Baumer

Passion for Sensors

Manual

Inclination sensors GIM140R with CANopen® interface

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1 Document history

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

Document index	Date	Firmware version	CANopen Revision Number Obj. 1018	Author	Changes
0001 (1.0)	20.10.2017	From V01-30	0000.0000h	zazg	Initial version replaces all draft documents
0002 (1.1)	09/08/2018	From V01-30	0000.0000h	gia	Added cut off frequency to the digital filter configuration (2603h) description table
0003 (1.2)	20.12.2018	From V01-30	0000.0000h	zazg	Update PDO format
0004 (1.3)	01.03.2019	From V01-30	0000.0000h	gua	Paragraph 5.3.7, removed old filter table
0005 (1.4)	08.03.2019	From V01-30	0000.0000h	zazg	Update filter values, minimum refresh PDO time, PDO mapping
0006 (1.5)	12.04.2019	From V01-30	0000.0000h	zazg	Update filter values, minimum refresh PDO time
0007 (1.6)	28.05.2019	From V01-30	0000.0000h	fgin	Updated object dictionary, filter settings
0008 (1.7)	01.08.2019	From V01-30	0000.0000h	zazg	
0009 (1.8)	13.09.2019	From V01-30	0000.0000h	zazg	Errata correction in the preset SDO paragraph 5.3.6
0010 (1.9)	09.10.2019	From V01-30	0000.0000h	zazg	Added filter MEMS SDO and paragraph 5.3.8
0011 (1.91)	13.11.2019	From V01-30	0000.0000h	zazg	Removed the necessity of unlock the filter MEMS SDO and RW dummy byte
0012 (2.0)	15.05.2020	From V01-30	0000.0000h	zazg	Update filter default setting
0013 (2.1)	22.06.2020	From V01-30	0000.0000h	zazg	Update CiA profile information
0014	08.09.2020	From V01-30	0000.0000h	mis / gua	- Introduce firmware version and CANopen revision number in this table - Adapted manual filename name and EDS file name - Adapted vendor ID - Errata / language / format corrections - Set the parameters in the object list with the "SAVE" attribute, paragraph 11.

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

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

Created by:
Sensor Systems Srl
Chiari, Italy

2 Safety and operating instructions

Intended purpose of the equipment

- The inclination sensor is a precision measuring device to determine 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 inclination sensor in their original packaging.
- Never drop inclination sensors or expose them to major vibrations.
- The inclination sensor contains electronic components. At its disposal, local environmental guidelines must be followed.

Assembly

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

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

Supplementary information

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

3 Product assignment

Product	Product Code	Device Name	EDS File
Inclination sensor	0x0540	GIM140R	GIM140R_0x0540_V00.00.eds
Inclination sensor - redundant version	0x0540	GIM140R	GIM140R_0x0540_V00.00.eds

4 System overview

4.1 General

The inclination sensor is a measuring system with CANopen interface. It supports scaling and presetting in consideration of CANopen device profile for inclinometer CiA 410 from users organization “CAN in Automation” (CiA).

4.2 Supported profiles

Following CANopen profiles are supported:

- CiA 301 / Version 4.2 (Communication profile)
- CiA 410 / Version 2.0 (Inclinometer device profile)
- CiA 305 / Version 3.0 (LSS Layer Setting Services)

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 410)
- 1 Emergency Producer (according to CiA 301 / CiA 410)
- 1 Heartbeat Producer (according to CiA 301)

5 NMT service / network management

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 sensor 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

See paragraph 5.2.1 respectively send 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	0x21	0x00	ID	0x00	0x00	0x00

Note: Values below 1 or above 127 are not accepted and the existing setting remains valid. Store settings / new entries to EEPROM is carried out by 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	0x21	0x00	BR	0x00	0x00	0x00

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

6.3.4 How to change the angle resolution

This object shall indicate the resolution of the Slope long16 (object 6010h) and Slope lateral16 (object 6020h) based on 0,001°. Store settings / new entries to EEPROM is carried out by SAVE command (see par. “How to save data”) followed by a turnoff and on.

This resolution is also valid for the 32-bit value objects (6110h, 6120h). 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 (6000h)	
Value	**Description**
01h (1d)	0.001°
Ah (10d)	0.01°
64h (100d)	0.1°
3E8h (1000d)	1°

6.3.5 Operating parameters (6011h/6111h)

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:

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. 6011h operating parameter influences 6010h slope).

The 16bit and 32bit values are hardwired internally (i.e. changing the operating parameter at 6011h changes the operating parameter at 6111h)

6.3.6 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:

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 6014h changes the differential offset at 6114h)

i.e: Send this SDO message to set the zero of X axis or Z axis (1-dim.):

COB-ID	**Len**	**D0**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**
0x600 + ID	8	0x2B	0x12	0x60	0x00	0x00	0x00	0x00	0x00

i.e: Send this SDO message to set the zero of Y axis:

COB-ID	**Len**	**D0**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**
0x600 + ID	8	0x2B	0x22	0x60	0x00	0x00	0x00	0x00	0x00

6.3.7 Digital low pass filter configuration (2603h)

The digital low pass filter cut-off frequency can be adjusted by object 2603h. The cut-off frequency has to be written to the sensor in 0.1 Hz resolution (i.e. a cut-off frequency of 5 Hz has to be configured by writing a 50d to the sensor.

The following cut-off frequencies are possible:

Configuration of digital filter (2603h)	
Cut-off frequency	**Description**
0	Digital filter deactivated
0.1…1 Hz	In 0.1 Hz steps
1…25 Hz	In 1 Hz steps

The default cut-off filter frequency is 2 Hz.

7 PDO service / process data

7.1 General

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

7.2 PDO transmission types

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

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

Both PDOs support all transmission types.

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

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

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

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

etc.

7.3 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
0x180 + ID	8	T0a	T1a	P0a	P1a	P0b	P1b

Where:
T represents the temperature in degrees.
P is the actual inclination value in degrees or tenths of degrees (depending on the resolution settings) and the suffixes ’a’ and ’b’ refers to axis ’X’ and ’Y’ respectively in 2-dimensional applications. The suffix ‘a’ could indicates also the 0-360° angle in 1-dimensional applications

Interpretation example
Considering a resolution of 0.1°:
P0 = 0x84, P1 = 0x03
It means P = 0x00000384 (900 decimal) = 90°
The axis 'b' is represented in a similar way.

7.4 PDO mapping

The inclination 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
Angle 1 value Invers	0x21200120	Object 2120h, subindex 01h, data length 32 bits
Angle 2 value Invers	0x21200220	Object 2120h, subindex 02h, data length 32 bits
Firmware version	0x21950010	Object 2195h, subindex 00h, data length 16 bits
String Customer	0x21960020	Object 2196h, subindex 00h, data length 32 bits
Dummy double word	0x21970020	Object 2197h, subindex 00h, data length 32 bits
Dummy word	0x21980010	Object 2198h, subindex 00h, data length 16 bits
Dummy byte	0x21990008	Object 2199h, subindex 00h, data length 8 bits
X axis raw acceleration	0x5FF00110	Object 5FF0h, subindex 01h, data length 16 bits
Y axis raw acceleration	0x5FF00210	Object 5FF0h, subindex 02h, data length 16 bits
Z axis raw acceleration	0x5FF00310	Object 5FF0h, subindex 03h, data length 16 bits
X axis filtered acceleration	0x5FF00410	Object 5FF0h, subindex 04h, data length 16 bits
Y axis filtered acceleration	0x5FF00510	Object 5FF0h, subindex 05h, data length 16 bits
Z axis filtered acceleration	0x5FF00160	Object 5FF0h, subindex 06h, data length 16 bits
Slope Long 16bit Angle 1	0x60100010	Object 6010h, subindex 00h, data length 16 bits
Slope Long 32bit Angle 1	0x61100020	Object 6110h, subindex 00h, data length 32 bits
Slope Lateral 16bit Angle 1	0x60200010	Object 6020h, subindex 00h, data length 16 bits
Slope Lateral 32bit Angle 1	0x61200020	Object 6120h, subindex 00h, data length 32 bits
Temperature	0x65110010	Object 6511h, subindex 00h, data length 16 bits

To change PDO mapping in order: first disable the mapping, write 0 to 0x1A0x-0, write the desired mapping entry, write the number of PDO contents to 0x1A0x-0 and enable the PDO again.

7.4.2 Default mapping of inclination sensor redundant

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

TPDO1

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
181h	8	xx	xx	xx	xx	yy	yy

2-dimensional:
Byte 0...1: temperature (Object 6511h-0)
Byte 2...3: X axis X (Object 6010h-0)
Byte 4...5: Y axis Y (Object 6020h-0)

1-dimensional:
Byte 0…1: temperature (Object 6511h-0)
Byte 2....3: Axis X/Vertical (Object 6010h-0)

7.5 Timing

The minimal cycle time for TPDOs is 20 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 memory operations
- Changing the scaling parameters

8 EMCY service / emergency

8.1 General

If there is an error on the sensor, the sensor 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 COB-ID

The COB-ID for the emergency message can be modified in object 1014h.
Default Value: 80h + node ID
Changes will be applied immediately.

The COB-ID is stored internally as a difference to the default COB-ID. Example:
Node ID: 4 COB-ID Emergency: 84h (Default value)
COB-ID Emergency: 87h (Changed by user)
Node ID: 9 COB-ID Emergency: 89h (Adapted automatic)

8.3 Emergency message

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

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

8.4 Error register

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

8.4.1 Communication error

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

8.4.2 Generic error

A generic error is indicated for all other errors.
An inclination sensor specific alarm or warning will also cause a generic error.
After a generic error the sensor changes to pre-operational mode.

8.5 Error codes / EMCY messages

The following error codes are generated by the sensor:

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

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
701h	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 25 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 node ID 1 and baud rate 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

10.2 LSS addressing

The needed value for LSS addressing is the serial number of the sensors. This serial number is printed on a label on the inclination sensor housing.

10.3 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 : ECh
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 : = ECh

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 inclination 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 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	0x0004019A		CiA410
0x1001	0	Error register	U8	ro	0x00		Bit-coded to profile CiA410 0x00: no error 0x01: generic error 0x10: communication error 0x20: device profile error 0x80: manufacturer specific error
0x1003	0	Predefined error list	U8	ro	0x00		Errors in the list (up to 8)
	1…8	History errors	U32	ro	0x00000000		Errors occurred according to the Error codes list, the last error is in the sub-index
0x1005	0	COB ID Sync object	U32	rw	0x00000080	X	Sensor generates no sync message (bit 30 =0) 11-bits identifier system (bit 29=0)
0x1008	0	Device name	STR	ro	GIM140R		Sensor device designation (see paragraph 2.1)
0x1009	0	HW version	STR	ro	1.0		Hardware version
0x100A	0	FW version	STR	ro	1.30		Software version (ASCII Characters i.e. version 1.00 = 31 56 30 30) (! Attention, as specified in the segmented mode: Send 60 00 00 00 00 00 00 00 after the command 40 0A 10 00 00 00 00 00 to see this string)
0x1010	0	Numbers of save-options	U8	ro	0x01		
	1	“save all parameters”	U32	rw	0x00000001	X	The parameters are saved only writing the key string “save” (0x73-0x61-0x76-0x65)
0x1011	0	Numbers of restore-options	U8	ro	0x01		
	1	Reset for all parameters	U32	rw	0x00000001	X	If the key string “load” (0x6C-0x6F-0x61-0x64) is entered here, the parameters are assigned to the factory default values and are valid after the next reset.
0x1014	0	COB ID Emergency	U32	rw	0x00000080 +ID	X	bit 30 = 1 The sensor generates EMCY message
0x1015	0	Inhibit time Emergency	U16	rw	0x0000	X	Inhibit time for the EMCY message. The value shall be given in multiples of 100 µs. The value 0 shall disable the inhibit time.
0x1017	0	Producer heartbeat time	U16	rw	0x0000	X	Time interval [msec] where sensor generates a producer heartbeat
0x1018	0	Numbers of identity-options	U8	ro	0x04		
	1	Vendor ID	U32	ro	0x0000005F		0x00EC – GIM series products
	2	Product code	U32	ro	0x00000540		As described in paragraph 2.1
	3	Revision number	U32	ro	0x00000000		
	4	Serial number	U32	ro	-		Depending on SN of 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

Object	Sub-index	Name	Format	Access	Default value	Save	Description
	1	COB ID TPDO1	U32	rw	0x180+Node ID	X	Bit 31 = 0 -> TPDO activated Bit 31 = 1 -> TPDO not activated (not transmitted)
	2	Transmission type	U8	rw	0xFE	X	Transmission type (synchronous/asynchronous)
	3	Inhibit time	U16	rw	0x0000	X	Minimum interval time between consecutive TPDOs
	5	Event time TPDO1	U16	rw	0x0064	X	Used if 1800.02 is 0xFE or 0xFF
0x1A00	0	TPDO1 mapping	U8	ro	0x03		Number of objects integrated in TPDO1
	1	Index in obj directory	U16	ro	0x65110010		Temperature
	2	Index in obj directory	U16	ro	0x60100010		X Axis/Vertical
	3	Index in obj directory	U16	ro	0x60200010		Y Axis
0x1F80	0	NMT Startup	U32	rw	-	X	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
0x2100	0	Baud rate	U8	rw	0x03	X	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)
0x2101	0	Node ID	U8	rw	0x01	X	0x01...0x7F
0x2195	0	Fw version	U16	ro, m	0x0000		Obj. 0x100A in 16 bit
0x2196	0	String Customer	U32	rw, m	0x00000000	X	4 byte to write the name of the customer
0x2197	0	Dummy double word	U32	rw, m	0x00000000	X	4 byte of empty space to compose PDO with dynamic mapping
0x2198	0	Dummy word	U16	rw, m	0x0000	X	2 byte of empty space to compose PDO with dynamic mapping
0x2199	0	Dummy byte	U8	rw, m	0x00	X	1 byte of empty space to compose PDO with dynamic mapping
0x2603	0	Digital Filter Configuration	U16	rw	0x0014	X	Frequency cut-off value
0x3000	0	Baud rate setting	U8	rw	0x03	X	Same as object 2100h
0x3001	0	Node Id	U8	rw	0x01	X	Same as object 2101h
0x5FF0	0	Acceleration	U8	ro			
	1	X axis raw acceleration	I16	ro, m			
	2	Y axis raw acceleration	I16	ro, m			
	3	Z axis raw acceleration	I16	ro, m			
	4	X axis filtered acceleration	I16	ro, m			
	5	Y axis filtered acceleration	I16	ro, m			
	6	Z axis filtered acceleration	I16	ro, m			

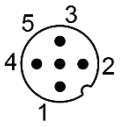
11.3 Standardized device profile area (inclinometer device profile CiA DS 410)

Object	Sub-index	Name	Format	Access	Default value	Save	Description
0x6000	0	Resolution	U16	rw	0x0064	X	This object shall indicate the resolution of Slope long16 (object 6010h) and Slope lateral16 (object 6020h) objects based on 0,001°. This resolution is also valid for the 32-bit value objects (6110h and 6120h).
0x6010	0	Slope long 16-bit	I16	ro, m	0x0000		This object provides the 16-bit slope value of the longitudinal axis. The slope value is given in angular degrees with resolution given in object 6000h.
0x6011	0	Slope long 16-bit operating parameter	U8	rw	0x02	X	If scaling is enabled, the Slope long16 value shall be calculated accordingly to the following equation: Slope long16-bit = slope physically measured + 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.
0x6012	0	Slope long 16-bit preset value	I16	rw	0x0000	X	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 6013h). The Slope long16-bit offset is calculated with respect to object 6014h. The value shall be given in degree (angle) with the resolution given in object 6000h.
0x6013	0	Slope long 16-bit offset	I16	rw	0x0000	X	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 6000h. The following equation shall be applied: Slope long16-bit offset = Slope long16-bit preset value at tacc – slope physically measured angle at tacc – Differential slope long16-bit offset (tacc = time when accessing object 6012h)
0x6014	0	Differential slope long 16-bit offset	I16	rw	0x0000	X	This object shall shift the Slope long16-bit value (object 6010h) independent of Slope long16-bit preset value (object 6012h) and Slope long16-bit offset (object 6013h). The value shall be given in degree (angle) with the resolution given in object 6000h.
0x6020	0	Slope lateral 16-bit (for 2-dimensional sensor only)	I16	ro, m	0x0000		This object provides the 16-bit slope value of the lateral axis. The slope value is given in angular degrees with resolution given in object 6000h.
0x6021	0	Slope lateral 16-bit operating parameter (for 2-dimensional sensor only)	U8	rw	0x02	X	If scaling is enabled, the Slope lateral16-bit value shall be calculated accordingly to the following equation: Slope lateral16-bit = physically measured angle + Differential slope lateral16-bit offset + Slope lateral16-bit offset. If scaling is disabled, the Slope lateral16-bit value shall be equal to the physical measured angle.
0x6022	0	Slope lateral 16-bit preset value (for 2-dimensional sensor only)	I16	rw	0x0000	X	Accessing this object by means of SDO shall set directly the actual lateral slope value to a desired lateral slope value. The calculated application-offset of the lateral slope value is given in Slope lateral16-bit offset (object 6023h). The Slope lateral16-bit offset is calculated with respect to object 6024h. The value shall be given in degree (angle) with resolution given in object 6000h.
0x6023	0	Slope lateral 16-bit offset (for 2-dimensional sensor only)	I16	rw	0x0000	X	This object shall indicate the application-offset of the lateral axis. The value shall be given in angular degrees with resolution given in object 6000h. The following equation shall be applied: Slope lateral16-bit offset = Slope lateral16-bit preset value at tacc –physically measured slope at tacc – Differential slope lateral16-bit offset (tacc = time when accessing object 6022h)
0x6024	0	Slope lateral 16-bit differential offset (for 2-dimensional	I16	rw	0x0000	X	This object shall shift the Slope lateral16-bit value (object 6020h) independent of Slope lateral16-bit preset value (object 6022h) and Slope lateral16-bit offset (object

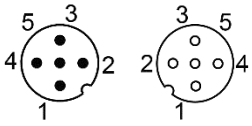
		sensor only)					6023h). The value shall be given in angular degrees with resolution given in object 6000h.
0x6110	0	Slope long 32-bit	I32	ro, m	0x00000000		This object provides the 32-bit slope value of the longitudinal axis. The slope value is given in angular degrees with resolution given in object 6000h.
0x6111	0	Slope long 32-bit operating parameter	U8	rw	0x02	X	See description for object 6011h
0x6112	0	Slope long 32-bit preset value	I32	rw	0x00000000	X	See description for object 6012h
0x6113	0	Slope long 32-bit offset	I32	rw	0x00000000	X	See description object 6013h
0x6114	0	Differential slope long 32-bit offset	I32	rw	0x00000000	X	See description for object 6014h
0x6120	0	Slope lateral 32-bit (for 2-dimensional sensor only)	I32	ro, m	0x00000000		See description for object 6020h
0x6121	0	Slope lateral 32-bit operating parameter (for 2-dimensional sensor only)	U8	rw	0x02	X	See description for object 6021h
0x6122	0	Slope lateral 32-bit preset value (for 2-dimensional sensor only)	I32	rw	0x00000000	X	See description for object 6022h
0x6123	0	Slope lateral 32-bit offset (for 2-dimensional sensor only)	I32	rw	0x00000000	X	See description for object 6023h
0x6124	0	Differential slope lateral 32-bit offset (for 2-dimensional sensor only)	I32	rw	0x00000000	X	See description for object 6024h
0x6511	0	Device temperature	I16	ro, m	0x0000		Internal device temperature of inclination sensor

12 Terminal assignment

12.1 Cable with connector M12, 5-pin

Pin	Assignment	Description	Connector
1	GND	Ground referred to +Vs	 M12 flange connector (plug), A-coded
2	+Vs	Supply voltage	
3	CAN_GND	CAN bus ground	
4	CAN_H	CAN bus signal (dominant High)	
5	CAN_L	CAN bus signal (dominant Low)	

12.2 Cable with connector 2xM12, 5-pin

Pin	Assignment	Description	Connector
1	CAN_GND	Ground connection relating to CAN	 M12 flange connector (plug / socket), 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)	

12.3 Cable

§	Assignment	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
Cable data: 5 x 0.5 mm2		

Terminals of the same significance are internally connected and identical in their functions.
Max. load on the internal terminal connections Vs-Vs and GND-GND is 0.5 A each.