OPERATING INSTRUCTIONS

AHS/AHM36 CANopen
AHS/AHM36 CANopen Inox

Absolute Encoder

SICK
Sensor Intelligence.

Described product

AHS/AHM36 CANopen

AHS/AHM36 CANopen Inox

Manufacturer

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Legal information

Original document

This document is an original document of SICK STEGMANN GmbH.

Contents

1 About this document

Please read this chapter carefully before working with this documentation and the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox Absolute Encoder.

1.1 Function of this document

These operating instructions are designed to address the technical personnel of the machine manufacturer or the machine operator in regards to correct configuration, electrical installation, commissioning, operation and maintenance of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox Absolute Encoder.

1.2 Target group

The operating instructions are addressed at the planners, developers and operators of systems in which one or more AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox Absolute Encoders are to be integrated. They also address people who initialize the use of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox or who are in charge of servicing and maintaining the device.

These instructions are written for trained persons who are responsible for the installation, mounting and operation of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox in an industrial environment.

1.3 Information depth

These operating instructions contain information on the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox Absolute Encoder on the following subjects:

- product features
- electrical installation
- commissioning and configuration
- fault diagnosis and troubleshooting
- conformity

These operating instructions do not contain any information on the mounting of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox. You will find this information in the mounting instructions included with the device.

They also do not contain any information on technical specifications, dimensional drawings, ordering information or accessories. You will find this information in the product information for the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox.

Planning and using measurement systems such as the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox also requires specific technical skills beyond the information in the operating instructions and mounting instructions. The information required to acquire these specific skills is not contained in this document.

When operating the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox, the national, local and statutory rules and regulations must be observed.

Additional information

You will find additional information at www.can-cia.org.

1.4 Scope

NOTE

These operating instructions apply to the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox Absolute Encoder with the following type codes:

- Singleturn Encoder Basic = AHS36B-xxCx004096
- Multiturn Encoder Basic = AHM36B-xxCx012x12
- Singleturn Encoder Advanced = AHS36A-xxCx016384
- Multiturn Encoder Advanced = AHM36A-xxCx014x12
- Singleturn Encoder Inox = AHS36I-xxCx016384
- Multiturn Encoder Inox = AHM36I-xxC-x014x12

1.5 Abbreviations used

CAN	Controller Area Network
CANopen®	CANopen is a registered trademark of CAN in Automation e.V.
CMR	Counts per Measuring Range
CNR_D	Customized Number of Revolutions, Divisor = divisor of the customized number of revolutions
CNR_N	Customized Number of Revolutions, Nominator = nominator of the customized number of revolutions
COB-ID	Communication Object Identifier = address of the communication object
CoS	Change of State
CPR	Counts Per Revolution = resolution per revolution
EDS	Electronic Data Sheet
EEPROM	Electrically Erasable Programmable Read-only Memory
EMGY	Emergency Message
LSS	Layer Setting Services = services for the configuration of Node ID and baud rate
NMT	Network Management
Node ID	Node Identifier = node address
PDO	Process Data Object
PLC	Programmable Logic Controller
PMR	Physical Measuring Range
PRS	Physical Resolution Span (per revolution)
RTR	Remote Transmission Request = request telegram for PDOs
SDO	Service Data Object

1.6 Symbols used

NOTE

Refer to notes for special features of the device.

LED symbols describe the state of a diagnostics LED. Examples:

● The LED is illuminated constantly.

◐ The LED flashes evenly.

◐ The LED flashes with a short duty cycle.

○ The LED is off.

▶ Take action ...

Instructions for taking action are shown by an arrow. Read carefully and follow the instructions for action.

WARNING
Warning!

A warning notice indicates an actual or potential risk or health hazard. They are designed to help you to prevent accidents.

Read carefully and follow the warning notices.

2 On safety

This chapter deals with your own safety and the safety of the equipment operators.

▶ Please read this chapter carefully before working with the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox or with the machine or system in which the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox is used.

2.1 Authorized personnel

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox Absolute Encoder must only be installed, commissioned and serviced by authorized personnel.

NOTE

Repairs to the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox are only allowed to be undertaken by trained and authorized service personnel from SICK STEGMANN GmbH.

The following qualifications are necessary for the various tasks:

Activity	Qualification
Mounting	• Basic technical training • Knowledge of the current safety regulations in the workplace
Electrical installation and replacement	• Practical electrical training • Knowledge of current electrical safety regulations • Knowledge on the use and operation of devices in the related application (e.g. industrial robots, storage and conveyor technology)
Commissioning, operation and configuration	• Knowledge on the current safety regulations and the use and operation of devices in the related application • Knowledge of automation systems • Knowledge of CANopen® • Knowledge of automation software

Table 1: Authorized personnel

2.2 Intended use

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox Absolute Encoder is a measuring device that is manufactured in accordance with recognized industrial regulations and meets the quality requirements as per ISO 9001:2008 as well as those of an environment management system as per ISO 14001:2009.

An encoder is a device for mounting that cannot be used independent of its foreseen function. For this reason an encoder is not equipped with immediate safe devices.

Measures for the safety of persons and systems must be provided by the constructor of the system as per statutory regulations.

Due to its design, the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox can only be operated within an CANopen® network. It is necessary to comply with the CANopen® specifications and guidelines for setting up a CANopen® network.

In case of any other usage or modifications to the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox, e.g. opening the housing during mounting and electrical installation, or in case of modifications to the SICK software, any claims against SICK STEGMANN GmbH under warranty will be rendered void.

2.3 General safety notes and protective measures

WARNING
Please observe the following procedures in order to ensure the correct and safe use of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox!

The encoder is to be installed and maintained by trained and qualified personnel with knowledge of electronics, precision mechanics and control system programming. It is necessary to comply with the related standards covering the technical safety stipulations.

All safety regulations are to be met by all persons who are installing, operating or maintaining the device:

- The operating instructions must always be available and must always be followed.
- Unqualified personnel are not allowed to be present in the vicinity of the system during installation and maintenance.
- The system is to be installed in accordance with the applicable safety stipulations and the mounting instructions.
- All work safety regulations of the applicable countries are to be followed during installation.
- Failure to follow all applicable health and work safety regulations may result in injury or damage to the system.
- The current and voltage sources in the encoder are designed in accordance with all applicable technical regulations.

2.4 Environmental protection

Please note the following information on disposal.

Assembly	Material	Disposal
Packaging	Cardboard	Waste paper
Shaft	Stainless steel	Scrap metal
Flange	Aluminium / Stainless steel	Scrap metal
Housing	Aluminium die cast with Zinc nickel coating / stainless steel	Scrap metal
Electronic assemblies	Various	Electronic waste

Table 2: Disposal of the assemblies

3 Quick start instructions on the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox

3.1 Node ID/Baud rate

The following prerequisites must be met for the communication with the master:

- A correct node ID must be set on the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox. Correct is:
  - a node ID that is not in use in the CANopen network
  - a node ID that the master expects
- The same baud rate must be set on the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox as on the master.

The following parameters are set on the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox in the factory:

- Node ID: 5
- Baud rate: 125 kbit/s

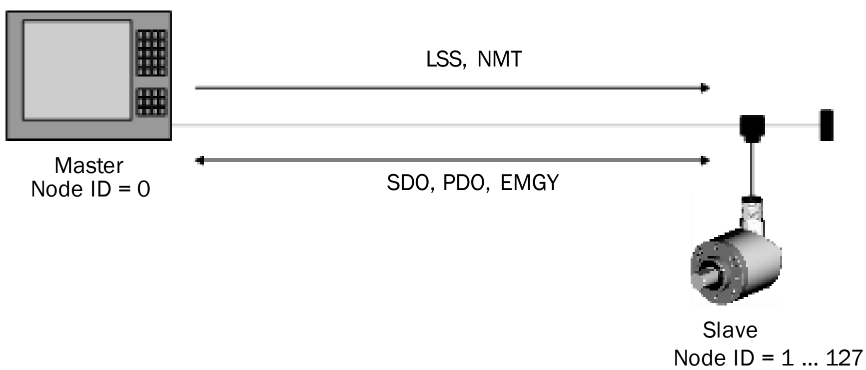


Figure 1: Encoder in the CANopen network

The following communication parameters can be assigned to the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox:

- Node ID: 1 to 127 (as a rule 0 is assigned to the master)
- Baud rate: 10 kbit/s, 20 kbit/s, 50 kbit/s, 100 kbit/s, 125 kbit/s, 250 kbit/s, 500 kbit/s, 800 kbit/s, 1,000 kbit/s

Set the node ID and the baud rate as follows:

- using the manufacturer-specific object 2009h
- using Layer Setting Services (see section 5.4 on page 24)

Changing node ID and/or baud rate using the object 2009h

To change the node ID and/or the baud rate using the object 2009h, proceed as follows:

▶ Entering the access code in object 2009.1h: 98127634h
▶ Change node ID and/or baud rate in the objects 2009.2h and 2009.3h
▶ Save parameters with the aid of object 1010.1h: 65766173h (corresponds to "save" in ASCII)

NOTE

The changes will only be active after restarting the encoder (switch off and on again the supply voltage).

Integration of several encoders

- Integrate encoder 1 in the network and change the node ID (e.g. node ID 4).
- Then integrate encoder 2 in the network and change the node ID if necessary.

NOTE

It is imperative you ensure there are **not** several encoders or other bus users with an identical node ID in the same network.

3.2 Parameterization

3.2.1 EDS file

An EDS file is available for the straightforward interfacing of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox to a CANopen master. This file contains, amongst others, the default parameters of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox and the default configuration of the process data.

You can download the EDS file from www.sick.com:

- Enter the seven-digit part number of your encoder directly in the **Find** field on the homepage.
- Click the related search result.
  A page with all the information and files for your device will open.
- Download the EDS file.
- Integrate the EDS file in the engineering tool for your control.

3.2.2 Save or restore parameters

Saving modified parameters in the EEPROM – Save command

All parameters configured in the encoder's EEPROM are saved using object 1010h.

- For this purpose enter the command 65766173h (corresponds to "save" in ASCII) in object 1010.1h.

NOTE

If the Save command is not run, **the previous parameters** will be loaded from the EEPROM the next time the encoder is started.

Resetting encoders to default factory settings – Load command

The parameters are reset to the default factory settings using the object 1011h.

- For this purpose enter the command 64616F6Ch (corresponds to "load" in ASCII) in the object 1011.1h.

NOTE

The node ID and baud rate set are not in general reset to the default factory settings.

The Save command must be run after the Load command. If the Save command is not run, **the previous parameters** will be loaded from the EEPROM the next time the encoder is started.

3.3 Process data objects (PDOs)

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox supports four Transmit PDOs and one Receive PDO.

Transmit PDOs

Data are sent by the encoder to the PLC using the four Transmit PDOs.

The four Transmit PDOs are defined by the following objects:

- The objects 1800h … 1803h contain the communication parameters.
- The objects 1A00h … 1A03h contain the mapping of the objects.

The mapping is variable and can be modified.

Receive PDO

Data are received from the PLC by the encoder using the Receive PDO. The mapping for this Receive PDO is fixed and cannot be modified.

3.3.1 PDO communication

In the factory the transmission type for the Transmit PDOs is set to 255 in the objects 1800h … 1803h. This corresponds to the device-specific triggering.

NOTE

As an event timer is not configured, the Transmit PDOs are only transferred once on changing to the Operational status!

Changing factory setting for transmission type

For the cyclic or acyclic output of the Transmit PDOs by the encoder, there are the following options:

- ▶ Change the event timer in the objects 1800h … 1803h (see Table 63 ff. from page 56).
- ▶ Configure a trigger event using the CoS event handling configuration (see Table 119 on page 80).
- ▶ Change the transmission type in the objects 1800h … 1803h (see Table 63 ff. from page 56).

Pay attention to the inhibition time

The inhibition time for the PDOs (configured in the objects 1800.3h … 1803.3h) in principle limits the communication of a device on the CANopen bus. It always has a higher priority than the event timer, the CoS events and the sync triggering.

If, e.g., the event timer is set to 100 ms and the inhibition time is set to 1 s, the corresponding PDO is only sent every second.

3.3.2 PDO mapping

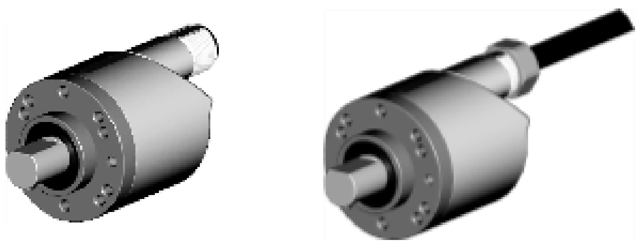
You will find which objects are mapped by default in the related transmit PDOs in section 6.3.3 on page 56.

4 Product description

This chapter provides information on the special features and properties of the Absolute Encoder AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox. It describes the construction and the operating principle of the device.

▶ Please read this chapter before mounting, installing and commissioning the device.

4.1 Special features



With male connector With cable outlet

Figure 2: Connection types

Properties	Singleturn Encoder Basic	Multiturn Encoder Basic	Singleturn Encoder Advanced	Multiturn Encoder Advanced	Singleturn Encoder Inox	Multiturn Encoder Inox
CANopen interface	■	■	■	■	■	■
Supports the encoder profile CiA DS-406	■	■	■	■	■	■
Diagnostic functions via CANopen	–	–	■	■	■	■
12 bit singleturn resolution (1 to 4,096 steps)	■	■	–	–	–	–
14 bit singleturn resolution (1 to 16,384 steps)	–	–	■	■	■	■
12 bit multiturn resolution (1 to 4,096 revolutions)	–	■	–	■	–	■
24 bit total resolution	–	■	–	–	–	–
26 bit total resolution	–	–	–	■	–	■
Round axis functionality	–	–	–	■	–	■
Absolute Encoder in 36 mm design	■	■	■	■	■	■
Electro-sensitive, magnetic scanning	■	■	■	■	■	■
Flexible cable outlet/M12 male connector	■	■	■	■	■	■
Large number of mechanical adaptation options	■	■	■	■	■	■
Compact design	■	■	■	■	■	■
Face mount flange, servo flange, blind hollow shaft	■	■	■	■	■	■
Stainless steel variant	–	–	–	–	■	■
Enclosure rating IP69K	–	–	–	–	■	■

Table 3: Special features of the encoder variants

4.2 Operating principle of the encoder

The sensing system in the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox Absolute Encoder is based on absolute acquisition of revolutions without an external voltage supply or battery. As a consequence the encoder can immediately output its absolute position again after switching off and switching back on.

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox acquires the position of rotating axes and outputs the position in the form of a unique digital numeric value. The highest reliability is achieved by means of electro-sensitive, magnetic scanning.

The AHS36 CANopen and AHS36 CANopen Inox is a singleturn encoder.

Singleturn encoders are used if absolute acquisition of the rotation of a shaft is required.

The AHM36 CANopen and AHM36 CANopen Inox is a multiturn encoder.

Multiturn encoders are used if more than one shaft revolution must be acquired absolutely.

4.2.1 Scaleable resolution

The resolution per revolution and the total resolution can be scaled and adapted to the related application.

The resolution per revolution can be scaled in integers from 1 ... 4,096 (Basic) or from 1 ... 16,384 (Advanced / Inox).

The total resolution of the AHM36 CANopen and AHM36 CANopen Inox must be 2^n times the resolution per revolution. This restriction is not relevant if the round axis functionality is activated.

4.2.2 Preset function

The position value for an encoder can be set with the aid of a preset value. I.e. the encoder can be set to any position within the measuring range. In this way, e.g., the encoder's zero position can be adjusted to the machine's zero point.

On switching off the encoder, the offset, the difference between the real position value and the value defined by the preset, is saved. On switching back on the new preset value is formed from the new real position value and the offset. Even if the position of encoder changes while it is switched off, this procedure ensures the correct position value is still output.

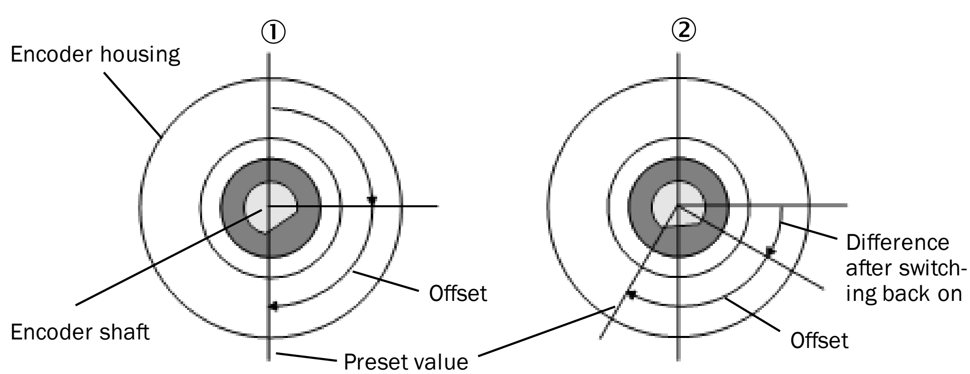


Figure 3: Saving the offset

① = on switching off

② = on switching back on

4.2.3 Round axis functionality

The encoder supports the function for round axes. The steps per revolution are set as a fraction. As a result, the total resolution does not have to be configured to 2^n times the resolution per revolution and can also be a decimal number (e.g. 12.5).

NOTE

The output position value is adjusted with the zero point correction, the counting direction set and the gearbox parameters entered.

Example with transmission ratio

A rotating table for a filling system is to be controlled. The resolution per revolution is pre-defined by the number of filling stations. There are nine filling stations. For the precise measurement of the distance between two filling stations, 1,000 steps are required.

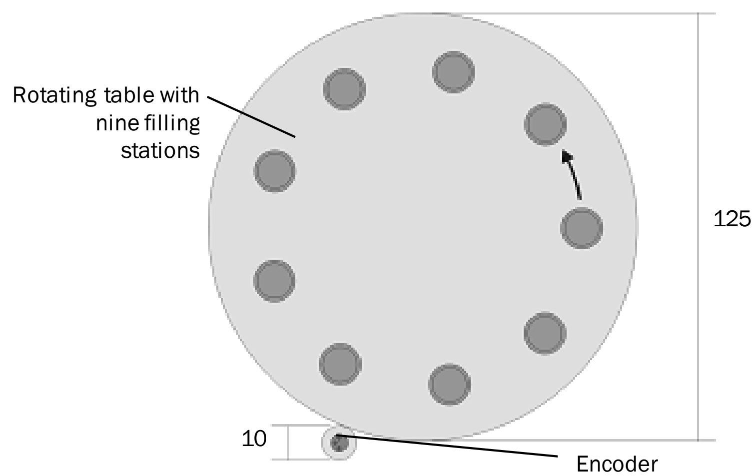


Figure 4: Example position measurement on a rotating table with transmission ratio

The number of revolutions is pre-defined by the transmission ratio = 12.5 of the rotating table gearing.

The total resolution is then 9 × 1,000 = 9,000 steps, to be realized in 12.5 revolutions of the encoder. This ratio cannot be realized via the resolution per revolution and the total resolution, as the total resolution is not 2^n times the resolution per revolution.

The application problem can be solved using the round axis functionality. Here the resolution per revolution is ignored. The total resolution as well as the nominator and divisor for the number of revolutions are configured.

9,000 steps are configured as the total resolution.

For the nominator for the number of revolutions 125 is configured, 10 as the divisor ($^{125}/_{10}$ = 12.5).

After 12.5 revolutions (that is after one complete revolution of the rotating table) the encoder reaches the total resolution of 9,000.

Example without transmission ratio

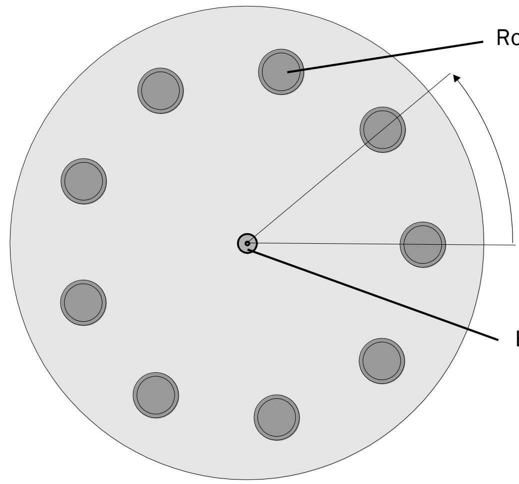


Figure 5: Example position measurement on a rotating table without transmission ratio

The encoder is mounted directly on the rotating table. The transmission ratio is 1:1.

The rotating table has 9 filling stations. The encoder must be configured such that it starts to count with 0 at one filling station and counts to 999 on moving to the next filling station position.

1,000 steps are configured as the total resolution.

For the nominator for the number of revolutions 1 is configured, 9 as the divisor ($^1/_9$ revolutions = 1,000).

After $^1/_9$ revolutions of the encoder shaft there are 1,000 steps, then the encoder starts to count at 0 again.

4.2.4 Electronic cam mechanism

An electronic cam mechanism can be configured using the encoder. Two so-called CAM channels with up to eight cam switching positions are supported ①. This is a limit switch for the position.

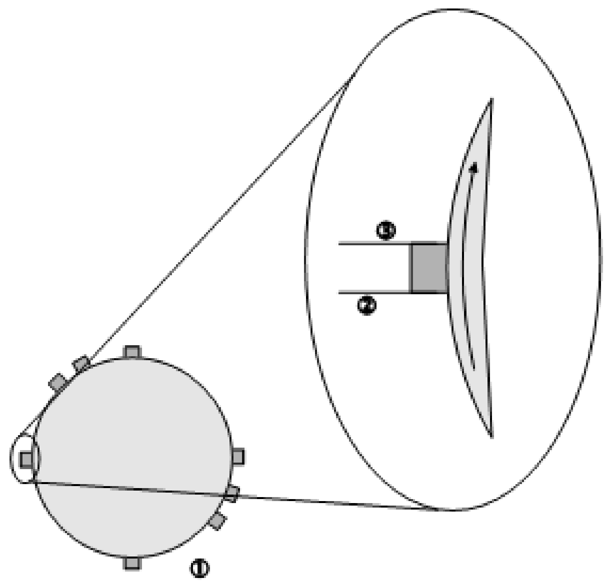


Figure 6: Example electronic cam mechanism

Among other parameters, each cam has parameters for the lower switching point ② and the upper switching point ③, which can be configured via CANopen (see section 6.4.2 on page 65).

4.3 Controls and status indicators

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox Absolute Encoder has one status LED.

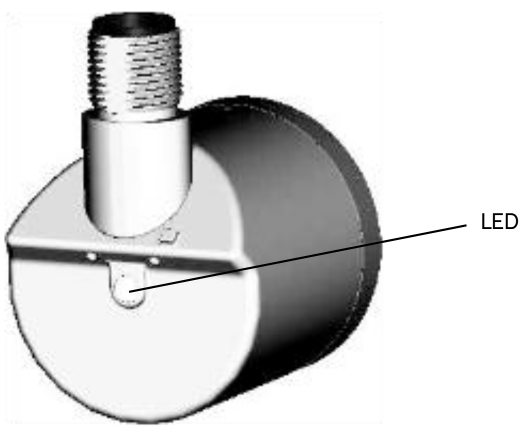


Figure 7: Position of the LED

The LED is multi-colored. Table 138 on page 97 shows the meaning of the signals.

5 Integration in CANopen

5.1 Communication profile

The CANopen communication protocol (documented in CiA DS-301) defines how the devices exchange data with each other in a CANopen network.

5.1.1 CANopen in the OSI model

The CANopen protocol is a standardized layer-7 protocol for the CAN bus. This layer is based on the CAN Application Layer (CAL).

The relevant objects in the encoder profile DS-406 are implemented in the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox (see section 6.4 on page 61).

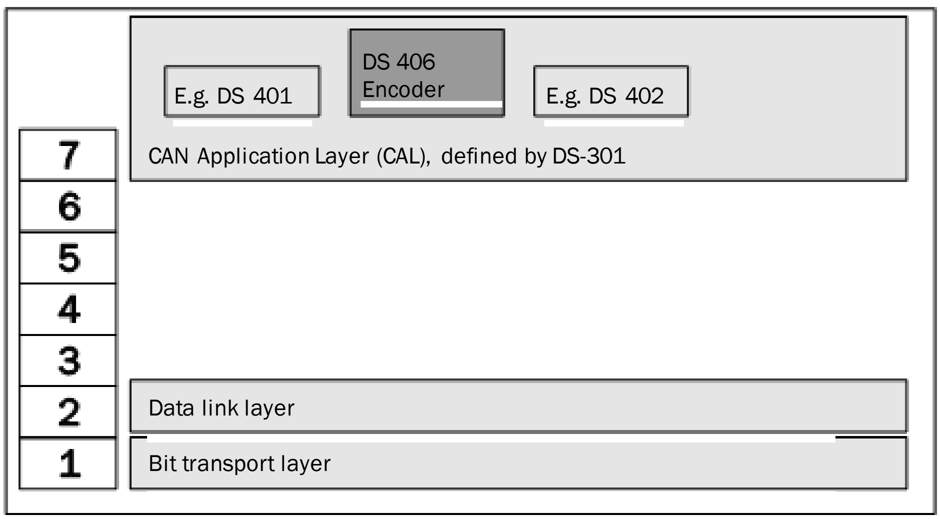


Figure 8: CANopen in the OSI model

NOTE

Layers 3 ... 6 are not used with CANopen.

5.1.2 Communication channels

CANopen has various communication channels (SDO, PDO, Emergency Messages). These channels are formed with the aid of the Communication Object Identifier

(COB-ID). The COB-IDs are based on the node IDs for the individual devices on the CANopen bus (see section 5.2 on page 23).

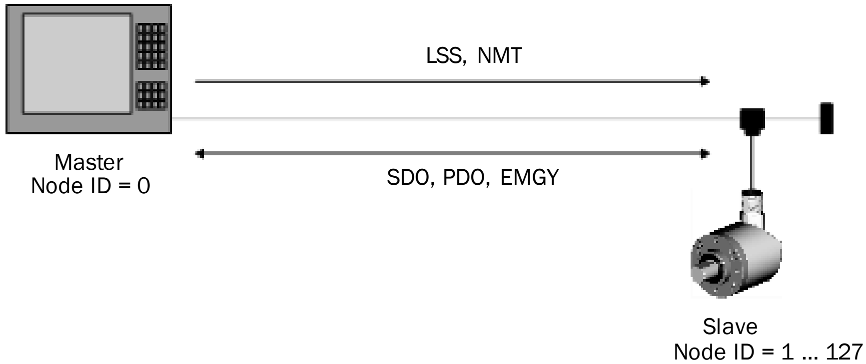


Figure 9: Communication channels

- To set the encoder's node ID, so-called Layer Setting Services (LSS) are used (see section 5.4 on page 24).
- Then communication with the encoder via the Network Management Services (NMT) is possible (see section 5.5 on page 28) and its CANopen state machine can be switched to the required status (Pre-operational, Operational or Stopped) by the master.
- In the Pre-operational status, Service Data Objects (SDO) can be used for communication and configuration (see section 5.6 on page 31). In the Operational status, Process Data Objects (PDO) and Emergency Messages (EMGY) can also be used for communication (see section 5.7 on page 33).

5.1.3 Topology

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox is integrated in the CANopen trunk using T-connectors (the T-connectors are available as accessories). The trunk must be terminated at the end using a 120-Ohm terminator. In this way reflections are prevented. This action is not necessary on the stubs to the encoders.

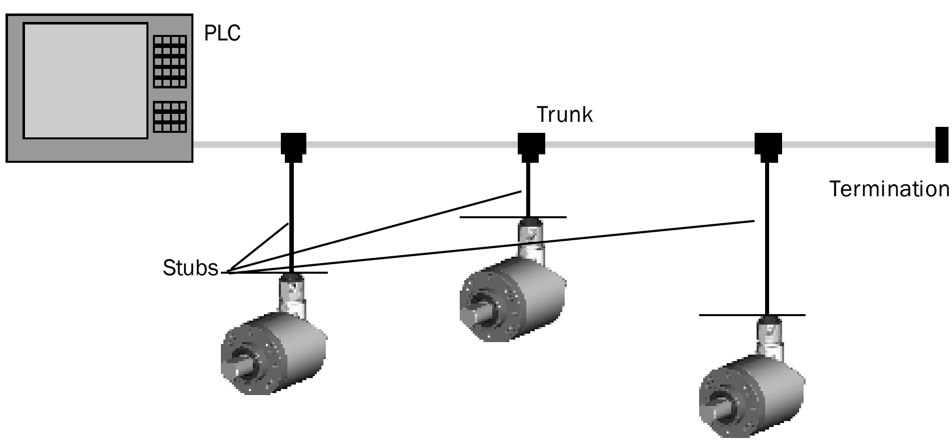


Figure 10: AHx36 in the CANopen topologie

Table 137 on page 90 shows the maximum length of the stubs for different baud rates.

5.2 Node IDs and COB-IDs

The encoder's node ID can be configured with the aid of the following methods:

- SDO access to the manufacturer-specific object 2009h – Network Configuration (see Table 122 on page 81)
- access via Layer Setting Services (see section 5.4 on page 24)

There can be a maximum of 128 devices in a CANopen network, one master and up to 127 slaves. Each device is given a unique node ID (node address).

The COB-IDs (Communication Object Identifier) derive the communication channels from this ID.

COB-ID calculation [Dec] [Hex]	ID ranges [Dec] [Hex]	Function	Direction as seen from the encoder
0	0	Network management	Receive
128 + Node ID 0080h + Node ID	129 ... 255 0081h ... 00FFh	Emergency Message	Send
384 + Node ID 0180h + Node ID	385 ... 511 0181h ... 01FFh	Transmit PDO 1	Send
512 + Node ID 0200h + Node ID	513 ... 639 0201h ... 027Fh	Receive PDO 1	Receive
640 + Node ID 0280h + Node ID	641 ... 767 0281h ... 02FFh	Transmit PDO 2	Send
896 + Node ID 0380h + Node ID	897 ... 1023 0381h ... 03FFh	Transmit PDO 3	Send
1152 + Node ID 0480h + Node ID	1153 ... 1279 0481h ... 04FFh	Transmit PDO 4	Send
1408 + Node ID 0580h + Node ID	1409 ... 1535 0581h ... 05FFh	Transmit SDO	Send
1536 + Node ID 0600h + Node ID	1537 ... 1663 0601h ... 067Fh	Receive SDO	Receive
1792 + Node ID 0700h + Node ID	1793 ... 1919 0701h ... 077Fh	Node Guarding, Heartbeat, Boot-Up	Send
2020 07E4h	2020 07E4h	Transmit LSS	Send
2021 07E5h	2021 07E5h	Receive LSS	Receive

Table 4: Communication object identifier for the encoder

Example:

The encoder is given the node ID = 5, it then sends emergency messages via the ID 133, Transmit PDOs via the ID 389, 645, 901 as well as 1157 and the Transmit SDO via the ID 1413.

5.3 Baud rate

The transmission speed on the CANopen bus is defined using the baud rate. Pay attention to the following criteria:

- The same baud rate must be set on the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox as on the master.
- The higher the baud rate in the CANopen network, the lower the bus load.
- The longer the cables used, the lower the possible baud rate. Pay attention to the maximum lenghts of the stubs depending on the baud rate (see Table 137 on page 90).

The encoder supports the following baud rates:

Baud rate	Supported by the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox
1,000 kbit/s	Yes
800 kbit/s	Yes
500 kbit/s	Yes
250 kbit/s	Yes
125 kbit/s	Yes
100 kbit/s	Yes
50 kbit/s	Yes
20 kbit/s	Yes
10 kbit/s	No
Automatic detection	No

Table 5: Supported baud rates

The encoder's baud rate can be configured with the aid of the following methods:

- SDO access to the manufacturer-specific object 2009h – Network Configuration (see Table 122 on page 81)
- access via Layer Setting Services (see section 5.4 on page 24)

5.4 Layer Setting Services (LSS)

To set the **node ID** and the **baud rate** of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox, the Layer Setting Services are supported.

The LSS slave is accessed via its LSS address (identity object), which is saved in object 1018h (see Table 57 on page 53). The LSS address comprises:

- manufacturer ID
- product Code
- revision number
- serial number

Via the LSS the master requests the individual services that are then executed by the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox. The communication between the LSS master and LSS slave is undertaken using the LSS telegrams.

The following COB-IDs are used:

07E4h = LSS slave to LSS master

07E5h = LSS master to LSS slave

Format of an LSS telegram

NOTE

An LSS telegram is always 8 bytes long. Byte 0 contains the Command Specifier (CS), followed by 7 bytes for the data. All unused bytes must be set to zero.

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	CS	**Data**						

Table 6: Format of an LSS telegram

Switch Mode Global

The Switch Mode Global command switches on or off the configuration mode. The command is not acknowledged, the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox does not respond.

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07E5h	04h	Mode	00h	00h	00h	00h	00h	00h

Table 7: Format of the Switch Mode Global command

Byte 1 mode:

00h = switches off the LSS configuration mode

01h = switches to the LSS configuration mode

Configure Node ID

The node address is configured with the aid of this command.

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07E5h	11h	Node ID	00h	00h	00h	00h	00h	00h

Table 8: Format of the Configure Node ID command

Byte 1 node ID:

01h = node address 1

...

7Fh = node address 127

Response:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07E4h	11h	Error code	Error extend	00h	00h	00h	00h	00h

Table 9: Response to the Configure Node ID command

Byte 1 error code:

00h = parameterization successful

01h = parameter invalid

FFh = contains a specific error code

Byte 2 error extend:

The error extension is manufacturer-specific and always 00h on the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox.

Configure Bit Timing Parameters

The baud rate is configured based on a baud rate table using this command.

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07E5h	13h	00h	Table index	00h	00h	00h	00h	00h

Table 10: Format of the Configure Bit Timing Parameters command

Byte 1 table index from the baud rate table:

Table index	Baud rate	Supported by the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox
0	1,000 kbit/s	Yes
1	800 kbit/s	Yes
2	500 kbit/s	Yes
3	250 kbit/s	Yes
4	125 kbit/s	Yes
5	100 kbit/s	Yes
6	50 kbit/s	Yes
7	20 kbit/s	Yes
8	10 kbit/s	No
9	Automatic detection	No

Table 11: Baud rate table

Response:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07E4h	13h	Error code	Error extend	00h	00h	00h	00h	00h

Table 12: Response to the Configure Bit Timing Parameters command

Byte 1 error code:

00h = parameterization successful

01h = parameter invalid

FFh = contains a specific error code

Byte 2 error extend:

The error extension is manufacturer-specific and always 00h on the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox.

Store Configuration

This command saves the configuration.

NOTE

However, the configuration is not saved in non-volatile memory (EEPROM). This action must be undertaken using the object 1010h – Save Parameters (see Table 50 on page 51).

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07E5h	17h	00h	00h	00h	00h	00h	00h	00h

Table 13: Format of the Store Configuration command

Response:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07E4h	17h	Error code	Error extend	00h	00h	00h	00h	00h

Table 14: Response to the Store Configuration command

Byte 1 error code:

00h = save successful

01h = Store Configuration command is not supported

02h = memory error occurred

FFh = contains a specific error code

Byte 2 error extend:

The error extension is manufacturer-specific and always 00h on the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox.

Inquire LSS address service

Using this command the encoder's node ID and the manufacturer ID, the product code, the revision number and the serial number can be read from object 1018h (see Table 57 on page 53).

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07E5h	CMD	00h	00h	00h	00h	00h	00h	00h

Table 15: Format of the Inquire LSS address service command

Byte 1 CMD from the command table:

CMD	Parameter	Subindex of object 1018h
5Eh	Node ID	
5Dh	Serial Number	.4
5Ch	Revision Number	.3
5Bh	Product Code	.2
5Ah	Vendor ID	.1

Table 16: Command table

Response

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07E4h	CMD	Data-X {LsB}	Data-X	Data-X	Data-X {MsB}	00h	00h	00h

Table 17: Response to the Inquire LSS address service command

NOTE

The data are 4 bytes long, in the byte order “Little Endian”. If the data read are shorter than 4 bytes, the remaining bytes are filled with 0.

Identify Non-Configured Slave Device

Devices that have not been configured can be identified by with the aid of this command.

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07E5h	4Ch	00h	00h	00h	00h	00h	00h	00h

Table 18: Format of the Identify Non Configured Slave Device command

Response

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07E4h	50h	00h	00h	00h	00h	00h	00h	00h

Table 19: Response to the Identify Non-Configured Slave Device command

5.5 Network management (NMT)

The Network Management (NMT) has the task of initializing users on a CANopen network, adding the users to the network, stopping and monitoring them.

In a CANopen network there is always only one NMT master (Network Management Master), all other devices, that is also the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox, are NMT slaves. The NMT master has control of all devices and can change their status.

Typically an NMT master is realized by a PLC or a PC.

5.5.1 CANopen state machine

As in every CANopen slave, a so-called CANopen state machine is implemented in the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox. A differentiation is made between the following statuses:

Status	Description
Initializing	The initialization starts. The device application and the device communication are initialized. Then the node switches automatically to the Pre-operational status.
Pre-operational	The encoder is ready for configuration, acyclic communication can take place via SDO. However, the encoder is not yet able to participate in PDO communication and also does not send any emergency messages.
Operational	In this status the encoder is fully operational and can transmit messages independently (PDOs, emergency messages).
Stopped	In this status the encoder is disabled for communication (active connection monitoring via node guarding remains active).

Table 20: Status of the CANopen state machine

5.5.2 Network Management Services

The specific status of the CANopen state machine is changed via the NMT services. The NMT telegrams for device control use the COB-ID 0 and are given the highest priority.

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
00h	CCD	Node ID	00h	00h	00h	00h	00h	00h

Table 21: Format of the NMT telegram

Byte 0, CCD	Parameter
01h	Start Remote Node Places the encoder in the Operational status.
02h	Stop Remote Node Places the encoder in the Stopped status and stops its communication (active connection monitoring via node guarding remains active).
80h	Enter Pre-operational Places the encoder in the Pre-operational status. All communication channels except the PDOs can be used.
81h	Reset node Resets the value for the profile parameters to the default value. Then the encoder changes to the Reset Communication status.
82h	Reset communication Places the encoder in the Reset Communication status. Then the encoder changes to the Initialization status.

Table 22: Meaning of byte 0

Transitions between the individual operating statuses

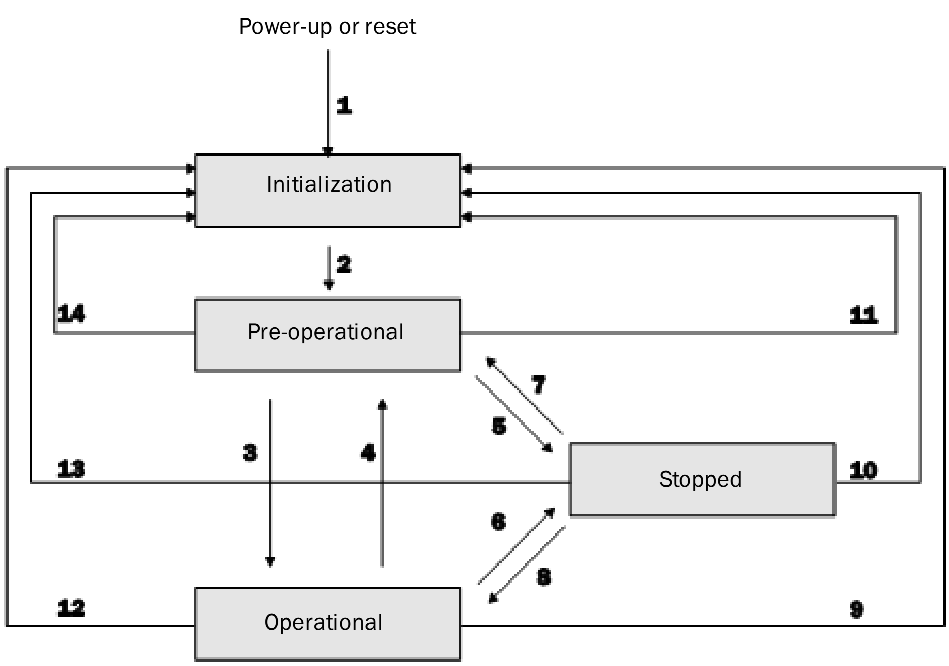


Figure 11: Transitions between the operating statuses

Transition	Description
1	After power-up the encoder enters the Initialization status.
2	After initialization the encoder automatically switches to the Pre-operational status.
3 and 8	The encoder switches to the Operational status with the Start Remote Node command.
4 and 7	The encoder switches back to the Pre-operational status with the Enter Pre-operational State command.
5 and 6	The encoder switches to the Stopped status with the Stop Remote Node command.
9, 10 and 11	The encoder switches to the Initialization status with the Reset Node command.
12, 13 and 14	The encoder switches to the Initialization status with the Reset Communication command.

Table 23: Transitions between the operating statuses

5.5.3 Boot-up message

To signal that a device is ready for operation after switching on, a so-called boot-up message is sent. This message uses the ID from the NMT Error Control protocol and is permanently linked to the device address set (700h + node ID).

5.5.4 Node Guarding and Heartbeat

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox can be monitored permanently using the Node Guarding protocol or the Heartbeat protocol.

NOTE

It is not possible to use the Node Guarding protocol and the Heartbeat protocol on one node. If the **Heartbeat Time** parameter in the object 1017h is not equal to 0 (see Table 56 on page 53), the Heartbeat protocol is used.

Node guarding

The status of the encoder is checked at regular intervals using the Node Guarding telegram. The encoder responds within the response time configured in the objects 100Ch and 100Dh (see Table 48 on page 50).

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
700h + Node ID	Status	00h	00h	00h	00h	00h	00h	00h

Table 24: Format of the Node Guarding telegram

Byte 0, status	Parameter
Bit 7	0
Bit 6 … 0	Operating status of the encoder: 127 = Pre-operational 5 = Operational 4 = Stopped 0 = boot up

Table 25: Meaning of byte 0

Example for an encoder in the Operational status:

85h, 05h, 85h = no error

85h, 05h, 05h = error

NOTE

If node guarding is active, the encoder expects a corresponding status request from the NMT master within a specific interval. If this is not the case, the slave changes to the Pre-operational status.

Heartbeat

If the Heartbeat telegram is used, the encoder sends its status autonomously at regular intervals. This status can be monitored by any other user in the network.

The heartbeat time is configured using object 1017h (see Table 56 on page 53).

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
700h + Node ID	Status	00h	00h	00h	00h	00h	00h	00h

Table 26: Format of the Heartbeat telegram

Byte 0, status	Parameter
Bit 7	Toggle bit The bit changes its value after each request.
Bit 6 ... 0	Operating status of the encoder: 127 = Pre-operational 5 = Operational 4 = Stopped 0 = Boot up

Table 27: Meaning of byte 0

5.6 Service Data Objects (SDO)

The Service Data Objects (SDO) form the communication channel for the transmission of device parameters (e.g. programming the encoder resolution) and are used for status requests.

Data of any length can be transmitted using SDOs. The data may need to be divided between several CAN messages. An SDO is always transmitted with confirmation, i.e. the reception of each message is acknowledged by the receiver.

Transmit SDO and Receive SDO

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox has one Transmit SDO channel and one Receive SDO channel to which two CAN identifiers are assigned.

The SDO communication is compliant with the client-server model. In this process the encoder represents an SDO server.

The SDO client (e.g. the PLC) specifies in its request the parameter, the access type (read/write) and, if necessary, the value. The encoder undertakes the write or read access and responds to the request.

The data area of a CAN telegram, maximum 8 bytes long, is configured by an SDO as follows:

COB-ID	CCD	Index		Subindex	Data			
600h + Node ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7

Table 28: Format of the SDO

The Command Code (CCD) identifies whether data are to be read or written. In the case of an error, the data area contains a 4-byte error code that provides information on the origin of the error (see section 8.4.3 on page 99).

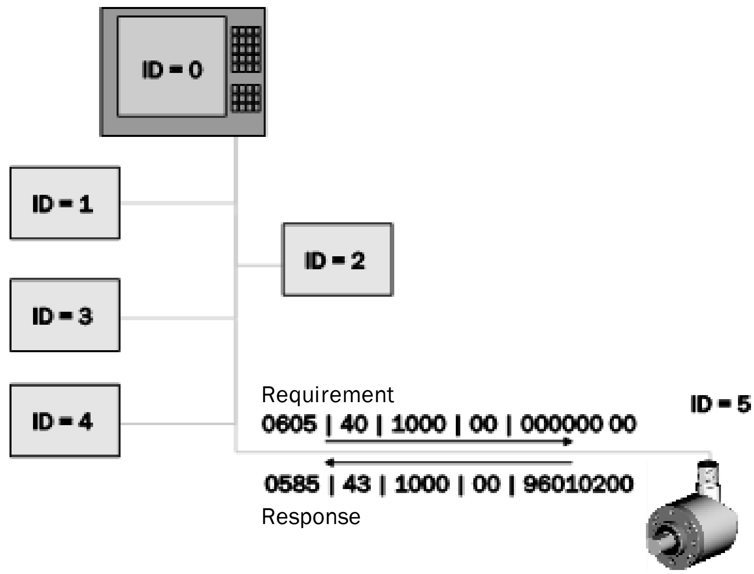


Figure 12: Example for Transmit SDO and Receive SDO

In the example the encoder (ID = 5) receives from the PLC via the ID 0605h (Receive SDO 0600h + encoder ID) a read request (CCD = 40h) for the object 1000h (see Table 37 on page 48).

The encoder responds via ID 0585h (Transmit SDO 0580h + encoder ID) with the return message (CCD = 43h) 0200h = multiturn encoder, 9601h device profile = encoder.

5.7 Process Data Objects (PDO)

Process data objects (PDO) are used for the quick and efficient exchange of real time data (e.g. I/O data, set or actual values).

A PDO is transmitted without acknowledgment.

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox supports one Receive PDO and four Transmit PDOs.

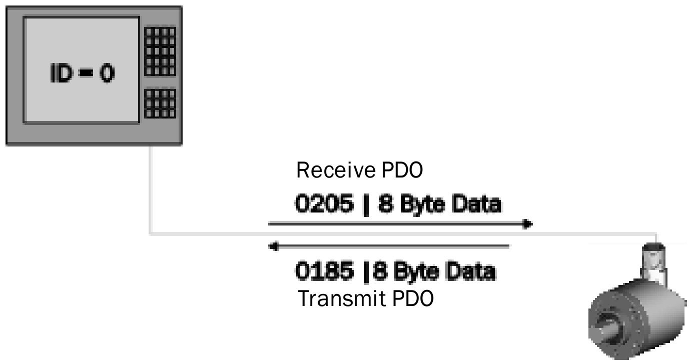


Figure 13: Example for Transmit PDO and Receive PDO

8 data bytes are available on the transmission of the process data.

COB-ID	Data							
0180h + Node ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7

Table 29: Format of the Transmit PDOs

5.7.1 PDO mapping

The format of the Transmit PDOs between the master and the encoder must be harmonized by means of so-called PDO mapping. The process data can be arranged as required in the PDO message. For this purpose the address (that is the index and subindex) from the object directory as well as the size (number of bits) are entered in the mapping object (see Table 68 ff. from page 58).

Example:

Object 1A00h contains the following objects by default:

6004.00h – Position Value

2010.01h – Device Status Word, S_STAT-A

2010.02h – Device Status Word, S_STAT-B

The contents of the objects are transmitted in the Transmit PDO.

COB-ID	Data							
0180h + Node ID	00	00	00	01	00	00	00	00
	Position value = 1				No error		No error	

Table 30: Example for a Transmit PDO

5.7.2 PDO data transmission

Bus load

Please note:

- The more PDOs and the more often these PDOs are sent, the higher the bus load in the CANopen network.
- The higher the baud rate in the CANopen network, the lower the bus load.
- The longer the cables used, the lower the possible baud rate.

For optimal communication a compromise therefore needs to be found between all three factors mentioned.

If a Transmit PDO is not used, it should be deactivated. For this purpose set bit 31 to 1 in subindex .1 of the related object 180xh.

The PDOs can be transmitted cyclically or acyclically. This aspect is defined by the objects 180xh and the transmission type defined in their subindex .02.

Object **Subindex**	Designation	Data values
180xh	Communication Parameter for the 1st Transmit PDO	–
.0	Number of entries	5
.1	COB-ID	00000180h + Node ID
.2	Transmission Type	0 Transmission only on switching on the encoder 1 … 240 Cyclic transmission. Cyclic with the SYNC messages 252 Request by RTR telegram (synchronous transmission) 253 Request by RTR telegram (asynchronous transmission) 254 Application-specific triggering **255 Device-specific triggering**
.3	Inhibition Time	0 … 65,535
.4	Reserved	–
.5	Event Timer	0 … 65,535

Table 31: Example for the communication parameters

Cyclic data transmission

For cyclic data transmission there are the following options:

- The process data are sent with the master's SYNC messages. The cycle is formed from a multiple of the Sync messages. The factor can be between 1 and 240.
- The process data are sent using an event timer to suit the specific application or device. An event timer is available for each PDO. It can be configured between 0 and 65,535 ms.

Acyclic data transmission

For acyclic data transmission the encoder is triggered by one of the following criteria:

- On application-specific/device-specific triggering
  The transmission of the PDOs is controlled by an event (CoS triggering). This event is defined in object 2007h (see Table 119 on page 80).
- On request (RTR telegram)
  In this case another bus user (as a rule the master) requests the process data.

NOTE

The combination of cyclic and acyclic data transmission by event timer and CoS triggering is not permitted.

Event timer and CoS triggering do not limit each other!

If an object is to be transmitted cyclically and acyclically, it must be mapped to two different PDOs.

NOTE

In the factory the encoder's Transmit PDOs are set to device-specific triggering. As a consequence the encoder outputs all Transmit PDOs once on start-up. However the event timer is at 0. For this reason the Transmit PDOs are initially only output once.

For the cyclic or acyclic output of the Transmit PDOs by the encoder, there are the following options:

- ▶ Change the event timer in the objects 1800h ... 1803h (see Table 63 ff. from page 56).
- ▶ Configure a trigger event using the CoS event handling configuration (see Table 119 on page 80).
- ▶ Change the transmission type in the objects 1800h ... 1803h (see Table 63 ff. from page 56).

Inhibition time

The inhibition time for the PDOs (configured in the objects 1800.3h ... 1803.3h) in principle limits the communication of a device on the CANopen bus. It always has a higher priority than the event timer, the CoS events and the sync triggering.

If, e.g., the event timer is set to 100 ms and the inhibition time is set to 1 s, the corresponding PDO is only sent every second.

NOTE

The inhibition time has no effect on triggering by RTR telegrams.

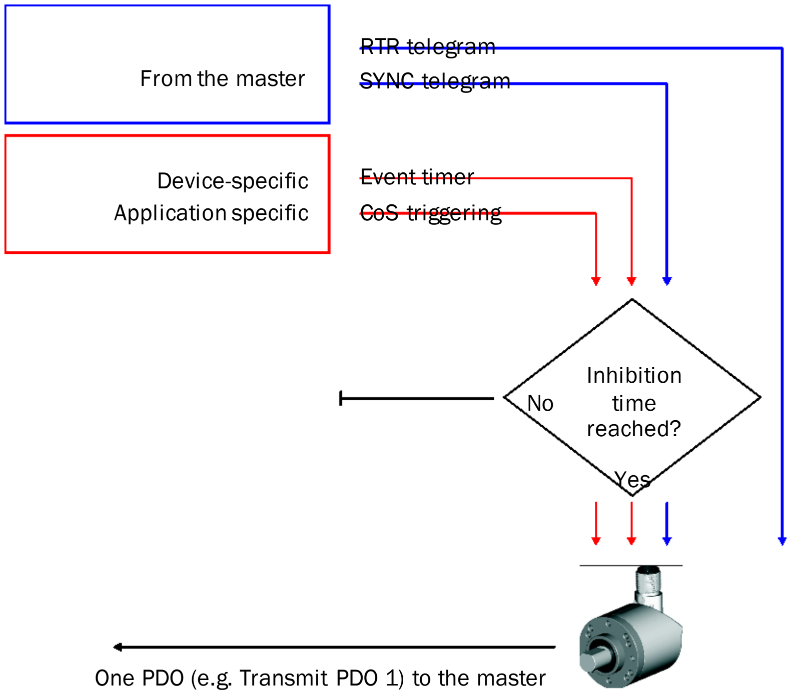


Figure 14: Sending Transmit PDOs

5.7.3 Asynchronous or synchronous formation of the position

With bit 15 of object 6000h (see Table 74 on page 62) you can define whether the position is formed asynchronously or synchronously.

- Asynchronous formation of the position
  The formation of the position by the encoder is not synchronized. It operates autonomously using its own cycle. The encoder determines the position every 250 µs[1)] with a jitter of 20 µs. A PDO always "takes" the last position value, which may already be 250 µs old.
- Synchronous formation of the position
  The formation of the position by the encoder is synchronized to the Sync messages from the master. The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox forms the position on the reception of a SYNC message. In this case it is not possible to determine a speed value, the speed is output as 0.

NOTE

- The output data from the master (essentially for the preset function) cannot be synchronized.
- The input data for the master (essentially the position data) can be synchronized.

1) Additional latency time due to sensor-internal processes: 500 µs.

5.8 Configurable functions

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox is configured, e.g., in the TwinCAT® configuration tool with the aid of various objects.

The most important objects for the configuration of the functions are listed in the following. A complete list of the objects can be found in chapter 6 "Object library" on page 46.

WARNING
During the configuration of the encoder, make sure there are no persons in a system's hazardous area!

All parameter changes have a direct effect on the operation of the encoder. For this reason the position value may change during configuration, e.g. due to the implementation of a preset or change of scale. This change could cause an unexpected movement that may result in a hazard for persons or damage to the system or other items.

NOTE
All functions described in the following for which parameters can be set can also be configured in the encoder's start-up configuration.

5.8.1 EDS file

To be able to integrate the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox straightforwardly in a CANopen master, there is an EDS file. This file contains the following information on the features of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox:

- information on the manufacturer of the device
- name, type and version number of the device
- type and version number of the protocol used for this device
- default parameters of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox and default configuration of the process data

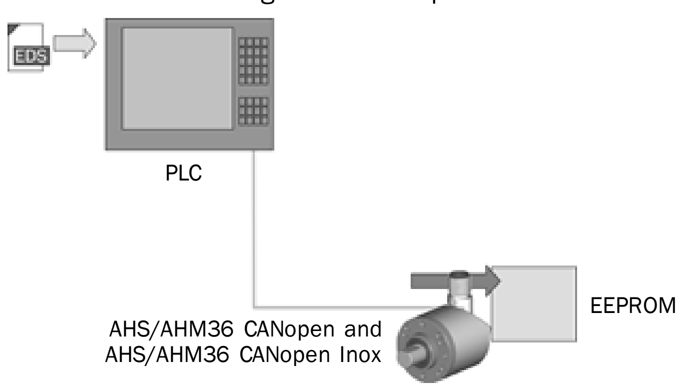


Figure 15: EDS file

5.8.2 Scaling parameters

The scaling parameters are configured by the objects 6000h, 6001h and 6002h.

6000	Operating parameters	RW	0x0000 (0)
6001	Measuring units per revolution	RW	0x00004000 (16384)
6002	Total Measuring Range	RW	0x00004000 (16384)

Figure 16: Objects 6000h, 6001h and 6002h in TwinCAT®

6000h – Operating Parameters

Using the object **6000h** (see Table 74 on page 62) the parameters **Support additional Error Code**, **Scaling** and **Code sequence** are configured. The object is configured using a bit sequence 16 bits wide.

Example:

Bit 0 = code sequence ccw = 1

Bit 2 = scaling on = 1

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1

Table 32: Example for binary code

The binary value must be converted into a hexadecimal value and entered in the configuration dialog box.

101b = 5h

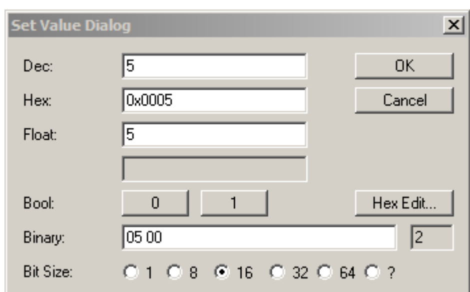


Figure 17: Example for the parameterization of object 6000h

Scaling

This parameter makes it possible to scale the resolution per revolution and the total resolution.

NOTE

Only if the parameter **Scaling** is configured to **1** are the values entered for the resolution and total resolution applied.

Code sequence

The code sequence defines which direction of rotation increases the position value; the direction of rotation is defined looking at the shaft.

- clockwise (cw) = increasing position value on clockwise revolution of the shaft
- counterclockwise (ccw) = increasing position value on counter clockwise revolution of the shaft

6001h – Counts Per Revolution (CPR)

The resolution per revolution is configured using the object **6001h** (see Table 76 on page 63).

NOTE

The parameter is not used if the round axis functionality is activated.

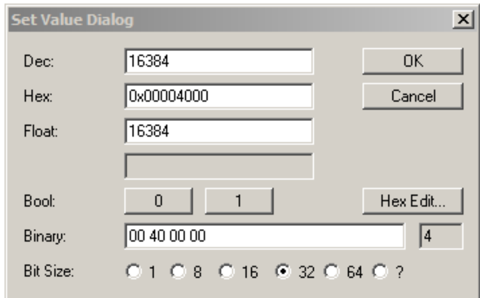


Figure 18: Example for the parameterization of object 6001h

The resolution of the AHS/AHM36 CANopen Basic is max. 4,096 steps per revolution. The resolution can be scaled from 1 ... 4,096 as an integer.

The resolution of the AHS/AHM36 CANopen Advanced / Inox is max. 16,384 steps per revolution. The resolution can be scaled from 1 ... 16,384 as an integer.

6002h – Total Measuring Range

The total resolution is configured using the object **6002h** (see Table 77 on page 63).

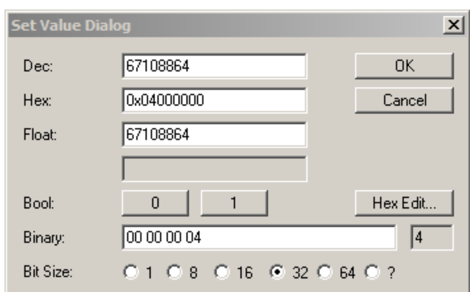


Figure 19: Example for the parameterization of object 6002h

The total resolution, that is the measuring range of the AHM36 CANopen Basic, is max. 16,777,216 steps. The total resolution of the AHM36 CANopen Advanced / Inox is max. 67,108,864 steps.

The total resolution must be 2^n times the resolution per revolution.

NOTE

This restriction is not relevant if the round axis functionality is activated.

Resolution per revolution	n	Total resolution
1,000	3	8,000
8,179	5	261,728
2,048	11	4,194,304

Table 33: Examples for total resolution

NOTE

The parameters are only written to the non-volatile memory in the EEPROM using the object 1010h with the aid of the data word 65766173h = “save” (see Table 50 on page 51).

5.8.3 Preset function

The position value for an encoder can be set with the aid of the preset function. I.e. the encoder can be set to any position within the measuring range.

NOTE

The preset value must lie within the measuring range configured.

WARNING

Before triggering the preset function, check whether there is a hazard from the machine or system in which the encoder is integrated!

The preset function results in a change in the position value output by the encoder. This change could cause an unexpected movement that may result in a hazard for persons or damage to the system or other items.

The preset value can be set with the aid of the following methods:

- using acyclic communication (SDO) with the object 6003h
- using cyclic communication (PDO) with the object 2000h. The value from object 2005h is used.

Acyclic communication (SDO)

The preset value is transferred directly to the encoder using the object **6003h – Preset Value** (see Table 78 on page 63). The encoder immediately adopts the preset value that is written to the object as the new position value.

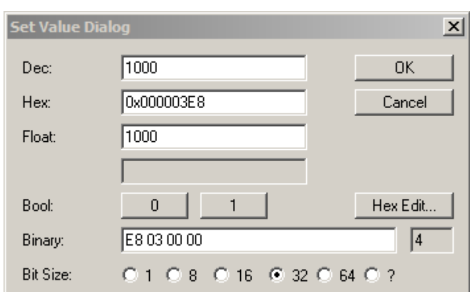


Figure 20: Example for the parameterization of object 6003h

The function is available if the encoder is in the Pre-operational or Operational status.

Cyclic communication (PDO)

The preset value is initially transferred to the encoder using the object **2005h – Configuration Preset Value** (see Table 117 on page 78), but is not yet applied as a new position value.

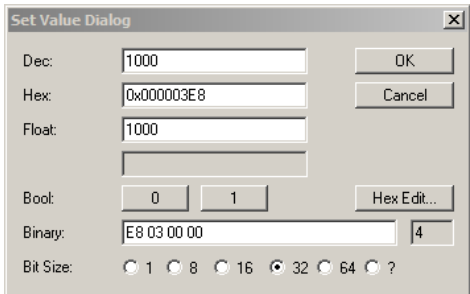


Figure 21: Example for the parameterization of object 2005h

The function is triggered using the object **2000h – Control Word 1** (see Table 111 on page 75).

The function is available if the encoder is in the Operational status.

The object is configured using a bit sequence 16 bits wide.

Example:

Bit 12 = preset is set = 1

Bit 11 = preset mode shift positive = 1

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0

Table 34: Example for binary code

The binary value must be converted into a hexadecimal value and entered in the configuration dialog box.

1100000000000b = 1800h

5.8.4 Cyclic process data

The cyclic process data are defined using the process data objects (see section 6.3 on page 54).

The object to be incorporated in the objects **1A00h**, **1A01h**, **1A02h** or **1A03h** is entered with its object number, the subindex and the data length (see Table 72 on page 60).

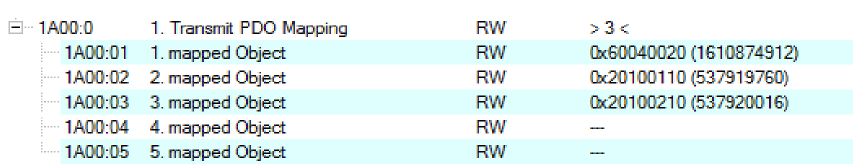


Figure 22: Example for the parameterization of object 1A00h

Example:

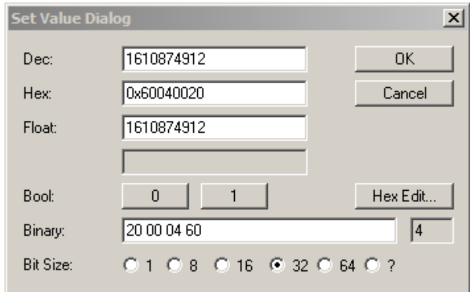


Figure 23: Example for the parameterization of subindex 1A00.01h

60040020h

Object = 6004h

Subindex = 00h

Data length = 20h (32 Bit)

NOTE

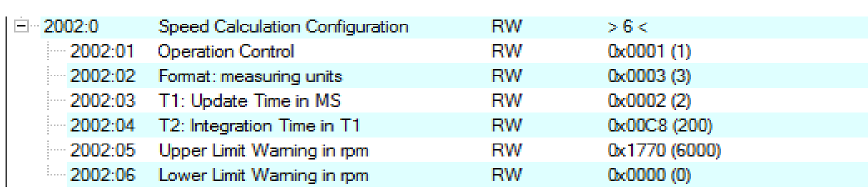
In the factory the encoder's Transmit PDOs are set to device-specific triggering. As a consequence the encoder outputs all Transmit PDOs once on start-up. However the event timer is at 0. For this reason the Transmit PDOs are initially only output once.

For the cyclic or acyclic output of the Transmit PDOs by the encoder, there are the following options:

- Change the event timer in the objects 1800h … 1803h (see Table 63 ff. from page 56).
- Configure a trigger event using the CoS event handling configuration (see Table 119 on page 80).
- Change the transmission type in the objects 1800h … 1803h (see Table 63 ff. from page 56).

5.8.5 Speed measurement

The speed measurement is configured using the object **2002h – Speed Calculation Configuration** (see Table 114 on page 77).



2002:0	Speed Calculation Configuration	RW	> 6 <
2002:01	Operation Control	RW	0x0001 (1)
2002:02	Format: measuring units	RW	0x0003 (3)
2002:03	T1: Update Time in MS	RW	0x0002 (2)
2002:04	T2: Integration Time in T1	RW	0x00C8 (200)
2002:05	Upper Limit Warning in rpm	RW	0x1770 (6000)
2002:06	Lower Limit Warning in rpm	RW	0x0000 (0)

Figure 24: Example for the parameterization of object 2002h

Using the subindex **2002.02h – Format: Measuring Units** you can define the units in which the speed is transmitted.

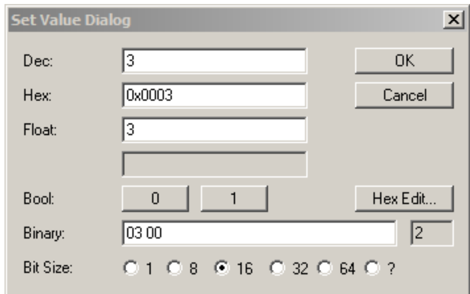


Figure 25: Example for the parameterization of subindex 2002.02h

Possible units are:

- cps
- cp10ms
- cp100ms
- rpm
- rps

The factory setting is 3h = rpm.

Using the other Subindices you can configure the refresh time as well as the maximum and minimum speed (see Table 114 on page 77).

5.8.6 Round axis functionality

The Round axis functionality removes the restriction for the AHM36 Advanced / Inox that the total resolution must be 2^n times the resolution per revolution. The shaft is considered as an **endless shaft**.

The resolution per revolution is not configured directly, instead the nominator and divisor for the number of revolutions are defined.

The Round axis functionality is configured using the object **2001h – Endless-Shaft Configuration** (see Table 113 on page 76).

2001:0	Endless-Shaft Configuration	RW	> 3 <
2001:01	Operating Mode Control	RW	0x00000001 (1)
2001:02	Number of Revolutions: Nominator	RW	0x00000800 (2048)
2001:03	Number of Revolutions: Divisor	RW	0x00000001 (1)

Figure 26: Example for the parameterization of object 2001h

The total resolution can be scaled from 1 … 67,108,864 (Advanced / Inox) as an integer.

The nominator (2001.02h – Number of Revolutions, Nominator) can be scaled from 1 … 2,048 as an integer. The default factory setting for the nominator is 2,048.

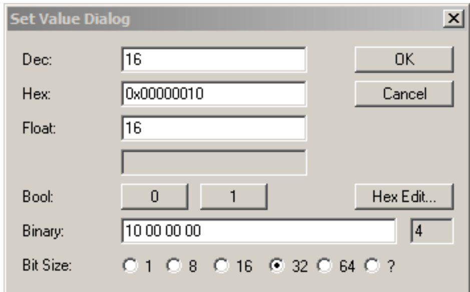


Figure 27: Example for the parameterization of subindex 2001.03h

The divisor (2001.03h – Number of Revolutions, Divisor) can be scaled from 1 … 2,048 as an integer. The default factory setting for the divisor is 1.

Due to the physical limit of the resolution per revolution, the following condition also applies:

Total resolution ÷ (nominator for the number of revolutions ÷ divisor for the number of revolutions) ≤ 16,384.

5.8.7 Electronic cam mechanism

An electronic cam mechanism can be configured using the encoder. Two so-called CAM channels with up to eight cam switching positions are supported. This is a limit switch for the position.

The electronic cam mechanism is configured using several objects (see section 6.4.2 “Objects for the electronic cam mechanism (CAM)” on page 65).

6300:0	CAM state register	RW	> 2 <
6301:0	Cam enable register	RW	> 2 <
6301:01	Cam enable channel 1	RW	0x00 (0)
6301:02	Cam enable channel 2	RW	0x00 (0)
6302:0	Cam polarity register	RW	> 2 <
6310:0	Cam 1 low limit	RW	> 2 <
6310:01	Cam 1 low limit channel 1	RW	0x00000000 (0)
6310:02	Cam 1 low limit channel 2	RW	0x00000000 (0)
6311:0	Cam 2 low limit	RW	> 2 <
6312:0	Cam 3 low limit	RW	> 2 <
6313:0	Cam 4 low limit	RW	> 2 <
6314:0	Cam 5 low limit	RW	> 2 <
6315:0	Cam 6 low limit	RW	> 2 <
6316:0	Cam 7 low limit	RW	> 2 <
6317:0	Cam 8 low limit	RW	> 2 <
6320:0	Cam 1 high limit	RW	> 2 <
6321:0	Cam 2 high limit	RW	> 2 <
6322:0	Cam 3 high limit	RW	> 2 <
6323:0	Cam 4 high limit	RW	> 2 <
6324:0	Cam 5 high limit	RW	> 2 <
6325:0	Cam 6 high limit	RW	> 2 <
6326:0	Cam 7 high limit	RW	> 2 <
6327:0	Cam 8 high limit	RW	> 2 <
6330:0	Cam 1 hysteresis	RW	> 2 <
6331:0	Cam 2 hysteresis	RW	> 2 <
6332:0	Cam 3 hysteresis	RW	> 2 <
6333:0	Cam 4 hysteresis	RW	> 2 <
6334:0	Cam 5 hysteresis	RW	> 2 <
6335:0	Cam 6 hysteresis	RW	
6336:0	Cam 7 hysteresis	RW	
6337:0	Cam 8 hysteresis	RW	

Figure 28: Objects for the electronic cam mechanism

The cams are enabled using the object **6301h – CAM Enable Register**, the polarity is defined using the object **6302h – CAM Polarity Register**.

Each position parameter is defined by its minimum switching point (objects **6310h** to **6317h**), its maximum switching point (objects **6320h** to **6327h**) and its switching hysteresis (objects **6330h** to **6337h**).

6 Object library

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox contains various types of objects:

- standard objects with 1000 series object numbers
- encoder profile-specific objects with 6000 series object numbers
- manufacturer-specific objects with 2000 series object numbers

6.1 Nomenclature

Abbreviation	Meaning
R	Read = read only
R/W	Read/Write = read and write access
STRG	String = character string of variable length
BOOL	Boolean = logical value 0 or 1
INT	Integer value (negative/positive) (e.g. INT-8 = –128 ... +127)
UINT	Unsigned integer = integer value (e.g. UINT-32 = 0 ... 4.294.967.295)
Array	Series of data of one data type (e.g. array UINT-8 = character string of data type UINT-8)
Record	Series of data with different data types (e.g. UINT-8, UINT-32, UINT-32, UINT-16)

Table 35: Nomenclature of the access types and data types

6.2 Standard objects

Object **Subindex**	Access	Data type	Designation
1000h	R	UINT-32	Device Type
1001h	R	UINT-8	Error Register
1003h	R/W	Record	Predefined Error Field
1005h	R/W	UINT-32	COB-ID SYNC Message
1008h	R	STRG	Device Name
1009h	R	STRG	Hardware Version Number
100Ah	R	STRG	Software Version Number
100Ch	R/W	UINT-16	Node Guarding – Guard Time
100Dh	R/W	UINT-8	Node Guarding – Life Time Factor
1010h .0 … .1	R/W	Record	Save Parameters
1011h .0 … .1	R/W	Record	Load/Restore Parameters
1014h	R/W	UINT-32	COB-ID Emergency Message
1015h	R/W	UINT-16	Emergency Inhibit Time
1017h	R/W	UINT-16	Heartbeat Time
1018h .0 … .4	R	Record	Identity Object
1400h .0 … .2	R/W	Record	Communication Parameter for the 1st Receive PDO
1600h .0 and .1	R/W	Record	Mapping Parameter for the 1st Receive PDO
1800h .0 … .5	R/W	Record	Communication Parameter for the 1st Transmit PDO
1801h .0 … .5	R/W	Record	Communication Parameter for the 2nd Transmit PDO
1802h .0 … .5	R/W	Record	Communication Parameter for the 3rd Transmit PDO
1803h .0 … .5	R/W	Record	Communication Parameter for the 4th Transmit PDO
1A00h .0 … .3	R/W	Record	Mapping Parameter for the 1st Transmit PDO
1A01h .0 … .4	R/W	Record	Mapping Parameter for the 2nd Transmit PDO
1A02h .0 … .3	R/W	Record	Mapping Parameter for the 3rd Transmit PDO
1A03h .0 … .4	R/W	Record	Mapping Parameter for the 4th Transmit PDO

Table 36: Implemented standard objects

6.2.1 Detailed information on the standard objects

NOTE

In the following only those objects are described in detail for which the content is not clear from the overview (see Table 36 on page 47).

Object 1000h – Device Type

This object specifies the device type and the device profile implemented.

Object	Access	Data type	Designation	Data values
1000h	R	UINT-32	Device Type	See Table 38

Table 37: Object 1000h

Bit	Description	Data values	
31 … 24	The device type is output in the bits 31 … 16.	**01h**	Singleturn encoder
23 … 16		**02h**	Multiturn encoder
15 … 8	The device profile supported is output in the bit 15 … 0.	**01.96h**	Device profile = Encoder
7 … 0			

Table 38: Object 1000h – details

Object 1001h – Error Register

Object	Access	Data type	Designation	Data values
1001h	R	UINT-8	Error Register	See Table 40

Table 39: Object 1001h

The encoder writes error messages to this object. It is part of the emergency message (see section 8.4.1 on page 97).

Bit	Description	Data values	
7	Manufacturer-specific error	**0**	Not active
		1	Active
6	Reserved	**0**	
5	Device profile specific error	**0**	Not active
		1	Active
4	Communication error (PDO length exceeded)	**0**	Not active
		1	Active
3	Temperature error	**0**	Not active
		1	Active
2	Voltage error	**0**	Not active
		1	Active
1	Reserved	**0**	
0	Generic error	**0**	Not active
		1	Active

Table 40: Object 1001h – details

Object 1003h – Predefined Error Field

Object **Subindex**	Access	Data type	Designation	Data values
1003h	R/W	Record	Predefined Error Field	–
.0	R/W	UINT-8	Number of entries	0 ... 4
.1	R	UINT-32	Error 1	00000000h ... FFFFFFFFh
.2	R	UINT-32	Error 2	00000000h ... FFFFFFFFh
.3	R	UINT-32	Error 3	00000000h ... FFFFFFFFh
.4	R	UINT-32	Error 4	00000000h ... FFFFFFFFh

Table 41: Object 1003h

NOTE

- The number of errors is saved in the subindex .0. If an error has not yet occurred, the value of the subindex is = 0. Read access is responded to with an SDO error message 08000024h or 08000000h.
- Each new error is saved in subindex .1, older errors move to the next higher subindex.
- To delete the error list, 00h must be written to subindex .0.

Byte 0	1	2	3
Object 1003h		S_STAT-A-LsB	S_STAT-A-MsB
EMGY error code		Error field	

Table 42: Object 1003h – details

Object 1005h – COB-ID SYNC Message

Object	Access	Data type	Designation	Data values
1005h	R/W	UINT-32	COB-ID SYNC Message	See Table 44

Table 43: Object 1005h

Bit	Description	Data values
31	Reserved	**0**
30	Defines whether the device generates the SYNC message.	**0** Device does not generate a SYNC message. **1** Not supported
29	Defines which bit width is used.	**0** 11 Bit **1** Not supported
28 ... 0	29-bit width CAN ID	**0**
11 ... 0	11-bit width CAN ID	**80h**

Table 44: Object 1005h – details

Object 1008h – Device Name

The object contains the device name dependent on the encoder type.

Object	Access	Data type	Designation	Data values
1008h	R	STRG 16 byte	Device Name	AHS36B-xxCx04096 AHM36B-xxCx12x12 AHS36A-xxCx16384 AHM36A-xxCx14x12

Table 45: Object 1008h

Object 1009h – Hardware Version Number

Object	Access	Data type	Designation	Data values
1009h	R	STRG 8 byte	Hardware Version Number	E.g. HW_01.01 (depending on the release)

Table 46: Object 1009h

Object 100Ah – Software Version Number

Object	Access	Data type	Designation	Data values
100Ah	R	STRG 8 byte	Software Version Number	E.g. SW_01.01 (depending on the release)

Table 47: Object 100Ah

Object 100Ch – Node Guarding – Guard Time

Object	Access	Data type	Designation Description	Data values
100Ch	R/W	UINT-16	Node Guarding – Guard Time Configured monitoring time in ms	0000h … 7FFFh

Table 48: Object 100Ch

Object 100Dh – Node Guarding – Life Time Factor

Object	Access	Data type	Designation Description	Data values
100Dh	R/W	UINT-8	Node Guarding – Life Time Factor Factor for the multiplication of the monitoring time	64h … FFh

Table 49: Object 100Dh

The monitoring time multiplied by the life time factor yields the cycle used to monitor the encoder.

Object 1010h – Save Parameters

Using this object the parameters are written to EEPROM with the aid of the data word 65766173h = “save” (ASCII code).

WARNING
Check whether the parameters have actually been written to the EEPROM!

The data are only written to the EEPROM in the status Pre-operational. The command is not executed in any other status, but it is also not identified as denied.

- Check whether the parameters have been saved using the object **2010.03h – State Flag 3 (S_STAT-C)** (see Table 126 on page 83).

If the data are not saved in the EEPROM, the encoder loads the data last saved the next time the encoder is switched on. This situation can result in hazards for persons or damage to the system!

Object **Subindex**	Access	Data type	Designation Description	Data values
1010h	R/W	Record	Save Parameters	–
.0	R/W	UINT-8	Number of entries	1
.1	R/W	UINT-32	Total Class Parameters The parameters for all object types are saved.	See Table 51

Table 50: Object 1010h

Bit	Designation	Data values
31 … 24	Byte 3	65h = e
23 … 16	Byte 2	76h = v
15 … 8	Byte 1	61h = a
7 … 0	Byte 0	73h = s

Table 51: Object 1010h – details

Object 1011h – Load/Restore Parameter

Using this object the parameters are reset to the factory settings with the aid of the data value 64616F6Ch = “load” (ASCII code).

NOTE

- Node ID and baud rate (objects 2009.2h and 2009.3h) are not reset.
- The data are only reset to the factory settings in the Pre-operational status. The command is not executed in any other status, but it is also not identified as denied.
- To reset the communication parameters of the objects 180xh and 2007h and the mapping of the objects 1A00h …1A03h to the default factory settings, a Reset Node must be run via the NMT services after the Load command (81h, see Table 22 on page 29).
- Then the data must be saved in the EEPROM using the object **1010h – Save Parameters**, otherwise the encoder will load the data saved in the EEPROM the next time it is switched on.

Object **Subindex**	Access	Data type	Designation Description	Data values
1011h	R/W	Record	Load/Restore Parameter	–
.0	R/W	UINT-8	Number of entries	1
.1	R/W	UINT-32	Total Class Parameters The parameters for all object types are loaded.	See Table 53

Table 52: Object 1011h

Bit	Designation	Data values
31 … 24	Byte 3	64h = d
23 … 16	Byte 2	61h = a
15 … 8	Byte 1	6Fh = o
7 … 0	Byte 0	6Ch = l

Table 53: Object 1011h – details

Object 1014h – COB-ID Emergency Message

Object	Access	Data type	Designation Description	Data values
1014h	R	UINT-32	COB-ID Emergency Message Communication object identifier of the emergency message The value is calculated from 00000080h + the node ID 1 … 127. Example: A device with node ID = 2 transmits with COB-ID 00000082h.	00000081h … FFFFFFFFh

Table 54: Object 1014h

Object 1015h – Emergency Inhibit Time

Object	Access	Data type	Designation Description	Data values
1015h	R/W	UINT-16	Emergency Inhibit Time Contains the configured inhibit time for the emergency message in ms. With the value 0 the inhibit time is inactive.	0000h … FFFFh

Table 55: Object 1015h

Object 1017h – Heartbeat Time

Object	Access	Data type	Designation Description	Data values
1017h	R/W	UINT-16	Heartbeat Time Heartbeat cycle time in ms. With the value 0 the heartbeat is inactive.	0000h … 7FFFh

Table 56: Object 1017h

Object 1018h – Identity Object

Object **Subindex**	Access	Data type	Designation Description	Data values
1018h	R	Record	Identity Object	–
.0	R	UINT-8	Number of entries	4
.1	R	UINT-32	Vendor ID	01000056h = SICK
.2	R	UINT-32	Product Code	00007721h = AHS36 Basic 00007722h = AHM36 Basic 00007723h = AHS36 Advanced / Inox 00007724h = AHM36 Advanced / Inox
.3	R	UINT-32	Revision Number	00010001 = 1.01 (depending on the release)
.4	R	UINT-32	Serial Number YYWWxxxx (year/week/ sequential number)	See Table 58

Table 57: Object 1018h

Bit	Designation
31 … 24	Device code
23 … 16	YY (year)
15 … 10	WW (week)
9 … 0	Sequential number

Table 58: Object 1018h – details

6.3 Process Data Objects

The process data objects are used to define which objects are transmitted to the control system or received from the control system and in which manner. The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox supports one Receive PDO and four Transmit PDOs.

- Data are received from the PLC by the encoder using the Receive PDO. The mapping for this PDO is fixed and cannot be modified.
- Data are sent by the encoder to the PLC using the four Transmit PDOs. The mapping for these PDOs is variable and can be modified.

Both the Receive PDO and the four Transmit PDOs are defined each in two objects.

- The Receive PDO is defined by the following objects:
  - Object 1400h contains the communication parameters.
  - Object 1600h contains the mapped object.
- The four Transmit PDOs are defined by the following objects:
  - The objects 1800h … 1803h contain the communication parameters.
  - The objects 1A00h … 1A03h contain the mapped objects.

6.3.1 Basic PDO structure

Object **Subindex**	Access	Data type	Designation Description	Data values
xxxxh	R/W	RECORD	Receive PDO Transmit PDO	–
.0	R	UINT-8	Number of entries	1 … 5
.1 … .5	R/W	UINT-32	Mapping Information Number	See Table 60

Table 59: Structure of the PDOs

Bit	Designation	Data values
31 … 16	Index of the mapped object	xxxxh
15 … 8	Subindices of the mapped object	1 … 5
7 … 0	Length of the mapped object in bits	08h = UINT-8 10h = UINT-16 20h = UINT-32

Table 60: Structure of the PDOs – details

6.3.2 Parameter of the Receive PDO

Object 1400h – Communication Parameter for the 1st Receive PDO

Object **Subindex**	Access	Data type	Designation Description	Data values
1400h	R/W	RECORD	Communication Parameter for the 1st Receive PDO	–
.0	R	UINT-8	Number of entries	2
.1	R/W	UINT-32	COB-ID 0200h + Node ID (see Table 4 on page 23)	0201h ... 027Fh
.2	R/W	UINT-8	Transmission Type Transmission type (see Table 67 on page 58)	0 ... 255

Table 61: Object 1400h

Object 1600h – Mapping Parameter for the 1st Receive PDO

NOTE

The object **2000h – Control Word 1** is mapped to the object 1600h. This aspect cannot be modified.

Object **Subindex**	Access	Data type	Designation Description	Data values
1600h	R/W	RECORD	Mapping Parameter for the 1st Receive PDO	–
.0	R	UINT-8	Number of entries	1
.1	R/W	UINT-32	Control Word 1 (see Table 111 on page 75)	20000010h

Table 62: Object 1600h

6.3.3 Parameter of the Transmit PDOs

Object 1800h – Communication Parameter for the 1st Transmit PDO

Object **Subindex**	Access	Data type	Designation Description	Data values [default value]
1800h	R/W	RECORD	Communication Parameter for the 1st Transmit PDO	–
.0	R/W	UINT-32	Number of entries	5
.1	R/W	UINT-32	COB-ID 0180h + Node ID (see Table 4 on page 23)	00000180h + Node ID
.2	R/W	UINT-8	Transmission Type Transmission type (see Table 67 on page 58)	0 … 255 [255]
.3	R/W	UINT-16	Inhibition Time Idle time between two transmissions (× 0.1 ms)	0 … 65,535 [0]
.4	–	–	Reserved	–
.5	R/W	UINT-16	Event Timer Timer for device-specific or application-specific triggering (× 1 ms)	0 … 32,767 [0]

Table 63: Object 1800h

NOTE

Object 1800.05h is linked with object 6200h (see Table 81 on page 64). Modified values are mutually applied.

Object 1801h – Communication Parameter for the 2nd Transmit PDO

Object **Subindex**	Access	Data type	Designation Description	Data values [default value]
1801h	R/W	RECORD	Communication Parameter for the 2nd Transmit PDO	–
.0	R/W	UINT-32	Number of entries	5
.1	R/W	UINT-32	COB-ID 0280h + Node ID (see Table 4 on page 23)	00000280h + Node ID
.2	R/W	UINT-8	Transmission Type Transmission type (see Table 67 on page 58)	0 … 255 [255]
.3	R/W	UINT-16	Inhibition Time Idle time between two transmissions (× 0.1 ms)	0 … 65,535 [0]
.4	–	–	Reserved	–
.5	R/W	UINT-16	Event Timer Timer for device-specific or application-specific triggering (× 1 ms)	0 … 32,767 [0]

Table 64: Object 1801h

Object 1802h – Communication Parameter for the 3rd Transmit PDO

Object **Subindex**	Access	Data type	Designation Description	Data values [default value]
1802h	R/W	RECORD	Communication Parameter for the 3rd Transmit PDO	–
.0	R/W	UINT-32	Number of entries	5
.1	R/W	UINT-32	COB-ID 0380h + Node ID (see Table 4 on page 23)	00000380h + Node ID
.2	R/W	UINT-8	Transmission Type Transmission type (see Table 67 on page 58)	0 … 255 [255]
.3	R/W	UINT-16	Inhibition Time Idle time between two transmissions (× 0.1 ms)	0 … 65,535 [0]
.4	–	–	Reserved	–
.5	R/W	UINT-16	Event Timer Timer for device-specific or application-specific triggering (× 1 ms)	0 … 32,767 [0]

Table 65: Object 1802h

Object 1803h – Communication Parameter for the 4th Transmit PDO

Object **Subindex**	Access	Data type	Designation Description	Data values [default value]
1803h	R/W	RECORD	Communication Parameter for the 4th Transmit PDO	–
.0	R/W	UINT-32	Number of entries	5
.1	R/W	UINT-32	COB-ID 0480h + Node ID (see Table 4 on page 23)	00000480h + Node ID
.2	R/W	UINT-8	Transmission Type Transmission type (see Table 67 on page 58)	0 … 255 [255]
.3	R/W	UINT-16	Inhibition Time Idle time between two transmissions (× 0.1 ms)	0 … 65,535 [0]
.4	–	–	Reserved	–
.5	R/W	UINT-16	Event Timer Timer for device-specific or application-specific triggering (× 1 ms)	0 … 32,767 [0]

Table 66: Object 1803h

6.3.4 Transmission types

Number	Description
0	The PDOs are transmitted asynchronously on switching on the encoder.
1 ... 240	The PDOs are sent synchronously and cyclically. The digit defines how many SYNC telegrams are necessary until the PDOs are sent. If the value is, e.g., 2, the transmission is made after every 2nd SYNC telegram.
252	PDOs are only sent if they are requested by an RTR telegram (as per synchronous transmission).
253	PDOs are only sent if they are requested by an RTR telegram (as per asynchronous transmission).
254	Application-specific triggering
255	Device-specific triggering This is the default setting.

Table 67: Transmission types

The application-specific and device-specific triggering only differ in that with device-specific triggering the PDOs are transmitted once on changing to the Operational status.

For application-specific and for device-specific triggering, the event timer is used as a trigger. In addition the event defined in the CoS event handling configuration is used as a trigger (see Table 119 on page 80). The two triggers are linked using an OR operator.

NOTE

The combination of cyclic and acyclic data transmission by event timer and CoS triggering is not permitted.

Event timer and CoS triggering do not limit each other!

If an object is to be transmitted cyclically and acyclically, it must be mapped to two different PDOs.

Object 1A00h – Mapping Parameter for the 1st Transmit PDO

Object **Subindex**	Access	Data type	Designation Description	Data values
1A00h	R/W	RECORD	Mapping Parameter for the 1st Transmit PDO	–
.0	R/W	UINT-8	Number of entries	3
.1	R/W	UINT-32	6004h Position Value	See Table 72 on page 60
.2	R/W	UINT-16	2010.01h STW-1 – Device Status Word, S_STAT-A	
.3	R/W	UINT-16	2010.02h STW-1 – Device Status Word, S_STAT-B	

Table 68: Object 1A00h – default subindices

Object 1A01h – Mapping Parameter for the 2nd Transmit PDO

Object **Subindex**	Access	Data type	Designation Description	Data values
1A01h	R/W	RECORD	Mapping Parameter for the 2nd Transmit PDO	–
.0	R/W	UINT-8	Number of entries	4
.1	R/W	UINT-8	1001h Error Register	See Table 72 on page 60
.2	R/W	UINT-16	6503h Alarm Status	
.3	R/W	UINT-16	6505h Warning Status	
.4	R/W	UINT-16	2018.02h Time Counter Sec	

Table 69: Object 1A01h – default subindices

Object 1A02h – Mapping Parameter for the 3rd Transmit PDO

Object **Subindex**	Access	Data type	Designation Description	Data values
1A02h	R/W	RECORD	Mapping Parameter for the 3rd Transmit PDO	–
.0	R/W	UINT-8	Number of entries	3
.1	R/W	UINT-16	6030.01h Speed Value 16-Bit	See Table 72 on page 60
.2	R/W	UINT-16	2015h Temperature Value	
.3	R/W	UINT-32	2016h Position Value, Raw	

Table 70: Object 1A02h – default subindices

Object 1A03h – Mapping Parameter for the 4th Transmit PDO

Object **Subindex**	Access	Data type	Designation Description	Data values
1A03h	R/W	RECORD	Mapping Parameter for the 4th Transmit PDO	–
.0	R/W	UINT-8	Number of entries	4
.1	R/W	UINT-8	6300.01h CAM State Register, Channel 1	See Table 72 on page 60
.2	R/W	UINT-8	6300.02h CAM State Register, Channel 2	
.3	R/W	UINT-16	2010.03h STW-1 – Device Status Word, S_STAT-C	
.4	R/W	UINT-32	2017h Speed Value 32-Bit	

Table 71: Object 1A03h – default subindices

6.3.5 Objects and their subindices that can be mapped

Object **Subindex**	Length [Bit]	Designation	Mapping values	Details see
1001h	8	Error Register	10010008h	Table 39, page 48
6004h	32	Position Value	60040020h	Table 79, page 64
6030h .1	 16	 Speed Value	 60300110h	Table 80, page 64
6503h	16	Alarm Status	65030010h	Table 95, page 70
6505h	16	Warning Status	65050010h	Table 99, page 71
6300h .1 .2	 8 8	CAM State Register Channel 1 Channel 2	 63000108h 63000208h	Table 82, page 65
2010h .1 .2 .3	 16 16 16	STW-1 – Device Status Word S_STAT-A S_STAT-B S_STAT-C	 20100110h 20100210h 20100310h	Table 123, page 81
2014h	32	Time Counter	20140020h	Table 130, page 87
2015h	16	Temperature Value	20150010h	Table 131, page 87
2016h	32	Position Value, Raw	20160020h	Table 132, page 87
2017h	32	Speed Value 32-Bit	20170020h	Table 133, page 87
2018h .1 .2	 16 16	Time Counter Signals Time Counter MSec Time Counter Sec	 20180110h 20180210h	Table 134, page 88

Table 72: Objects and their subindices that can be mapped

Changing the PDO mappings

NOTE

Parameter changes to the PDO mapping objects are only executed in the status Pre-operational.

How to change the content of the mapping objects:

- First set bit 31 to 1 in the corresponding object 180xh in subindex .1.
- In object 1A0xh set the subindex .0 to 0.
- Configure the objects to be mapped in the subindices .1 to .n of object 1A0xh.
- Set the subindex .0 of the object 1A0xh to the number of mapped objects.
- Then set bit 31 to 0 again in the corresponding object 180xh in subindex .1.

6.4 Encoder profile specific objects

Object **Subindex**	Access	Data type	Designation
6000h	R/W	UINT-16	Operating Parameter
6001h	R/W	UINT-32	Counts Per Revolution (CPR)
6002h	R/W	UINT-32	Total Measuring Range
6003h	R/W	UINT-32	Preset Value
6004h	R	UINT-32	Position Value
6030h .0 … .1	R	Array UINT-16	Speed Value
6200h	R/W	UINT-16	Cyclic Timer
6300h .0 … .2	R	Array UINT-8	CAM State Register
6301h .0 … .2	R/W	Array UINT-8	CAM Enable Register
6302h .0 … .2	R/W	Array UINT-8	CAM Polarity Register
6310h … **6317h** .0 … .2	R/W	Array UINT-32	CAM-1 … 8 – Lower Limit setting
6320h … **6327h** .0 … .2	R/W	Array UINT-32	CAM-1 … 8 – Upper Limit setting
6330h … **6337h** .0 … .2	R/W	Array UINT-16	CAM-1 … 8 – Hysteresis setting
6500h	R	UINT-16	Operating Status
6501h	R	UINT-32	Physical Resolution Span (PRS) Singleturn Resolution
6502h	R	UINT-16	Number of Revolutions
6503h	R	UINT-16	Alarm Status
6504h	R	UINT-16	Supported Alarms
6505h	R	UINT-16	Warning Status
6506h	R	UINT-16	Supported Warnings
6507h	R	UINT-32	Version Of Profile & Software
6508h	R	UINT-32	Operating Time
6509h	R	INT-32	Internal Offset Value
650Ah .0 … .3	R	Array UINT-32	Module Identification
650Bh	R	UINT-32	Serial Number

Table 73: Implemented encoder profile specific objects

6.4.1 Encoder parameters

Object 6000h – Operating Parameters

Object	Access	Data type	Designation	Data values
6000h	R/W	UINT-16	Operating Parameters	See Table 75

Table 74: Object 6000h

Bit	Designation Description	Data values
15	RT-SYNC mode The encoder determines the position every 250 µs[2). A Transmit PDO with a transmission type of 1 … 240 (see Table 67 on page 58) always “takes” the last position value, which may already be 250 µs old. If the RT SYNC mode is active, then the formation of the position is synchronized with the SYNC messages from the master. This means the position value is determined at exactly the point at which the request for the Transmit PDO arrives. In this case it is not possible to determine a speed value, the speed is output as 0.	**0** Not active **1** Active
14 … 3	Reserved	–
2	Scaling The bit enables scaling with objects 6001h and 6002h.	**0** Not active **1** Active
1	Commissioning diagnostic control	**1** Always active
0	Code sequence (cw, ccw) The code sequence defines the direction of rotation, viewed on the shaft, in which the position value increases. • Clockwise = increasing position value on clockwise revolution of the shaft • Counterclockwise = increasing position value on counterclockwise revolution of the shaft	**0** cw **1** ccw

Table 75: Object 6000h – details

2) Additional latency time due to sensor-internal processes: 500 µs.

Object 6001h – Counts Per Revolution (CPR)

The resolution per revolution is configured using this parameter.

NOTE

The parameter is not used if the round axis functionality is activated.

Object	Access	Data type	Designation Description	Data values [default value]
6001h	R/W	UINT-32	Counts Per Revolution (CPR) Number of steps per revolution	AHx36 Basic = 00000001h ... 00000FFFh [00000FFFh] AHx36 Advanced / Inox = 00000001h ... 00003FFFh [00003FFFh]

Table 76: Object 6001h

Object 6002h – Total Measuring Range

The total resolution required is configured using this parameter.

Object	Access	Data type	Designation Description	Data values
6002h	R/W	UINT-32	Total Measuring Range Total resolution	AHS36 Basic = 1 ... 00001000h AHS36 Advanced / Inox = 1 ... 00004000h AHM36 Basic = 1 ... 01000000h AHM36 Advanced / Inox = 1 ... 04000000h

Table 77: Object 6002h

Object 6003h – Preset Value

The position value of the encoder is set to a preset value using this parameter. In this way, e.g., the encoder's zero position can be adjusted to the machine's zero point.

Object	Access	Data type	Designation Description	Data values
6003h	R/W	UINT-32	Preset Value Preset value	–

Table 78: Object 6003h

NOTE

- On writing the value to the object, it is immediately applied as a new position value.
- The preset value must lie within the measuring range configured.

Object 6004h – Position Value

The actual position value can be output using this object.

Object	Access	Data type	Designation Description	Data values
6004h	R	UINT-32	Position Value Current position value	–

Table 79: Object 6004h

NOTE

An error code (Err_PosVal) can also be output instead of the position value (see Table 124 on page 83). The output of the Err_PosVal must be configured using the object 6000h (see Table 74 on page 62).

Object 6030h – Speed Value

The actual speed can be read using this object.

Object **Subindex**	Access	Data type	Designation Description	Data values
6030h	R	Array INT-16	Speed Value	–
.0	R	INT-16	Number of entries	1
.1	R	INT-16	Speed Value Speed in 16 Bit	–32,768 ... +32,767

Table 80: Object 6030h

Object 6200h – Cyclic Timer

Object	Access	Data type	Designation Description	Data values
6200h	R/W	UINT-16	Cyclic Timer PDO cycle time in ms	0000h ... FFFFh

Table 81: Object 6200h

NOTE

Object 6200h is linked with object 1800.05h (see Table 63 on page 56). Modified values are mutually applied.

6.4.2 Objects for the electronic cam mechanism (CAM)

A so-called electronic cam mechanism can be configured using the encoder. One CAM channel with up to eight cam switching positions is supported. Each position parameter is defined by its minimum switching point (objects 6310h to 6317h), its maximum switching point (objects 6320h to 6327h) and its switching hysteresis (objects 6330h to 6337h).

Object 6300h – CAM State Register

The cam switching states are output using the object 6300h.

Object **Subindex**	Access	Data type	Designation	Data values
6300h	R	Array UINT-8	CAM State Register	–
.0	R	UINT-8	Number of entries	2
.1	R	UINT-8	Channel 1	00h … FFh
.2	R	UINT-8	Channel 2	00h … FFh

Table 82: Object 6300h

Bit	Designation	Data values
7	Cam 8	**0** Not active **1** Active
6	Cam 7	**0** Not active **1** Active
5	Cam 6	**0** Not active **1** Active
4	Cam 5	**0** Not active **1** Active
3	Cam 4	**0** Not active **1** Active
2	Cam 3	**0** Not active **1** Active
1	Cam 2	**0** Not active **1** Active
0	Cam 1	**0** Not active **1** Active

Table 83: Object 6300h – details

If, for instance, the value read is 01h (00000001b), then cam 1 is active. None of the other cams are active. If, for instance, the value read is 88h (10001000b), then cams 8 and 4 are active. None of the other cams are active.

Object 6301h – CAM Enable Register

Each cam switching position on the CAM channel must be enabled individually in the encoder. The individual cams are enabled by writing the appropriate value to the object 6301h, subindex .1 or subindex .2.

Every cam switching position that is to be used must be set to 1 in binary notation.

Object **Subindex**	Access	Data type	Designation Description	Data values
6301h	R/W	Array UINT-8	CAM Enable Register	–
.0	R	UINT-8	Number of entries	2
.1	R/W	UINT-8	Channel 1	00h … FFh
.2	R/W	UINT-8	Channel 2	00h … FFh

Table 84: Object 6301h

Bit	Designation	Data values
7	Cam 8	**0** Not used **1** Used
6	Cam 7	**0** Not used **1** Used
5	Cam 6	**0** Not used **1** Used
4	Cam 5	**0** Not used **1** Used
3	Cam 4	**0** Not used **1** Used
2	Cam 3	**0** Not used **1** Used
1	Cam 2	**0** Not used **1** Used
0	Cam 1	**0** Not used **1** Used

Table 85: Object 6301h – details

If, for instance 4Ah (01001010b) is transmitted in the subindex, the cams 2, 4 and 7 are used. All other cams are not used.

Object 6302h – CAM Polarity Register

Using the CAM Polarity Register it can be defined whether the cams are output as active high or active low. By default the cams are defined as active high. They therefore output 1 when the cam switching position is reached.

Object **Subindex**	Access	Data type	Designation Description	Data values
6302h	R/W	Array UINT-8	CAM Polarity Register	–
.0	R	UINT-8	Number of entries	2
.1	R/W	UINT-8	Channel 1	00h … FFh
.2	R/W	UINT-8	Channel 2	00h … FFh

Table 86: Object 6302h

Bit	Designation	Data values
7	Cam 8	**0** High active **1** Low active
6	Cam 7	**0** High active **1** Low active
5	Cam 6	**0** High active **1** Low active
4	Cam 5	**0** High active **1** Low active
3	Cam 4	**0** High active **1** Low active
2	Cam 3	**0** High active **1** Low active
1	Cam 2	**0** High active **1** Low active
0	Cam 1	**0** High active **1** Low active

Table 87: Object 6301h – details

Objects 6310h … 6317h – CAM 1 … 8, Lower Limit setting

The lower switching point of a cam switching position is defined using the Lower Limit. Each individual cam switching position (CAM 1 to CAM 8) has its own Lower Limit object (6310h = cam 1 … 6317h = cam 8).

NOTE

- The lower switching point can only be configured, i.e. its value changed, if the upper switching point for the same CAM has already been set (see Table 89 on page 68).
- The value for the lower switching point must be lower than the value for the upper switching point.

Object **Subindex**	Access	Data type	Designation Description	Data values [default value]
6310h ... 6317h	R/W	Array UINT-32	CAM-1 ... 8, Lower Limit	–
.0	R	UINT-32	Number of entries	2
.1	R/W	UINT-32	Channel 1	0 ... PMR[3] – 1 [0]
.2	R/W	UINT-32	Channel 2	0 ... PMR[3] – 1 [0]

Table 88: Object 6310h ... 6317h

Objects 6320h ... 6327h – CAM-1 ... 8, Upper Limit setting

The upper switching point for a cam switching position is defined using the Upper Limit. Each individual cam switching position (CAM 1 to CAM 8) has its own Upper Limit object (6320h = cam 1 ... 6327h = cam 8).

Object **Subindex**	Access	Data type	Designation Description	Data values [default value]
6320h ... 6327h	R/W	Array UINT-32	CAM-1 ... 8, Upper Limit	–
.0	R	UINT-32	Number of entries	2
.1	R/W	UINT-32	Channel 1	0 ... PMR[3] – 1 [PMR – 1]
.2	R/W	UINT-32	Channel 2	0 ... PMR[3] – 1 [PMR – 1]

Table 89: Object 6320h ... 6327h

Objects 6330h ... 6337h – CAM-1 ... 8, Hysteresis setting

The width of the hysteresis of the switching points can be defined using the CAM hysteresis. For each individual cam switching position (CAM 1 to CAM 8) a dedicated CAM hysteresis can be set (6330h = cam 1 ... 6337h = cam 8).

Object **Subindex**	Access	Data type	Designation Description	Data values
6330h ... 6337h	R/W	Array UINT-16	CAM-1 ... 8, Hysteresis	–
.0	R	UINT-16	Number of entries	2
.1	R/W	UINT-16	Channel 1	0000h ... FFFFh
.2	R/W	UINT-16	Channel 2	0000h ... FFFFh

Table 90: Object 6330h ... 6337h

[3] Physical measuring range, depending on the encoder type.

6.4.3 Objects for diagnostics

Object 6500h – Operating Status

Object	Access	Data type	Designation	Data values
6500h	R	UINT-16	Operating Status	See Table 92

Table 91: Object 6500h

Bit	Designation	Data values
15 … 13	Reserved	–
12	Support additional Error Code	**0** No **1** Yes
11 … 3	Reserved	–
2	Scaling	**0** Not active **1** Active
1	Commissioning diagnostic control	**0** Not active **1** Active
0	Code sequence (cw, ccw)	**0** cw **1** ccw

Table 92: Object 6500h – details

Object 6501h – Physical Resolution Span (PRS), Singleturn Resolution

Object	Access	Data type	Designation Description	Data values
6501h	R	UINT-32	PRS, Singleturn Resolution Physical singleturn resolution	AHx36 Basic = 00001000h AHx36 Advanced / Inox = 00004000h

Table 93: Object 6501h

Object 6502h – Number of Revolutions

Object	Access	Data type	Designation Description	Data values
6502h	R	UINT-16	Number of Revolutions Physical multiturn resolution	AHS36 Basic/Advanced / Inox = 0001h AHM36 Basic/Advanced / Inox = 1000h

Table 94: Object 6502h

Object 6503h – Alarm Status

Object	Access	Data type	Designation Description	Data values
6503h	R	UINT-16	Alarm Status	See Table 96

Table 95: Object 6503h

Bit	Designation	Data values
15 … 13	Reserved	–
12	EEPROM error Dependent of Bit 15 and 7 of object 2010.01h (see Table 124 on page 83)	**0** Not active **1** Active
11 … 1	Reserved	–
0	Position error Dependent of Bit 14, 12 … 6 and 4 of object 2010.01h (see Table 124 on page 83)	**0** Not active **1** Active

Table 96: Object 6503h – details

NOTE

The related bit remains active until the alarm is reset by the encoder and the encoder can again determine a correct position. The bit then changes to inactive again.

Object 6504h – Supported Alarms

Object	Access	Data type	Designation Description	Data values
6504h	R	UINT-16	Supported Alarms Alarms implemented in the encoder	1001h

Table 97: Object 6504h

Bit	Designation	Data values
15 … 13	Manufacturer-specific	**0** Not supported
12	EEPROM error	**1** Supported
11 … 2	Reserved	–
1	Commissioning diagnostics	**0** Not supported
0	Position error	**1** Supported

Table 98: Object 6504h – details

Object 6505h – Warning Status

Object	Access	Data type	Designation Description	Data values
6505h	R	UINT-16	Warning Status	0000h ... FFFFh

Table 99: Object 6505h

NOTE

Unlike alarms, the encoder can still form a correct position value if warnings have occurred.

Bit	Description	Data values
15	Supply voltage outside the permissible range	**0** Not active **1** Active
14	Reserved	–
13	Operating temperature outside the permissible range	**0** Not active **1** Active
12	Frequency/rotational speed outside the range allowed	**0** Not active **1** Active
11 ... 1	Reserved	–
0	Maximum frequency/rotational speed outside the range allowed	**0** Not active **1** Active

Table 100: Object 6505h – details

NOTE

The related bit remains active until the warning is reset by the encoder. It then changes to inactive again.

Object 6506h – Supported Warnings

Object	Access	Data type	Designation Description	Data values
6506h	R	UINT-16	Supported Warnings Warnings implemented in the encoder	B003h

Table 101: Object 6506h

Bit	Description	Data values
15	Supply voltage outside the permissible range	**1** Supported
14	Reserved	–
13	Operating temperature outside the permissible range	**1** Supported
12	Frequency outside the permissible range	**1** Supported
11 … 6	Reserved	–
5	Reference point not reached	**0** Not supported
4	Battery voltage too low	**0** Not supported
3	Max. operating time exceeded	**0** Not supported
2	CPU watchdog status	**0** Not supported
1	Minimum internal LED current in the sensors reached	**0** Not supported
0	Maximum frequency exceeded	**1** Supported

Table 102: Object 6506h – details

Object 6507h – Version Of Profile & Software

Object	Access	Data type	Designation Description	Data values
6507h	R	UINT-32	Version Of Profile & Software The first two bytes contain the software version, the next two the profile version.[4)]	00000000h … FFFFFFFFh

Table 103: Object 6507h

Bit	Description	Example values	
31 … 24	First part of the software version	03h	3.1
23 … 16	Last part of the software version	01h	
15 … 8	First part of the profile version	01h	1.40
7 … 0	Last part of the profile version	40h	

Table 104: Object 6507h – details

4) Internal manufacturer software version, can vary from the objects 100Ah and 1018h.

Object 6508h – Operating Time

Object	Access	Data type	Designation Description	Data values
6508h	R	UINT-32	Operating Time Operating time in units of 0.1 h	00000000h … FFFFFFFFh

Table 105: Object 6508h

Object 6509h – Internal Offset Value

Object	Access	Data type	Designation Description	Data values
6509h	R	UINT-32	Internal Offset Value Offset value, calculated from the Preset function 6003h or 2000h and 2005h (see section 4.2.2 on page 17)	00000000h … FFFFFFFFh

Table 106: Object 6509h

Object 650Ah – Module Identification

Object **Subindex**	Access	Data type	Designation Description	Data values [default value]
650Ah	R	Array UINT-32	Module Identification	–
.0	R	UINT-32	Number of entries	3
.1	R	UINT-32	Manufacturer Offset Value Manufacturer-specific offset	[0]
.2	R	UINT-32	Position Value Minimum Lowest position value	[0]
.3	R	UINT-32	Position Value Maximum Highest position value	PMR[5] – 1

Table 107: Object 650Ah

Object 650Bh – Serial Number

Object	Access	Data type	Designation Description	Data values
650Bh	R	UINT-32	Serial Number YYWWxxxx (year/week/sequential number)	Serial number

Table 108: Object 650Bh

[5] Physical measuring range, depending on the encoder type.

6.5 Manufacturer-specific objects

In the manufacturer-specific objects a differentiation is made between the following object types:

- objects for the encoder configuration
- objects that provide status information

Object **Subindex**	Access	Data type	Designation
2000h	R/W	UINT-16	Control Word 1
2001h .0 … .3	R/W	Array UINT-32	Endless-Shaft Configuration
2002h .0 … .6	R/W	Array UINT-16	Speed Calculation Configuration
2004h	R/W	UINT-32	Configuration Install Service
2005h	R/W	UINT-32	Configuration Preset Value
2006h .0 … .4	R/W	Record	Physical Measuring Range Limits
2007h .0 … .8	R/W	Record	CoS-Event Handling Configuration
2008h	R/W	Record	Diagnosis Service-A Configuration
2009h .0 … .3	R/W	Record	Network Configuration

Table 109: Implemented manufacturer-specific objects for the encoder configuration

Object **Subindex**	Access	Data type	Designation
2010h .0 … .3	R	Array UINT-16	Device Status Word (STW-1)
2011h .0 … .8	R	Array UINT-32	Real Scaling Parameter Settings
2012h .0 … .15	R	Record	Diagnosis Service Parameter
2013h .0 … .16	R	Record	Diagnosis Error Logging Parameter
2014h	R	UINT-32	Time Counter
2015h	R	UINT-16	Temperature Value
2016h	R	UINT-32	Position Value, Raw
2017h	R	INT-32	Speed Value 32-Bit
2018h .0 … .2	R	Array UINT-16	Time Counter Signals
2019h	R	UINT-32	Internal Process Cycle Time

Table 110: Implemented manufacturer-specific objects that provide status information

6.5.1 Objects for the encoder configuration

Object 2000h – Control Word 1

This object sets the encoder to a preset value.

Object	Access	Data type	Designation	Data values
2000h	R/W	UINT-16	Control Word 1	See Table 112

Table 111: Object 2000h

Bit	Designation Description	Data values
15 ... 13	Reserved	–
12	Preset Function Request (PreReq) Sets the preset value that is passed with the object 2005h (see Table 117 on page 78).	**0** Inactive **1** Active
11	Preset Mode = Shift Positive The preset value is added to the current position value.	**0** Inactive **1** Active
10	Preset Mode = Shift Negative The preset value is subtracted from the current position value.	**0** Inactive **1** Active
9 ... 1	Reserved	–
0	Preset Mode = Preset Zero Sets the position value to 0.	**0** Inactive **1** Active

Table 112: Object 2000h – details

NOTE

- If no preset mode with bit 11, 10 or 0 is specified, then the preset value from object 2005h is applied as the position value.
- Bits 11, 10 and 0 must be used exclusively. If several of these three bits have the value 1, then the preset function is not executed.
- The preset function is triggered with the rising edge (transition of bit 12 from 0 to 1). To set a preset value again, the bit must therefore be reset to 0.

Object 2001h – Endless-Shaft Configuration

Object **Subindex**	Access	Data type	Designation Description	Data values [default value]
2001h	R/W	Array UINT-16	Endless-Shaft configuration	–
.0	R/W	UINT-16	Number of entries	3
.1	R/W	UINT-16	Control of Endless-Shaft Mode Activates the round axis functionality	**2** Active **1** Not active
.2	R/W	UINT-16	Number of Revolutions, Nominator Nominator for the number of revolutions (CNR_N)	1 ... 2,048 [2,048]
.3	R/W	UINT-16	Number of Revolutions, Divisor Divisor for the number of revolutions (CNR_D)	1 ... 2,048 [1]

Table 113: Object 2001h

NOTE

The Round axis functionality can only be used with the multiturn encoder. It is only executed if scaling has been enabled using object 6000h.

Object 2002h – Speed Calculation Configuration

Object **Subindex**	Access	Data type	Designation Description	Data values [default value]
2002h	R/W	Array UINT-16	Speed Calculation Configuration	–
.0	R/W	UINT-16	Number of entries	6
.1	R/W	UINT-16	Operation Control Controls the mode for the speed calculation	**0** Not active **1** Active
.2	R/W	UINT-16	Format: measuring units Speed measuring unit	**0** cps **1** cp100ms **2** cp10ms **3** rpm **4** rps
.3	R/W	UINT-16	T1 Update Time in MS Refresh time in ms	AHS36 = 2 AHM36 = 1 ... 50 [2]
.4	R/W	UINT-16	T2 Integration Time Integration cycle dependent on T1	1 ... 200 [200]
.5	R/W	UINT-16	Upper Limit Warning in rpm Maximum speed, a warning is output if the speed exceeds this value.	AHS36B: [9,000] AHM36B: [6,000] AHS36A: 0 ... 6,100 AHM36A: 0 ... 6,100
.6	R/W	UINT-16	Lower Limit Warning in rpm Minimum speed, a warning is output if the speed drops below this value.	[0]

Table 114: Object 2002h

The speed is calculated from the average of several measurements. The integration cycle T2 defines the number of values from which the average is calculated. The refresh time T1 defines the time between the individual measurements.

Example:

If T1 = 2 ms and T2 = 200, then the speed is calculated from the last 0.4 s.

Object 2004h – Configuration Install Service

Object	Access	Data type	Designation	Data values
2004h	R/W	UINT-32	Configuration Install Service	See Table 116

Table 115: Object 2004h

Service Codes	Description
44656632h	Loads the factory parameters for the communication (PDO mapping).
44656633h	Loads the factory manufacturer-specific parameters and the factory parameters for the encoder profile.
70100100h	Reset-0, simulates switching on/off the encoder (power-on). Parameters will not be saved.
70100101h	Reset-1, simulates switching on/off the encoder (power-on). Parameters (Offset, Preset value and Offset for round axis) will be saved.

Table 116: Object 2004h – Service Codes

Object 2005h – Configuration Preset Value

A preset value is transferred to the encoder using this parameter. This preset value must be set using the object 2000h (see Table 111 on page 75).

Object	Access	Data type	Designation	Data values
2005h	R/W	UINT-32	Configuration Preset Value	0 ... CMR-1

Table 117: Object 2005h

NOTE

The preset value must lie within the measuring range configured.

Object 2006h – Physical Measuring Range Limits

Object **Subindex**	Access	Data type	Designation Description	Data values [default value]
2006h	R/W	Record	Physical Measuring Range Limits	–
.0	R	UINT-8	Number of entries	4
.1	R/W	INT-16	Temperature Lower Limit Defines the lower limit for the internal operating temperature[6] in °C.	AHx36 Basic = –20 ... +70 [–20] AHx36 Advanced / Inox = –40 ... +100 [–40]
.2	R/W	INT-16	Temperature Upper Limit Defines the upper limit for the internal operating temperature[6] allowed in °C.	AHx36 Basic = –20 ... +85 [+85] AHx36 Advanced / Inox = –40 ... +120 [+120]
.3	R/W	UINT-16	Supply voltage Lower Limit Defines the lower limit for the supply voltage allowed in mV.	9000 ... 30,000 [10,000]
.4	R/W	UINT-16	Supply voltage Upper Limit Defines the upper limit for the supply voltage allowed in mV.	10,000 ... 30,000 [30,000]

Table 118: Object 2006h

[6] The internal operating temperature of the encoder can be higher than the ambient temperature due to self-heating. It is affected, among other issues, by the rotational speed and the heat dissipation in the installation situation.

Object 2007h – CoS-Event Handling Configuration

This object is used to output a Change of State message. The parameters define the trigger value for the CoS message.

NOTE

- The value 0 signifies that the parameter is inactive, that is no CoS message is triggered.
- All CoS events are linked with an OR operator. I.e. if several CoS events are defined, the corresponding PDO is transmitted on the change of any individual event.

Object **Subindex**	Access	Data type	Designation Description	Data values [default value]
2007h	R/W	Record	CoS-Event Handling Configuration	–
.0	R	UINT-8	Number of entries	8
.1	R/W	UINT-32	CoS_PosVal_Scal CoS triggering by the scaled position value (Object 6004h)	0 … ½ CMR [0]
.2	R/W	UINT-32	CoS_PosVal_RAW CoS triggering by the unscaled position value (Object 2016h)	0 … ½ PMR – 1 [0]
.3	R/W	UINT-32	CoS_SpeedVal_RAW CoS triggering by the speed value (Object 6030.01h)	0 … ½ $Speed_{max}$ – 1 [0]
.4	R/W	UINT-16	CoS_TempVal CoS triggering by the temperature value (Object 2017h)	0 … 100 [0]
.5	R/W	UINT-16	CoS_FLAG-xx Status CoS triggering by various objects (see Table 120)	0 … FFFF [0]
.6 … .8	–	–	Reserved	–

Table 119: Object 2007h

Bit 15 … 12	Bit 11 … 8	Bit 7 … 4	Bit 3 … 0	CoS trigger criterion
–	–	–	0001	CAM State Register, Channel 1 (Object 6300.01h)
–	–	–	0010	CAM State Register, Channel 2 (Object 6300.02h)
–	–	0001	–	Alarm Status (Object 6503h)
–	–	0010	–	Warning Status (Object 6505h)
–	0001	–	–	State Flag 1, S_STAT-A (Object 2010.01h)
–	0010	–	–	State Flag 2, S_STAT-B (Object 2010.02h)
–	0100	–	–	State Flag 3, S_STAT-C (Object 2010.03h)

Table 120: Object 2007h – CoS_FLAG-xx Status

Object 2008h – Diagnosis Service-A Configuration

Using the object it can be defined how the entries in the object 2012h are handled (see Table 128 on page 85).

Object **Subindex**	Access	Data type	Designation Description	Data values
2008h	R/W	Record	Diagnosis Service-A Configuration	–
.0	R	UINT-8	Number of entries	2
.1	R/W	UINT-16	Defines how the entries in the diagnostics table are handled. 1 = Relative (Entries can be deleted.) 9 = Absolute	1, 9 [1]
.2	R/W	UINT-16	Deletes the entries in the diagnostics table.	35

Table 121: Object 2008h

Object 2009h – Network Configuration

Object **Subindex**	Access	Data type	Designation Description	Data values [default value]
2009h	R/W	Record	Network Configuration	–
.0	R	UINT-8	Number of entries	3
.1	R/W	UINT-32	Access code Write protection for the following parameters	98127634h
.2	R/W	UINT-8	Node ID Node address of the encoder in CANopen	1 ... 127 [5]
.3	R/W	UINT-8	Baud rate index (see Table 11 on page 26)	0 ... 8 [4]

Table 122: Object 2009h

6.5.2 Objects that provide status information

Object 2010h – STW-1 – Device Status Word

Object **Subindex**	Access	Data type	Designation Description	Data values
2010h	R	Array UINT-16	STW-1 – Device Status Word	–
.0	R	UINT-16	Number of entries	3
.1	R	UINT-16	State Flag 1, S_STAT-A	0000h ... FFFFh
.2	R	UINT-16	State Flag 2, S_STAT-B	0000h ... FFFFh
.3	R	UINT-16	State Flag 3, S_STAT-C	0000h ... FFFFh

Table 123: Object 2010h

Bit	Description	Error code of the emergency message	Err_PosVal
15	Memory error: Invalid EEPROM checksum on initialization	5080h	–12
14	Reserved	–	–
13	Error of the Sync multi counter: • Speed exceeds the upper limit of 12,500 rpm Or • Number of current errors on the calculation of the singleturn position above the limit of 10 errors	1060h	–11
12	Reserved	–	–
11	Position error: Invalid or no synchronization from the singleturn counter to the multiturn counter	5051h	–8
10	Position error: Singleturn position incorrect	5050h	–7
9	Position error: Error on the calculation of the vector length $Sin^2 + Cos^2$ in the multiturn stage	5051h	–6
8	Position error: Error on the calculation of the vector length $Sin^2 + Cos^2$ in the singleturn stage	5050h	–5
7	Position and memory error: Invalid communication with the I^2C device in the main module	5070h	–4
6	Position error: Error on the calculation of the amplitude values Sin + Cos in the singleturn stage	5050h	–3
5	Warning in relation to the speed: Current measured value outside of the minimum or maximum limit	1050h	–
4	Position error: Error on the calculation of the amplitude values, Sin + Cos in the multiturn stage	5051h	–2
3	Warning in relation to the supply voltage: Current measured value outside of the minimum or maximum limit	3100h	–
2	Reserved	–	–
1	Warning in relation to the temperature: Current measured value outside of the minimum or maximum limit	4200h	–
0	Warning: General start-up error at power-on	–	–

Table 124: Object 2010h – State Flag 1 (S_STAT-A)

NOTE

- If several errors occur, the position value –16 is output.
- Instead of the position value, the Err_PosVal is output and makes it possible to identify an error based on the cyclic process data (see Table 79 on page 64). The output of the Err_PosVal must be configured using the object 6000h (see Table 74 on page 62).

Bit	Description
15	Memory error caused by invalid checksum on reading the EEPROM during encoder initialization: • In the area of the sensor configuration data
14	• In the area of the device configuration data
13	• In the area of the diagnostics of the basic process data
12	• In the area of the diagnostics of the service data
11	• In the area of the user configuration, communication mapping
10	Reserved
9	• In the area of the user configuration, parameters for the electronic cam mechanism (CAM)
8	• In the area of the user configuration, basic parameters
7 ... 6	Reserved
5	Warning, speed exceeds configured maximum value
4	Warning, triggered on executing the preset function. The preset value is outside the measuring range (CMR).
3	Warning, occurred on changing or writing parameter values: • In the area of the manufacturer-specific objects
2	Reserved
1	• In the area of the encoder profile specific objects
0	• In the area of the PDO configuration

Table 125: Object 2010h – State Flag 2 (S_STAT-B)

Bit	Description
15 ... 13	Reserved
12	Preset function has been triggered and confirmed by object 2000h (see Table 111 on page 75).
11 ... 4	Reserved
3 2	Status information on saving internal diagnostic data: Bit 3 = 1 and Bit 2 = 0: Save operation complete Bit 3 = 0 and Bit 2 = 1: Save operation requested and operation in progress
1 0	Saving the configuration data using the Save command (object 1010h, see Table 50 page 51): Bit 1 = 1 and Bit 0 = 0: Save operation complete Bit 1 = 0 and Bit 0 = 1: Save operation requested and operation in progress

Table 126: Object 2010h – State Flag 3 (S_STAT-C)

Object 2011h – Real Scaling Parameter Settings

Object **Subindex**	Access	Data type	Designation Description	Data values
2011h	R	Array UINT-32	Real Scaling Parameter Settings	–
.0	R	UINT-32	Number of entries	8
.1	R	UINT-32	Endless-Shaft Operation Mode	**1** Not active **2** Active
.2	R	UINT-32	Endless-Shaft Offset Offset of the endless shaft function	00000000h … 40000000h
.3	R	UINT-32	Internal PMR Shift Value Internal PMR shift value	–
.4	R	UINT-32	CNR_N, Number of Revolutions, Nominator Nominator for the number of revolutions	1 … 2,048
.5	R	UINT-32	CNR_D, Number of Revolutions, Divisor Divisor for the number of revolutions	1 … 2,048
.6	R	UINT-32	CMR, Counts per Measuring Range Total resolution	1 … 40000000h
.7	R	UINT-32	CPR, Counts Per Revolution (Integer) Steps per revolution, digits before the decimal separator	Ex.: at 1.555 = 1
.8	R	UINT-32	CPR, Counts Per Revolution (Fract) Steps per revolution, digits after the decimal separator	Ex.: at 1.555 = 555

Table 127: Object 2011h

Object 2012h – Diagnosis Service Parameter

NOTE

The object 2008h defines how the entries in the diagnostic table are handled (see Table 121 on page 81).

Object **Subindex**	Access	Data type	Designation Description	Data values
2012h	R	Record	Diagnosis Service Parameter	–
.0	R	UINT-8	Number of entries	15
.1	R	UINT-32	Number of Switch-On Power-up counter	–
.2	R	UINT-32	Operating Time Moving Operating time in s, the time during which the encoder has moved is output[7].	–
.3	R	UINT-16	Max. Operating Speed Maximum speed in rpm since the encoder has been in operation.	–
.4	R	UINT-32	Starts with Direction Forward Counter for start of the encoder in forward direction[7]	–
.5	R	UINT-32	Starts with Direction Backward Counter for start of the encoder in backward direction[7]	–
.6	R	UINT-32	Starts with Alternating Directions Counter for the number of direction changes[7]	–
.7	R	UINT-32	Operating Hours counter Operating hours counter (× 0.1 h)	–
.8	R	INT-16	Min. Operating Temperature Minimum operating temperature in °C	–
.9	R	INT-16	Max. Operating Temperature Maximum operating temperature in °C	–
.12	R	INT-16	Min. Supply voltage Minimum supply voltage in mV	–
.13	R	INT-16	Max. supply voltage Maximum supply voltage in mV	–
.14	R	UINT-32	Reserved	–
.15	R	UINT-32	Counter of Diagnosis Storage Counter for the save processes in the EEPROM	–

Table 128: Object 2012h

[7] From movements with a speed >12 rpm.

Object 2013h – Diagnosis Error Logging Parameter

Object **Subindex**	Access	Data type	Designation Description	Data values
2013h	R	Record	Diagnosis Error Logging Parameter	–
.0	R	UINT-8	Number of entries	16
.1	R	UINT-32	Warning: General start-up error at power-on	–
.2	R	UINT-32	Warning in relation to the temperature: Current measured value outside of the minimum or maximum limit	–
.3	R	UINT-32	Reserved	–
.4	R	UINT-32	Warning in relation to the supply voltage: Current measured value outside of the minimum or maximum limit	–
.5	R	UINT-32	Position error: Error on the calculation of the amplitude values, Sin + Cos in the multiturn stage	–
.6	R	UINT-32	Warning in relation to the speed: Current measured value outside of the minimum or maximum limit	–
.7	R	UINT-32	Position error: Error on the calculation of the amplitude values Sin + Cos in the singleturn stage	–
.8	R	INT-16	Position and memory error: Invalid communication with the I^2C device in the main module	–
.9	R	INT-16	Position error: Error on the calculation of the vector length $Sin^2 + Cos^2$ in the singleturn stage	–
.10	R	INT-16	Position error: Error on the calculation of the vector length $Sin^2 + Cos^2$ in the multiturn stage	–
.11	R	INT-16	Position error: Singleturn position incorrect	–
.12	R	INT-16	Position error: Invalid or no synchronization from the singleturn counter to the multiturn counter	–
.13	R	INT-16	Reserved	–
.14	R	UINT-32	Error of the Sync multi counter: • Speed exceeds the upper limit of 12,500 rpm Or • Number of current errors on the calculation of the singleturn position above the limit of 10 errors	–

Object **Subindex**	Access	Data type	Designation Description	Data values
.15	R	UINT-32	Reserved	–
.16	R	UINT-16	Memory error: Invalid EEPROM checksum on initialization	–

Table 129: Object 2013h

Object 2014h – Time Counter

Object	Access	Data type	Designation Description	Data values
2014h	R	UINT-32	Time Counter Operating hours counter in ms, starts at 0 after each power-up	00000000h ... FFFFFFFFh

Table 130: Object 2014h

Object 2015h – Temperature Value

Object	Access	Data type	Designation Description	Data values
2015h	R	UINT-16	Temperature Value Operating temperature in °C[8)]	–

Table 131: Object 2015h

Object 2016h – Position Value, Raw

Object	Access	Data type	Designation Description	Data values
2016h	R	UINT-32	Position Value, Raw Position value independent of any preset value and independent of the configured scaling	AHS36 Basic = 0 ... 00000FFFh AHS36 Advanced / Inox = 0 ... 00003FFFh AHM36 Basic = 0 ... 00FFFFFFh AHM36 Advanced / Inox = 0 ... 03FFFFFFh

Table 132: Object 2016h

Object 2017h – Speed Value 32-Bit

Object	Access	Data type	Designation Description	Data values
2017h	R	INT-32	Speed Value 32-Bit Speed value in 32 Bit	–

Table 133: Object 2017h

8) Depending on the mounting and the encoder rotational speed, can vary by up to 15 °C from the ambient temperature.

Object 2018h – Time Counter Signals

Object **Subindex**	Access	Data type	Designation Description	Data values
2018h	R	Array UINT-16	Time Counter Signals	–
.0	R	UINT-16	Number of entries	2
.1	R	UINT-16	Time Counter MSec Time counter in ms	0000h … FFFFh
.2	R	UINT-16	Time Counter Sec Time counter in s	0000h … FFFFh

Table 134: Object 2018h

Object 2019h – Process Cycle Time

Either the internal or the external cycle time is output via this object.

Object	Access	Data type	Designation Description	Data values
2019h	R	UINT-32	Process Cycle Time Cycle time in µs	125 … 100,000

Table 135: Object 2019h

7 Commissioning

This chapter provides information on the electrical installation, configuration and commissioning of the Absolute Encoder AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox.

- Please read this chapter before mounting, installing and commissioning the device.

7.1 Electrical installation

WARNING
Switch the voltage supply off!

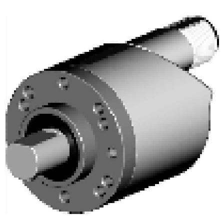
The machine/system could unintentionally start up while you are connecting the devices.

- Ensure that the entire machine/system is disconnected during the electrical installation.

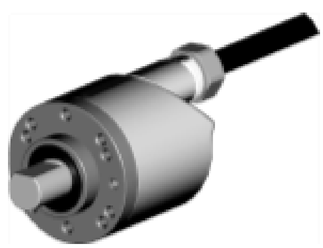
For the electrical installation you will need male and female connectors (see product information for the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox).

7.1.1 Connection of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox

The connection on the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox is on the rear. It is of rotating design. As a consequence it can be used angled either upward, to the left or to the right, or (as shown) axial to the rear.



With male connector



With cable outlet

Figure 29: Connection types

The connection on the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox is designed either as an M12×5 male connector or as a cable outlet with flying leads.

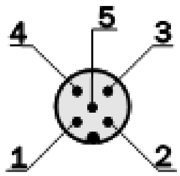


Figure 30: Male connector of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox

Pin	Wire color	Signal	Function
1	White	SHIELD	Shielding
2	Red	VDC	Supply voltage encoder 10 ... 30 VDC
3	Blue	GND/CAN GND	Encoder ground
4	Black	CAN high	CAN signal
5	Pink	CAN low	CAN signal
Housing		–	Shielding

Table 136: Pin assignment of the connection plug/core color on the connecting cable

NOTE

- Pay attention to the maximum lenghts of the stubs (see Table 137 on page 90).
- Mount all cables with strain relief.
- Use twisted pair cables.

Baud rate	Length of an individual stub	Total length of all stubs
1,000 kbit/s	< 1 m	< 5 m
500 kbit/s	< 5 m	< 25 m
250 kbit/s	< 10 m	< 50 m
125 kbit/s	< 20 m	< 100 m
50 kbit/s	< 50 m	< 250 m

Table 137: Maximum length of the stubs

NOTE

The baud rate of the encoder can be configured in the following manner:

- using object 2009h (see Table 122 on page 81)
- by accessing via Layer Setting Services (see section 5.4 on page 24)

7.2 Settings on the hardware

It is not possible to make any settings on the hardware. Baud rate and node ID are configured via the Layer Setting Services (see section 5.4 on page 24).

7.3 Configuration

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox can be integrated into a control system. For this purpose an ESI file is loaded into the system.

7.3.1 Default delivery status

The AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox is supplied with the following parameters:

- Code sequence = cw, clockwise
- Scaling = none
- Resolution per revolution AHx36 Basic = 4,096
- Resolution per revolution AHx36 Advanced / Inox = 16,384
- Total resolution AHS36 Basic = 4,096
- Total resolution AHM36 Basic = 16,777,216
- Total resolution AHS36 Advanced / Inox = 16,384
- Total resolution AHM36 Advanced / Inox = 67,108,864
- Preset value = 0
- Speed measuring unit = rpm
- Round axis functionality = not activated
- Nominator for the number of revolutions (Round axis functionality) = 2,048
- Divisor for the number of revolutions (Round axis functionality) = 1

7.3.2 System configuration

NOTE

All configuration information relates to Beckhoff controllers that are configured and diagnostics undertaken using the configuration tool TwinCAT®.

Baud rate and device ID are configured via the Layer Setting Services (see section 5.4 on page 24).

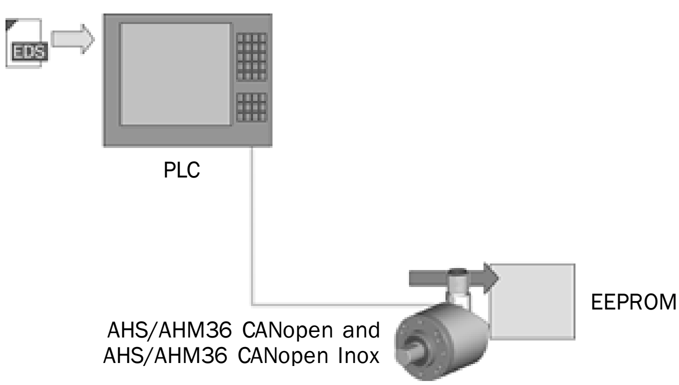


Figure 31: Integration in TwinCAT® with EDS file

- ▶ Start the TwinCAT® system manager.
- ▶ Choose on the context menu for the **CiA** node in the device tree the command **Scan boxes...**.

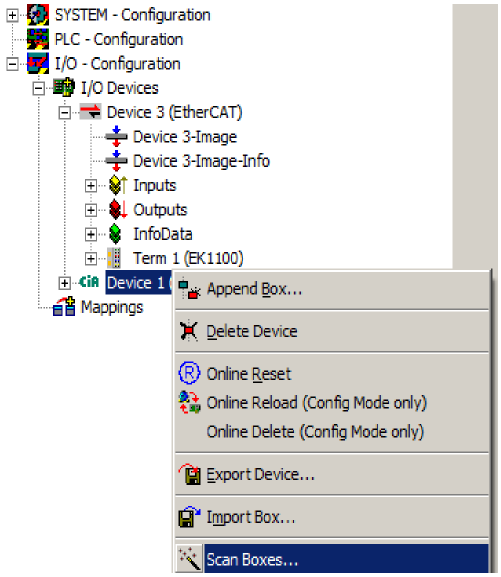


Figure 32: Context menu ***Scan boxes...***

The encoder is displayed in the device tree as **Box n** (in the example with factory-configured node ID 5).

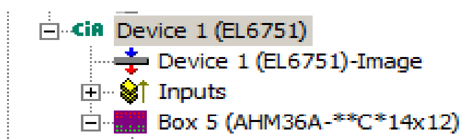


Figure 33: Encoder in the device tree

- On the **Online** tab, click **Advanced...**.
  The **Advanced settings** dialog box is opened.

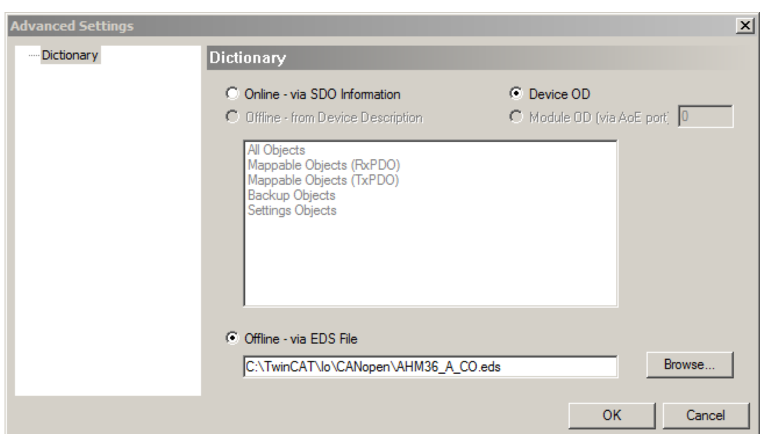


Figure 34: Advanced settings dialog box

- Choose **Offline - via EDS file** and the appropriate EDS file using the **Browse** button.

NOTE

A dedicated EDS file is available for each encoder type:

- Singleturn Encoder Basic = AHS36_B_CO.eds
- Multiturn Encoder Basic = AHM36_B_CO.eds
- Singleturn Encoder Advanced = AHS36_A_CO.eds
- Multiturn Encoder Advanced = AHM36_A_CO.eds
- Singleturn-Encoder Inox = AHS36_I_CO.eds
- Multiturn-Encoder Inox = AHM36_I_CO.eds

- Then change to the configuration mode of the TwinCAT® system manager.

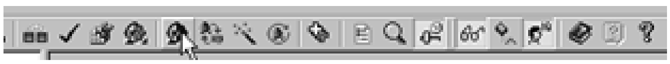


Figure 35: Configuration mode button

Prompts are displayed as to whether the TwinCAT® system manager is to change to the configuration mode, whether the data are to be loaded from the I/O device and whether the system is to be placed in the Free Run operating mode.

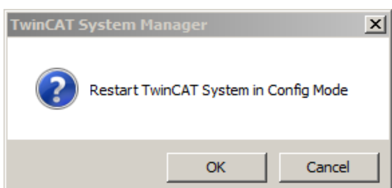


Figure 36: Configuration mode prompt

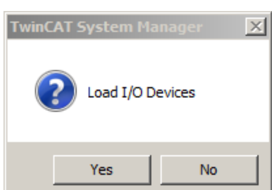


Figure 37: Load I/O Devices prompt

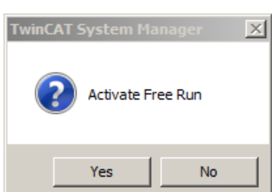


Figure 38: Free Run prompt

- Click **OK** or **Yes**.

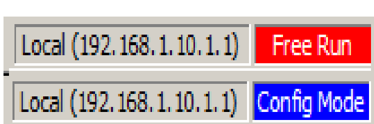
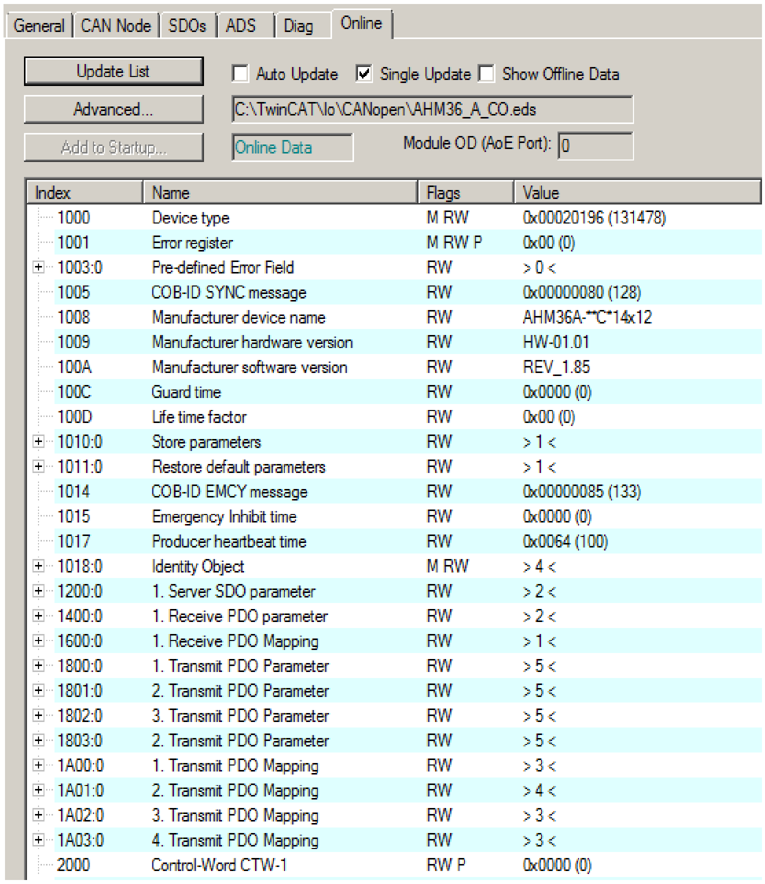


Figure 39: Status indication for the free run mode or configuration mode

The status indication at the bottom right changes between **Free Run** in red and **Config Mode** in blue.



Index	Name	Flags	Value
1000	Device type	M RW	0x00020196 (131478)
1001	Error register	M RW P	0x00 (0)
1003:0	Pre-defined Error Field	RW	> 0 <
1005	COB-ID SYNC message	RW	0x00000080 (128)
1008	Manufacturer device name	RW	AHM36A-**C*14x12
1009	Manufacturer hardware version	RW	HW-01.01
100A	Manufacturer software version	RW	REV_1.85
100C	Guard time	RW	0x0000 (0)
100D	Life time factor	RW	0x00 (0)
1010:0	Store parameters	RW	> 1 <
1011:0	Restore default parameters	RW	> 1 <
1014	COB-ID EMCY message	RW	0x00000085 (133)
1015	Emergency Inhibit time	RW	0x0000 (0)
1017	Producer heartbeat time	RW	0x0064 (100)
1018:0	Identity Object	M RW	> 4 <
1200:0	1. Server SDO parameter	RW	> 2 <
1400:0	1. Receive PDO parameter	RW	> 2 <
1600:0	1. Receive PDO Mapping	RW	> 1 <
1800:0	1. Transmit PDO Parameter	RW	> 5 <
1801:0	2. Transmit PDO Parameter	RW	> 5 <
1802:0	3. Transmit PDO Parameter	RW	> 5 <
1803:0	2. Transmit PDO Parameter	RW	> 5 <
1A00:0	1. Transmit PDO Mapping	RW	> 3 <
1A01:0	2. Transmit PDO Mapping	RW	> 4 <
1A02:0	3. Transmit PDO Mapping	RW	> 3 <
1A03:0	4. Transmit PDO Mapping	RW	> 3 <
2000	Control-Word CTW-1	RW P	0x0000 (0)

Figure 40: Online tab

All object parameters can now be read or configured on the **Online** tab.

NOTE

In the factory the encoder's Transmit PDOs are set to device-specific triggering. As a consequence the encoder outputs all Transmit PDOs once on start-up. However the event timer is at 0. For this reason the Transmit PDOs are initially only output once.

For the cyclic or acyclic output of the Transmit PDOs by the encoder, there are the following options:

- Change the event timer in the objects 1800h … 1803h (see Table 63 ff. from page 56).
- Configure a trigger event using the CoS event handling configuration (see Table 119 on page 80).
- Change the transmission type in the objects 1800h … 1803h (see Table 63 ff. from page 56).

7.4 Tests before the initial commissioning

WARNING
Commissioning requires a thorough check by authorized personnel!

Before you operate a system equipped with the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox for the first time, make sure that the system is first checked and released by authorized personnel. Please read the notes in chapter 2 “On safety” on page 9.

8 Fault diagnosis

This chapter describes how to identify and rectify errors and malfunctions of the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox Absolute Encoder.

8.1 In the event of faults or errors

WARNING
Cease operation if the cause of the malfunction has not been clearly identified!

Stop the machine if you cannot clearly identify or allocate the error and if you cannot safely rectify the malfunction.

8.2 SICK STEGMANN support

If you cannot remedy an error with the help of the information provided in this chapter, please contact your local SICK STEGMANN subsidiary.

8.3 Error and status indications on the LED

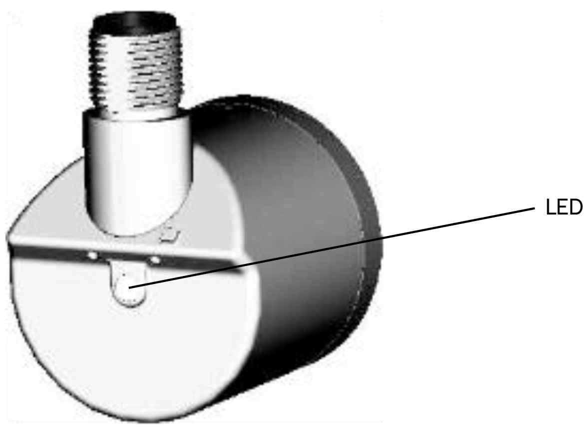


Figure 41: Position of the LED

8.3.1 Meaning of the LED displays

The LED indicates the CANopen status of the encoder and errors on the CANopen bus.

Display	Description
Status indications	
Green	Status of the CANopen state machine = Stopped
Green	Status of the CANopen state machine = Pre-operational
● Green	Status of the CANopen state machine = Operational
Error messages	
○ Off	No supply voltage
● Red	Busoff The CANopen master is disconnected from the bus.
Red	Invalid configuration
Red	Counter for the internal CAN controller has reached the warning level for "error frames".
Red	Error within the Node Guarding telegram or the Heartbeat telegram

Table 138: Meaning of the LED displays

8.4 Diagnostics via CANopen

8.4.1 Emergency Messages

If the encoder detects an internal error, then an emergency message is sent automatically by the AHS/AHM36 CANopen and AHS/AHM36 CANopen Inox.

For this purpose a message is formed from the error code in the object 1003h (see Table 41 on page 49), the error register in the object 1001h (see Table 39 on page 48) and the Device Status Word in the object 2010h (see Table 123 on page 81).

Byte 0	1	2	3	4	5	6	7
Object 1003h		Object 1001h	Object 2010.01h		Object 2010.02h		0
Error code		Error register	Error field				

Table 139: Emergency Message Format

The object 2010h – Device Status Word is manufacturer-specific. The contents of the subindices .1 and .2 are written to the emergency message.

Error code of the object 1003h	Error register of the object 1001h	Description
0000h	00h	No error or reset error
8000h	01h	Generic error
3000h	05h 0000.0101b	Generic voltage error
3100h	05h	Input voltage outside the operating range
4000h	09h 0000.1001b	Generic temperature error

Error code of the object 1003h	Error register of the object 1001h	Description
4200h	09h	Encoder temperature outside the operating range
8100h	11h 0001.0001b	Generic communication error
8110h	11h	CAN overrun (a telegram was lost)
8130h	11h	Life Guard Error
8200h	11h	Generic protocol error
8210	11h	PDO not executed due to an error in the telegram length
5000h	21h 0011.0001b	Generic error related to the device profile
5050h	21h	Encoder error in the singleturn area (from CANopen V4.3)
5051h	21h	Encoder error in the multiturn area (from CANopen V4.3)
5070h	81h	Position and memory error: Invalid communication with the I^2C device in the main module
5080h	81h	Memory error: Invalid EEPROM checksum on initialization
1050h	81h	Warning in relation to the speed: Current measured value outside of the minimum or maximum limit
1060h	81h	Error of the Sync multi counter: • Speed exceeds the upper limit of 12,500 rpm Or • Number of current errors on the calculation of the singleturn position above the limit of 10 errors.

Table 140: Error codes and error registers

If there is no longer an error present, the encoder transmits an emergency message with the error code 0000h and error register 0000h.

8.4.2 Alarms, warnings and status

Alarms, warnings and the encoder status can be read from the following objects:

- 6503h – Alarm Status (see Table 95 on page 70)
- 6505h – Warning Status (see Table 99 on page 71)
- 2010h – STW-1 – Device Status Word (see Table 123 on page 81)

8.4.3 Error during the SDO transfer

In the case of an error during the SDO transfer, a so-called Abort-SDO-Transfer-Request is transmitted with an error code. The following errors are possible:

Value	Description
05030000h	Toggle bit has not changed.
05040000h	SDO protocol time-out
05040001h	Client/server command invalid or unknown
05040005h	Memory too small
06010000h	Object access not supported
06010001h	Read access to an object that can only be written
06010002h	Write access to an object that can only be read
06020000h	Object does not exist in the object directory
06040041h	The object cannot be mapped in the PDO.
06040042h	The number and length of the mapped objects exceed the PDO length.
06040043h	General parameter incompatibility
06040047h	General incompatibility in the device
06060000h	Access error due to a hardware error
06070010h	Incorrect data type, length of the service parameters is incorrect
06070012h	Incorrect data type, length of the service parameters too long
06070013h	Incorrect data type, length of the service parameters too short
06090011h	Subindex does not exist.
06090030h	Parameter value range exceeded, only on write access
06090031h	Parameter value written too long
06090032h	Parameter value written too short
06090036h	Maximum value is smaller than minimum value
08000000h	Generic error
08000020h	Data can not be transmitted or saved in the application.
08000021h	Data can not be transmitted or saved in the application. Reason: local control system
08000022h	Data can not be transmitted or saved in the application. Reason: actual device status
08000023h	Dynamic object directory creation error or object directory does not exist

Table 141: Error during the SDO transfer

9 Annex

9.1 Conformity with EU directives

EU declaration of conformity (extract)

The undersigned, representing the following manufacturer herewith declares that the product is in conformity with the provisions of the following EU directive(s) (including all applicable amendments), and that the respective standards and/or technical specifications have been applied.

Complete EU declaration of conformity for download: www.sick.com

10 List of illustrations

11 List of tables

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