

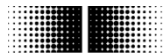
Manual

Cable transducers GCA3/5 with CANopen[®] interface Inclination sensor integrated (option)

GCA3/5 Firmware Version 1.23 and higher

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1 1 Document history

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

Document index	Date	Firmware version	CANopen Revision Number Obj. 1018	Author	Changes
0000 (Rev11)	-	From V01-23	0000.0000h	zazg	Version replacing all previous documents
0001	24.09.2020	From V01-23	0000.0000h	mis / gua	<ul style="list-style-type: none"> - Introduce firmware version and CANopen revision number in this table - Adapted manual filename name and EDS file name - Errata / language / format corrections - Set the parameters in the object list with the "SAVE" attribute, paragraph 11.
0002	09.02.2021	From V01-23	0000.0000h	zazg	<ul style="list-style-type: none"> - Changed the linear position and angular position information.
0003	22.03.2021	From V01-23	0000.0000h	mis / gua	<ul style="list-style-type: none"> - Updated the product assignment, paragraph 3 - Updated Node IDs with default address for CANopen redundant version, paragraph 10 - Updated OBJ 0x3001 description, paragraph 11.2 (Manufacturer specific profile area) - Insert note for products with CANopen redundant, paragraph 11.2 (Manufacturer specific profile area) - Insert note for products with CANopen redundant and inclination sensor integrated, paragraph 11.3 (Standardized device profile area)

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

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2 Safety and operating instructions

Intended purpose of the equipment

- The cable transducer is a precision measuring device to determine linear and angular positions and to supply the downstream device with measured values in the form of electronic output signals. The inclination sensor must not be used for any other purpose.
- Unless this product is specially labeled, it may not be used for operation in potentially explosive environments. Make sure by appropriate safety measures, that in case of error or failure of the inclination sensor, no danger to persons or damage to the system or operating facilities occurs.

Personnel qualification

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

Safety remarks

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

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

Transport, storage and disposal

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

Assembly

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

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

Electrical commissioning

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

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

Supplementary information

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

3 Product assignment

3.1 Cable transducer

Product	Product Code	Device Name	EDS File
GCA5			
Cable transducer GCA5-PM	0x0521	GCA5	GCA3-5_0x0521_V00.00.eds
Cable transducer GCA5-PM redundant (2-channel design)	0x0521	GCA5	GCA3-5_0x0521_V00.00.eds
Cable transducer GCA5-PM with integrated inclinometer	0x0521	GCA5	GCA3-5_0x0521_V00.00.eds
Cable transducer GCA5-PM redundant (2-channel design with integrated inclinometer)	0x0521	GCA5	GCA3-5_0x0521_V00.00.eds
GCA3			
Cable transducer GCA5-PM	0x0521	GCA3	GCA3-5_0x0521_V00.00.eds
Cable transducer GCA5-PM redundant (2-channel design)	0x0521	GCA3	GCA3-5_0x0521_V00.00.eds
Cable transducer GCA5-PM with integrated inclinometer	0x0521	GCA3	GCA3-5_0x0521_V00.00.eds
Cable transducer GCA5-PM redundant (2-channel design with integrated inclinometer)	0x0521	GCA3	GCA3-5_0x0521_V00.00.eds

4 System Overview

4.1 General

The cable transducer is a linear measuring system with a CANopen interface. It supports scaling and presetting.

In consideration of encoder device profile CiA 406, it behaves like an absolute linear encoder - class C2 (exception diagnostic part). It has also implemented the inclinometer device profile CiA 410 from users organization "CAN in Automation" (CiA).

4.2 Supported profiles

Following CANopen profiles are supported:

- CiA 301 / Version 4.2.0 (Communication profile)
- CiA 305 / Version 3.0.0 (LSS Layer Setting Services)
- CiA 406 / Version 4.0.2 (Encoder device profile)
- CiA 410 / Version 2.0.0 (Inclinometer device profile)

4.3 Supported CANopen services

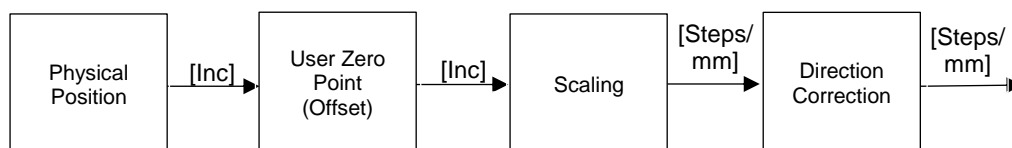
Following CANopen services are supported:

- 1 Network Management (according to CiA 301)
- 1 SDO Server (according to CiA 301)
- 2 TPDOs (according to CiA 301/CiA 406/ CiA 410)
- 1 Emergency Producer (according to CiA 301/CiA 406/ CiA 410)
- 1 Heartbeat Producer (according to CiA 301)

4.4 Function principle

4.4.1 Overview

Figure 1: Function principle overview



4.4.2 Scaling

The object 6005 indicates the measuring step settings for position and speed.

The value of position step setting (sub-index 01_h) is given in multiples of 0,001 μm .

The value of speed step setting (sub-index 02_h) is given in multiples of 0,01 mm/s.

Example 1: A position step setting of 1'000'000 nm/step means that the position output unit is 1mm.

5 NMT Service

5.1 Supported commands

Following NMT commands are supported:

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

There is no difference between NMT Reset and NMT Communication Reset

5.2 Boot up message

Send NMT message to initialize the sensor

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

Note: ID can be 0 for broadcast initialization

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

COB ID	Byte 0
700h + node ID	00

6 SDO service / service data

6.1 General

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

6.2 Save/load parameters

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

6.2.1 Save

Writing "save" to 0x1010-x saves the corresponding objects to the non-volatile memory. After a reset or power-on, the parameters are loaded from the non-volatile memory. The SDO request to 1010h-x is answered after saving.

6.2.2 Load

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

6.2.3 Safe non-volatile operation

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

6.2.4 Side effect

Save/Load operations interrupt the updating of position.

6.3 Examples writing parameters

6.3.1 How to save data

Send the SDO message

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

6.3.2 How to change the node ID

Send the SDO message

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x600 + ID	8	0x2F	0x01	0x30	0x00	ID	0x00	0x00	0x00

Note: values below 1 or above 127 are not accepted and the existing setting remains valid. After setting the new entries a SAVE command (see par. "How to save data") followed by a turnoff and on.

6.3.3 How to change the baud rate

Send the SDO message

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x600 + ID	8	0x2F	0x00	0x30	0x00	BR	0x00	0x00	0x00

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

6.3.4 How to change the length direction

There are 2 ways for changing direction.

6.3.4.1 First method (CiA 406)

Send the SDO message.

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

Where PAR is the parameter setting as follows

PAR	MEANING
0x00	Positive direction (length increase pulling the cable), length expressed in unit of 0.1 mm
0x01	Negative direction (length decrease pulling the cable), length expressed in unit of 0.1 mm
0x04	Positive direction (length increase pulling the cable), resolution depends on object 0x6005
0x05	Negative direction (length decrease pulling the cable), resolution depends on object 0x6005

6.3.4.2 Second method

Send the SDO message

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x600 + ID	8	0x2F	0x02	0x21	0x01	DIR	0x00	0x00	0x00

Where DIR is the direction: 0 = positive (0 to FS), 1 = negative (0 to -FS)
 If it is necessary to set negative direction (FS to 0), the object 2119.0 must be set to 0.

6.3.5 How to change the length resolution

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

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x600 + ID	8	0x23	0x05	0x60	0x01	R0	R1	R2	R3

Where R0...R3 represents the unit of measure of the output length, expressed in nm (Nanometer).

For example, to obtain a resolution of 1 mm:

R0 = 0x40, R1 = 0x42, R2 = 0x0F, R3 = 0x00

It means R = 0x000F4240 (1'000'000 decimal) = 1'000'000nm = 1 mm.

I.e: if it's necessary to have the measure expressed in 10 mm, the value to write must be 10'000'000 nm, to obtain instead a resolution of 0.1 mm, the value to write will be 100'000 nm

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

6.3.6 How to set the Preset

Send the SDO message to set the desired value:

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x600 + ID	8	0x23	0x10	0x60	0x01	R0	R1	R2	R3

Where R0...R3 represent the desired output length, expressed in according with the resolution.

For example, if the resolution is 1 mm and the desired value in that position is 300 mm:

R0 = 0x2C, R1 = 0x01, R2 = 0x00, R3 = 0x00

It means R = 0x0000012C (300 decimal).

if the resolution is 0.1 mm and the desired value in that position is 300 mm:

R0 = 0xB8, R1 = 0x0B, R2 = 0x00, R3 = 0x00

It means R = 0x00000BB8 (3000 decimal).

For the Zero it's only necessary to set R = 0x00000000 (0 decimal)

6.3.7 How to change the angle resolution

This object shall indicate the resolution of the inclinometer of Slope long16 (object 6810h) based on 0.001°.

This resolution is also valid for the 32-bit value object (6910h). In case of low resolution, the value is 10d. In case of high resolution the value is 1d. The following table describes all possible resolutions:

Resolution (6800h/7000h)	
Value	Description
01h (1d)	0.001°
Ah (10d)	0.01°
64h (100d)	0.1°
3E8h (1000d)	1°

6.3.8 Operating parameters (6811h/6911h)

The above mentioned operating parameter influences the output inclination in the following manner:

Bit Mask:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Reserved						s	i
Default	-						1	0

i = Inversion (0 = Do not enable inversion; 1 = Enable inversion)

s = Scaling (0 = Do not enable scaling; 1 = Enable scaling)

Scaling means that the following equation is applied:



$$\text{Inclination} = A + B + C$$

Where

- A is a physically measured angle;
- B is a differential slope offset;
- C is a slope offset.

The operating parameters are applied for the according slope (i.e. 6811h operating parameter influences 6810h slope).

The 16-bit and 32-bit values are hardwired internally (i.e. changing the operating parameter at 6811h changes the operating parameter at 6911h).

6.3.9 Offset parameters and calculation

This object shall indicate the application offset of the longitudinal axis. The value shall be given in angular degrees with the resolution given in object 6000h. The following formula applied:

$$\text{Slope offset} = A - B - C$$

Where

- A is a slope preset value at t_{acc} ;
- B is a slope physical measured at t_{acc} ;
- C is a differential slope offset and t_{acc} = time when accessing object a preset object

The 16-bit and 32-bit values are hardwired internally (i.e. changing the differential offset at 6814h changes the differential offset at 6914h)

i.e.: Send the SDO message to set the angle zero:

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x600 + ID	8	0x2B	0x12	0x68	0x00	0x00	0x00	0x00	0x00

6.3.10 Digital low pass filter configuration for angle (2603h) and length (2103)

Angle filter:

The digital Angle filter's cut-off frequency can be adjusted through the object 2603h.

The IIR coefficient is expressed in tenths of hertz. E.g.: $F_c = 3 \text{ Hz} \rightarrow 30d(0x1E)$.

The value can be selected in a range from 0 to 300(30Hz).

The default coefficient is 30(3.0Hz).

Length filter:

The Length Filter can be adjusted through the object 2103h.

The IIR coefficient is expressed in %.

The value can be selected in a range from 0 to 100

The default coefficient is 20.

7 PDO service / process data

7.1 General

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

7.2 PDO transmission types

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

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

Both PDOs support all transmission types.

Transmission type 255 and 254: The PDO is transmitted timer driven. The time interval between 2 PDOs can be adapted in the object 180xh-5

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

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

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

etc.

7.3 COB-ID

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

The format of the TPDO is:

TPDO1

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x180 + ID	8	P0	P1	P2	P3	0	0	0	0

where P is the actual position value in 0.1 mm or other scale (depending on the resolution settings).

Interpretation example

Considering a resolution of 0.1 mm:

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

It means P = 0x00002710 (10'000 decimal) = 1'000 mm

TPDO2 (enabled in case of inclination sensor integrated)

COB-ID	Len	D0	D1	D2	D3	D4	D5	D6	D7
0x280 + ID	8	R0a	R1a	0	0	0	0	0	0

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

Interpretation example

Considering a resolution of 0.1°:

P0 = 0x84, P1 = 0x03

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

7.4 PDO mapping

The sensor supports dynamic mapping.

7.4.1 Mappable objects

The following objects are mappable (see Object dictionary for further specifications):

Mapping content	Mapping entry	Description
Length raw value	0x20000120	Object 2000h, subindex 01h, data length 32 bit
Length value	0x21100120	Object 2110h, subindex 01h, data length 32 bit
Firmware version	0x21950008	Object 2195h, subindex 00h, data length 8 bit
String customer	0x21960020	Object 2196h, subindex 00h, data length 32 bit
Dummy double word	0x21970020	Object 2197h, subindex 00h, data length 32 bit
Dummy word	0x21980010	Object 2198h, subindex 00h, data length 16 bit
Dummy byte	0x21990008	Object 2199h, subindex 00h, data length 8 bit
Length value	0x60040020	Object 6004h, subindex 00h, data length 32 bit
Length value	0x60200120	Object 6020h, subindex 01h, data length 32 bit
Speed value	0x60300120	Object 6030h, subindex 01h, data length 32 bit
Slope long 16-bit angle	0x68100010	Object 6810h, subindex 00h, data length 16 bit
Slope long 32-bit angle	0x69100020	Object 6910h, subindex 00h, data length 32 bit

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

7.4.2 Default mapping of absolute encoder redundant with cable-pull

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

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
184h	8	xx	xx	xx	xx	00	00	00	00

Byte 0...3: Length (Object 6020h-1)

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
284h	8	xx	xx	xx	xx	00	00	00	00

Byte 0...3: Angle (Object 6910h-0)

7.5 Timing

The minimal cycle time for TPDOs is 50 msec

7.6 Exceptions of accurate calculation of process data

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

- Non-volatile operations
- Changing the scaling parameters

8 EMCY service / emergency

8.1 General

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

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

8.2 Emergency message

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

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

8.3 Error register

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

8.3.1 Communication error

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

8.3.2 Generic error

A generic error is indicated for all other errors.

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

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

8.4 Error codes / EMCY messages

The following error codes are generated by the device:

Error Code	Meaning
0x0000000000000000	Error reset or no error
0x0010010000000000	Generic error
0x1081110000000000	CAN RX overflow
0x1082110000000000	PDO not processed due to length error
0x01FF810000000000	Wire break
0x02FF810000000000	Inclinometer break

9 Heartbeat service

9.1 General

The sensor supports a heartbeat producer according CiA 305.

Example for a heartbeat protocol:

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

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

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

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

9.2 COB-ID

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

9.3 Timing

The minimal cycle time for heartbeat messages is 10 msec.

10 LSS Layer setting services

In spring 2000, CiA drafted a new protocol intended to ensure standardized procedures, as described under Layer Setting Services and Protocol, CiA Draft Standard Proposal 305 (LSS).

The sensor is supplied by default with single node-ID (default factory setting node-ID 4) for version CANopen, and with double node-ID (default factory setting node-ID 4 and node-ID 5) for version CANopen redundant. Default factory setting for both versions is 250 kBaud.

Using LSS, several sensors with the same node ID can be connected to the bus system. To allow individual sensors to be addressed, LSS is used.

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

Stopped Mode

10.1 LSS addressing

The baud rate and node ID can be configured by LSS (according to CiA 305). Another possibility to change the baud rate and node ID is to access to the objects 0x3000 and 0x3001 (see object directory).

The LSS service is only available in NMT Stopped Mode.

10.2 Supported LSS commands

- Switch state global

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

Message structure

COB ID:

Consumer -> Producer: 2021 = 7E5h

Consumer <- Producer: 2020 = 7E4h

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

This is followed by up to seven attached data bytes.

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

Switch mode global

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

Mode : 0 -> Operation mode

1 -> Configuration mode

Selective switch mode

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

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

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

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

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

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

Vendor ID : 0x005F – GCA series products

Product code : Internal product code for the respective sensor

Revision number : Current revision number of the sensor

Serial number : Unique, consecutive serial number

Mode : The sensor's response is the new mode (0=operating mode; 1=configuration mode)

Setting the node ID

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

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

Node ID : The inclination sensor's new node ID

Error code : 0=OK; 1=Node ID outside range; 2...254=reserved; 255->Specific error

Specific error : If Error code=255->application-specific error code.

Setting the bit timing

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

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

TableSel : Selects the bit timing table 0 : Standard CiA bit timing table

1...127 : Reserved for CiA
 128...255: Manufacturer-specific tables

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

Saving the configuration protocol

This protocol saves the configuration parameters in the EEPROM.

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

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

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

Activate bit timing parameters

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

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

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

Request vendor ID

Requesting the vendor ID of a selected sensor

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

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

Vendor ID : = 0x005F – GCA series products

Request product code

Request product code of a selected sensor

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

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

Product code : Manufacturer-dependent product code

Request revision number

Request revision number of a selected sensor

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

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

Revision number : Current revision

Request serial number

Request serial number of a selected sensor

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

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

Serial number: Unique consecutive serial number of the sensor

Range request

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

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

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

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

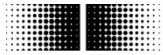
7E5h ->	49h	Revision number HIGH	reserved
---------	-----	----------------------	----------

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

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

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

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



11 Object directory

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

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

11.1 Communication profile area

Object	Sub-index	Name	Format	Access	Default value	Save	Description
0x1000	0	Device type	U32	ro	0x000A0196		CiA406
0x1001	0	Error register	U8	ro	0x00		Bit-coded to profile CiA 406 0x00: no error 0x01: generic error 0x10: communication error 0x20: device profile error 0x80: manufacturer specific error
0x1003	0	Predefined error list	U8	ro	0x00		Errors in the list (up to 8)
	1...8	History errors	U32	ro	0x00000000		Errors occurred according to the error codes list, the last error is in the sub-index
0x1005	0	COB ID Sync object	U32	rw	0x00000080	yes	Sensor generates no sync message (bit 30 =0) 11-bits identifier system (bit 29=0)
0x1008	0	Device name	STR	ro	-		Device designation (see paragraph 3)
0x1009	0	HW version	STR	ro	1.0		Hardware version
0x100A	0	FW version	STR	ro	-		Software version (ASCII characters, i.e. version 1.28 = 31 56 32 38) (! Attention, as specified in the segmented mode: Send 60 00 00 00 00 00 00 00 after the command 40 0A 10 00 00 00 00 00 to see this string)
0x1010	0	Numbers of save-options	U8	ro	0x01		
	1	"save all parameters"	U32	rw	0x00000001	yes	The parameters are saved only writing the key string "save" (0x73-0x61-0x76-0x65)
0x1011	0	Numbers of restore-options	U8	ro	0x01		
	1	Restore all parameters	U32	rw	0x00000001	yes	If the key string "load" (0x6C-0x6F-0x61-0x64) is entered here, the parameters are assigned to default values / factory settings and are valid after the next reset.
0x1014	0	COB ID Emergency	U32	rw	0x00000080 +ID	yes	bit 30 = 1 The sensor generates EMCY message
0x1017	0	Producer heartbeat time	U16	rw	0x0000	yes	Time interval [msec] where sensor generates a producer heartbeat
0x1018	0	Numbers of identity-options	U8	ro	0x04		
	1	Vendor ID	U32	ro	-		0x005F – GCA series products
	2	Product code	U32	ro	-		As described in paragraph 2.1
	3	Revision number	U32	ro	0x00000000		
	4	Serial number	U32	ro	-		Depending by the SN of the product
0x1200	0	Server SDOs	U8	ro	0x02		
	1	COB ID Rx SDO	U32	ro	0x600 + ID		bit 31=0 -> valid SDO
	2	COB ID Tx SDO	U32	ro	0x580 +ID		bit 31=0 -> valid SDO
0x1800	0	TPDO1	U8	ro	0x05		Number of the entries TPDO1
	1	COB ID TPDO1	U32	rw	0x180 + Node ID	yes	Bit 31 = 0 -> TPDO activated Bit 31 = 1 -> TPDO not activated (not transmitted)
	2	Transmission type	U8	rw	0xFE	yes	Transmission type (synchronous/asynchronous)

Object	Sub-index	Name	Format	Access	Default value	Save	Description
	3	Inhibit time	U16	rw	0x0000	yes	Minimum interval time between consecutive TPDOs
	5	Event time TPDO1	U16	rw	0x0064	yes	Used if 1800.02 is 0xFE or 0xFF
0x1801	0	TPDO2	U8	ro	0x05		Number of the entries TPDO2
	1	COB ID TPDO2	U32	rw	0x280+Node ID	yes	Bit 31 = 0 -> TPDO activated Bit 31 = 1 -> TPDO not activated (not transmitted)
	2	Transmission type	U8	rw	0xFE	yes	Transmission type (synchronous/asynchronous)
	3	Inhibit time	U16	rw	0x0000	yes	Minimum interval time between consecutive TPDOs
	5	Event time TPDO2	U16	rw	0x0064	yes	Used if 1801.02 is 0xFE or 0xFF
0x1A00	0	TPDO1 mapping	U8	ro	0x02		Number of objects integrated in TPDO1
	1	index in obj directory	U32	ro	0x60200120		Cable length
	2	index in obj directory	U32	ro	0x21970020		
0x1A01	0	TPDO2 mapping	U8	ro	0x02		Number of objects integrated in TPDO2
	1	index in obj directory	U32	ro	0x69100020		Angle
	2	index in obj directory	U32	ro	0x21970020		
0x1F80	0	NMT Startup	U32	rw	0x00000000	yes	Configuration of the start-up behavior of a device that is able to perform the NMT

11.2 Manufacturer specific profile area

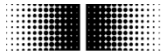
Object	Sub-index	Name	Format	Access	Default value	Save	Description
0x2000	0	Length raw channel value	U8	ro	2		Number of the entries
	1	Length raw value	U32	ro, m			length in 0.1 mm (internal raw value)
	2	<i>Reserved</i>	<i>U32</i>				
0x2101	0	Length preset values	U8	ro	2		Number of the entries
	1	Length preset value	I32	rw	0	yes	Same as object 6010.01 (it is possible to set a value only equal to zero)
	2	<i>Reserved</i>	<i>I32</i>				
0x2102	0	Length direction	U8	ro	2	yes	Number of the entries
	1	Length direction	U8	rw		yes	direction (0=increasing when pull; 1= decreasing when pull)
	2	<i>Reserved</i>	<i>U8</i>				
	3	Length preset value	I32	rw	0x00000000	yes	Preset the value (it's possible to set a value different from Zero, accordingly to the resolution)
	4	<i>Reserved</i>	<i>I32</i>				
0x2103	0	Length filter strength	U8	rw	0x14	yes	IIR coefficient expressed in % (lower values->more filtering)
0x2110	0	Length value	U8	ro	2		Number of the entries
	1	Length value	I32	ro, m			length in 0.1 mm or other scale (depending on resolution)
	2	<i>Reserved</i>	<i>I32</i>				
	3	Length value Invers	I32	ro, m			opposite value (FS-value)
	4	<i>Reserved</i>	<i>I32</i>				
0x2119	0	Inversion Length Behavior	U8	ro	1		If it's equals to 1 means: Length goes from 0 to -FS (if either 2102.01 is equal to 1) If it's equals to 0 means: Length goes from FS to 0 (if either 2102.01 is equal to 1)
0x2120	0	Length value	U8	ro	2		Number of the entries
	1	Angle value Invers	U32	ro, m			Angle opposite value (FS-value)
	2	<i>Reserved</i>	<i>U32</i>				
0x2194	0	Type of rotation	U8	ro	1		Number of the entries
	1	Rotation axis	U8	rw	1	yes	Orientation of inclinometer measuring axis

Object	Sub-index	Name	Format	Access	Default value	Save	Description
							1= vertical installation of cable transducer with horizontal axis of inclinometer measuring axis (cannot be changed)
0x2195	0	Fw version	U16	ro, m	-		Obj. 0x100A in 16 bit
0x2196	0	String customer	U32	rw, m	0x00000000		4 byte of empty space for customer specific content (e.g. customer name)
0x2197	0	Dummy double word	U32	ro, m	0x00000000		4 byte of empty space to compose PDO with dynamic mapping
0x2198	0	Dummy word	U16	ro, m	0x0000		2 byte of empty space to compose PDO with dynamic mapping
0x2199	0	Dummy byte	U8	ro, m	0x00		1 byte of empty space to compose PDO with dynamic mapping
0x2603	0	Angle filter strength	U16	rw	0x1E		IIR coefficient expressed in Hz (lower values->more filtering)
0x3000	0	Baud rate	U8	rw	0x03	yes	0=1000 kbits/s 1=800 kbits/s 2=500 kbits/s 3=250 kbits/s 4=125 kbits/s 5=100 kbits/s 6=50 kbits/s 7=20 kbits/s 8=10 kbits/s The baud rate is activated after a reset or power-on (if parameter is saved to non-volatile memory)
0x3001	0	Node ID	U8, rw	rw	0x04 (0x05h)	yes	Node number 1...127 (0x01...0x7F) Products with CANopen are equipped with one node-ID: Channel A: Node-ID 4 (default factory setting 04h) Products with CANopen redundant (2-channel) are equipped with two node-IDs (each channel has its own node-ID)*: Channel A: Node-ID 4 (default factory setting 04h) Channel B: Node-ID 5 (default factory setting 05h)

*Note: For products with CANopen redundant (2-channel), the measuring function objects 0x6xxxh (standardized device profile area) exist in parallel for each channel / node-ID, and can be accessed simultaneously in parallel.

11.3 Standardized device profile area

Object	Sub-index	Name	Format	Access	Default value	Save	Description
0x6000	0	Length parameters	U16	rw	0x0000	yes	See paragraph 'How to change the length direction'
0x6002	0	Length total range	U32	rw	0x00000000	yes	Not used
0x6003	0	Length preset value	I32	rw	0x00000000	yes	Set the zero length values
0x6004	0	Length value	I32	ro, m	-		Length value
0x6005	0	Length position setting	U8	ro	0x02		Number of the entries
	1	Length position setting	U32	rw	0x0000F4240	yes	Express the resolution in nanometers
	2	Speed setting	U32	rw	0x0000F4240	yes	Express the resolution in nanometers
0x6010	0	Length preset values	U8	ro	0x02		Number of the entries
	1	Length preset value	I32	rw	0x00000000	yes	Preset the value
	2	<i>Reserved</i>	U32				




Object	Sub-index	Name	Format	Access	Default value	Save	Description
0x6020	0	Length value	U8	ro	0x02		Same as object 2110.00
	1	Length value	I32	ro, m	-		Same as object 2110.01
	2	<i>Reserved</i>	U32				
0x6030	0	Speed value	U8	ro	2		Number of the entries
	1	Speed value	I32	ro, m	-		Speed value
	2	<i>Reserved</i>	U32				
0x6800	0	Resolution Angle**	U16	rw	0x0064	yes	This object shall indicate the resolution of Slope long16-bit (object 6810h) and Slope lateral16-bit (object 6820h) objects based on 0,001°. This resolution is also valid for the 32-bit value objects (6910h and 6920h).
0x6810	0	Slope Long 16-bit**	I16	ro, m	-		This object shall provide the 16-bit slope value of the longitudinal axis. The value shall be given in degree (angle) with the resolution given in object 6800h.
0x6811	0	Slope long 16-bit operating parameter**	U8	rw	0x02	yes	If scaling is enabled, the Slope long16-bit value shall be calculated accordingly to the following equation: Slope long16-bit = physically measured angle + Differential slope long16-bit offset + Slope long16-bit offset If scaling is disabled, the Slope long16-bit value shall be equal to the physical measured angle.
0x6812	0	Slope long 16-bit preset value**	I16	rw	0x0000	yes	Accessing this object by means of SDO shall set directly the actual longitudinal slope value to a desired longitudinal slope value. The calculated application-offset of the longitudinal slope value is given in Slope long16-bit offset (object 6813h). The Slope long16-bit offset is calculated with respect to object 6814h. The value shall be given in degree (angle) with the resolution given in object 6800h.
0x6813	0	Slope long 16-bit offset**	I16	ro	0x0000		This object shall indicate the application-offset of the longitudinal axis. The value shall be given in degree (angle) with the resolution given in object 6800h. The following equation shall be applied: Slope long16-bit offset = Slope long16-bit preset value at tacc – slope physical measured at tacc – Differential slope long16-bit offset (tacc = time when accessing object 6812h)
0x6814	0	Differential slope long 16-bit offset**	I16	rw	0x0000	yes	This object shall shift the Slope long16-bit value (object 6810h) independent of Slope long16-bit preset value (object 6812h) and Slope long16-bit offset (object 6813h). The value shall be given in degree (angle) with the resolution given in object 6800h.
0x6910	0	Slope Long 32-bit**	I32	ro, m			See description of object 6810h
0x6911	0	Slope long 32-bit operating parameter**	U8	rw	0x02	yes	See description of object 6811h
0x6912	0	Slope long 32-bit preset value**	I32	rw	0x00000000	yes	See description of object 6812h
0x6913	0	Slope long 32-bit offset**	I32	ro	0x00000000		See description of object 6813h
0x6914	0	Differential slope long 32-bit offset **	I32	rw	0x00000000	yes	See description of object 6814h

*Note: For products with CANopen redundant (2-channel), the measuring function objects 0x6xxxh (standardized device profile area) exist in parallel for each channel / node-ID, and can be accessed simultaneously in parallel.

**Note: The inclinometer objects 6800h...6914h exist for products with integrated inclinometer only.

12 Terminal assignment

12.1 Connector M12, plug, 5-pin

Pin	Signals	Description	Connector
1	CAN_GND	Ground connection relating to CAN	 M12 connector (plug), A-coded
2	+Vs	Voltage supply	
3	GND	Ground connection relating to +Vs	
4	CAN_H	CAN bus signal (dominant High)	
5	CAN_L	CAN bus signal (dominant Low)	

12.2 Cable

Core color	Signals	Description
White	GND	Ground connection relating to +Vs
Brown	+Vs	Voltage supply
Green	CAN_H	CAN bus signal (dominant High)
Yellow	CAN_L	CAN bus signal (dominant Low)
Grey	CAN_GND	Ground connection relating to CAN

Terminal assignments above refer to standard product configuration.

Terminal assignment for customized product may be different. In this case, refer to related product datasheet.