom right of the debug screen: 

CANopen Object Dictionary

5

Introduction

This section describes each CANopen network interface module dictionary object.

What's in this Chapter?

This chapter contains the following sections:

5.1 Communication Objects 1000h to 1FFFh (DS 301)

Introduction

This section lists the objects relating to communication. Each object, with all its technical characteristics, is described according to the CANopen standard.

What's in this Section?

This section contains the following topics:

Object 1000h: Device Type

Description

This object indicates the device type and its functionalities. It consists of a 16-bit field indicating the profile used (406 for DS406: encoder profile) and a second 16-bit field which provides information on the encoder type.

Representation of the object:

31 16	15 0
Encoder type	Profile used
Most significant word	Least significant word

Encoder type:

Value	Description
0001_h	Single-turn absolute rotary encoder
0002_h	Multi-turn absolute rotary encoder
0003_h	Single-turn absolute rotary encoder with electronic revolution counter
0004_h	Incremental rotary encoder
0005_h	Incremental rotary encoder with electronic counting
0006_h	Incremental linear encoder
0007_h	Incremental linear encoder with electronic counting
0008_h	Absolute linear encoder
0009_h	Absolute linear encoder with cyclic coding
$000A_h$	Multi-sensor encoder interface
$000B_h$ ...$FFFF_h$	Reserved

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	UNSIGNED32	20196 h	RO	no	no

Object 1001h: Error Register

Description

This object can store internal errors. It is mandatory for all devices, and is used with the EMCY object, which indicates errors.

The following error can be displayed:

Bit	Meaning
0	Generic error

These bits represent the Boolean "OR" for the errors present on the node.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	UNSIGNED8	-	RO	no	no

Object 1002h: Manufacturer Status Register

Description

Diagnostics data is saved in this double word. This object is used with the EMCY message.

Representation of the object:

31 16	15 0
Additional information	Error code
Most significant word	Least significant word

Bit Assignment

Registers	Description
Bits 0 ... 15	Bits [0...8]: not used Bit [9]: communication error or external error Bits [10...15]: not used
Bits 16 ... 31	Bits [16... 31] : not used

NOTE:

Bit values:
- 0: no error
- 1: error

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	UNSIGNED32	-	RO	no	no

Object 1003h: Pre-defined Error Field (PEF)

Description

This object is a double word used to store the device errors indicated by the EMCY object. This object is used to keep an error log.

- Sub-index 0 contains the number of errors recorded. A 0 value means that there is no error recorded (for example, after reinitialization of the PEF object).
- The least significant word contains the error code.
- The most significant word stores additional information specific to the error indicated on the encoder.

Representation of the object:

31 16	15 0
Additional information	Error code
Most significant word	Least significant word

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	Number of sub-indexes = Number of errors recorded	UNSIGNED8	0	rw	no	no
1 h	Most recent error	UNSIGNED32	-	ro	no	no
2 h	Second to last error	UNSIGNED32	-	ro	no	no
...						
FE h						

Appearance of a New Error

When a new error appears, the codes that are already present are moved up to the next level sub-index: the error in sub-index 1 is moved to sub-index 2, the error in sub-index 2 is moved to sub-index 3, etc.

Reset

The error code log can only be cleared by writing the value 0 in sub-index 0 of object 1003h.

NOTE: Eliminating the cause of an error does not delete the error code from the PEF.

List of error codes

Error Code	Diagnostics	Cause
0000 h	ERROR_RESET_OR_NO_ERROR	An error has been rectified
1000 h	GENERIC_ERROR	Internal communication error
6101 h	SOFTWARE_RX_QUEUE_OVERRUN	Overrun of the receive memory
6102 h	SOFTWARE_TX_QUEUE_OVERRUN	Overrun of the transmit memory
8100 h	COMMUNICATION	Transmission/reception counter synchronization error (EMCY transmit message if the counter value is > 96)
8120 h	CAN_IN_ERROR_PASSIVE_MODE	Interruption of the CAN controller
8130 h	LIFE_GUARD_ERROR	Node-Guarding Error
8140 h	BUS_OFF	Transmission counter buffer overrun

Object 1005h: COB-ID SYNC message

Description

This object contains the synchronization message identifier.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	UNSIGNED32	80 h	ROMAP	no	yes

Object 1008h: Manufacturer Device Name

Description

This object contains the device name.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	STRING	Osicoder	RO	no	no

Objet 1009h: Manufacturer Hardware Device (MHV)

Description

This object contains the hardware version of the device, in the form HVxx.yy.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	STRING	-	RO	no	no

Object 100Ah: Manufacturer's Software Version (MSV)

Description

This object contains the software version of the device, in the form 'SVxx.yy'.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	STRING	-	RO	no	no

Object 100Ch: Guard Time

Description

Object 100Ch contains the ''Guard-Time'' parameter expressed in milliseconds. This is the time between two pollings of the node by the master (presence of the node).

''Guard-Time' is zero if the protocol is not used.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	UNSIGNED16	0	rw	no	yes

Object 100Dh: Life Time Factor

Description

Object 100Dh contains the "Life-Time-Factor" parameter which, multiplied by the value of the 100Ch ''Guard-Time'' object, is the time allowed by the master before stopping the node when the node does not respond to the master.

"Life-Time-Factor" is zero if the protocol is not used.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	UNSIGNED8	0	RW	no	yes

Object 1010h: Store parameters

Description

This object supports the saving of the parameters to the non-volatile memory. To save the parameters, the "save" character string (6576 6173h) must be written in the sub-index, which prevents unintended saving.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	Number of sub-indexes	UNSIGNED8	1	RO	no	no
1 h	Store all parameters	UNSIGNED32	-	RW	no	no

Operation

To save the parameters, the "save" character string (6576 6173h) must be written in the corresponding index:

	Most significant word		Least significant word	
ISO 8859 (ASCII) signature	e	v	a	s
Hex value	65 h	76 h	61 h	73 h

Information on the storage functionality is read from sub-index 1. The result obtained, 0000 0001h, indicates that the module only saves its parameters when it receives the command to do so.

Object 1011h: Restore Default parameters

Description

This object restores the device's default parameters. To restore the parameters, the "load" character string (6461 6F6Ch) must be written in the relevant sub-index, which prevents unintended restoring.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	Number of sub-indexes	UNSIGNED8	1	RO	no	no
1 h	Restore all default parameters.	UNSIGNED32	-	RW	no	no

NOTE: The restoration of parameters will only be taken into account after a power up.

Operation

To restore the parameters, the "load" (6461 6F6Ch) character string must be written in the corresponding index:

	Most significant word		Least significant word	
ISO 8859 (ASCII) signature	d	a	o	l
Hex value	64 h	61 h	6F h	6C h

Information on whether it is possible to restore the module's factory parameters is read from sub-index 1. The result obtained, 00000001h, indicates that the factory parameters can only be restored when the module receives the command to do so.

Object 1014h: COB-ID Emergency (EMCY) message

Description

This object contains the EMCY emergency message identifier.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	UNSIGNED32	80 h + NODE-ID	RW	no	yes

Object 1015h: Inhibit Time EMCY

Description

This object contains the EMCY emergency message inhibit time. This time must be a multiple of 100 µs.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	UNSIGNED16	0	RW	no	yes

Object 1016h: Consumer heartbeat time

Description

This object is used to configure the period required by the consumer (the encoder) for receiving the Heartbeat message from the bus master.

The value of this object must be greater than the value of object 1017h.

The time must be a multiple of 1 ms.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	Number of sub-indexes	UNSIGNED8	1	ro	no	yes
1 h	Consumer heartbeat time	UNSIGNED32	0	rw	no	yes

Content of the Variable

The content of sub-index 1 is as follows:

Bit	31 to 24	23 to 16	15 to 0
Value	0 (Reserved)	Encoder address	Monitoring time in ms

If the value of the object is 0 h, no encoder is monitored.

Object 1017h: Producer heartbeat time

Description

This object is used to configure the cycle time of the Hearbeat transmission message.

The time must be a multiple of 1 ms.

If the value of the object is 0, the object is not used.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	UNSIGNED16	0	RW	no	yes

If the Heartbeat error monitoring protocol is selected, the producer transmits a Heartbeat message periodically, according to the "Producer Heartbeat Time" parameter. The nodes responsible for monitoring this message (Heartbeat Consumer) generate a Heartbeat event if the message is not received within the configured time (Consumer Heartbeat Time).

Object 1018h: Identity Object

Description

This object contains general information about the device.

The Vendor ID is the manufacturer's identifier (sub-index 1h).

The Product code gives the specific version of the encoder (sub-index 2h).

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

The major revision number indicates changes to CANopen functionalities. The minor revision number indicates changes to functionalities specific to the device:

31 16	15 0
Major revision number	Minor revision number
Most significant word	Least significant word

The Serial number identifies the device (sub-index 4h).

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	Number of inputs	UNSIGNED8	4h	RO	no	no
1 h	Vendor ID	UNSIGNED32	0700005A h	RO	no	no
2 h	Product code	UNSIGNED32	1602D h	RO	no	no
3 h	Revision number	UNSIGNED32	00010001 h	RO	no	no
4 h	Serial number	UNSIGNED32	XXXXXXXX: Individual according to production	RO	no	no

Object 1200h: Server SDO Parameter

Description

This object contains the message identifiers for SDO communication.

Object Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	Number of sub-indexes	UNSIGNED8	2 h	RO	no	no
1 h	Client to Server	UNSIGNED32	600 h + Node ID	RO	no	no
2 h	Server to Client	UNSIGNED32	580 h + Node ID	RO	no	no

Object 1800h: 1st Transmit PDO communication Parameter

Description

This object contains the communication parameters for the Transmit PDO.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	Number of sub-indexes	UNSIGNED8	5	RO	no	possible
1 h	COB-ID	UNSIGNED32	180 h + Node ID	RW	no	possible
2 h	Transmission mode	UNSIGNED8	FEh (254 d)	RW	no	possible
3 h	Inibit time	UNSIGNED32	0	RW	no	possible
4 h	Not available	-	-	-	-	-
5 h	Event timer	UNSIGNED32	0	RW	no	possible

Transmission mode

The PDO transmission mode can be configured as described in the table below.

Transfer code (decimal)	Transmission mode					Notes
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only	
0		x	x			Send PDO on first Sync message following an event
1...240	x		x			Send PDO every n (n = 0...240) Sync messages
241...251	Reserved					-
252			x		x	Update data immediately after the Remote Request and send the PDO at the next SYNC
253				x	x	Update data and send PDO on Remote Request
254				x		Send PDO on specific manufacturer event
255				x		Send PDO on specific encoder event

COB-ID Structure

The structure of a COB-ID for CAN2.0A is shown in the following table:

Bit No.	Value	Meaning
31 (MSB)	0	The PDO object exists
	1	The PDO object does not exist
30	0	RTR mechanism authorized
	1	RTR mechanism unauthorized
29	0	11-Bit ID (CAN 2.0A)
28 - 11	0	if bit 29 = 0
10 - 0 (LSB)	X	Bit 10 - 0 of the identifier

Inhibit Time (Sub-index 3)

For "Transmit PDOs", the "inhibit time" for PDO transmissions can be entered in this 16-bit field. If data is changed, the PDO sender checks whether an "inhibit time" has expired since the last transmission. A new PDO transmission can only take place if the "inhibit time" has expired. The "inhibit time" is useful for asynchronous transmission (transmission mode 254 d, 255 d), to avoid overloads on the CAN bus. The "inhibit time" is a multiple of 100 µs of object 1800 sub-index 03.

The following table shows some examples of values.

Value	Time in ms
0000 h	0
64 h	10
3E8 h	100
1388 h	500
2710 h	1000
FFFF h	6553

Event Timer (Sub-index 5)

The "event timer" only operates in asynchronous transmission mode (transmission mode 254 d, 255 d). If the data changes before the "event timer" expires, a temporary telegram is sent. If a value > 0 is written in this 16-bit field, the TPDO is always sent after the "event timer" expires. The value written in object 1800 sub-index 05 corresponds to the "event timer" in ms. When the "event timer" expires, the data transfer takes place even if no data has changed.

Object 1801h: 2nd Transmit PDO communication Parameter

Description

This object contains the communication parameters for the second Transmit PDO.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	Number of sub-indexes	UNSIGNED8	5	RO	no	yes
1 h	COB-ID	UNSIGNED32	280 h + Node ID	RW	no	yes
2 h	Transmission mode	UNSIGNED8	1 h	RW	no	yes
3 h	Inibit time	UNSIGNED16	0	RW	no	yes
4 h	Not available	-	-	-	-	-
5 h	Event timer	UNSIGNED16	0	RW	no	yes

Transmission mode

The PDO transmission mode can be configured as described in the table below.

Transfer code (decimal)	Transmission mode					Notes
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only	
0		x	x			Send PDO on first Sync message following an event
1 to 240	x		x			Send PDO every n (n = 0...240) Sync messages
241 to 251	Reserved					-
252			x		x	Update data immediately after the Remote Request and send the PDO at the next SYNC
253					x	Update data and send PDO on Remote Request
254				x		Send PDO on specific manufacturer event
255				x		Send PDO on specific encoder event

Inhibit Time (Sub-index 3)

For "Transmit PDOs", the "inhibit time" for PDO transmissions can be entered in this 16-bit field. If data is changed, the PDO sender checks whether an "inhibit time" has expired since the last transmission. A new PDO transmission can only take place if the "inhibit time" has expired. The "inhibit time" is useful for asynchronous transmission (transmission mode 254 d, 255 d), to avoid overloads on the CAN bus. The "inhibit time" is a multiple of 100 µs of object 1801 sub-index 03.

The following table shows some examples of values.

Value	Time in ms
0000 h	0
64 h	10
3E8 h	100
1388 h	500
2710 h	1000
FFFF h	6553

Event Timer (Sub-index 5)

The "event timer" only operates in asynchronous transmission mode (transmission mode 254 d, 255 d). If the data changes before the "event timer" expires, a temporary telegram is sent. If a value > 0 is written in this 16-bit field, the TPDO is always sent after the "event timer" expires. The value written in 1801 sub-index 05 corresponds to the "event timer" in ms. The data transfer takes place even if no data has changed.

Object 1A00h: 1st Transmit PDO Mapping Parameter

Description

This object is used to describe the objects that will be transported by the PDO.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	Number of sub-indexes	UNSIGNED8	1	RW	no	yes
1 h	1st object in PDO	UNSIGNED32	60040020 h	RW	no	yes

Data Field Structure

Each data object to be transported is represented in the following way:

Bits	31 to 16	15 to 8	7 to 0
Data	Index number of the object to be transported	Sub-index number of the object to be transported	Length of the object to be transported
Example	6004 h	00 h	20 h

NOTE: The maximum total length of data transported by the PDO is 8 bytes.

Object 1A01h: 2nd Transmit PDO Mapping Parameter

Description

This object is used to describe the objects that will be transported by the PDO.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	Number of sub-indexes	UNSIGNED8	1	RW	no	yes
1 h	1st object in PDO	UNSIGNED32	60040020 h	RW	no	yes

Data Field Structure

Each data object to be transported is represented in the following way:

Bits	31 to 16	15 to 8	7 to 0
Data	Index number of the object to be transported	Sub-index number of the object to be transported	Length of the object to be transported
Example	6004 h	00 h	20 h

NOTE: The maximum total length of data transported by the PDO is 8 bytes.

5.2 Manufacturer Specific Objects 2000h to 5FFFh

Object 5FFFh: SED Data Object

Description

This object contains the manufacturer's name and the conformity class for Transparent Ready.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	Number of inputs	Unsigned 8	2	RO	No	-
1 h	Manufacturer	VISIBLE_STRING	Telemecanique	Constant	No	-
2 h	Conformity class	VISIBLE_STRING	S10	Constant	No	-

5.3 Encoder Specific Objects 6000h to 9FFFh (DS 406)

Introduction

This section lists the encoder specific objects. Each object, with all its technical characteristics, is described according to the CANopen standard.

What's in this Section?

This section contains the following topics:

Object 6000h: Operating parameters

Presentation

The code sequence (Complement) can be selected as the operating parameter.

CMS	Index	Default value	Value range	Data length
SDO	6000h	4h	0h - 5h	Unsigned 16

Bit	Function	Bit = 0	Bit = 1	Service
0	Direction of angular measurement	Clockwise	Reverse	Available
1	Diagnostic check	Inhibited	Enabled	Not available
2 *	Scaling function	Inhibited	Enabled	Available
3	Direction of linear measurement	Forward	Reverse	N/A
4...11	Reserved			N/A
12	Manufacturer-specific function	-	-	N/A
13	Manufacturer-specific function	-	-	N/A
14	Manufacturer-specific function	-	-	N/A
15	Manufacturer-specific function	-	-	N/A

* If bit no. 2 = 0, then objects 6001h and 6002h are not operational.

General description of the parameters

Master to absolute rotary encoder: (parameter put in place)

FC	NN	Command	Index		Sub-index	Service data/Process data			
SDO (rx)		Load	6000h			Byte 4	Byte 5		
1100 b	1-89 d	22	60	00	00	**X**	00		

X Required direction

The code sequence (Complement) determines the counting direction in which the output process value increases or decreases. The code sequence is determined by Bit 0 in index 6000h:

Bit 0	Code sequence	Code
0	Clockwise	Increasing CW
1	Counter-clockwise	Decreasing CCW

When transmission has been successful, the encoder responds with a confirmation message:

FC	**NN**	**Command**	**Index**		**Sub-index**	**Service data/Process data**			
SDO (tx)		Load	6000h			Byte 4	Byte 5	Byte 6	Byte 7
1011 b	1-89 d	60	60	00	00	00	00	00	00

Example

Aim: Absolute rotary encoder in CCW direction, decreasing.

Bit matrix:

Bit 0 = 1 (Decreasing (CCW))

Result bit matrix X = 01h

Node number NN = 01

Master to absolute rotary encoder: (parameter put in place)

COB-ID	**Command**	**Index**		**Sub-index**	**Service data/Process data**			
	Load	6000h			Byte 4	Byte 5		
601	22	60	00	00	**01**	00		

Absolute rotary encoder to master: (Confirmation)

COB-ID	**Command**	**Index**		**Sub-index**	**Service data/Process data**			
	Load	6000h			Byte 4	Byte 5	Byte 6	Byte 7
581	60	60	00	00	00	00	00	00

Object 6001h: Measuring Units per revolution

Presentation

The Measuring Units per Revolution parameter is used to program the required number of steps per revolution. Choose a value between 1 and 8192:

CMS	Index	Default value	Value range	Data length
SDO	6001h	-	0h - 2000h	Unsigned 32

General description of the parameters

Master to absolute rotary encoder: (parameter put in place)

FC	NN	Command	Index		Sub-index	Service data/Process data			
SDO (rx)		Load	6001			Byte 4	Byte 5	Byte 6	Byte 7
1100 b	1-89 d	22	60	01	00	**X**	**X**	**00**	**00**

X: Required measuring units per revolution (< 13 bits)

If the required value exceeds that of the encoder resolution, the code will not be transmitted. It is therefore important that the parameter is within the range of possible values.

When transmission has been successful, the encoder responds with a confirmation message:

FC	NN	Command	Index		Sub-index	Service data/Process data			
SDO (tx)		Load	6001h			Byte 4	Byte 5	Byte 6	Byte 7
1011 b	1-89 d	60	60	01	00	00	00	00	00

Programming example

Programming example: Measuring units per revolution

Aim: Absolute rotary encoder with 4096 steps per revolution.

Measuring units per revolution: 4096 steps = 1000 h

Node number NN = 01

Master to absolute rotary encoder: (parameter put in place)

COB-ID	**Command**	**Index**		**Sub-index**	**Service data/Process data**			
	Load	6001h			Byte 4	Byte 5	Byte 6	Byte 7
601	22	60	01	00	**00**	**10**	**00**	**00**

Absolute rotary encoder to master: (Confirmation)

COB-ID	**Command**	**Index**		**Sub-index**	**Service data/Process data**			
	Load	6001h			Byte 4	Byte 5	Byte 6	Byte 7
581	60	60	01	00	00	00	00	00

Object 6002h: Total measuring range in measuring units

Presentation

This parameter is used to program the required number of measuring units from the global measuring range. This value must not exceed that of the total resolution of the absolute rotary encoder, printed on the encoder nameplate:

CMS	Index	Default value	Value range	Data length
SDO	6002h	2.000.000h	0h - 2.000.000h	Unsigned 32

Note:

The following combinations of letters will be used

- **PGA**: Total physical resolution of the encoder
- **PAU**: Physical resolution per revolution
- **GA**: Total resolution (client parameter)
- **AU**: Measuring units per revolution (client parameter)

If the required measuring units per revolution is lower than the actual physical resolution per revolution of the encoder, then the total resolution must be written as follows:

Total resolution: GA = (PGA*AU)/PAU, with AU ≤ PAU

If the total resolution of the encoder is lower than the total physical resolution, the resolution in the parameters must be a multiple of the total physical resolution:

k = PGA/GA, with k being a whole number

General description of the parameters

Master to absolute rotary encoder: (parameter put in place)

FC	NN	Command	Index		Sub-index	Service data/Process data			
SDO (rx)		Load	6002h			Byte 4	Byte 5	Byte 6	Byte 7
1100 b	1-89 d	22	60	02	00	**X**	**X**	**X**	**X**

X: Required measuring units per revolution (< 15 bits)

When transmission has been successful, the encoder responds with a confirmation message:

FC	NN	Command	Index		Sub-index	Service data/Process data			
SDO (tx)		Load	6002h			Byte 4	Byte 5	Byte 6	Byte 7
1011 b	1-89 d	60	60	02	00	00	00	00	00

Programming example

Aim: Absolute rotary encoder with a total resolution of 24 bits.

A total resolution of 24 bits is the equivalent of 1000000 h

Node number NN = 1

Master to absolute rotary encoder: (parameter put in place)

COB-ID	**Command**	**Index**		**Sub-index**	**Service data/Process data**			
	Load	6002h			Byte 4	Byte 5	Byte 6	Byte 7
601	22	60	02	00	**00**	**00**	**00**	**01**

Absolute rotary encoder to master: (Confirmation)

COB-ID	**Command**	**Index**		**Sub-index**	**Service data/Process data**			
	Load	6002h			Byte 4	Byte 5	Byte 6	Byte 7
581	60	60	02	00	00	00	00	00

Object 6003h: Preset Value

Presentation

The preset value is the required position value to be reached at a certain physical location of the axis. The position value is fixed as being the process value required by the presetting of the parameters.

To avoid execution time errors, the preset value must not exceed the total resolution of the parameters.

CMS	Index	Default value	Value range	Data length
SDO	6003h	0h	0h - total resolution	Unsigned 32

General description of the parameters

Master to absolute rotary encoder: (parameter put in place)

FC	NN	Command	Index		Sub-index	Service data/Process data			
SDO (rx)		Load	6003h			Byte 4	Byte 5	Byte 6	Byte 7
1100 b	1-89 d	22	60	03	00	**X**	**X**	**X**	**X**

X: Required preset value

When transmission has been successful, the encoder responds with a confirmation message like the following:

FC	NN	Command	Index		Sub-index	Service data/Process data			
SDO (tx)		Load	6003h			Byte 4	Byte 5	Byte 6	Byte 7
1011 b	1-89 d	60	60	03	00	00	00	00	00

Programming example

Aim: Absolute rotary encoder with a preset value at 0

The preset value at 0 is equivalent to X = 0h

Node number NN = 1

Master to absolute rotary encoder: (parameter put in place)

COB-ID	Command	Index		Sub-index	Service data/Process data			
	Load	6003h			Byte 4	Byte 5	Byte 6	Byte 7
601	22	60	03	00	**00**	**00**	**00**	**00**

Absolute rotary encoder to master: (Confirmation)

COB-ID	Command	Index		Sub-index	Service data/Process data			
	Load	6003			Byte 4	Byte 5	Byte 6	Byte 7
581	60	60	03	00	00	00	00	00

Object 6004h: Position Value

Description

This object is used to define the position of the encoder.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	Unsigned 32	-	ROMAP	Optional	No

Object 6200h: Cyclic Timer

Cyclic mode

The absolute rotary encoder transmits the current process value cyclically - without being polled by the host. The cycle time can be programmed in milliseconds for values between 1 ms and 65535 ms. (For example: 64h = 100ms).

CMS	Index	Default value	Value range	Data length
SDO	6200h	0h	0h - 10000h	Unsigned 16

General description of the parameters:

Master to absolute rotary encoder: (parameter put in place)

FC	NN	Command	Index		Sub-index	Service data/Process data			
SDO (rx)		Load	6200h			Byte 4	Byte 5	Byte 6	Byte 7
1100 b	1-89 d	22	62	00	00	**X**	**X**	00	00

X: Required cycle time

Absolute rotary encoder to master: (Confirmation)

FC	NN	Command	Index		Sub-index	Service data/Process data			
SDO (tx)		Load	6200h			Byte 4	Byte 5	Byte 6	Byte 7
1011 b	1-89 d	60	62	00	00	00	00	00	00

Disabling cyclic mode

To disable absolute rotary encoder cyclic mode, send the following message (disabling of cyclic mode):

Master to absolute rotary encoder: (parameter put in place)

COB-ID	Command	Index		Sub-index	Service data/Process data			
	Load	6200			Byte 4	Byte 5	Byte 6	Byte 7
601	22	62	00	00	00	00	00	00

Absolute rotary encoder to master: (Confirmation)

COB-ID	Command	Index		Sub-index	Service data/Process data			
	Load	6200			Byte 4	Byte 5	Byte 6	Byte 7
581	60	62	00	00	00	00	00	00

SYNC mode

When it has received the SYNC telegram sent by the host, the absolute rotary encoder sends the current position value. If several nodes are programmed in SYNC mode, they respond according to their COB-ID. Programming an offset time is not applicable.

It is also possible to program a number of ignored SYNC messages:

CMS	Index	Sub-Index	Default value	Value range	Data length
SDO	1801	2h	1h	1h - 100h	Unsigned 8

General description of the parameters:

Master to absolute rotary encoder: (parameter put in place)

FC	NN	Command	Index		Sub-index	Service data/Process data			
SDO (rx)		Load	1801h		2h	Byte 4	Byte 5	Byte 6	Byte 7
1100 b	1-89 d	22	18	01	02	**X**	00	00	00

X: Number of SYNC messages after which the encoder sends the process value.

Absolute rotary encoder to master: (Confirmation)

FC	NN	Command	Index		Sub-index	Service data/Process data			
SDO (tx)		Load	1801h		2h	Byte 4	Byte 5	Byte 6	Byte 7
1011 b	1-89 d	60	18	01	02	00	00	00	00

As with cyclic mode, SYNC mode can also be disabled, using the same procedure. To disable it, PDO 2 must be addressed with index 1802h.

Example: Number of SYNC messages

Aim: Absolute rotary encoder with 3 SYNC messages

Number of SYNC messages: X = 03h

Node number NN = 01 d

Master to absolute rotary encoder: (parameter put in place)

COB-ID	Command	Index		Sub-index	Service data/Process data			
	Load	1801h		2h	Byte 4	Byte 5	Byte 6	Byte 7
601	22	18	01	02	**03**	00	00	00

Absolute rotary encoder to master: (Confirmation)

COB-ID	Command	Index		Sub-index	Service data/Process data			
	Load	1801h		2h	Byte 4	Byte 5	Byte 6	Byte 7
581	60	18	01	02	00	00	00	00

Pulled mode

The connected host requests the current process value using a remote transmission request message. The absolute rotary encoder reads the current position value, optionally calculates the adjustment parameters and, using the same COB-ID, sends the process value that is obtained. The PDO (rx) with function code 001 is used by the encoder to transmit the position value.

This type of transmission mode must only be used in operational mode.

CMS	Bit remote transmission request (RTR)	Data length
PDO	1	0

Object 6500h: Operating Status

Description

This object contains the operating status of the encoder. It provides information on the encoder internal parameters.

Values

The values of this object are outlined in the following table:

Bit	Function	Value = 0	Value = 1	C1	C2
0	Code Sequence	CW	CCW	Mandatory	Mandatory
1	Commissioning Diagnostic Control	Not supported	Supported	Optional	Optional
2	Scaling function control	Disabled	Enabled	Optional	Mandatory
3	Measuring direction	CW	CCW	Optional	Optional
4...11	Reserved				
12	Manufacturer-specific function	Disabled	Enabled	Optional	Optional
13	Manufacturer-specific function	Disabled	Enabled	Optional	Optional
14	Manufacturer-specific function	Disabled	Enabled	Optional	Optional
15	Manufacturer-specific function	Disabled	Enabled	Optional	Optional

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	Unsigned 16	-	RO	No	No

Objet 6501h : Singleturn Resolution (Rotary)

Description

This object indicates the number of steps per revolution according to the position of the encoder. The maximum encoder resolution is 2^{13}.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	Unsigned 32	-	RO	No	No

Object 6502h: Number of Distinguishable Revolutions

Description

This object indicates the number of revolutions that the encoder can execute. The maximum number of encoder revolutions is 2^{12}

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	Unsigned 16	-	RO	No	No

Object 6503h: Alarms

Description

This object contains the various alarm messages. An alarm will be displayed if an encoder malfunction causes a position error. The alarm bit remains enabled until the alarm is cleared and the encoder is able to provide a correct position value.

Values

The values of this object are outlined in the following table:

Bit	Function	Value = 0	Value = 1	C1	C2
0	Position error	No	Yes	Optional	Optional
1	Commissioning diagnostics	Not supported	Supported	-	-
2...11	Reserved				
12	Manufacturer-specific alarm	Disabled	Enabled	Optional	Optional
13	Manufacturer-specific alarm	Disabled	Enabled	Optional	Optional
14	Manufacturer-specific alarm	Disabled	Enabled	Optional	Optional
15	Manufacturer-specific alarm	Disabled	Enabled	Optional	Optional

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	Unsigned 16	-	RO	No	No

Object 6504h: Supported Alarms

Description

This object indicates the alarms supported by the encoder.

Values

The values of this object are outlined in the following table:

Bit	Function	Value = 0	Value = 1
0	Position error	No	Yes
1	Commissioning diagnostics	No	Yes
2...11	Reserved		
12	Manufacturer-specific alarm	No	Yes
13	Manufacturer-specific alarm	No	Yes
14	Manufacturer-specific alarm	No	Yes
15	Manufacturer-specific alarm	No	Yes

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	Unsigned 16	-	RO	No	No

Object 6505h: Warnings

Description

This object indicates if the tolerances of certain encoder internal parameters have been exceeded

Values

The values of this object are outlined in the following table:

Bit	Function	Value = 0	Value = 1	C1	C2
0	Position error	No	Yes	Optional	Optional
1	Light control reserve	Not reached	Error	Optional	Optional
2	CPU watchdog status	OK	Reset	Optional	Optional
3	Operating time limit warning	No	Yes	Optional	Optional
4	Battery charge	OK	Too slow	Optional	Optional
5	Reference point	Reached	Not reached	Optional	Optional
6...11	Reserved				
12	Manufacturer-specific warning	N/A	N/A	Optional	Optional
13	Manufacturer-specific warning	N/A	N/A	Optional	Optional
14	Manufacturer-specific warning	N/A	N/A	Optional	Optional
15	Manufacturer-specific warning	N/A	N/A	Optional	Optional

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	Unsigned 16	-	RO	No	No

Object 6506h: Supported Warnings

Description

This object indicates the alarms supported by the encoder.

Values

The values of this object are outlined in the following table:

Bit	Function	Value = 0	Value = 1
0	Frequency exceeded	Not supported	Supported
1	Light control reserve	Not supported	Supported
2	CPU watchdog status	Not supported	Supported
3	Operating time llimit warning	Not supported	Supported
4	Battery charge	Not supported	Supported
5	Reference point	Not supported	Supported
6...11	Reserved		
12	Manufacturer-specific warning	Not supported	Supported
13	Manufacturer-specific warning	Not supported	Supported
14	Manufacturer-specific warning	Not supported	Supported
15	Manufacturer-specific warning	Not supported	Supported

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	Unsigned 16	-	RO	No	No

Object 6507h: Profile and Software Version

Description

This object indicates the encoder hardware profile version and software version.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	Unsigned 32	-	RO	No	No

Object 6508h: Operating Time

Description

This object indicates the encoder operating time. The operating time is recorded in the EEPROM memory as long as the encoder is powered up.

This function is not available for this encoder. The value given is FFFFFFFFh.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	Unsigned 32	FFFFFFFh	RO	No	Yes

Object 6509h: Offset Value

Description

This object indicates the offset value. The offset value is calculated by the Preset value function (see *Object 6003h: Preset Value, page 81*). It is then used by the encoder to offset the position value.

The offset value is recorded and can be read in the encoder.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	Unsigned 32	-	RO	No	No

Object 650Ah: Module Identification

Description

This object indicates the manufacturer-specific offset value, as well as the minimum and maximum position values.

The offset value is stored in sub-index 1.

The minimum and maximum position values are stored in sub-indexes 2 and 3 respectively.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	Number of inputs	Unsigned 32	-	RO	No	No
1 h	Manufacturer offset value	Unsigned 32	0h	RO	No	No
2 h	Manufacturer minimum position value	Unsigned 32	0 h	RO	No	No
3 h	Manufacturer maximum position value	Unsigned 32	1FFFFFF h	RO	No	No

Object 650Bh: Serial Number

Description

This object indicates the encoder serial number.

Characteristics

The characteristics of this object are outlined in the following table:

Sub-index	Description	Data type	Default value	Access	PDO Mapping	Backed up
0 h	-	Unsigned 32	-	RO	No	No

Diagnostics

6

Status Indication Provided by the LEDs in the Connection Base

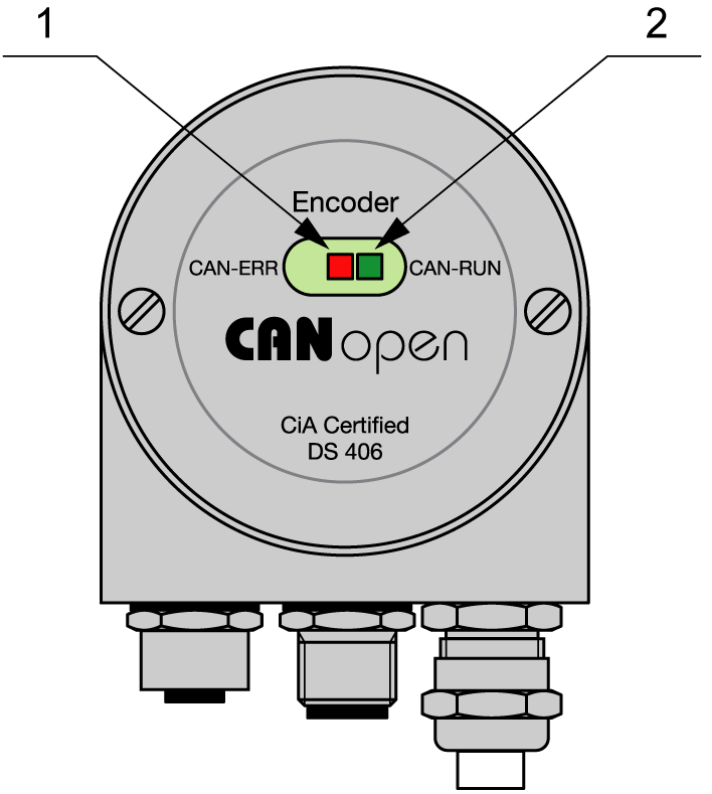
Principle

Two LEDs are located on the base. They indicate the status of the encoder in the CANopen network.

The red CAN ERR LED indicates errors. The green CAN RUN LED indicates the encoder status.

Description

LEDs on the connection base:



No.	Description
1	RED LED
2	GREEN LED

LED status table for diagnostics conforming to DR 303-3 V1.2:

No.	LED	Type of flashing	Status/Possible cause
1	CAN ERR (red)	Off	No error
2		1 flash	The internal error counter has reached or exceeded the maximum level.
3		2 flashes	Detection of a guard event or a heartbeat event.
4		3 flashes	Synchronization error: message not received in the defined period.
5		Flashing	Error in the bus address or speed.
6		On	Bus off.
7	CAN RUN (green)	1 flash	Module in Stopped mode.
8		Flashing	Module in pre-operational mode.
9		On	Module in operational mode.

When both LEDs are off, the encoder is not supplied with power.

Appendices

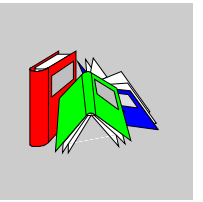
FAQ

A

FAQ

Problem	Possible cause	Possible solution
The encoder does not respond after power-up.	The bus is active but the installed encoder is not responding to the bootup message from the master.	• Turn off the PLC • Turn off the encoder power supply. • Remove the encoder base. • Check the baud rate using the two rotary switches. • Refit the base. • Turn the encoder power supply back on. • Turn the PLC back on.
There is a position value error during transmission.	Malfunctions may occur during transmission of the position value. The CAN bus may also be temporarily in off mode. The messages transmitted are therefore incorrect.	Check that each end of the bus is fitted with a line terminator (see *Line Terminator, page 18*). If the last node of the bus is an encoder, the line terminator is placed in the base and activated by a switch.
Too many ERROR frames	The bus is overloaded by too many ERROR frames.	Check that all the nodes are configured at the same speed. If one of the nodes is at a different speed, correct this speed (see *Transmission Speed, page 17*). If a node is incorrectly configured, it automatically generates error frames.

Glossary



A

Address

Number, assigned to each node, irrespective of whether it is a master or slave. The encoder address (non-volatile) is configured in the base with rotary switches.

APV

Absolute Position Value.

B

Baud rate

Transmission speed formulated in number of bits per second.

Bus node

Device that can send and/or receive or amplify data by means of the bus.

Byte

8-bit unit of data = 1 byte.

C

CAL

CAN application layer.

CAN

Controller Area Network or CAN multiplexing network.

CANopen

Application layer of an industrial network based on the CAN bus.

CCW

Counter-clockwise

CiA

CAN In Automation, organization of manufacturers and users of devices that operate on the CAN bus.

COB

Elementary communication object on the CAN network. All data is transferred using a COB.

COB-ID

COB-Identifier. Identifies an object in a network. The ID determines the transmission priority of this object. The COB-ID consists of a function code and a node number.

CW

Clockwise

E

EDS file

Standardized file containing the description of the parameters and the communication methods of the associated device.

F

FAQ

Frequently Asked Questions

FC

Function code. Determines the type of message sent via the CAN network.

L

Line terminator

Resistor terminating the main segments of the bus.

LMT

Network management object.

This is used to configure the parameters of each layer in the CAN.

M

Master

"Active" device within the network, that can send data without having received a request. It controls data exchange and communication management.

N

NMT

Network management object.

This is responsible for managing the execution, configuration and errors in a CAN network.

NN

Node number

P

PCV

Process Value

PDO

Communication object, with a high priority for sending process data.

PV

Preset Value: Configuration value

R

RO

Read Only: Parameter that is only accessible in read mode.

ROMAP

Read Only MAPable: Parameter that can be polled by the PDO.

RW

Read/Write: Parameter that can be accessed in read or write mode.

S

SDO

Communication object, with a low priority for messaging (configuration, error handling, diagnostics).

Slave

Bus node that sends data at the request of the master. Absolute rotary encoders are always slaves.

SyCon

Dedicated software tool with a uniform interface under Windows for configuring industrial networks and setting device parameters. This tool uses the description files (GSD, EDS, etc).

W

WO

Write Only: Parameter that is only accessible in write mode.

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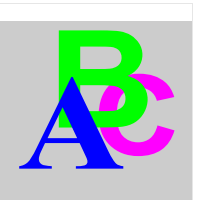

R

S

T

W

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As standards, specifications and design change from time to time, please ask for confirmation of the information given in this publication

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