

Manual

Rotary sensor EAM280/EAM500/BMSK50 with CANopen

For Redundant and not-redundant version

Software Revision (Firmware Version) 2.92

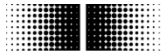
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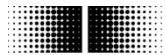
07.19
Subject to modification in technic and design.

Errors and omissions excepted



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1 Safety and operating instructions

1.1 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.

1.2 Intended purpose of the equipment

- The angle transducer is a precision measuring device that is used to record angle positions. It provides measuring values as electronic output signals for the subsequently connected device. It 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 angle transducer, no danger to persons or damage to the system or operating facilities occurs.

1.3 Commissioning

- 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.

1.4 Safety remarks

- Prior to commissioning the equipment, check all electrical connections.
- If installation, electrical connection or any other work performed at the angle transducer or at the equipment is not correctly executed, this can result in a malfunction or failure of the angle transducer.
- Steps must be taken to exclude any risk of personal injury, damage to the plant or to the operating equipment as a result of encoder failure or malfunction by providing suitable safety precautions.
- Angle transducers 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.

1.5 Transport and storage

- Only ever transport or store transducers in their original packaging.
- Never drop transducers or expose them to major vibrations.

1.6 Assembly

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

The shaft, ball bearings or electronic components can be damaged. In this case, safe and reliable operation cannot be guaranteed.

1.7 Electrical commissioning

- Do not modify the transducer 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 transducer. Install the angle transducer 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 transducer.
- Unused outputs must not be connected.

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

2 Product Assignment

2.1 Angle transducer

Product	Device Name	EDS-file
Angle transducer	EAM280/EAM500/ BMSK50	EAM280.eds or EAM500.eds or BMSK50.eds

3 System Overview

3.1 General

The angle transducer is a linear 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 linear encoder - Class C2 (exception diagnostic part).

3.2 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

3.3 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)

3.4 Function Principle

3.4.1 Overview

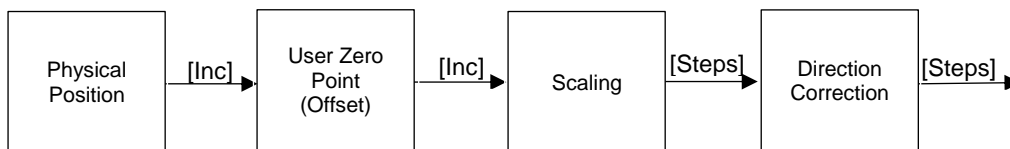


Figure 1: Function principle overview

3.4.2 Scaling

The step size for all position objects can be adapted in the object 0x6000.

The basic unit is tenth of degree.

4 NMT Service

4.1 Supported commands

Following NMT commands are supported:

- NMT Start
- NMT Preoperational
- NMT Stop
- NMT Reset
- NMT Communication Reset

There is no difference between NMT Reset and NMT Communication Reset

4.2 Boot up message

Send NMT message to initialize the device

COB-ID	Len	D0	D1
0x000	2	0x01	ID

Note: ID can be 0 for broadcast initialization

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

COB ID	Byte 0
700h + node ID	00

5 SDO service

5.1 General

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

5.2 Save/load parameters

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

5.2.1 Save

Writing “save” to 0x1010-x saves the corresponding objects to the non-volatile memory. After a reset or power-on, the parameters are loaded from the non-volatile memory.

The SDO request to 1010h-x is answered after saving.

5.2.2 Load

Writing “load” to 1011h-x restores the corresponding objects. The parameters are restored after a reset or power-on.

5.2.3 Safe non-volatile operation

To ensure safe non-volatile operation, the time between access object 1010h-x or 1011h-x and a reset or power-on has to be at least 600 ms.

5.2.4 Side effect

Save/Load operations interrupt the updating of position.

5.3 Examples writing parameters

5.3.1 How to change the node ID

Send the SDO message

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x600 + ID	8	0x2F	0x01	0x21	0x00	ID	0x00	0x00	0x00

Note: 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. “How to save data”) followed by a turnoff and on.

5.3.2 How to change the baud rate

Send the SDO message

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x600 + ID	8	0x2F	0x00	0x21	0x00	BR	0x00	0x00	0x00

Note: Values above 7 are not accepted and the existing setting remains valid. After setting the new entries a SAVE command (see par. “How to save data”) followed by a turnoff and on.

5.3.3 How to change the angle direction and resolution

Send the SDO message.

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x600 + ID	8	0x2B	0x00	0x60	0x00	PAR	0x00	0x00	0x00

where PAR is the parameter setting as follow

PAR	MEANING
0x00	angle increase CW, no scaling enabled
0x01	angle increase CCW, no scaling enabled
0x04	angle increase CW, scaling enabled
0x05	angle increase CCW, scaling enabled

5.3.4 How to set the zero position

Send the SDO message to set the zero of channel 1 and 2 (only in Redundant version)

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x600 + ID	8	0x23	0x03	0x60	0x00	0x00	0x00	0x00	0x00

Note: after setting the new entries a SAVE command (see paragraph 5.3.5 Save/load) followed by a turnoff and on.

5.3.5 How to save data

Send the SDO message to save data:

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x600 + ID	8	0x23	0x10	0x10	0x01	0x73	0x61	0x76	0x65

6 PDO Service

6.1 General

The device supports TPDO1 and TPDO2. PDOs are only transmitted in NMT operational mode.

6.2 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.

6.3 COB-ID

The COB-ID for both PDOs is changeable (in Object 180xh-1)

The format of the TPDO is:

TPDO1

COB-ID	Len	D0	D1	D2	D3
0x180 + ID	4	P0a	P1a	P2a	P3a

where P is the actual position value in 0.1° or other scale (depending on the resolution settings) and the suffixes 'a' refers to channels 'a'.

Interpretation example

Considering a resolution of 0.1°:

P0 = 0x10, P1 = 0x27, P2 = P3 = 0

It means P = 0x000003E8 (1000 decimal) = 100°

The channel 'b' is represented in a similar way (but typically in a reverse order so, in the zero position, channel 'b' is 3600° and at FS his value is 0).

Considering a resolution of 1°:

P0 = 0x64, P1 = 0x00, P2 = P3 = 0

It means P = 0x00000064 (100 decimal) = 100°

TPDO2 (N.B. available only on the redundant version)

COB-ID	Len	D0	D1	D2	D3
0x280 + ID	4	P0a	P1a	P2a	P3a

where P is the actual rotation value in degrees or tenths of degrees (depending on the resolution settings)

Interpretation example

Considering a resolution of 0.1°:

P0 = 0x84, P1 = 0x03, P2 = P3 = 0

It means P = 0x00000384 (900 decimal) = 90°

6.3.1 PDO Mapping

The encoder supports dynamic mapping.

6.3.2 Mappable objects

The following objects are mappable:

Mapping content	Mapping entry	Description
Position encoder A	0x60040020	Object 6004h Subindex 00h, data length 32 Bit
Position encoder A	0x60200120	Object 6020h Subindex 01h, data length 32 Bit
Position encoder B	0x60200220	Object 6020h Subindex 02h, data length 32 Bit
Position encoder A	0x21110110	Object 2111h Subindex 01h, data length 16 Bit
Position encoder B	0x21110210	Object 2111h Subindex 02h, data length 16 Bit
Version Customer	0x21950008	Object 2195h Subindex 00h, data length 8 Bit
String Customer	0x21960020	Object 2196h Subindex 00h, data length 32 Bit
Empty space 32bit	0x21970020	Object 2197h Subindex 00h, data length 32 Bit
Empty space 16bit	0x21980010	Object 2198h Subindex 00h, data length 16 Bit
Empty space 8bit	0x21990010	Object 2199h Subindex 00h, data length 8 Bit
Data0	0x23000110	Object 2300h Subindex 01h, data length 16 Bit
Data1	0x23000210	Object 2300h Subindex 02h, data length 16 Bit
Data2	0x23000310	Object 2300h Subindex 03h, data length 16 Bit
Data3	0x23000410	Object 2300h Subindex 04h, data length 16 Bit
Data4	0x23000510	Object 2300h Subindex 05h, data length 16 Bit
Data5	0x23000610	Object 2300h Subindex 06h, data length 16 Bit
Data6	0x23000710	Object 2300h Subindex 07h, data length 16 Bit

To change PDO mapping first disable the mapping by writing 0 to 0x1A0x-0. Write the desired mapping entry and enable the mapping again by writing the number of PDO contents to 0x1A0x-0.

6.3.3 Default mapping of absolute encoder redundant

6.3.4 The mappings for both PDOs are the same. The position will be transmitted in byte 0..3.

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3
18Ah	4	xx	xx	xx	xx

Byte 0..3: position A (Object 6020h-1) *(N.B. available only on the redundant version)*

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3
28Ah	4	xx	xx	xx	xx

Byte 0..3: position B (Object 6020h-2)

6.4 Timing

The minimal cycle time for TPDOs is 10 ms.

6.5 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

7 Emergency Service

7.1 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).

Error codes are accessible by the error field (object 1003h-x). A history of maximal 8 error codes is stored in the error field.

7.2 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)

7.3 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)	-	-	-	-	-

7.4 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

7.4.1 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.

7.4.2 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.

7.5 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
0x01FF810000000000	Absence Magnet (Magnetic Field too low)

8 Heartbeat Service

8.1 General

The device supports a heartbeat producer according CiA 301.

8.2 COB-ID

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

8.3 Timing

The minimal cycle time for heartbeat messages is 1 ms.

9 LSS slave

9.1 General

The baud rate and node ID can be configured by LSS (according to CiA 305). Another possibility to change the baud rate and node ID is to access to the objects 0x2100 and 0x2101 (see object directory).

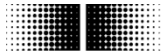
The LSS service is only available in NMT Stopped Mode.

9.2 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

9.3 LSS address

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



10 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 = mappable
Default	Default value on first init
Description	Additional information

10.1 Communication Profile Area

Object	Sub-index	Name	Type	Default value	Description
0x1000	0	Device type	U32, ro	0x00080196	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	Sensor generates no sync message (bit 30 =0) 11-bits identifier system (bit 29=0)
0x1008	0	Device name	str, ro	EAM280/ EAM500/ BMSK50	Device designation
0x1009	0	HW version	str, ro	1.0	Hardware version
0x100A	0	SW version	str, ro	2.83	Software version
0x1010	0	Numbers of save-options	U8, ro	0x01	
	1	"save all parameters"	U32, rw	0x00000001	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	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	bit 30 = 1 The sensor generates EMCY message
0x1017	0	Producer heartbeat time	U16, rw	0x00	Time interval [ms] where sensor generates a producer heartbeat
0x1018	0	Numbers of identity-options	U8, ro	0x01	
	1	Vendor ID	U32, ro	0x0000005F	
	2	Product code	U32, ro	0x00000000	
	3	Revision number	U32, ro	0x00000000	
	4	Serial number	U32, ro	0x00000000	
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, rw	0x05	Number of the entries TPDO1
	1	COB ID TPDO1	U32, rw	0x180+Node ID	Bit 31 = 0 -> TPDO activated Bit 31 = 1 -> TPDO not activated (not transmitted)
	2	Transmission type	U8, rw	0xFE	Transmission type (synchronous/asynchronous)
	3	Inhibit time	U16, rw	0x0000	Minimum interval time between consecutive TPDOs
	5	Event time TPDO1	U16, rw	0x0064	Used if 1800.02 is 0xFE or 0xFF
0x1801	0	TPDO2	U8, rw	0x05	Number of the entries TPDO2
	1	COB ID TPDO2	U32, rw	0x280+Node ID	Bit 31 = 0 -> TPDO activated Bit 31 = 1 -> TPDO not activated (not transmitted)
	2	Transmission type	U8, rw	0xFE	Transmission type (synchronous/asynchronous)
	3	Inhibit time	U16, rw	0x0000	Minimum interval time between consecutive TPDOs
	5	Event time TPDO2	U16, rw	0x0064	Used if 1801.02 is 0xFE or 0xFF
0x1A00	0	TPDO1 mapping	U8, ro	0x01	Number of objects integrated in TPDO1
	1	index in obj directory	U32, ro	0x60200120	Angle channel 1
0x1A01	0	TPDO2 mapping	U8, ro	0x01	Number of objects integrated in TPDO2
	1	index in obj directory	U32, ro	0x60200120	Angle channel 2 (N.B. Available only on the Redundant version)

10.2 Manufacturer Specific Profile Area

Objekt	Sub-index	Name	Type	Default value	Description
0x2100	0	Baud rate setting	U8, rw	0x03	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	0x01...0x7F
0x2110	0	Version control	U32, rw	0x08	
0x2111	0	Biggest subindex	U8, ro	0x02	Number of entries
	1	Angle 1	U16, ro,m		MSB – LSB swapped respect to obj.0x6020.1
	2	Angle 2	U16, ro,m		N.B. Available only on the Redundant version, MSB – LSB swapped respect to obj.0x6020.2
0x2195	0	Version customer	U8, ro,m	0x1B	Fw version to compose PDO with dynamic mapping (ex. 1B = 27 = fw 2.7)
0x2196	0	String customer	U32, rw,m	0x00000000	4 byte to optional insert the customer "name" in the PDO
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	
	2	Data 1	U16, rw,m	0x00	
	3	Data 2	U16, rw,m	0x00	
	4	Data 3	U16, rw,m	0x00	
	5	Data 4	U16, rw,m	0x00	
	6	Data 5	U16, rw,m	0x00	
0x2603	0	Filter	U16, rw	0x04	(ex. with internal sensor refresh time of 25 ms, it means $25\text{ms} \cdot 4 = 100\text{ ms}$ to achieve the correct value)

10.3 Standardized Device Profile Area

Object	Sub-index	Name	Type	Default value	Description
0x6000	0	Parameters	U16, rw	0x04	see paragraph 'How to change the angle direction and resolution'
0x6001	0	Units per revolution	U32, rw	0xE10	
0x6003	0	Preset	U32, rw	0x00	Set the "Zero " position for Angle 1
0x6004	0	Angle 1	U32, ro,m		
0x6010	0	preset	U8, ro	0x02	
	1	Preset Angle 1	U32, rw		Set the "Zero " position for Angle 1
	2	Preset Angle 2	U32, rw		Set the "Zero " position for Angle 2 (N.B. Available only on the Redundant version)
0x6020	0	Angles	U8, ro	0x02	Number of entries
	1	Angle 1	U32, ro,m		
	2	Angle 2	U32, ro,m		N.B. Available only on the Redundant version
0x6500	0	Parameters	U16, rw	0x04	see paragraph 'How to change the angle direction and resolution'
0x6501	0	Maximum resolution	U32, ro	0xFA0	not used
0x6502	0	Overall Measuring Range	U32, ro	0xFA0	not used
0x6503	0	Alarm	U16, ro	0x00	Bit 0 = 0 means Magnetic Field correct Bit 0 = 1 means Magnetic Field incorrect (probably absence of magnet) and channels assume value equal to 0
0x6504	0	Report	U16, ro	0x00	Analysis of the internal primary sensor error

Appendix

Wire Assignments

Signal	Description
White	0 V / GND
Brown	+Vs
Green	CAN_H
Yellow	CAN_L
Grey	CAN_GND