

Manual

Absolute encoder EAM280/EAM500 with CANopen[®] interface

Baumer Sensors Srl

Via Caduti del Lavoro 9
25032 Chiari (BS)
Phone +39 030 7000916
info.bsit@baumer.com
www.baumer.com

12.21
Subject to modification in technic and design
Errors and omissions excepted

Contents

1	Document history	4
2	Safety and operating instructions	5
3	Product Assignment.....	6
3.1	Absolute encoder.....	6
4	System Overview	7
4.1	General.....	7
4.2	Supported Profiles	7
4.3	Supported CANopen Services	7
4.4	Function Principle	7
4.4.1	Overview.....	7
4.4.2	Scaling.....	7
4.5	Redundant or full redundant design.....	8
5	NMT Service	9
5.1	Supported commands.....	9
5.2	Boot-up message.....	9
6	SDO service.....	10
6.1	General.....	10
6.2	Save/load parameters.....	10
6.2.1	Save	10
6.2.2	Load.....	10
6.2.3	Safe non-volatile operation	10
6.2.4	Side effect.....	10
6.3	Node ID and Baud rate setting.....	10
6.3.1	Node-ID	10
6.3.2	Baud rate	11
6.3.3	Position direction and scaling	11
6.3.4	How to change the Angle resolution	11
6.3.5	How to set the zero position	12
6.3.6	How to set the Filter.....	12
7	PDO Service	13
7.1	General.....	13
7.2	PDO transmission types	13
7.3	TPDOs.....	13
7.3.1	PDO Mapping	13
7.3.2	Default mapping.....	13
7.3.3	PDO mapping procedure	14
7.3.4	Mappable objects.....	15
7.4	Timing.....	15
7.5	Exceptions of accurate calculation of process data	15
8	Emergency Service.....	16
8.1	General.....	16
8.2	COB-ID	16
8.3	Emergency message	16
8.4	Error register.....	16
8.4.1	Communication error	16
8.4.2	Generic error.....	16
8.5	Error codes / EMCY messages.....	16



8.6	Sensor Diagnostics	16
8.7	Error behavior	17
9	Heartbeat Service	18
9.1	General	18
9.2	COB-ID	18
9.3	Timing	18
10	LSS slave.....	19
10.1	Layer Setting Services	19
10.2	LSS address	19
10.3	Supported commands.....	19
11	Object directory	22
11.1	Communication Profile Area	22
11.2	Manufacturer Specific Profile Area	23
11.3	Standardized Device Profile Area	23

1 Document history

This document is subject to changes. In order to have the most current version please download on www.baumer.com

Document index	Date	Firmware version	CANopen Revision Number Obj. 1018	Author	Changes
0001	09.04.2021	From V02-92	0000.0000h	gua	- Introduce firmware version and CANopen revision number in this table
0002	28.04.2021	From V02-92	0000.0000h	zazg/gua	- General revision
0003	03.12.2021		0000.0000h	zazg	- Deleted obj. 0x2110,0x2195,0x2196 references from manual
0004	14.07.2022		0000.0000h	zazg	- Deleted obj. 0x6500 reference from manual
0005	25.08.2023		0000.0000h	zazg	- Deleted obj. 0x6008,0x6030,0x6502 references from manual and reference to PDO3 and PDO4
0006	25.09.2023		0000.0000h	zazg	- Update obj. 0x1000 and 0x1009 default values and minor changes
0007	19.04.2024	From V3.0.4	0000.0000h	bson	<ul style="list-style-type: none"> - Updated company name - Updated references to eds files - Changed Device Type and Product Code - Updated function principle diagram - Added chapter 4.5 Redundant or full redundant design - Updated Emergency messages - Added objects referring to speed - Added object 0x2117 related to alarms - Added object 0x1029 related to error behavior - Changed object 0x6503 description - Removed chapter on terminal assignments

Disclaimer of liability

The present manual was compiled with utmost care, errors and omissions reserved. For this reason Baumer rejects any liability for the information compiled in the present manual. Baumer nor the author will accept any liability for direct or indirect damages resulting from the use of the present information.

At any time we should be pleased receiving your comments and proposals for further improvement of the present manual.

Created by:
Baumer Sensors Srl
Chiari, Italy

2 Safety and operating instructions

Intended purpose of the equipment

- The encoder is a precision measuring device that is used to record positions and speeds. It provides measuring values as electronic output signals for the subsequently connected device. The sensor must not be used for any other purpose.
- Unless this product is specially labeled, it may not be used for operation in potentially explosive environments.
- Make sure by appropriate safety measures, that in case of error or failure of the sensor, no danger to persons or damage to the system or operating facilities occurs.

Personnel qualification

- Installation and assembly of this product may be performed only by a person qualified in electronics and precision mechanics.
- Consider also the operation manual of the machine manufacturer.

Maintenance

- The sensor is maintenance-free and must not be opened up nor mechanically or electronically modified. Opening up the sensor can lead to injury.

Safety remarks

- Prior to commissioning the equipment, check all electrical connections.
- If installation, electrical connection or any other work performed at the sensor or at the equipment is not correctly executed, this can result in a malfunction or failure of the sensor.
- Steps must be taken to exclude any risk of personal injury, damage to the plant or to the operating equipment as a result of sensor failure or malfunction by providing suitable safety precautions.
- Sensor must not be operated outside the specified limited values (see detailed product documentation).

Failure to comply with the safety remarks can result in malfunctions, personal injury or damage to property.

Transport, storage and disposal

- Only ever transport or store sensors in their original packaging.
- Never drop sensors or expose them to major vibrations.
- The sensor contains electronic components. At its disposal, local environmental guidelines must be followed.

Assembly

- Avoid impacts or shocks on the housing.
- Avoid any twist or torsion on the housing.
- Do not open the sensor or make any mechanical changes to it.

The sensor housing or electronic components can be damaged. In this case, safe and reliable operation cannot be guaranteed.

Electrical commissioning

- Do not modify the sensor electrically and remove power supply while connecting it electrically.
- The electrical connection must not be attached or removed under power supply.
- Ensure that the entire plant is installed in line with EMC requirements. The installation environment and wiring affect the electromagnetic compatibility of the sensor.
- Install the sensor and supply cables separately or at a long distance from cables with high interference emissions (frequency converters, contactors etc.)
- Where working with consumers which have high interference emissions, make available a separate power supply for the sensor.
- Unused outputs must not be connected.

Failure to observe these instructions can result in malfunctions, material damage or personal injury.

Supplementary information

- This manual is intended as a supplement to already existing documentation (catalogues, data sheets and assembly instructions).
- The manual must be read without fail before initial commissioning of the equipment.

3 Product Assignment

3.1 Absolute encoder

Product	Product Code	Device Name	EDS File
EAM280			
Absolute encoder singleturn CANopen	0x0500	EAM280/500	EAM280-500_ 0x0500_V00.02.eds
Absolute encoder singleturn CANopen redundant (2-sensing)	0x0500	EAM280/500	EAM280-500_ 0x0500_V00.02.eds
EAM500R-K			
Absolute bearingless encoders CANopen	0x0500	EAM280/500	EAM280-500_ 0x0500_V00.02.eds
Absolute bearingless encoders CANopen redundant (2-sensing)	0x0500	EAM280/500	EAM280-500_ 0x0500_V00.02.eds

4 System Overview

4.1 General

The encoder is a rotary measuring system with a CANopen interface. It supports scaling and presetting. In consideration of “CAN in Automation” (CiA) Profile 406 for Encoders, it's an Absolute rotary encoder - Class C2. (exception diagnostic part).

4.2 Supported Profiles

Following CANopen profiles are supported:

- CiA 301 / Version 4.1 (Communication)
- CiA 305 / Version 1.0 (LSS)
- CiA 406 / Version 3.2 (Encoder Profile)
 - Absolute encoder redundant (2-sensing)

4.3 Supported CANopen Services

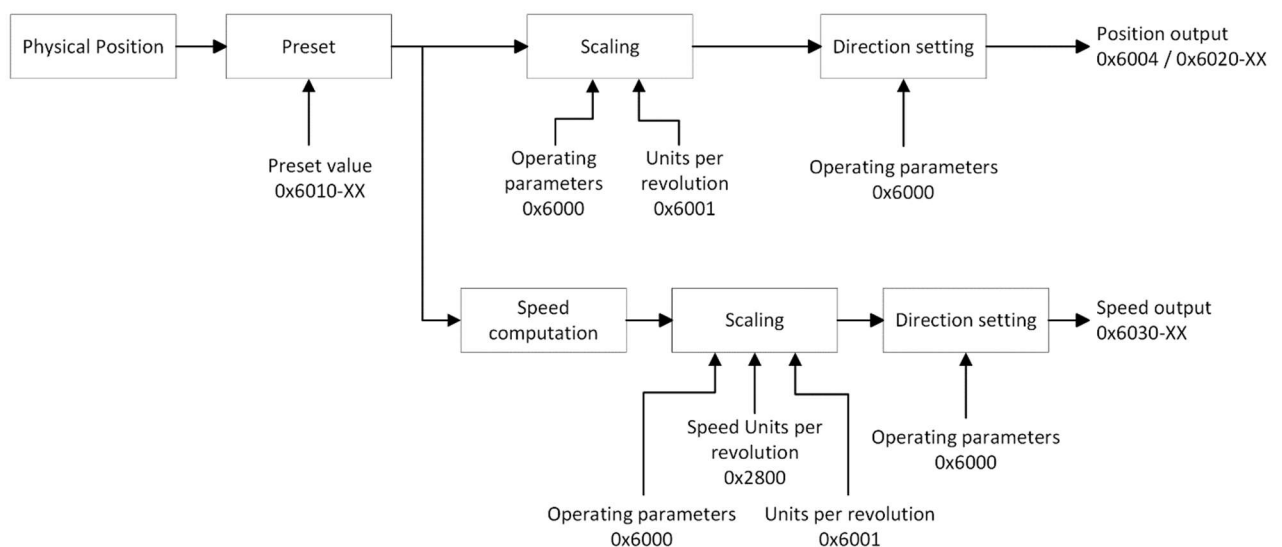
Following CANopen services are supported:

- 1 Network Management (according to CiA 301)
- 1 SDO Server (according to CiA 301)
- 2 TPDOs (according to CiA 301/CiA 406)
- 1 Emergency Producer (according to CiA 301/CiA 406)
- 1 Heartbeat Producer (according to CiA 301)
- 1 LSS Client (according to CiA 305)

4.4 Function Principle

4.4.1 Overview

Figure 1: Function principle overview



4.4.2 Scaling

The step size for all position objects can be adapted in the object 0x6001.

The basic unit is tenth of degree.

4.5 Redundant or full redundant design

In a sensor with full redundant design (2-channel), there are two separate nodes with two different node IDs connected with the same connector to the network. This means that each node has its own objects that can be read by addressing the correct node ID.

In a sensor with redundant design (2-sensing), there are two primary sensors that are read by a single node with a single node ID connected to the network. The values of each primary sensor read by the node are written to separate objects.

5 NMT Service

5.1 Supported commands

Following NMT commands are supported:

NMT Command	Code	Description
Start	0x01	Switch to the "Operational" state
Preoperational	0x80	Switch to the "Stop" state
Stop	0x02	Switch to the "Pre-Operational" state
Reset	0x81	Reset node
Communication Reset	0x82	Reset communication

NMT Frame:

COB-ID	DLC	Byte 0	Byte 1
		NMT Command	Node-ID
0x000	2	0xXX	0xYY

Examples:

NMT Command: Preoperational

Node-ID: all nodes (broadcast)

COB-ID	DLC	Byte 0	Byte 1
		NMT Command	Node-ID
0x000	2	0x80	0x00

NMT Command: Reset

Node-ID: 5

COB-ID	DLC	Byte 0	Byte 1
		NMT Command	Node-ID
0x000	2	0x81	0x05

5.2 Boot-up message

After a power-on or NMT reset, the device will send a Boot up message.

COB-ID	Byte 0
	Data
0x700 + Node-ID	0x00

By default, it starts in pre-operational mode.

Send NMT message to put the device in operational mode.

COB-ID	DLC	Byte 0	Byte 1
		NMT Command	Node-ID
0x000	2	0x01	0xYY

Note: ID can be 0 for broadcast initialization

6 SDO service

6.1 General

The device supports 1 SDO server (Expedited read/write, segmented read)

6.2 Save/load parameters

The device supports saving parameters to a non-volatile memory.

6.2.1 Save

Object 1010h-1, save all parameters

Writing "save" (ASCII) to 0x1010.1h saves the corresponding objects to the non-volatile memory.

The device must not reset or turned off before the object 1010h-1 has responded (see par. 6.2.3).

After a reset or power-on, the parameters are loaded from the non-volatile memory.

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0x600 + Node-ID	8	0x23	0x10	0x10	0x01	0x73	0x61	0x76	0x65
						s	a	v	e

6.2.2 Load

Object 1011h-1, load all parameters

Writing "load" (ASCII) to 1011.1h restores the corresponding objects.

The device must not reset or turned off before the object 1011h-1 has responded (see par. 6.2.3).

The parameters are restored after a reset or power-on.

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0x600 + Node-ID	8	0x23	0x11	0x10	0x01	0x6C	0x6F	0x61	0x64
						l	o	a	d

6.2.3 Safe non-volatile operation

To ensure safe non-volatile operation, the user must ensure no power interruption immediately after sending of the save command to object 1010h-x (otherwise, the factory values are restored at the next power up).

The time between access object 1010h-1 or 1011h-1 and a reset or power-off has to be at least 600 ms.

6.2.4 Side effect

Save/Load operations interrupt the updating of position.

6.3 Node ID and Baud rate setting

6.3.1 Node-ID

Object 2101h, node-id settings.

Send the SDO message

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0x600 + Node-ID	8	0x2F	0x01	0x21	0x00	ID	0x00	0x00	0x00

ID: values below 1 or above 127 are not accepted and the existing setting remains valid.

After setting the new entries a SAVE command (see par. “6.2 Save/load parameters”) followed by a reset or power-on is necessary to adopt the new value.

6.3.2 Baud rate

Object 2100h, baud rate settings.

Send the SDO message

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0x600 + Node-ID	8	0x2F	0x00	0x21	0x00	BR	0x00	0x00	0x00

BR: values above 7 are not accepted and the existing setting remains valid.

After setting the new entries a SAVE command (see par. “6.2 Save/load parameters”) followed by a reset or power-on is necessary to adopt the new value.

6.3.3 Position direction and scaling

Object 6000h, operating parameters.

Send the SDO message

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0x600 + Node-ID	8	0x2B	0x00	0x60	0x00	PAR	0x00	0x00	0x00

where PAR is the parameter setting as follow

PAR	Meaning	
	Direction	Scaling
0x00	Position increase CW	disabled
0x01	Position increase CCW	disabled
0x04	Position increase CW	enabled
0x05	Position increase CCW	enabled

Example scaling

For an angle value of $90^\circ = 900_{\text{dec}} = 384_{\text{hex}}$

PAR = 0 : the value is independent to the 6001 obj and is expressed in 16 bit steps = $16384 = 4000_{\text{hex}}$

PAR = 1 : the value is independent to the 6001 obj but the angle direction is inverted and is expressed in 16 bit steps = $49152 = C000_{\text{hex}}$

If obj 6001 = $3600_{\text{dec}} = E10_{\text{hex}}$

PAR = 4 (default value) : the value is expressed according to the 6001 obj = $900 = 384_{\text{hex}}$

PAR = 5 : the value is expressed according to the 6001 obj but the angle direction is inverted = $2700 = A8C_{\text{hex}}$

If obj 6001 = $36000_{\text{dec}} = 8CA0_{\text{hex}}$

PAR = 4 (default value) : the value is expressed according to the 6001 obj = $9000 = 2328_{\text{hex}}$

PAR = 5 : the value is expressed according to the 6001 obj but the angle direction is inverted = $27000 = 6978_{\text{hex}}$

6.3.4 How to change the Angle resolution

Set the parameters as explained in previous paragraph, then send the SDO message

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x600 + ID	8	0x23	0x01	0x60	0x00	R0	R1	R2	R3

where R0...R3 represents the unit of measure of the output angle.

For example, to obtain a resolution of 0.1deg:

R0 = 0x10, R1 = 0x0E, R2 = 0x00, R3 = 0x00

It means R = 0x00000E10 (3600 decimal).

Note: it's necessary to be sure that in the object 6000h the value present is 4 or 5.

6.3.5 How to set the zero position

Object 6003h,6010h-1, preset value encoder (Channel 1).

Send the SDO message to set the zero of channel 1

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0x600 + Node-ID	8	0x23	0x03	0x60	0x00	0x00	0x00	0x00	0x00

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0x600 + Node-ID	8	0x23	0x10	0x60	0x00	0x00	0x00	0x00	0x00

Note: after setting the new, entry a SAVE command.

Object 6010.2h*, preset value encoder (Channel 2).

Send the SDO message to set the zero of channel 2

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0x600 + Node-ID	8	0x23	0x10	0x60	0x02	0x00	0x00	0x00	0x00

Note: after setting the new, entry a SAVE command.

*Note: Only available for products with CANopen redundant (2-sensing)

6.3.6 How to set the Filter

Object 2603h

Send the SDO message to set the Filter value

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0x600 + Node-ID	8	0x2B	0x03	0x26	0x00	FILT	0x00	0x00	0x00

The angle is averaged on FILT samples.

Example:

FILT = 4 (Default), with internal sensor refresh time of 25 ms, it means $25\text{ms} \times 4 = 100\text{ ms}$ to achieve the correct value

7 PDO Service

7.1 General

By default only TPDO1 and TPDO2 in case of redandant version (2-sensign) are enabled. PDOs are only transmitted in NMT operational mode.

7.2 PDO transmission types

The following transmission types are supported (object 180x-2):

- Synchronous transmission (1-240)
- Asynchronous transmission (255)
- Manufacturer transmission (254)

Both PDOs support all transmission types.

Transmission type 255 and 254: The PDO is transmitted timer driven.

The time interval between 2 PDOs can be adapted in the object 180xh-5

Transmission type 1-240: The PDO is transmitted after the n-th sync frame.

Transmission type 1: The PDO is transmitted after one sync frame.

Transmission type 2: The PDO is transmitted after two sync frames.

etc.

7.3 TPDOs

The COB-ID for both PDOs is changeable (in Object 1800h-1 and 1801h-1, 1800h-2 and 1801h-3)

The format of the TPDO is:

TPDO_n

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0xn80 + Node-ID	8	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX

Where n is the PDO nbr:

- 1 = PDO1
- 2 = PDO2

7.3.1 PDO Mapping

The encoder supports dynamic mapping.

7.3.2 Default mapping

TPDO1

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3
		LSB			MSB
0x18A	8	0xXX	0xXX	0xXX	0xXX

where XX is the actual position value (Object 6020h-1).

TPDO2*

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3
		LSB			MSB
0x28A	8	0xXX	0xXX	0xXX	0xXX

where XX is the actual position value (Object 6020h-2).

Example:

TPDO1

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3
		LSB			MSB

0x180 + Node-ID	8	0xE8	0x03	0x00	0x00
-----------------	---	------	------	------	------

Considering a resolution of 0.1°:

Position value = 0x000003E8 (1000 decimal) = 100°

TPDO2*

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3
		LSB			MSB
0x280 + Node-ID	8	0x84	0x03	0x00	0x00

Considering a resolution of 0.1°:

Position value = 0x00000384 (900 decimal) = 90°

*Note: Only available for products with CANopen redundant (2-sensing)

7.3.3 PDO mapping procedure

PDO mapping entries can only be changed using the defined mapping procedure:

1. Set PDO invalid by switching Bit 31 in the related COB-ID entry

Object 180X.1h(1) bit 31 =1

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0xn80 + Node-ID	8	0x23	0x0X(1)	0x18	0x01	0x00	0x00	0x00	0x80

2. Set PDO mapping invalid by writing 00h to sub-index 00h of the related mapping entries.

Object 1A0X.0h(1)

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0xn80 + Node-ID	8	0x2F	0x0X(1)	0x1A	0x00	0x00	0x00	0x00	0x00

3. Adjust the desired PDO mapping.

Object 1A0X.0h(1)

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0xn80 + Node-ID	8	0x23	0x0X(1)	0x1A	OBJ_NBR(2)	SIZE(4)	SUB	OBJ_LSB	OBJ_MSB

4. Set sub-index 00h of the related mapping index to number of mapped objects.

Object 1A0X.0h(1)

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0xn80 + Node-ID	8	0x2F	0x0X(1)	0x1A	0x00	TOT_NBR(3)	0x00	0x00	0x00

5. Switch PDO valid by means of Bit 31 in the related COB-ID entry

Object 180X.1h(1) bit 31 =0

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Command	Object LSB	Object MSB	Subindex	Data 0	Data 1	Data 2	Data 3
0xn80 + Node-ID	8	0x23	0x0X(1)	0x18	0x01	0x80 + Node-ID	n	0x00	0x40

(1) Where X is:

- 0 for PDO1
 - 1 for PDO2
 - 2 for PDO3
 - 3 for PDO4
- (2) Where OBJ_NBR increase starting from 1 to maximum 8 every obj associated mapped
- (3) Where TOT_NBR is the Total number of mapped object
- (4) Where SIZE is:
- 8h for 1 byte obj.
 - 10h for 2 byte obj.
 - 20h for 4 byte obj.

7.3.4 Mappable objects

The mappable objects are listed in chapter 11 Object directory and identified with the “m” (mappable) symbol in the Access column.

Follow the procedure defined in chapter 7.3.3 PDO mapping procedure to change the mapping entries.

7.4 Timing

The minimal cycle time for TPDOs is 25 ms.

7.5 Exceptions of accurate calculation of process data

The following operations could interrupt the accurate calculation of process data such as position, speed, warnings and alarms:

- Non-volatile operations
- Changing the scaling parameters

8 Emergency Service

8.1 General

If there is an error on the device, the device commits an emergency message and sets the corresponding bits in the error register (Object 1001h).

8.2 COB-ID

The COB-ID for the emergency message can be modified in object 1014h.

Default Value: 80h + node ID

Changes will be applied immediately.

The COB-ID is stored internally as a difference to the default COB-ID. Example:

Node ID: 4	COB-ID Emergency: 84h (Default value)
	COB-ID Emergency: 87h (Changed by user)
Node ID: 9	COB-ID Emergency: 89h (Adapted automatic)

8.3 Emergency message

The emergency message is transmitted if an error is indicated in the error register.

COB-ID	DLC	Byte0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
80h+node ID	8	Error code		Error register (object 1001h)	-	-	-	-	-

8.4 Error register

Error register (object 1001h)							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Manufacturer error	-	-	Communication error				Generic error

8.4.1 Communication error

Communication errors are indicated if the internal CAN message buffers are overflowed or there are malformed CAN frames on the bus. After a communication error the device changes to pre-operational mode.

8.4.2 Generic error

A generic error is indicated for all other errors.

An encoder specific alarm or warning will also cause a generic error.

After a generic error the device changes to pre-operational mode.

8.5 Error codes / EMCY messages

The following error codes are generated by the device:

Error Code	Meaning
0x0000000000000000	Error reset or no error
0x0010010000000000	Generic error
0x1081110000000000	CAN RX overflow
0x00FF810100000000	Absence Magnet (Magnetic Field too weak or too strong)
0x00FF810200000000	Error data from the sensor

8.6 Sensor Diagnostics

In case of sensor failure, the object 0x6503 provides information about the failure. It is a bit field of 16 bits where each bit indicates the fault detected. If an fault occurs, the value provided by the sensor is no longer valid (the output value remains

fixed at the last valid value) and the according bit indicates the error. When the fault ceases and the sensor is able to provide an accurate position value, the error is cleared.

Bit	Description	Meaning
0	Position error	Position error occurred (Absence of magnet or other sensor error)
1	-	Not used
2	-	Reserved
3	-	Reserved
4	-	Reserved
5	-	Reserved
6	-	Reserved
7	-	Reserved
8	-	Reserved
9	-	Reserved
10	-	Reserved
11	-	Reserved
12	Magnetic field error	Probably absence of magnet (magnetic field too weak or too strong)
13	Sensor error	Error data from the sensor
14	-	Not used
15	-	Not used

8.7 Error behavior

The object 1029 indicates which state the sensor should be set to if it is in the NMT state Operational and a communication error or severe internal errors are detected. In particular, the behavior is defined by:

- 0x1029-01: in case of communication error
- 0x1029-02: in case of device internal error

The following table indicates the values that can be set in the sub-index of the object.

Value	Description
0x00	Change to NMT state Pre-operational (only if currently in NMT state Operational)
0x01	No change of the NMT state
0x02	Change to NMT state Stopped

9 Heartbeat Service

9.1 General

The device supports a heartbeat producer according CiA 301.

Example for a heartbeat protocol:

COB-ID	Data/Remote	Byte 0
704h	D	7Fh(127d)

The heartbeat messages consist of the COB ID and one byte. In this byte, the NMT status is supplied.

0: BootUp-Event
4: Stopped
5: Operational
127: Pre-operational

In other words, the sensor is in the pre-operational mode (7Fh = 127).

9.2 COB-ID

The COB-ID for the heartbeat message is 700h + node ID.

9.3 Timing

The minimal cycle time for heartbeat messages is 1 ms.

10 LSS slave

10.1 Layer Setting Services

In the spring of 2000, CiA drafted a new protocol intended to ensure standardized occurrence. The procedure is described under Layer Setting Services and Protocol, CiA Draft Standard Proposal 305 (LSS).

The sensor is supplied by us as standard with the node ID 10 and a baud rate of 250 kBaud. Several sensors can be connected to the bus system with the same node ID. To allow individual sensors to be addressed, LSS is used.

Each sensor is fitted with its own unique serial number and is addressed using this number. In other words, an optional number of sensors with the same node ID can be connected to one bus system, and then initialized via LSS. Both the node ID and also the baud rate can be reset. LSS can only be executed in the **Stopped Mode**.

10.2 LSS address

The needed value for LSS addressing as serial number is printed on a label on the encoder housing.

10.3 Supported commands

- Switch state global
- Switch state selective
- Configure node ID protocol
- Configure bit timing parameters
- Store configuration
- Inquire identity serial number
- Inquire identity node ID

Message structure

COB ID:

Master -> Slave: 2021 = 7E5h

Master <- Slave: 2020 = 7E4h

After the COB ID, an LSS command specifier is transmitted.

This is followed by up to seven attached data bytes.

COB ID	cs	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
--------	----	--------	--------	--------	--------	--------	--------	--------

Switch Mode Global

7E5h ->	04h	Mode	reserved
---------	-----	------	----------

Mode : 0 -> Operation mode

1 -> Configuration mode

Selective switch mode

The following procedure can be used to address a certain sensor in the bus system.

7E5h ->	40h	Vendor ID	reserved
---------	-----	-----------	----------

7E5h ->	41h	Product code	reserved
---------	-----	--------------	----------

7E5h ->	42h	Revision number	reserved
---------	-----	-----------------	----------

7E5h ->	43h	Serial number	reserved
---------	-----	---------------	----------

7E5h ->	44h	Mode	reserved
---------	-----	------	----------

Vendor ID : 5Fh
 Product code : Internal product code for the respective sensor
 Revision number : Current revision number of the sensor
 Serial number : Unique, consecutive serial number
 Mode : The sensor's response is the new mode (0=operating mode; 1=configuration mode)

Setting the node ID

7E5h->	11h	Node ID	Reserved
--------	-----	---------	----------

7E4h<-	11h	ErrCode	Spec error	reserved
--------	-----	---------	------------	----------

Node ID : The encoder's new node ID
 Error code : 0=OK; 1=Node ID outside range; 2..254=reserved; 255->Specific error
 Specific error : If Error code=255->application-specific error code.

Setting the bit timing

7E5h ->	13h	tableSel	tableInd	reserved
---------	-----	----------	----------	----------

7E4h<-	13h	ErrCode	Spec error	reserved
--------	-----	---------	------------	----------

TableSel : Selects the bit timing table
 0 : Standard CiA bit timing table
 1..127 : Reserved for CiA
 128..255: Manufacturer-specific tables

TableInd : Bit timing entry in selected table (see table below).
 Error code : 0=OK; 1=Bit timing outside range; 2..254=reserved; 255->Specific error
 Specific error : If Error code=255 ->Application-specific error code.

Saving the configuration protocol

This protocol saves the configuration parameters in the EEPROM.

7E5h ->	17h	reserved
---------	-----	----------

7E4h<-	17h	ErrCode	Spec error	reserved
--------	-----	---------	------------	----------

Error code : 0=OK;1=Saving not supported;2=Access error;3..254=reserved;255->Specific error
 Specific error : If error code=255 ->Application-specific error code.

Activate bit timing parameters

The new bit timing parameters are activated with the command specifier 15h.

7E5h ->	15h	Switch delay	reserved
---------	-----	--------------	----------

Switch Delay : Reset delay in the slave in ms.
 : After the delay, the sensor logs on with the new baud rate.

Request vendor ID

Requesting the vendor ID of a selected sensor

7E5h ->	5Ah	reserved
---------	-----	----------

7E4h <-	5Ah	32 bit vendor ID	reserved
---------	-----	------------------	----------

Vendor ID : = 5Fh

Request product code

Request product code of a selected sensor

7E5h ->	5Bh	reserved
---------	-----	----------

7E4h <-	5Bh	Product code	reserved
---------	-----	--------------	----------

Product code : Manufacturer-dependent product code

Request revision number

Request revision number of a selected sensor

7E5h ->	5Ch	reserved	
---------	-----	----------	--

7E4h <-	5Ch	32 bit revision number	reserved
---------	-----	------------------------	----------

Revision number : Current revision

Request serial number

Request serial number of a selected sensor

7E5h ->	5Dh	reserved	
---------	-----	----------	--

7E4h <-	5Dh	32 bit serial number	reserved
---------	-----	----------------------	----------

Serial number: Unique consecutive serial number of the sensor

Range request

Sensors can also be searched for within a certain range. For this purpose, the following objects are sent in sequence:

7E5h ->	46h	Vendor ID	reserved
---------	-----	-----------	----------

7E5h ->	47h	Product code	reserved
---------	-----	--------------	----------

7E5h ->	48h	Revision number LOW	reserved
---------	-----	---------------------	----------

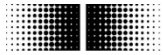
7E5h ->	49h	Revision number HIGH	reserved
---------	-----	----------------------	----------

7E5h ->	4Ah	Serial number LOW	reserved
---------	-----	-------------------	----------

7E5h ->	4Bh	Serial number HIGH	reserved
---------	-----	--------------------	----------

Each sensor with the relevant parameters logs on with the following message:

7E4h <-	4Fh	reserved	
---------	-----	----------	--



11 Object directory

The following tables provide a summary of all SDO objects supported by the encoder.

Object	Object number
Name	Object name
Format	U/I = Unsigned/Integer, No . = no of bits, ARR = Array, REC = Record, STR = String
Access	ro = read only, wo = write only, rw = read write, m = supports mapping
Default	Default parameter value on first init
Save	X = can be stored in the EEPROM / non-volatile memory
Description	Additional information

11.1 Communication Profile Area

Object	Sub-index	Name	Format	Access	Default value	Save	Description
0x1000	0	Device type	U32	ro	0x07010196		CiA406
0x1001	0	Error register	U8	ro	0x00		Bit-coded to profile CiA406 0x00: no error 0x01: generic error 0x10: communication error 0x20: device profile error 0x80: manufacturer specific error
0x1003	0	Predefined error list	U8	ro	0x00		Errors in the list (up to 8)
	1...8	History errors	U32	ro	0x00000000		Errors occurred according to the Error codes list, the last error is in the sub-index
0x1005	0	COB ID Sync object	U32	rw	0x00000080	X	Sensor generates no sync message (bit 30 =0) 11-bits identifier system (bit 29=0)
0x1008	0	Device name	STR	ro	-		EAM280/500
0x1009	0	HW version	STR	ro	-		Hardware version
0x100A	0	SW version	STR	ro	-		Software version (ASCII characters, i.e. version 1.28 = 31 56 32 38) (! Attention, as specified in the segmented mode: Send 60 00 00 00 00 00 00 00 after the command 40 0A 10 00 00 00 00 00 to see this string)
0x1010	0	Numbers of save-options	U8	ro	0x01		
	1	Save all parameters	U32	rw	0x00000001	X	The parameters are saved only writing the key string "save" (0x73-0x61-0x76-0x65)
0x1011	0	Numbers of restore-options	U8	ro	0x01		
	1	Reset for all parameters	U32	rw	0x00000001	X	If the key string "load" (0x6C-0x6F-0x61-0x64) is entered here, the parameters are assigned to the factory default values and are valid after the next reset.
0x1014	0	COB ID Emergency	U32	rw	0x40000080+ID	X	bit 30 = 1 The sensor generates EMCY message
0x1017	0	Producer heartbeat time	U16	rw	0x00	X	Time interval [msec] where sensor generates a producer heartbeat
0x1018	0	Numbers of identity-options	U8	ro	0x04		
	1	Vendor ID	U32	ro	0x0000005F		Baumer
	2	Product code	U32	ro	0x00000500		EAM280/500 series products
	3	Revision number	U32	ro	0x00000000		Product revision number
0x1029	0	Error behavior supported	U8	ro	0x02		
	1	Communication error	U8	rw	0x01	X	See paragraph 8.7
	2	Encoder internal error	U8	rw	0x00	X	See paragraph 8.7
0x1200	0	Server SDOs	U8	ro	0x02		
	1	COB ID Rx SDO	U32	ro	0x600 + ID		bit 31=0 -> valid SDO
	2	COB ID Tx SDO	U32	ro	0x580 +ID		bit 31=0 -> valid SDO
0x1800	0	TPDO1	U8	ro	0x05	X	Number of the entries TPDO1
	1	COB ID TPDO1	U32	rw	0x180+Node ID	X	Bit 31 = 0 TPDO activated Bit 31 = 1 TPDO not activated (not transmitted)
	2	Transmission type	U8	rw	0xFE	X	Transmission type (synchronous/asynchronous)
	3	Inhibit time	U16	rw	0x0000	X	Minimum interval time between consecutive TPDOs
0x1801	0	Event time TPDO1	U16	rw	0x0064	X	Used if 1800.02 is 0xFE or 0xFF
	1	TPDO2	U8	ro	0x05	X	Number of the entries TPDO2
0x1801	0	COB ID TPDO2	U32	rw	*0x280+Node ID 0x8280+Node ID	X	Bit 31 = 0 TPDO activated Bit 31 = 1 TPDO not activated (not transmitted)

Object	Sub-index	Name	Format	Access	Default value	Save	Description
	2	Transmission type	U8	rw	0xFE	X	Transmission type (synchronous/asynchronous)
	3	Inhibit time	U16	rw	0x0000	X	Minimum interval time between consecutive TPDOs
	5	Event time TPDO2	U16	rw	0x0064	X	Used if 1801.02 is 0xFE or 0xFF
0x1A00	0	TPDO1 mapping	U8	rw	0x01		Number of objects integrated in TPDO1
	1	index in obj directory	U32	rw	0x60200120		Position encoder (Channel 1)
0x1A01	0	TPDO2 mapping	U8	rw	0x01		Number of objects integrated in TPDO2
	1	index in obj directory	U32	rw	0x60200220		Position encoder (Channel 2)
0x1F80	0	NMT Startup	U32	rw	0x00000000	X	Configuration of the start-up behavior of a device that is able to perform the NMT

*Note: Only enabled for products with CANopen redundant (2-sensing)

11.2 Manufacturer Specific Profile Area

Object	Sub-index	Name	Format	Access	Default value	Save	Description
0x2100	0	Baud rate setting	U8	rw	0x03	X	0=1000 kBit/s 1=800 kBit/s 2=500 kBit/s 3=250 kBit/s 4=125 kBit/s 5=100 kBit/s 6=50 kBit/s 7=20 kBit/s The baudrate is activated after a reset or power-on (if parameter is saved to non volatile memory)
0x2101	0	Node Id	U8	rw	0x0A	X	0x01...0x7F
0x2111	0	Biggest subindex	U8	ro	0x02		Number of entries
	1	Position encoder (Channel 1)	U16	ro,m			MSB – LSB swapped respect to obj.0x6020.1
	2	Position encoder (Channel 2)*	U16	ro,m			MSB – LSB swapped respect to obj.0x6020.2
0x2116	0	Speed 16-bit	U8	ro	0x02		Number of entries
	1	Speed value (Channel 1)	I16	ro, m			16-bit Speed value (Channel 1)
	2	Speed value (Channel 2)*	I16	ro, m			16-bit Speed value (Channel 2)*
0x2117	0	Reserved	U16	ro, m			For internal use (sensor diagnostic flags)
0x2197	0	Dummy double word	U32	ro, m	0x00000000		4 byte of empty space to compose PDO with dynamic mapping
0x2198	0	Dummy word	U16	ro, m	0x00		2 byte of empty space to compose PDO with dynamic mapping
0x2199	0	Dummy byte	U8	ro, m	0x0		1 byte of empty space to compose PDO with dynamic mapping
0x2300		Customer EEPROM range	ARR				Optional data can be stored by the user
	0	Biggest subindex	U8	ro	0x07		
	1	Data 0	U16	rw, m	0x00	X	
	2	Data 1	U16	rw, m	0x00	X	
	3	Data 2	U16	rw, m	0x00	X	
	4	Data 3	U16	rw, m	0x00	X	
	5	Data 4	U16	rw, m	0x00	X	
	6	Data 5	U16	rw, m	0x00	X	
	7	Data 6	U16	rw, m	0x00	X	
0x2603	0	Position Filter	U16	rw	0x04	X	Coefficient Filter of the position. See paragraph 'How to set the Filter'
0x2604	0	Speed Filter	U16	rw	0x32	X	Coefficient Filter of the speed.
0x2800	0	Speed units per revolution	U32	rw	0x6	X	Measuring units per revolution for speed expressed in [rpm]

*Note: Only available for products with CANopen redundant (2-sensing)

11.3 Standardized Device Profile Area

Object	Sub-index	Name	Format	Access	Default value	Save	Description
0x6000	0	Parameters	U16	rw	0x04	X	see paragraph 'Position direction and scaling'
0x6001	0	Units per revolution	U32	rw	0xE10	X	see paragraph 'How to change the Angle resolution'
0x6003	0	Preset value encoder	I32	rw	0x00	X	Set the "Zero" position (Channel 1)



Object	Sub-index	Name	Format	Access	Default value	Save	Description
		(Channel 1)					
0x6004	0	Position encoder (Channel 1)	I32	ro, m			
0x6010	0	Preset	U8	ro	0x02		
	1	Preset value encoder (Channel 1)	I32	rw		X	Set the "Zero " position (Channel 1)
	2	Preset value encoder (Channel 2)*	I32	rw		X	Set the "Zero " position (Channel 2)
0x6020	0	Angles	U8	ro	0x02		Number of entries
	1	Position encoder (Channel 1)	U32	ro, m			Position encoder (Channel 1)
	2	Position encoder (Channel 2)*	U32	ro, m			Position encoder (Channel 2)*
0x6030	0	Speed	U8	ro	0x02		Number of entries
	1	Speed value (Channel 1)	I32	ro, m			Speed value (Channel 1)
	2	Speed value (Channel 2)*	I32	ro, m			Speed value (Channel 2)*
0x6501	0	Maximum resolution	U32	ro	0x0E10		See obj. 0x6001
0x6503	0	Alarm	U16	ro	0x00		See paragraph 8.6

*Note: Only available for products with CANopen redundant (2-sensing)