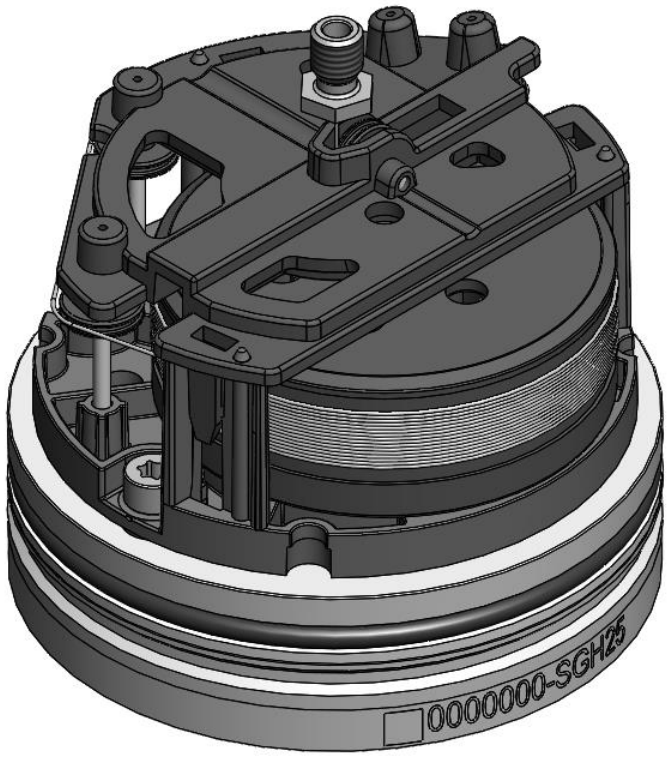
SGH25

(Redundant) Absolute Wire Encoder with CANopen Interface

User Manual



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1 General Information

1.1 Documentation

The following documents are available for this product:

- Data sheet; describes the technical data, the dimensions, the pin assignments, the accessories and the order code.
- Assembly Instructions; describes the mechanical and electrical assembly with all safety-relevant conditions and the associated technical specifications.
- User Manual; for commissioning and integrating the sensor in a field bus system.
- EDS file (electronic data sheet); with the help of this file, the integration and configuration in a CANopen network by means of commercial CANopen configurators is possible.

These documents are also available at **http://www.siko-global.com/p/sg61**

1.2 Definitions

Decimal values are specified as numbers without addition (e.g., 1234) unless they are specified in direct conjunction with binary or hexadecimal values. Then the extension d is used (e.g., 1234d). Binary values are used with b (e.g.,1011b) and hexadecimal values with h (e.g., 280H) following the digits.

2 Intended use

The SGH25 is available as a redundant version with two encoders and as a non-redundant version with one encoder. The SGH25 detects the stroke of a hydraulic cylinder as absolute travel information. The cable actuator can be parameterized and read via the CAN interface using the CANopen protocol.

The redundant version of the SGH25 is designed for redundant position and speed detection. The sensor can be used for applications up to Performance Level D (PLd) in the overall system. For this purpose, a higher-level, safe encoder evaluation device is required because the wire encoder with its internal sensor diagnosis is not able to initiate actions itself such as the initiation of a safe state. There are increased demands on the electrical and mechanical coupling of the wire encoder.

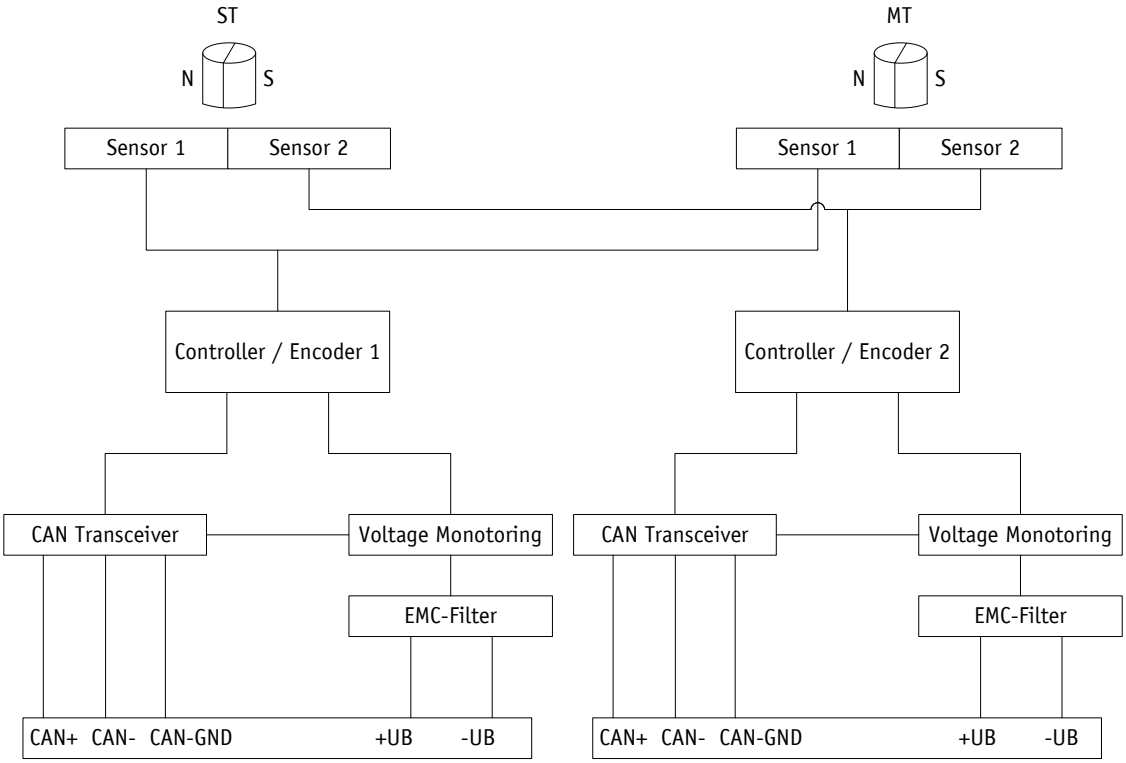

Fig. 1: Block diagram of redundant version

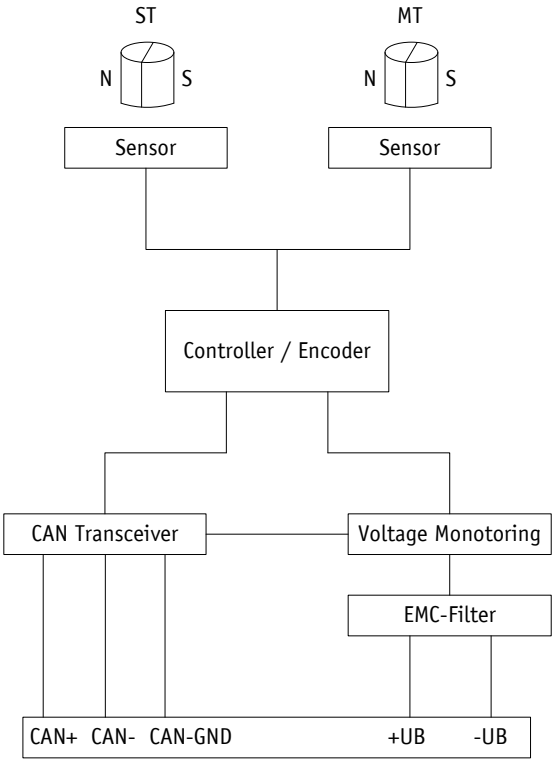

Fig. 2: Block diagram of non-redundant version

2.1 Switching on the supply voltage

The SGH25 initializes after it is switched on. The configuration parameters are loaded from the nonvolatile memory into the main memory of the controller.

As long as no changes have been made to the sensor, the sensor works with its default values. If parameters have been changed, the sensor works with the changed data. If these are also to be used after a power off/on, they must be stored.
Upon completion of the initialization procedure, each encoder sends a special NMT command, the boot-up message, to notify the system of its existence. The SGH25 is then in pre-operational mode. In this state, the encoder can be parameterized according to the requirements of the application via SDO commands. This concerns both the configuration parameters of the sensor system and the way in which it makes its position values available to the system (asynchronous or synchronous data transmission).

3 Operation description

3.1 Counting direction

The encoder supplies increasing position values. This property can be changed via the object 6000h: Operating Parameters.

3.2 Calibration

Due to the absolute measuring system, calibration is only required once during commissioning and can be performed at any point. As a result, the Gerber zero point can be adjusted with the mechanical zero point of the system. During calibration, the calibration value is used to calculate the position value. The resulting offset value is output in object 6509h: Offset value.
In the case of calibration, the following applies:

Position value = 0 + calibration value

3.3 Restore factory setting

To restore the delivery state of the device, the following option exists:

Access	Coding		The following are set to the factory setting
CANopen (cf. object 1011h: Restore Parameter)	1011h "load"	Subindex 1	All parameters
		Subindex 2	Only bus parameters
		Subindex 3	Only CiA 406 parameters
		Subindex 4	Only manufacturer-specific parameters

Table 1: Access factory settings

4 Communication via CAN bus (CANopen)

The basis for the SGH25 is the CANopen communication profile CiA 301 V4.2, the device profile for encoders CiA 406 V3.2 as well as the layer setting service (LSS) CiA 305 V3.0.0. The SGH25 supports device class C2. The details necessary for understanding operation are provided in this documentation. If you require more detailed information, we recommend the relevant specialist literature on CAN or CANopen.

4.1 Telegram structure

The data telegram of a CAN message consists of the following fields:

SOF	Identifier (COB ID)	Control field	Data field (a maximum of 8 bytes)	CRC	ACK/EOF

SOF:

(Start of Frame) Start bit of the telegram

Identifier (COB ID):

- All bus participants use the identifier to check whether the message is relevant to them.
- The identifier sets the priority of the message. The lower the value of the identifier, the higher the priority of the message. As a result, important messages are preferably transmitted via the bus.

The identifier field contains the identifier as well as bits for identifying the length of the identifier (11 or 29 bits). In addition, the identifier defines the device address, the channel selection and the data direction.

Consequently, the 11-bit identifier (COB identifier) is composed of a 4-bit function code and a 7-bit node number:

Bit no.	10	9	8	7	6	5	4	3	2	1	0
Type	Function code				Node number (Node ID)						
Assignment	x	x	x	x	0	0	x	x	x	x	X

The following function codes are defined in the "Pre-Defined Connection Set" (only those function codes that are used in this device are shown):

Object	Function code	Resulting COB ID	Object	Page
Network Management (NMT)	0000b	0	-	9
SYNC message	0001b	128d (80h)	1005h	30
Emergency message	0001b	128d (80h) + Node ID	1014h	36
TPD01	0011b	384d (180h) + Node ID	1800h	39
TPD02	0101b	640d (280h) + Node ID	1801h	40
SDO (tx)	1011b	1408d (580h) + Node ID	1200h	38
SDO (rx)	1100b	1536d (600h) + Node ID	1200h	38
Heartbeat message	1110b	1792d (700h) + Node ID	-	19
Node guard message	1110b	1792d (700h) + Node ID	-	19

Object	Function code	Resulting COB ID	Object	Page
LSS (tx)	-	2021d (7E4h)	-	20
LSS (rx)	-	2020d (7E5h)	-	20

Table 2: Overview of COB Identifiers

Changes to COB IDs are only possible in the PRE-OPERATIONAL NMT state. Via bit 31 = 1b, the COB ID must first be invalidated before it can be changed and reactivated.
An exception is the COB ID of the sync object. Bit 30 = 0b must be set there to change the COB ID. Since bit 30 cannot be set to 1b in the device, the COB ID could be changed at any time.

The node number (Node ID) (cf. Object 5F0Ah: Node ID and baud rate Bus CAN) is assigned once in each bus system from the master to the SGH25 during the configuration. The node numbers are in the range from 1 to 127. Node ID = 0 is reserved and may not be used.

The transfer of a newly set node number takes place only at a renewed initialization (cf. Chapter 4.2.1).

The SGH25 wire encoder is shipped from the factory in the non-redundant version with Node ID 1 (1h) and in the redundant version with Node ID 1 (1h) and 2 (2h).

Control field:

Contains bit-by-bit information about the number of user data and decides whether it is a data frame or remote transmission request (RTR) frame.

Data field:

Contains up to 8 bytes of user data. Depending on the channel selection, the user data has different meanings.

CRC:

Contains bits for error detection.

ACK/EOF:

The ACK/EOF field contains telegram confirmation bits as well as bits to identify the telegram end.

The exact description of the telegram can be found in the relevant CAN literature. In the following telegram descriptions, only the identifier (COB ID) and the data field are discussed for the sake of simplicity.

4.2 Node control

4.2.1 Network Management Services (NMT)

The master uses the NMT service to configure, manage and monitor network nodes. The device is always in one of the four communication states: "INITIALIZATION", "PRE-OPERATIONAL", "OPERATIONAL" or "STOPPED" (cf. Fig. 3)

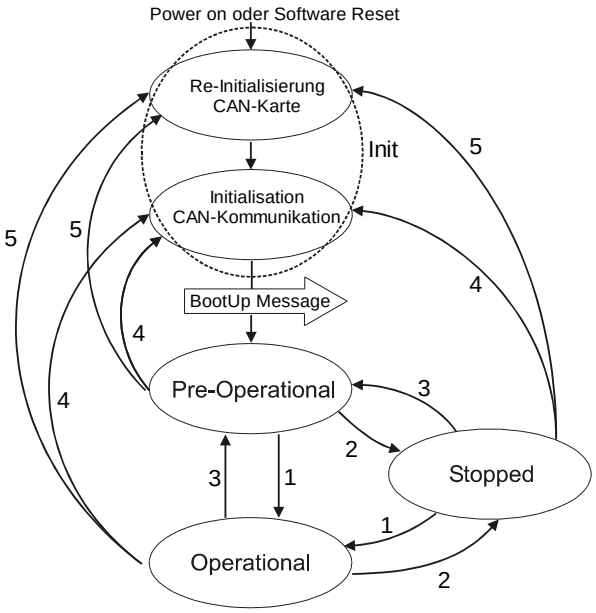

Fig. 3: NMT Status Diagram

4.2.1.1 NMT Communication States

NMT INITIALIZATION State

In this state, the device is not involved in what is happening on the bus. All hardware and software components are initialized. This state is reached after the device is switched on or after receiving the command code 81h ("Reset Node") of its own or the global address. After receiving the command code 82h ("Reset Communication"), the display is also in the initialization state. However, only the hardware and software are reinitialized that are related to the CAN communication. The device automatically signals the completion of the initialization with a boot-up message. As soon as the boot-up message has been sent successfully, the device is in the "PRE-OPERATIONAL" state.

NMT PRE-OPERATIONAL State

Parameterization data (SDO) can be exchanged in Pre-Operational mode. However, no process data (PDO) are transmitted.

NMT OPERATIONAL State

The exchange of process data is also released. COB ID and Transmit PDO Mapping parameters cannot be changed in this state.

NMT STOPPED State

With the exception of Heartbeat and Node Guarding, communication is stopped. Only NMT communication is possible.

4.2.1.2 Switching between the NMT communication states

To switch between the communication states, telegrams with the following structure are used:

State Change		Transition into Fig. 3	COB ID	Command	Node ID
From	To				
PRE-OPERATIONAL/STOPPED	OPERATIONAL	1d	0h	01h	x
OPERATIONAL/PRE-OPERATIONAL	STOPPED	2d	0h	02h	x
OPERATIONAL/STOPPED	PRE-OPERATIONAL	3d	0h	80h	x
OPERATIONAL/ PRE-OPERATIONAL/STOPPED	INITIALIZATION (Reset Node)	5d	0h	81h	x
OPERATIONAL/ PRE-OPERATIONAL/STOPPED	INITIALIZATION (Reset Communication)	4d	0h	82h	x

Table 3: Switching between communication states

If x = 0h is transmitted as Node ID, then the message is intended for all bus subscribers.

4.2.2 Boot-Up

The COB ID of the boot-up message consists of 700h and the Node ID. The NMT state "initialization" is output as data content.

COB ID	Byte 0
700h + Node-ID	00h

Table 4: Boot-up message

4.2.3 SYNC Object

CANopen makes it possible to interrogate inputs and set outputs simultaneously. A synchronization message serves for this (SYNC), which is a high priority CAN message. The identifier of the sync object can be set via the object 1005h (cf. 1005h: COB-ID SYNC Message).

4.3 Process Data Exchange

4.3.1 Transmission of Process Data Objects (PDO)

Process Data Objects (PDO) are used for a fast exchange of process data. A maximum of 8 bytes of user data can be transferred in a PDO. The SGH25 supports the transmit PDO services TPDO1 and TPDO2 according to CiA 301 and CiA 406.

4.3.1.1 Transmit PDO (from the SGH25 to the master)

A PDO transmission from the display to the bus master (TPDO) can be initiated by various events:

- Asynchronously controlled by internal device timer
- Synchronously in response to a SYNC message
- In response to an RTR message

TPDO1 and TPDO2 are formed from the position value and the speed value. The transmission behavior of TPDO1 is defined by the objects 1800h, 1A00h and 6200h and is assigned to asynchronous transmission. The TPDO2 is defined via the objects 1801h and 1A01h and serves for synchronous transmission. The assignment is set as a default and cannot be changed.

The messages are structured as follows:

COB ID	**User Data in Binary Code**					
	Byte 0 (LSB)	**Byte 1**	**Byte 2**	**Byte 3 MSB**	**Byte 4 (LSB)**	**Byte 5 MSB**
TPDO1 Configure Node ID	Position value				Speed value	
TPDO2 280h + Node ID						

Table 5: TPDO message

Asynchronous Data Transmission (TPDO1)

If a TPDO1 is to be sent cyclically, the cycle time in milliseconds must be entered in the object 1800h, subindex 05h. If the value 0 ms is written, TPDO1 is not sent. The function is switched off. The minimum value to be set is 1h (= 1 ms). Alternatively, the value can also be written in the internally linked object 6200h.

Synchronous data transmission (TPDO2)

Upon delivery, the device responds to each received SYNC message with the output of the TPDO2 message. In object 1801h, sub-index 02h, 1h is entered for synchronous transmission. If a value n is entered between 1d and 240d (= F0h), the device responds to every nth SYNC message.

RTR

Requests can be sent via RTR (cf. Chapter4.1 Control Field) to TPDO1 and TDPO2 .

4.4 Parameter Data Exchange

4.4.1 Transmission of Service Data Objects (SDO)

Service data objects are mainly used for device configuration via the object directory. SDOs are supported in the expedited request/response ("accelerated request and confirmation procedure") and in the normal request/response.

The identifier is set to 11 bits and cannot be changed.

Two different SDO services are available:

- SDO (rx) (Master → SGH25): 600h + Node ID
- SDO (tx) (SGH25 → Master): 580h + Node ID

These SDO identifiers cannot be changed!

4.4.1.1 Accelerated request and confirmation procedure

Except for the reading of the object 1008h: Manufacturer Device Name, all SDOs are exchanged between two parties in the "expedited request/response" procedure. The user data is already delivered with the initialization message.

These SDO messages have the following structure:

COB ID	User Data in Binary Code							
	Byte 0 read / write	Byte 1 LSB	Byte 2 MSB	Byte 3	Byte 4 LSB	Byte 5	Byte 6	Byte 7 MSB
SDO rx/tx + Node ID	Command byte	Index		Subindex	User data (parameters)			

Command byte, byte 0:

The command byte determines the type of access and the number of valid data bytes. For SGH25, the following command bytes are valid:

Command byte		Type	Function
Write Request	23h	SDO (rx), Initiate Download Request, expedited	Send parameter to slave (all 4 data bytes valid)
Write Request	2Bh	SDO (rx), Initiate Download Request, expedited	Send parameter to slave (2 bytes of 4 data bytes valid)
Write Request	2Fh	SDO (rx), Initiate Download Request, expedited	Send parameter to slave (1 byte of 4 data bytes valid)
Write Response	60h	SDO (tx), Initiate Download Response	Confirmation of data transfer to the master
Read Request	40h	SDO (rx), Initiate Upload Request	Request parameters of the slave
Read Response	43h	SDO (tx), Initiate Upload Response, expedited	Report parameters to Master (all 4 data bytes valid)

Command byte		Type	Function
Read Response	4Bh	SDO (tx), Initiate Upload Response, expedited	Report parameters to Master (2 bytes of 4 data bytes valid)
Read Response	4Fh	SDO (tx), Initiate Upload Response, expedited	Report parameters to Master (1 byte of 4 data bytes valid)
Error Response	80h	SDO (tx), Abort Domain Transfer	Slave reports error code to master

Table 6: Command encoding

Index, Bytes 1 and 2:

The index (object number) is entered in Intel data format in user data byte 2 (low byte) and user data byte 3 (high byte). The index of the object to be parameterized is entered there.

Subindex, Byte 3:

For objects that are executed as an array, the subindex indicates the number of the field.

User Data (Parameters), Bytes 4-7:

In the user data, the value of the parameter is entered in left-aligned Intel representation. Byte 4 = Low-Byte ... Byte 7 = High-Byte

4.4.1.2 Normal Request and Confirmation Procedure

If more than 4 bytes of service data have to be transmitted, the data is exchanged between two participants using the “normal request/response procedure”. This procedure is also initiated by an initialization message, and the actual user data are then transmitted in the following segment messages.

With the SGH25, this is only the case when the object 1008h: Manufacturer Device Name is read.

The initialization message has the following structure:

COB ID	User data in binary code							
	Byte 0 read / write	Byte 1 LSB	Byte 2 MSB	Byte 3	Byte 4 LSB	Byte 5	Byte 6	Byte 7 MSB
SDO rx/tx + Node ID	Command byte	Index		Subindex	User data (number of user data)			

The segment message has the following structure:

COB ID	User data in binary code							
	Byte 0 read / write	Byte 1 LSB	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7 MSB
SDO rx/tx + Node ID	Command byte	User data						

Initialization and segment message: Command Byte, Byte 0:

The command byte determines the type of access and the number of valid data bytes. The following command bytes are valid for the encoder:

Command Byte		Type	Function
Read Request	40h	SDO (rx), Normal Initiate Upload Request	Request parameter from slave (number of bytes to be transmitted)
Read Request	60h	SDO (rx), Normal Segment Upload Request	Request parameters from slave (user data)
Read Response	41h	SDO (tx), Normal Initiate Upload Response	Report parameter to master (number of bytes to be transferred)
Read Response	03h	SDO (tx), Normal Segment Upload Response	Report parameters to Master (user data)
Error Response	80h	SDO (tx), Abort Domain Transfer	Slave reports error code to master

Table 7: Command encoding

Initialization Message: Index, Bytes 1 and 2:

The index (object number) is entered in Intel data format in user data byte 2 (low byte) and user data byte 3 (high byte). The index of the object to be parameterized is entered there.

Initialization message: Subindex, Byte 3:

For objects that are executed as an array, the subindex indicates the number of the field.

Initialization message: User Data (Parameters), Bytes 4-7:

In the service data area, the value of the parameter is entered in left-aligned Intel representation. Byte 4 = Low-Byte ... Byte 7 = High-Byte

Segment message: User data (parameters), bytes 1-7:

In the user data area, the value of the parameter is entered in left-aligned Intel representation. Byte 1 = Low-Byte ... Byte 7 = High-Byte

4.4.1.3 Error response in SDO exchange

If the access is invalid, an error message (abort) is returned to the master.
The error codes are described in the CANopen profile (CiA 301) or in the encoder profile (CiA 406). The following table shows the error codes used:

Error Code	Description
05030000h	Toggle bit in normal transfer of request/response unequal.
06010000h	Incorrect access to an object.
06010001h	Read access to write-only.
06010002h	Write access to read-only.

Error Code	Description
06020000h	Object does not exist in the object dictionary.
06090011h	Subindex does not exist.
06090030h	Value range of the selected parameter incorrect.
08000020h	Parameters cannot be transferred or saved to the application.
08000022h	Parameters cannot be transferred or saved to the application due to the current state of the device.
08000024h	No data available

Table 8: Error codes

4.4.1.4 SDO Examples

Example of Reading SDO Parameters with Accelerated Request and Confirmation Procedure:

From the slave with device address 1h, the calibration value stored in object 6010h subindex 01h of the object directory is to be read.

Calculation of the identifier: 600h + Node ID = 600h +1h = 601h

Command 40h
Index: 6010h
Subindex: 01h
The current value is 510d = 01FEh

Request from master to slave with Node ID 1h:

COB ID	User Data							
	Command	Index L	Index H	Subindex	Data 0	Data 1	Data 2	Data 3
601h	40h	10h	60h	01h	x	x	x	x

Slaves response to the request:

Calculation of the identifier: 580h + Node ID = 581h

COB ID	User Data							
	Command	Index LB	Index HB	Subindex	Data 0	Data 1	Data 2	Data 3
581h	43h (4 bytes valid)	10h	60h	01h	FEh	01h	00h	00h

Example of Writing SDO Parameters with Accelerated Request and Confirmation Procedure:

In the slave with device address 1h, the calibration value, which is stored with 2 bytes in object 6200h of the object directory, is to be changed.

Calculation of the identifier: 600h + Node ID = 600h + 1h = 601h

Command: 2 bytes are to be written: 2Bh
Index: 6200h

Subindex: 00h
The new value should be 4500d = 1194h

Write a value from the master to the slave with Node ID 1h:

COB ID	User Data							
	Command	Index L	Index H	Subindex	Data 0	Data 1	Data 2	Data 3
601h	2Bh (2 bytes valid)	00h	62h	00h	94h	11h	00h	00h

Response of the slave to the command:

Calculation of the identifier: 580h + Node ID = 580h + 1h = 581h

COB ID	User Data							
	Command	Index L	Index H	Subindex	Data 0	Data 1	Data 2	Data 3
581h	60h	00h	62h	00h	00h	00h	00h	00h

Example of Reading SDO Parameters with Normal Request and Confirmation Procedure:

From SGH25 with device address 1h, the manufacturer device name stored in object 1008h of the object directory is to be read.

Calculation of the identifier: 600h + Node ID = 600h +1h = 601h

Command 40h

Index: 1008h

Subindex 00h

First request (initialization) from master to slave with Node ID 1h:

COB ID	User Data							
	Command	Index L	Index H	Subindex	Data 0	Data 1	Data 2	Data 3
601h	40h	08h	10h	00h	x	x	x	x

Slaves response to the request:

Calculation of the identifier: 580h + Node ID = 581h

COB ID	User Data							
	Command	Index LB	Index HB	Subindex	Data 0	Data 1	Data 2	Data 3
581h	41h	08h	10h	00h	05h	00h	00h	00h

Expected number of user data bytes: 5

Second request from master to slave with Node ID 1h:

COB ID	User Data							
	Command	Index L	Index H	Subindex	Data 0	Data 1	Data 2	Data 3
601h	60h	08h	10h	00h	x	x	x	x

Slaves response to the request:

COB ID	User Data							
	Command	Data 0	Data 1	Data 2	Data 3	Data 4	Data 5	Data 6
581h	03h	53h ("S")	47h ("G")	48h ("H")	32 h ("2")	35h ("5")	00h -	00h -

4.5 Node monitoring

4.5.1 Emergency service (EMCY)

The state of the bus participant is transmitted in the event of a fault via high-priority emergency messages. These messages have a data length of 8 bytes and contain error information.

The emergency message is transmitted as soon as a sensor or communication error has occurred or is rectified. The cause of the fault is stored in the fault buffer (cf Object 1003h: Pre-defined Error Field). An emergency object is only sent once per error event. If a cause of the fault has been eliminated, this is signaled by sending an emergency message with error code 0000h (No Error). If there are several malfunctions and one cause of the fault is eliminated, the error code 0000h is also output, but the remaining error state is specified in the error register.

Identifier	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
11/ 29 Bit	Emergency Error Code		Error Register (Object 1001h)	Manufacturer-specific error field (not used)				

Emergency Error Code

Error Description	Error Code
Malfunction cause eliminated	0000h
Bus status switches to Error Passive Mode	8120h
Recovered from Bus Off	8140h
Manufacturer specific: Position value error	FF05h
Manufacturer specific: Position error working area 1	FF15h
Manufacturer specific: Position error working area 2	FF16h

Table 9: Emergency Error Code

The identifier of the emergency object is set to 80h + Node ID by default, but can be changed via object 1014h (cf. Object 1014h COB ID emergency message). Sending an emergency message is only possible in the NMT state "OPERATIONAL" or "PRE-OPERATIONAL". The sending of emergency messages can be switched off by setting the COB ID valid bit to 1.

4.5.2 Node Guarding

Node Guarding is available for failure monitoring of the CANopen network. With Node Guarding, the master sets remote frames (RTR, remote transmission request) to the guarding identifiers of the bus nodes to be monitored. These respond with the guarding message. This contains the current NMT state of the node as well as a toggle bit whose value must change with each message. If the NMT state or toggle bit does not match the value expected by the master or there is no response occurs, the master assumes a node failure.

The time interval (life time) is set via the objects 100Ch (Guard Time) and 100Dh (Life Time Factor), within which the NMT master expects a message. The time interval "Life-Time" is calculated from the cycle time "Guard-Time", multiplied by the factor "Life-Time-Factor". If the NMT master does not receive a response to its RTR frame within the "life time", it can react with suitable measures. After powering up, Node Guarding is activated by sending the master's first RTR frame to the slave. If the value of one of the two objects (100Ch or 100Dh) is set to 0h, Node Guarding is deactivated.

The response of the node to the RTR frame of the master is structured as follows:

Identifier	**Byte 0**	
700h + Node-ID	Bit 7: Toggle Bit	Bit 6 ... 0: NMT state

Toggle Bit:

The toggle bit must alternate between two successive responses of the device. After the guarding protocol has been activated, the toggle bit must have the value 0 for the first response.

NMT State:

4: STOPPED

5: OPERATIONAL

127: PRE-OPERATIONAL

The identifier of the Node Guarding protocol is permanently set to 700h + Node ID and cannot be changed. Sending a Node Guard message is possible in the NMT sate "OPERATIONAL", "PREOPERATIONAL" or "STOPPED".

Note:

The literature recommends using the heartbeat for node monitoring. With the Node Guarding protocol, only the master can detect missing communication. The heartbeat, on the other hand, can be received by all participants.

4.5.3 Heartbeat

The master monitors the state of the slave device via the heartbeat protocol. The device automatically sends its NMT status cyclically in this case. The SGH25 is a heartbeat producer; it does not receive and process heartbeat protocols itself. The cycle time of the heartbeat message is set via object 1017h. If the cycle time is 0h, the heartbeat protocol is deactivated.

The heartbeat message consists of the COB ID and an additional byte. This byte stores the current NMT state.

COB ID	Byte 0
700h + Node-ID	NMT state

NMT State:

4: STOPPED

5: OPERATIONAL

127: PRE-OPERATIONAL

The identifier of the Heartbeat protocol is permanently set to 700h + Node ID and cannot be changed. Sending a Heartbeat message is possible in the NMT state "OPERATIONAL", "PREOPERATIONAL" or "STOPPED".

4.6 Layer Setting Service (LSS)

Layer Setting Service (LSS) is a special procedure described in CiA 305 for querying and configuring various parameters (Node ID, baud rate and identity object 1018h).

Each device must have a unique LSS number composed from the entries in object 1018h.

- Vendor ID 0000 0195h
- Product Code: FFFF FFFFh
- Revision number: FFFF FFFFh
- Serial number: xxxx xxxxh (respective serial number of the encoder))

To be able to use complete LSS functionality, all devices on the bus must support the LSS procedure. There must be an LSS master, and all nodes must start at the same baud rate. After booting, the device is in LSS waiting. To make a configuration, one or all devices must be switched to the LSS configuration. If the LSS master expects an answer to its command, only one LSS slave may be switched to the LSS configuration.

Two different LSS services are available:

- LSS (rx) (LSS Master → SGH25): 7E5h
- LSS (tx) (SGH25 → LSS Master): 7E4h

These LSS identifiers cannot be changed!

A message always consists of 8 bytes. Byte 0 contains the command (command specifier cs). This is followed by a maximum of 7 data bytes. Unused data bytes are reserved and must be populated with 00h.

Services	LSS waiting	LSS configuration
Switch state global	Yes	Yes
Switch state selective	Yes	No
Activate bit timing parameters	No	Yes, if all devices on the bus support LSS
Configure bit timing parameters	No	Yes
Configure Node ID	No	Yes
Store configuration	No	Yes

Request LSS address	No	Yes
Request Node ID	No	Yes

Table 10: State behavior of the supported LSS Services

4.6.1 State Change

4.6.1.1 Switch states of all LSS Devices (Switch state global)

With this command, all devices on the bus can be put into the LSS Waiting or LSS Configuration state. The LSS slave devices do not respond to this.

Master → All LSS Slaves

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	04h	Mode	00h	00h	00h	00h	00h	00h

Mode:

00h: Switch to LSS waiting state

01h: Switch to LSS configuration state

4.6.1.2 Switch states of individual devices (Switch state global)

With this command, individual LSS slave devices can be put into the LSS configuration state via the unique LSS number.

Master → SGH25

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	40h	Vendor ID				00h	00h	00h

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	41h	Product code				00h	00h	00h

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7

7E5h	42h	Revision number	00h	00h	00h

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	43h	Serial number				00h	00h	00h

SGH25 → Master

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E4h	44h	00h	00h	00h	00h	00h	00h	00h

4.6.2 Configuration

4.6.2.1 Node ID Setting (Configure Node ID)

The LSS master can configure the Node ID of individual LSS slaves in configuration mode. If the new Node ID should still available after a power off/on, then the "Store configuration" command must be given after the change. To immediately activate the new Node ID, the LSS slave must be put into the LSS Waiting and then an NMT "Reset Communication" 82h given. Another option is to perform a power off/on after "Store configuration".

Master → SGH25

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	11h	NID	00h	00h	00h	00h	00h	00h

NID:

01h … 7Fh: Node ID

SGH25 → Master

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E4h	11h	Error code	Spec error	00h	00h	00h	00h	00h

Error Code:

00h: Transmission successful

01h: not a valid Node ID

FFh: Implementation error, cf. Spec error

Spec-error:

This byte is not equal to 0 only in the case of an implementation error and error code FFh.

4.6.2.2 Configuration of the baud rate (Configure bit timing parameters)

This command can be used to configure the baud rate of a single or several LSS slaves. If the new baud rate should still available after a power off/on, then the "Store configuration" command must be given after the change. To activate the new baud rate, the command 4.6.2.3Activate Baud Rate (Activate bit timing parameters) must be given and the LSS slave put into LSS Waiting. Another option is to perform a power off/on after "Store configuration" to activate the new baud rate.

Master → SGH25

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	13h	Table selector	Table index	00h	00h	00h	00h	00h

Table selector:

00h: CiA 301 bit timing table

80h...FEh: Manufacturer-specific bit timing table

Table index:

Table index	Baud rate
0	1000 kbit/s
1	800 kbit/s
2	500 kbit/s
3	250 kbit/s
4	125 kbit/s
5	Reserved
6	50 kbit/s
7	20 kbit/s
8	Not supported
9	Not supported

The device only supports Table selector 00h and Table index 0 to 7.

SGH25 → Master

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E4h	13h	Error code	Spec error	00h	00h	00h	00h	00h

Error Code:

00h: Transmission successful

01h: not a valid baud rate

FFh: Implementation error, cf. Spec error

Spec-error:

This byte is not equal to 0 only in the case of an implementation error and error code FFh.

4.6.2.3 Activate Baud Rate (Activate bit timing parameters)

This command activates the baud rate newly set via 4.6.2.2Configuration of the baud rate (Configure bit timing parameters) without the necessity of a power off/on.

Master → SGH25

COB ID	User Data							
	Byte 0 Command	Byte 1 LSB	Byte 2 MSB	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	15h	Switch delay		00h	00h	00h	00h	00h

Switch Delay:

The Switch delay parameter defines the length of two delay times (d1, d2) of the same length and must correspond to a multiple of 1 ms. After expiry of the individual processing time and the delay time d1, the new baud rate is adopted internally. After the delay time d2 has elapsed, the LSS slave reports the boot-up via the newly set baud rate. This procedure prevents devices with different baud rates from being on the bus at the same time. During the two delay times d1 and d2, the LSS slave cannot send messages.

4.6.2.4 Store configuration

This command may only be executed if only one LSS slave is in configuration mode. The current settings are then be stored.

Master → SGH25

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	17h	00h	00h	00h	00h	00h	00h	00h

SGH25 → Master

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E4h	17h	Error code	Spec error	00h	00h	00h	00h	00h

Error Code:

00h: Transmission successful

01h: Store configuration is not supported

02h: Error during saving

FFh: Implementation error, cf. Spec error

Spec-error:

This byte is not equal to 0 only in the case of an implementation error and error code FFh.

4.6.3 Request parameters

The following requests may only be executed if only one LSS slave is in configuration mode.

4.6.3.1 Request vendor ID

Master → SGH25

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	5Ah	00h	00h	00h	00h	00h	00h	00h

SGH25 → Master

COB ID	User Data							
	Byte 0 Command	Byte 1 LSB	Byte 2	Byte 3	Byte 4 MSB	Byte 5	Byte 6	Byte 7
7E4h	5Ah	Vendor ID (cf. Object 1018.1h)				00h	00h	00h

4.6.3.2 Request product code

Master → SGH25

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	5Bh	00h	00h	00h	00h	00h	00h	00h

SGH25 → Master

COB ID	User Data							
	Byte 0 Command	Byte 1 LSB	Byte 2	Byte 3	Byte 4 MSB	Byte 5	Byte 6	Byte 7
7E4h	5Bh	Product Code (cf. Object 1018.2h)				00h	00h	00h

4.6.3.3 Request revision number

Master → SGH25

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	5Ch	00h	00h	00h	00h	00h	00h	00h

SGH25 → Master

COB ID	User Data							
	Byte 0 Command	Byte 1 LSB	Byte 2	Byte 3	Byte 4 MSB	Byte 5	Byte 6	Byte 7
7E4h	5Ch	Revision number (Object 1018.3h)				00h	00h	00h

4.6.3.4 Request serial number

Master → SGH25

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	5Dh	00h	00h	00h	00h	00h	00h	00h

SGH25 → Master

COB ID	User Data							
	Byte 0 Command	Byte 1 LSB	Byte 2	Byte 3	Byte 4 MSB	Byte 5	Byte 6	Byte 7
7E4h	5Dh	Serial number (object 1018.4h)				00h	00h	00h

4.6.3.5 Request Node ID

Master → SGH25

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E5h	5Eh	00h	00h	00h	00h	00h	00h	00h

SGH25 → Master

COB ID	User Data							
	Byte 0 Command	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
7E4h	5Eh	Node ID (NID)	00h	00h	00h	00h	00h	00h

4.7 Table of Objects

4.7.1 Object Overview

The following table provides an overview of the objects of the device.

Name	Description	Cf. page
1000h Device Type	Device profile and encoder type	29
1001h: Error Register	Current error state of the device	29
1002h: Manufacturer Status Register	Contains the Transmit Error Counter and the Receive Error Counter	29
1003h: Pre-defined Error Field	The object stores the 8 most recent error states	30
1005h: COB-ID SYNC Message	Setting of the COB ID of the SYNC object	30
1008h: Manufacturer Device Name	Device name in ASCII characters	31
1009h: Manufacturer Hardware Version	Specifies the hardware version of the device	31
100Ah: Manufacturer Software Version	Specifies the software version of the device	32
100Ch: Guard Time	Parameters for node guarding	32
100Dh: Life Time Factor	Parameters for node guarding	32
1010h: Store Parameter	Object for non-volatile storage of the settings	33
1011h: Restore Parameter	Object for restoring the factory settings	34
1014h COB ID emergency message	COB ID of the emergency object	36
1017h: Producer Heartbeat Time	Setting of the cycle time of the heartbeat timer	37
1018h: Identity Object	Contains the manufacturer number	37
1200h: Server SDO Parameter	SDO parameter	38
1800h 1. Transmit PDO Parameter	Transmit PDO for asynchronous transmission (timer-controlled)	39
1801h: 2. Transmit PDO Parameter	Transmit PDO for synchronous transmission	40
1A00h: 1. Transmit PDO Mapping Parameter	Describes the arrangement of the objects, which are shown in TPDO1	41
1A01h: 2. Transmit PDO Mapping Parameter	Describes the arrangement of the objects that are displayed in TPDO2	42
5000h: Diagnose CAN bus error	Provides information about the CAN bus errors that occurred	43
5F09h: Bus terminal.	Bus terminal.	43
5F0Ah: Node ID and baud rate Bus CAN	Setting of the Node ID and the baud rate	44
6000h: Operating Parameters	Setting of the scaling and the direction of rotation	44
6002h: Total number of measuring steps	Specifies the total number of measurement steps of the system	45

Name	Description	Cf. page
6003h: Preset value (calibration value)	Use object 6010h subindex 01h	45
6004h: Position value	Use object 6020h subindex 01h	45
6005h: Resolution	Setting of the resolution	45
6010h: Calibration value	Setting of the calibration value	46
6020h: Position value	Position value	47
6030h: Speed	Speed value	47
6200h: Cycle Timer	Identical with object 1800h, subindex 5	45
6400h: Work area (area state register)	Indicates whether the position value is within the set working ranges 1 and 2	48
6401h: Work Area Low Limit	Setting of the lower limits of the working range 1 and 2	49
6402h: Work Area High Limit	Setting of the upper limits of the working range 1 and 2	50
6500h: Operating Status	Output of the scaling and the direction of rotation	48
6501h: Single-turn resolution	The physical number of measuring steps per revolution	51
6502h: Number of distinguishable revolutions	Number of revolutions that the encoder can detect	51
6503h: Alarms	Display of error states	52
6504h: Supported Alarms	Specifies which alarm messages are supported	52
6505h: Warnings	Display of warnings	52
6506h: Supported Warnings	Specifies which warnings are supported	53
6507h: Profile and Software Version	Displays the version number of the device profile used and the version number of the device firmware	51
6508h: Operating Time	Operating hour meter (function is not supported)	53
6509h: Offset value	Encoder states at the time of calibration	54
650Ah: Module identification	Specifies the manufacturer-specific offset value as well as the smallest and largest transferable position value	54
650Bh: Serial number	Specifies the serial number	55
650Ch: Offset value for multi-sensor device	Encoder states at the time of calibration	55

Table 11: Object Overview

4.7.2 Object Description

4.7.2.1 1000h Device Type

The object 1000h specifies the device profile number.

Subindex	00h			
Description	Information about device profile and device type			
Access	ro			
PDO mapping	No			
Data type	UNSIGNED 32			
Default	000A0196h			
EEPROM	No			
Data content	Device profile number		Encoder type	
	Byte 0	Byte 1	Byte 2	Byte 3
	96h	01h	0Ah	00h

0196h (= 406d): CANopen Device Profile for Encoders

000Ah: Multi-sensor encoder interface

4.7.2.2 1001h: Error Register

The object 1001h displays the error state of the device.

Subindex	00h	
Description	Currently existing error state	
Access	ro	
PDO mapping	No	
Data type	UNSIGNED 8	
Default	0h	
EEPROM	No	
Data content	Bit	Significance
	0	Set bit indicates the occurrence of any error state
	4	Set bit indicates communication errors on the CAN bus (passive or Bus off)
	7	Manufacturer-specific (sensor error)
	1 -3 5-6	Not used

Faults and errors are signaled by an emergency message at the moment of their occurrence.

4.7.2.3 1002h: Manufacturer Status Register

Object 1002h outputs the counter readings of the tab "Receive Error Counter" and "transmit error counter". The contents of this tab provide information about transmission faults at the mounting location of the encoder.

Subindex	00h			
Description	Transmit Error Counter and Receive Error Counter			
Access	ro			
PDO mapping	No			
Data type	UNSIGNED 32			
Default	0h			
EEPROM	No			
Data content	Byte 0	Byte 1	Byte 2	Byte 3
	Receive Error Counter	Transmit Error Counter		

4.7.2.4 1003h: Pre-defined Error Field

In object 1003h, the 8 most recent error states are archived (cf. Chapter4.5.1).

- The entry under subindex 0 specifies the number of the stored errors.
- The most recent error state is always stored in subindex 01h. Previous error messages move in the position by one subindex further.
- The entire error list is deleted when you write the value 0h at subindex 00h.
- The entries in the error list have the format described in Chapter 4.5.1.

Subindex	00h
Description	Number of stored error messages
Access	rw
PDO mapping	No
Data type	UNSIGNED 8
Default	0h
EEPROM	Yes

Subindex	01h-08h
Description	Error messages that occurred
Access	ro
PDO mapping	No
Data type	UNSIGNED 32
Default	0h
EEPROM	Yes

4.7.2.5 1005h: COB-ID SYNC Message

The COB ID of the SYNC object is set by object 1005h.

Subindex	00h
Description	Defines the COB ID of the synchronization object (SYNC)

Access	rw (can only be described in the “Pre-Operational” state; cf. Chapter 4.1)	
PDO mapping	No	
Data type	UNSIGNED 32	
Default	80h	
EEPROM	Yes	
Data content	Bit 31	Not specified
	Bit 30	0: Device does not generate any SYNC message
	Bit 29	0: 11 bit identifier (CAN 2.0A) 1: 29 bit identifier (CAN 2.0B)
	Bit 28 ... 11	0: if Bit 29 = 0 X: Bits 28 - 11 of the SYNC COB ID if bit 29 = 1
	Bit 10 ... 0	X: Bits 10 - 0 of the SYNC COB ID

4.7.2.6 1008h: Manufacturer Device Name

Object 1008h specifies the device name. Because this contains 5 data bytes, the SDO Normal Transfer is required for reading (cf. Chapter 4.4.1.2).

Subindex	00h						
Description	Device name in ASCII characters						
Access	Const						
PDO mapping	No						
Data type	Visible_String						
Default	SGH25						
EEPROM	No						
	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
	53h ("S")	47h ("G")	48h ("H")	32 h ("2")	35h ("5")	00h -	00h -

4.7.2.7 1009h: Manufacturer Hardware Version

Object 1009h specifies the hardware version.

Subindex	00h			
Description	Hardware version in ASCII characters			
Access	Const			
PDO mapping	No			
Data type	Visible_String			
Default	V100.			
EEPROM	No			
Data content	Byte 0	Byte 1	Byte 2	Byte 3
	56h ("V")	30h ("1")	30h ("0")	31h ("0")

4.7.2.8 100Ah: Manufacturer Software Version

The object 100Ah specifies software version of the device.

Subindex	00h			
Description	Software version in ASCII characters			
Access	Const			
PDO mapping	No			
Data type	Visible_String			
Default	V100.			
EEPROM	No			
Data content	Byte 0	Byte 1	Byte 2	Byte 3
	56h ("V")	31h ("1")	30h ("0")	30h ("0")

4.7.2.9 100Ch: Guard Time

Object 100Ch specifies the cycle time set in the master for the node guarding (cf. Chapter 4.5.2). The cycle time width is entered in milliseconds. The value "0h" means that Node Guarding is deactivated.

Subindex	00h
Description	Guard Time
Access	rw
PDO mapping	No
Data type	UNSIGNED 16
Default	0h
EEPROM	Yes

4.7.2.10 100Dh: Life Time Factor

Object 100Dh specifies the Life Time Factor set in the master for the node guarding (cf. Chapter 4.5.2). The value "0h" means that Node Guarding is deactivated.

Subindex	00h
Description	Life Time Factor
Access	rw
PDO mapping	No
Data type	UNSIGNED 8
Default	0h
EEPROM	Yes

4.7.2.11 1010h: Store Parameter

With this object, parameters are transmitted into the EEPROM, so that they are safe from power outages. Depending on the selection of which subindex is accessed, different parameter groups are saved. The string "save" must also be transmitted as data content.

Subindex	00h
Description	Displays the largest supported subindex
Access	const
PDO mapping	No
Data type	UNSIGNED 8
Default	4h
EEPROM	No

Subindex	01h			
Description	Save all parameters			
Access	rw			
PDO mapping	No			
Data type	UNSIGNED 32			
Default	1h			
EEPROM	No			
Data content	Writing:			
	Byte 0	Byte 1	Byte 2	Byte 3
	73h ("s")	61h ("a")	76h ("v")	65h ("e")
	Read:			
	Bit 31 ... 2	0, reserved		
	Bit 1	0: Device does not store parameters independently		
	Bit 0	1: Device stores parameters on command		

Subindex	02h			
Description	Only save communication parameters (1000h-1FFFh, CiA 301)			
Access	rw			
PDO mapping	No			
Data type	UNSIGNED 32			
Default	1h			
EEPROM	No			
Data content	Writing:			
	Byte 0	Byte 1	Byte 2	Byte 3
	73h ("s")	61h ("a")	76h ("v")	65h ("e")
	Read:			
	Bit 31 ... 2	0, reserved		
	Bit 1	0: Device does not store parameters independently		
	Bit 0	1: Device stores parameters on command		

Subindex	03h			
Description	Only save application parameters (6000h-9FFFh, CiA 406)			
Access	rw			
PDO mapping	No			
Data type	UNSIGNED 32			
Default	1h			
EEPROM	No			
Data content	Writing:			
	Byte 0	Byte 1	Byte 2	Byte 3
	73h ("s")	61h ("a")	76h ("v")	65h ("e")
	Read:			
	Bit 31 ... 2	0, reserved		
	Bit 1	0: Device does not store parameters independently		
	Bit 0	1: Device stores parameters on command		

Subindex	04h			
Description	Only save manufacturer-specific parameters (2000h-5FFFh)			
Access	rw			
PDO mapping	No			
Data type	UNSIGNED 32			
Default	1h			
EEPROM	No			
Data content	Writing:			
	Byte 0	Byte 1	Byte 2	Byte 3
	73h ("s")	61h ("a")	76h ("v")	65h ("e")
	Read:			
	Bit 31 ... 2	0, reserved		
	Bit 1	0: Device does not store parameters independently		
	Bit 0	1: Device stores parameters on command		

4.7.2.12 1011h: Restore Parameter

The object 1011h restores the factory settings of the device depending on the selection. The string "load" must be sent as data content and then a reset performed. If the restored parameters are to be available permanently, they must be saved via the object 1010h: Store Parameter.

Subindex	00h
Description	Displays the largest supported subindex
Access	const
PDO mapping	No
Data type	UNSIGNED 8

Default	4h
EEPROM	No

Subindex	01h			
Description	Set all parameters to factory settings			
Access	rw			
PDO mapping	No			
Data type	UNSIGNED 32			
Default	1h			
EEPROM	No			
Data content	Writing:			
	Byte 0	Byte 1	Byte 2	Byte 3
	6Ch ("l")	6Fh ("o")	61h ("a")	64h ("d")
	Read:			
	Bit 31 ... 1	0, reserved		
	Bit 0	1: Device allows the loading of default parameters.		

Subindex	02h			
Description	Only set communication parameters to the factory setting (1000h-1FFFh, CiA 301)			
Access	rw			
PDO mapping	No			
Data type	UNSIGNED 32			
Default	1h			
EEPROM	No			
Data content	Writing:			
	Byte 0	Byte 1	Byte 2	Byte 3
	6Ch ("l")	6Fh ("o")	61h ("a")	64h ("d")
	Read:			
	Bit 31 ... 1	0, reserved		
	Bit 0	1: Device allows the loading of default parameters.		

Subindex	03h
Description	Only set application parameters to the factory setting (6000h-9FFFh, CiA 406)
Access	rw
PDO mapping	No
Data type	UNSIGNED 32
Default	1h
EEPROM	No
Data content	Writing:

	Byte 0	Byte 1	Byte 2	Byte 3
	6Ch ("l")	6Fh ("o")	61h ("a")	64h ("d")
	Read:			
	Bit 31 ... 1	0, reserved		
	Bit 0	1: Device allows the loading of default parameters.		

Subindex	04h			
Description	Only set manufacturer-specific parameters to the factory setting (2000h-5FFFh)			
Access	rw			
PDO mapping	No			
Data type	UNSIGNED 32			
Default	1h			
EEPROM	No			
Data content	Writing:			
	Byte 0	Byte 1	Byte 2	Byte 3
	6Ch ("l")	6Fh ("o")	61h ("a")	64h ("d")
	Read:			
	Bit 31 ... 1	0, reserved		
	Bit 0	1: Device allows the loading of default parameters.		

4.7.2.13 1014h COB ID emergency message

The COB ID of the emergency object is set by object 1014h (cf. Chapter 4.5.1.

Subindex	00h	
Description	Defines the COB ID of the emergency object (EMCY)	
Access	rw (can only be described in the “Pre-Operational” state; cf. Chapter 4.1)	
PDO mapping	No	
Data type	UNSIGNED 32	
Default	80h + Node ID	
EEPROM	Yes	
Data content	Bit 31	0: EMCY object exists/is valid 1: EMCY object does not exist/is invalid
	Bit 30	Always 0b
	Bit 29	0: 11 bit identifier (CAN 2.0A) 1: 29 bit identifier (CAN 2.0B)
	Bit 28 ... 11	0: if Bit 29 = 0b X: Bits 28 - 11 of the EMCYCOB ID if bit 29 = 1b
	Bit 10 ... 0	X: Bits 10 - 0 of the EMCY COB ID

4.7.2.14 1017h: Producer Heartbeat Time

The cycle time "Heartbeat Time" is set for the Heartbeat protocol by object 1017h. The cycle time width is entered in milliseconds.

Subindex	00h
Description	Defines the cycle time of the Heartbeat monitoring service
Access	rw
PDO mapping	No
Data type	UNSIGNED 16
Default	0
EEPROM	Yes
Data content	0d, 10d ... 65535d (0h, Ah ... FFFFh); The number value corresponds to a multiple of 1 ms. The value 0h deactivates the service.

4.7.2.15 1018h: Identity Object

The manufacturer identification number (Vendor ID) is indicated by object 1018h.

Subindex	00h
Description	Displays the largest supported subindex
Access	const
PDO mapping	No
Data type	UNSIGNED 8
Default	4h
EEPROM	No

Subindex	01h
Description	Manufacturer identification number (Vendor ID) assigned to SIKO GmbH by CiA
Access	ro
PDO mapping	No
Data type	UNSIGNED 32
Default	195h
EEPROM	No

Subindex	02h
Description	Product Code (function is not supported; only compatibility entry for various configurators)
Access	ro
PDO mapping	No
Data type	UNSIGNED 32
Default	FFFFFFFFh
EEPROM	No

Subindex	03h
Description	Revision Number (function is not supported; only compatibility entry for various configurators)
Access	ro
PDO mapping	No
Data type	UNSIGNED 32
Default	FFFFFFFFh
EEPROM	No

Subindex	04h
Description	Serial Number
Access	ro
PDO mapping	No
Data type	UNSIGNED 32
EEPROM	Yes

4.7.2.16 1200h: Server SDO Parameter

The COB IDs are specified for the server SDOs by object 1200h. The COB IDs cannot be changed.

Subindex	00h
Description	Displays the largest supported subindex
Access	const
PDO mapping	No
Data type	UNSIGNED 8
Default	2h
EEPROM	No

Subindex	01h
Description	COB ID Client -> Server (rx)
Access	ro
PDO mapping	No
Data type	UNSIGNED 32
Default	00000600h + Node ID
EEPROM	No

Subindex	02h
Description	COB ID Server -> Client (tx)
Access	ro
PDO mapping	No

Data type	UNSIGNED 32
Default	00000580h + Node-ID
EEPROM	No

4.7.2.17 1800h 1. Transmit PDO Parameter

According to CiA 406, TPDO1 is used for asynchronous PDO transmission.
The communication parameters for TPDO1 are set by object 1800h.

Subindex	00h
Description	Displays the largest supported subindex
Access	const
PDO mapping	No
Data type	UNSIGNED 8
Default	5h
EEPROM	No

Subindex	01h
Description	COB ID of PDO1
Access	rw (can only be described in the “Pre-Operational” state; cf. Chapter 4.1)
PDO mapping	No
Data type	UNSIGNED 32
Default	Configure Node ID
EEPROM	Yes

Subindex	02h	
Description	Transmission Type	
Access	rw	
PDO mapping	No	
Data type	UNSIGNED 8	
Default	FEh (254d)	
EEPROM	Yes	
Data content	FEh (254d) FFh (255d)	PDO has asynchronous characteristics (PDO is sent depending on the "Event Timer").
	FDh (253d)	The device only responds to an RTR request if RTR Bit 30 is released in the COB ID.

Subindex	03h
Description	Inhibit time (function is not supported; only compatibility entry for various configurators)
Access	ro
PDO mapping	No

Data type	UNSIGNED 16
Default	0h
EEPROM	No

Subindex	04h (is not used; access generates an error message)

Subindex	05h
Description	Event timer for TPDO1 hard-wired (CiA 406) with cyclic timer 6200h
Access	rw
PDO mapping	No
Data type	UNSIGNED 16
Default	0h
EEPROM	Yes
Data content	Writing the value 0h switches off the service. The content of this object is identical with object 6200h. If the value is changed when the timer is running, the change only takes effect after the next run of the timer.

Subindex	06h (is not used; access generates an error message)

4.7.2.18 1801h: 2. Transmit PDO Parameter

According to CiA 406, TPDO2 is used for synchronous PDO transmission.
The communication parameters for TPDO2 are set by object 1801h.

Subindex	00h
Description	Displays the largest supported subindex
Access	const
PDO mapping	No
Data type	UNSIGNED 8
Default	5h
EEPROM	No

Subindex	01h
Description	COB ID of PDO2
Access	rw (can only be described in the “Pre-Operational” state; cf. Chapter 4.1)
PDO mapping	No
Data type	UNSIGNED 32
Default	280h + Node ID
EEPROM	Yes

Subindex	02h

Description	Transmission Type	
Access	rw	
PDO mapping	No	
Data type	UNSIGNED 8	
Default	1h	
EEPROM	Yes	
Data content	1h (1) F0h (240)	PDO is sent after received 1d ... 240d SYNC messages.
	FCh (253)	The device only responds to an RTR request if RTR Bit 30 is released in the COB ID.

Subindex	03h
Description	Inhibit time (function is not supported; only compatibility entry for various configurators)
Access	ro
PDO mapping	No
Data type	UNSIGNED 16
Default	0h
EEPROM	No

Subindex	04h (is not used; access generates an error message)

Subindex	05h
Description	Event timer (function is not supported; only compatibility entry for various configurators)
Access	ro
PDO mapping	No
Data type	UNSIGNED 16
Default	0h
EEPROM	No

Subindex	06h (is not used; access generates an error message)

4.7.2.19 1A00h: 1. Transmit PDO Mapping Parameter

The objects are specified by object 1A00h that are depicted in the first Transmit PDO (TPDO1).

Subindex	00h
Description	Number of mapped objects
Access	const
PDO mapping	No
Data type	UNSIGNED 8

Default	2h
EEPROM	No

Subindex	01h
Description	1. Object of the PDO1 message (data bytes 0 to 3)
Access	ro
PDO mapping	No
Data type	UNSIGNED 32
Default	60200120h (position value of object 6020h, subindex 01h, 32 bit)
EEPROM	No

Subindex	02h
Description	2. Object of the PDO1 message (data bytes 4 to 5)
Access	ro
PDO mapping	No
Data type	UNSIGNED 32
Default	60300110h (speed 6030h, subindex 01h, 16 bit)
EEPROM	No

4.7.2.20 1A01h: 2. Transmit PDO Mapping Parameter

The objects are specified by object1A01h that are depicted in the second Transmit PDO (TPDO2).

Subindex	00h
Description	Number of mapped objects
Access	const
PDO mapping	No
Data type	UNSIGNED 8
Default	2h
EEPROM	No

Subindex	01h
Description	1. Object of the PDO2 message (data bytes 0 to 3)
Access	ro
PDO mapping	No
Data type	UNSIGNED 32
Default	60200120h (position value of object 6020h, subindex 01h, 32 bit)
EEPROM	No

Subindex	02h

Description	2. Object of the PDO2 message (data bytes 4 to 5)
Access	ro
PDO mapping	No
Data type	UNSIGNED 32
Default	60300110h (speed 6030h, subindex 01h, 16 bit)
EEPROM	No

4.7.2.21 5000h: Diagnose CAN bus error

A prioritized list of the CAN bus errors that occurred can be read via object 5000h.

Subindex	00h			
Description	Provides the CAN bus errors Acknowledge, Form, CRC and Stuff Error sorted according to frequency.			
Access	ro			
PDO mapping	No			
Data type	UNSIGNED 32			
Default	0h			
EEPROM	No			
Data content	Byte 0	Byte 1	Byte 2	Byte 3
	General Acknowledgment Error	Form error	CRC error	Stuff error
	0, 1, 2, 3, 4	0, 1, 2, 3, 4	0, 1, 2, 3, 4	0, 1, 2, 3, 4

Explanation of the data content:

0: Error does not occur at all

4: Most frequently occurring error

4.7.2.22 5F09h: Bus terminal.

Internal CAN bus termination resistance can be activated by object 5F09h.

Subindex	00h
Description	Switch CAN bus termination on or off
Access	rw
PDO mapping	No
Data type	UNSIGNED 8
Default	0h
EEPROM	Yes
Data content	0: internal bus termination not activated 1: internal bus termination activated

4.7.2.23 5F0Ah: Node ID and baud rate Bus CAN

Node ID and the baud rate bus can be set by object 5F0Ah.

Subindex	00h
Description	Displays the largest supported subindex
Access	const
PDO mapping	No
Data type	UNSIGNED 8
Default	2h
EEPROM	No

Subindex	01h
Description	Node ID
Access	rw
PDO mapping	No
Data type	UNSIGNED 8
Default	1h
EEPROM	Yes
Data content	01h ... 7Fh

Subindex	02h
Description	Baud rate of the CAN bus
Access	rw
PDO mapping	No
Data type	UNSIGNED 8
Default	5h (500 kBaud)
EEPROM	Yes
Data content	1: 20 kbit/s 2: 50 kbit/s 3: 125 kbit/s 4: 250 kbit/s 5: 500 kbit/s 6: 800 kbit/s 7: 1000 kbit/s

4.7.2.24 6000h: Operating Parameters

Operating parameters can be set via object 6000h.

Subindex	00h
Description	Operating Parameters
Access	rw
PDO mapping	No

Data type	UNSIGNED 16	
Default	4h	
EEPROM	Yes	
Data content	Bit 15 ... 4	Not used
	Bit 3	0: Counting direction of increasing values 1: Counting direction of decreasing values
	Bit 2	1: Release scaling
	Bit 1	Not used
	Bit 0	Not used

Scaling: The encoder works with its set resolution, which can be parameterized via object 6005h. It is not possible to switch off the scaling function.

Count direction is positive: increasing position values when you pull out the wire.

Counting direction is negative: falling position values when you pull out of the wire.

Note:

After you switch the count direction from negative to positive, a desired calibration value must be sent again.

4.7.2.25 6002h: Total number of measuring steps

Object 6002h specifies the total number of measurement steps of the system

Subindex	00h
Description	Total number of measuring steps
Access	rw
PDO mapping	No
Data type	UNSIGNED 32
Default	26560d (000067C0h)
EEPROM	Yes

4.7.2.26 6003h: Preset value (calibration value)

This object is not used. Cf. Object 6010h: Calibration value

4.7.2.27 6004h: Position value

This object is not used. Cf. Object 6020h: Position value

4.7.2.28 6005h: Resolution

The resolution is specified by object 6005h.

Subindex	00h
Description	Displays the largest supported subindex

Access	ro
PDO mapping	No
Data type	UNSIGNED 8
Default	2h
EEPROM	No

Subindex	01h
Description	Resolution of the linear sensor. According to CiA 406, the parameter must be specified in multiples of nm.
Access	rw
PDO mapping	No
Data type	UNSIGNED 32
Default	100000d (00002710h)
EEPROM	Yes
Data content	100000d (00002710h)

Subindex	02h
Description	Increment of the speed of the linear sensor. According to CiA 406, the parameter must be specified in multiples of 0.01 mm/s.
Access	rw
PDO mapping	No
Data type	UNSIGNED 32
Default	100d (64h)
EEPROM	Yes
Data content	100d (64h)

4.7.2.29 6010h: Calibration value

The position value of the encoder for calibration to a calibration value can be set via object 6010h. Position value = measurement value + calibration value

Subindex	00h
Description	Displays the largest supported subindex
Access	ro
PDO mapping	No
Data type	UNSIGNED 8
Default	1h
EEPROM	No

Subindex	01h
Description	Calibration value
Access	ro

PDO mapping	Yes
Data type	SIGNED 32
Default	0h
EEPROM	No
Data content	-26559d...26559d (FFFF9841h...000067BFh)

4.7.2.30 6020h: Position value

Object 6020h indicates the current position value of the encoder.

Subindex	00h
Description	Displays the largest supported subindex
Access	ro
PDO mapping	No
Data type	UNSIGNED 8
Default	1h
EEPROM	No

Subindex	01h
Description	Position value
Access	ro
PDO mapping	No
Data type	SIGNED 32
Default	0h
EEPROM	No

Position value = measurement value + calibration value

4.7.2.31 6030h: Speed

The speed can be read via object 6030h.

Subindex	00h
Description	Displays the largest supported subindex
Access	ro
PDO mapping	No
Data type	UNSIGNED 8
Default	1h
EEPROM	No

Subindex	01h
Description	Speed value in mm/s
Access	ro

PDO mapping	No
Data type	SIGNED 16
Default	0h
EEPROM	No

4.7.2.32 6200h: Cycle Timer

Object 6200h sets a cycle time, with which the PDO1 is to be output. This value is firmly linked to the object 1800h 1. Transmit PDO Parameter subindex 05h. The timer-controlled output is active as soon as a valid cycle time is entered and the device is operated in operational mode. The value 0h deactivates the function.

Subindex	00h
Description	Cycle Timer
Access	rw
PDO mapping	No
Data type	UNSIGNED 16
Default	0h
EEPROM	Yes
Data content	0d ... 65535d (0h...FFFFh)

4.7.2.33 6400h: Work area (area state register)

Object 6400h indicates whether the position value is within the set working ranges 1 and 2

Subindex	00h
Description	Displays the largest supported subindex
Access	ro
PDO mapping	No
Data type	UNSIGNED 8
Default	2h
EEPROM	No

Subindex	01h	
Description	State of work area 1	
Access	ro	
PDO mapping	No	
Data type	UNSIGNED 8	
Default	0h	
EEPROM	No	
Data content	Bit 7 ... 3	Not used
	Bit 2	0: Position value is within the work area 1: Position value is smaller than the set limit value in object 6401.1h

	Bit 1	0: Position value is within the work area 1: Position value is greater than the set limit value in object 6402.1h
	Bit 0	0: Position value is within the set work area 1: Position value is outside of the set work area

Subindex	02h	
Description	State of work area 2	
Access	ro	
PDO mapping	No	
Data type	UNSIGNED 8	
Default	0h	
EEPROM	No	
Data content	Bit 7 ... 3	Not used
	Bit 2	0: Position value is within the work area 1: Position value is smaller than the set limit value in object 6401.2h
	Bit 1	0: Position value is within the work area 1: Position value is greater than the set limit value in object 6402.2h
	Bit 0	0: Position value is within the set work area 1: Position value is outside of the set work area

4.7.2.34 6401h: Work Area Low Limit

A lower limit value for one of the two working areas can be set via object 6401h.

Subindex	00h
Description	Displays the largest supported subindex
Access	ro
PDO mapping	No
Data type	UNSIGNED 8
Default	2h
EEPROM	No

Subindex	01h
Description	Lower limit value of work area 1
Access	rw
PDO mapping	No
Data type	SIGNED 32
Default	0h
EEPROM	Yes
Data content	-53118d(FFFF3082h)...79677d(0001373Dh)

Subindex	02h
Description	Lower limit value of work area 2
Access	rw
PDO mapping	No
Data type	SIGNED 32
Default	0h
EEPROM	Yes
Data content	-53118d(FFFF3082h)...79677d(0001373Dh)

4.7.2.35 6402h: Work Area High Limit

A higher limit value for one of the two working areas can be set via object 6402h.

Subindex	00h
Description	Displays the largest supported subindex
Access	ro
PDO mapping	No
Data type	UNSIGNED 8
Default	2h
EEPROM	No

Subindex	01h
Description	Higher limit value of work area 1
Access	rw
PDO mapping	No
Data type	SIGNED 32
Default	0h
EEPROM	Yes
Data content	-53118d(FFFF3082h)...79677d(0001373Dh)

Subindex	02h
Description	Higher limit value of work area 2
Access	rw
PDO mapping	No
Data type	SIGNED 32
Default	0h
EEPROM	Yes
Data content	-53118d(FFFF3082h)...79677d(0001373Dh)

4.7.2.36 6500h: Operating Status

The object 6500h indicates the settings programmed with object 6000h.

Subindex	00h	
Description	Operating Status	
Access	ro	
PDO mapping	No	
Data type	UNSIGNED 16	
Default	4h	
EEPROM	No	
Data content	Bit 15 ... 4	Not used
	Bit 3	0: Counting direction of increasing values 1: Counting direction of decreasing values
	Bit 2	1: Release scaling
	Bit 1	Not used
	Bit 0	Not used

4.7.2.37 6501h: Single-turn resolution

Object 6501h specifies the physical number of measuring steps per revolution.

Subindex	00h
Description	Physical resolution
Access	ro
PDO mapping	No
Data type	UNSIGNED 32
Default	100000d (00002710h)
EEPROM	No

4.7.2.38 6502h: Number of distinguishable revolutions

Object 6502h specifies the number of revolutions that the encoder can record.

Subindex	00h
Description	Physical resolution
Access	ro
PDO mapping	No
Data type	UNSIGNED 16
Default	1
EEPROM	No

4.7.2.39 6503h: Alarms

In addition to the errors that are reported via the emergency message, object 6503h provides additional device-specific alarm messages. In the event of an error, the corresponding bit is set to 1.

Subindex	00h	
Description	Alarm messages	
Access	ro	
PDO mapping	No	
Data type	UNSIGNED 16	
Default	0h	
EEPROM	No	
Data content	Bit 15 ... 14	Not used
	Bit 13	0: Position value within the working range 2 1: Position limit value 2 exceeded or fallen below (work area 2)
	Bit 12	0: Position value within the working range 1 1: Position limit value 1 exceeded or fallen below (work area 1)
	Bit 11 ... 1	Not used
	Bit 0	0: Position value valid 1: Position value invalid

4.7.2.40 6504h: Supported Alarms

This object 6504h indicates which alarm messages are supported. The corresponding bits are set.

Subindex	00h	
Description	Supported alarm messages	
Access	ro	
PDO mapping	No	
Data type	UNSIGNED 16	
Default	3001h	
EEPROM	No	
Data content	Bit 15 ... 14	Not used
	Bit 13	Position limit 2 errors
	Bit 12	Position limit 1 error
	Bit 11 ... 1	Not used
	Bit 0	Position error

4.7.2.41 6505h: Warnings

Warning messages can be output via object 6505h. In the case of a warning message, the position value can still be valid unlike in the case of an alarm message.

Subindex	00h	
Description	Warnings	
Access	ro	
PDO mapping	No	
Data type	UNSIGNED 16	
Default	0h	
EEPROM	No	
Data content	Bit 0 ... 15	Not used

4.7.2.42 6506h: Supported Warnings

Object 6506h indicates which warning messages are supported.

Subindex	00h	
Description	Supported warnings	
Access	ro	
PDO mapping	No	
Data type	UNSIGNED 16	
Default	0000h	
EEPROM	No	
Data content	Bit 0 ... 15	Not used

4.7.2.43 6507h: Profile and Software Version

The object 6507h displays the used encoder profile (CANopen device profiles for encoders) and the firmware version number.

Subindex	00h			
Description	Profile and Software Version			
Access	ro			
PDO mapping	No			
Data type	UNSIGNED 32			
Default	01000302h			
EEPROM	No			
	Profile version		Software version	
	Byte 0 (LSB)	Byte 1	Byte 2	Byte 3 MSB
	02h	03h	01h	00h

4.7.2.44 6508h: Operating Time

The operating hours can be displayed via object 6508h. This function is not supported.

Subindex	00h
Description	Operation hours counter

Access	ro
PDO mapping	No
Data type	UNSIGNED 32
Default	FFFFFFFFh
EEPROM	No

4.7.2.45 6509h: Offset value

Object 6509h specifies the difference between the encoder value and the scaled position value calculated with the calibration value.

Subindex	00h
Description	Encoder states at the time of calibration
Access	ro
PDO mapping	No
Data type	SIGNED 32
Default	0h
EEPROM	Yes

4.7.2.46 650Ah: Module identification

Object 650Ah specifies the manufacturer-specific offset value as well as the smallest and largest transferable position value

Subindex	00h
Description	Displays the largest supported subindex
Access	ro
PDO mapping	No
Data type	UNSIGNED 8
Default	3h
EEPROM	No

Subindex	01h
Description	Manufacturer-specific offset value
Access	ro
PDO mapping	No
Data type	SIGNED 32
Default	0h
EEPROM	No

Subindex	02h
Description	Smallest transferable position value
Access	ro

PDO mapping	No
Data type	SIGNED 32
Default	-53118d (FFFF3082h)
EEPROM	No

Subindex	03h
Description	Largest transferable position value
Access	ro
PDO mapping	No
Data type	SIGNED 32
Default	79677d (0001373Dh)
EEPROM	No

4.7.2.47 650Bh: Serial number

Object 650Bh supplies the serial number of the encoder.

Subindex	00h
Description	Serial number
Access	ro
PDO mapping	No
Data type	UNSIGNED 32
Default	0h
EEPROM	Yes

4.7.2.48 650Ch: Offset value for multi-sensor device

Object 650C9h specifies the difference between the encoder value and the scaled position value calculated with the calibration value (equivalent to object 6509h: Offset value.

Subindex	00h
Description	Displays the largest supported subindex
Access	ro
PDO mapping	No
Data type	UNSIGNED 8
Default	1h
EEPROM	No

Subindex	01h
Description	Offset value
Access	ro
PDO mapping	No
Data type	SIGNED 32

Default	0h
EEPROM	Yes