IMS360

Dynamically Compensated Inclinometer

CANopen User Manual

088/25

Table of Contents

1 General Information

1.1 Documentation

The following documents are available for this product:

- Datasheet; describes the technical data, the dimensions, the connection assignments, the accessories and the order code.
- Assembly instruction; describes mechanical and electrical assembly with all safety-relevant conditions and the associated technical specifications.
- User guide; for commissioning and integrating the sensor into a fieldbus system.

These documents can also be found under **http://www.siko-global.com/p/IMS360.**

1.2 Definitions

Decimal values are given as digits without an addition (for example, 1234), except when they are given in direct association with binary or hexadecimal values. Then the extension "d" will be used (e.g. 1234d). Binary values are marked with "b" (e.g. 1011b) and hexadecimal values with "h" (e.g. 280h) after the digits.

1.3 History

Alteration	Date	Description
088/25	15.05.2025	Document created

2 Intended use

The IMS360 captures the absolute position information. The sensor can be parameterized and read out via the CAN interface using the CANopen protocol. For diagnostic purposes, there is an LED (red, green) in the sensor that indicates error or status information.

2.1 Switching on the supply voltage

After switching on, the IMS360 initializes itself. During initialization, the configuration parameters are loaded from the non-volatile memory into the controller's memory.

As long as no changes have been made, the sensor works with its default values. If parameters have been changed, the sensor works with the changed data. If these are to be used even after a power off/on, they must be saved. (See object 1008h: Manufacturer Device Name

The object 1008h specifies the device name. Since this consists of 7 bytes of data, a normal transfer is required to read the SDO.

Subindex	00h					
Description	Device Name in ASCII Notation					
Access	Visible String					
PDO-Mapping	no					
Data type	UNSIGNED 32					
Default	IMS360					
EEPROM	no					
Data content	Read:					
	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
	49h ("I")	4Dh ("M")	53h ("S")	33h ("3")	36h ("6")	30h ("0")

2.1.1 1009h: Manufacturer Hardware Version

Object 1009h specifies the hardware version.

Subindex	00h
Description	Hardware version in ASCII notation
Access	const
PDO-Mapping	no
Data type	Visible_String
Default	-
EEPROM	no
Data content	The hardware version is encoded in one byte and represents the revision number.

2.1.2 100Ah: Manufacturer Software Version

Subindex	00h
Description	Software version in ASCII notation
Access	const
PDO-Mapping	no
Data type	Visible_String
Default	-
EEPROM	no
Data content	The software version is encoded in three bytes and is divided into major version (MA), minor version (MI) and release number (REL) of the software.

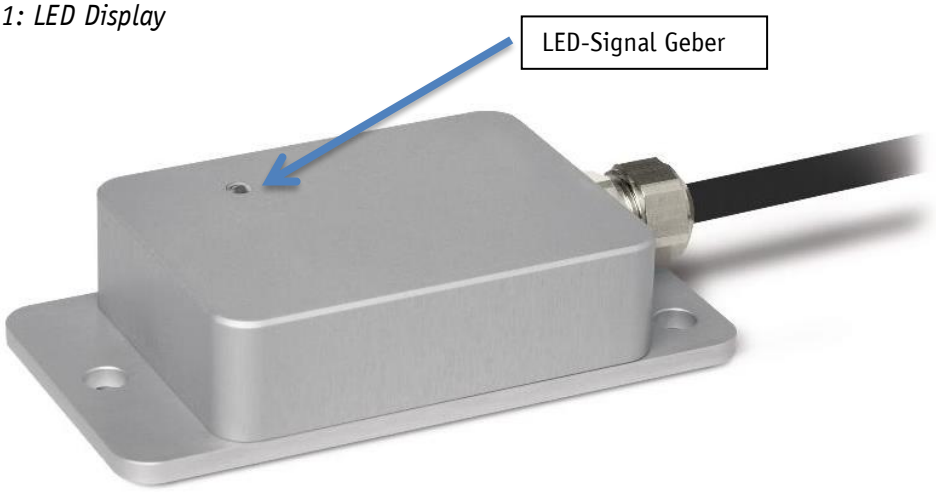
1010h: Store Parameter). After the initialization procedure is complete, the sensor sends a specific NMT command, the boot-up message, which informs the system of its availability. The IMS360 is now in Pre-Operational Mode. In this state, the encoder can be parameterized via SDO commands according to the requirements of the application. This applies both to the configuration parameters of the sensor unit and to the way in which it makes its position values available to the system (asynchronous or synchronous data transmission).

3 LED Display

The sensor has an LED in the colors green and red for diagnostic and status purposes.

- A green LED to indicate the NMT status (CAN Run LED)
- A red LED for CAN fault conditions (CAN Err LED) or LSS configuration status

Fig. 1: LED Display



CAN

Diagnostics (green):

LED Condition	Description
One	LED is on all the time
From	LED is constantly off
Flicker	Both LEDs flicker at a frequency of 10 Hz (50 ms on/off)
Flash	LED flashes at a frequency of 2.5 Hz (200 ms on/off)
Single Flashing	LED is 200 ms on, 1000 ms off
Double flashing	LED is 200 ms on, 200 ms off, 200 ms on, 1000 ms off

Table 1: CAN LED states according to CiA 303 Part 3

CAN Run LED (rot):

Device Condition	LED Condition
Pre-Operational	Flash
Operational	One
Stopped	Just blink

Table 2: CAN Run LED

CAN Err LED:

Error conditions	LED Condition
No error	From
Warning limit reached (at least one error counter (Transmit Error Counter CANTEC or Receive Error Counter CANREC) of the CAN controller has reached or exceeded the warning limit (too many error frames).	Just blink
Error Control Event: A guard event (if no RTR Node Guard has been received by the master within the set lifetime).	Double flashing
Bus off	One

Table 3: CAN Err LED

4 Description of Functions

4.1 Measuring range

The inclinometer supports 2 measurement ranges. A measuring range of 0 ... 360° and ±90°. The measurement range can be extended via the object 3120h: Sensor Configuration can be switched.

4.2 Calibration

Due to the absolute measuring system, calibration is only required once during commissioning and can be carried out at any point. This allows the inclinometer zero point to be aligned with the mechanical zero point of the system. During calibration (see chapter7.2.41), the calibration value is used to calculate the slope value.

4.3 Restore factory settings

To restore the device to its original state, there is the following option:

Access	Coding		Reset to factory settings
see object 1011h: Restore Parameter	1011h"load"	Subindex 1	all user parameters
		Subindex 2	Bus parameters only
		Subindex 3	nur CiA 406-Parameter
		Subindex 4	only manufacturer-specific parameters
		Subindex 5	all parameters

Table 4: Accessing Factory Settings

5 Signal processing and filtering

The IMS360 is equipped with two different types of filters:

- Low-pass filter "Critical Damped" and Butterworth
- Kalman filter (only if sensor fusion is supported by the sensor)

The following figure illustrates the data flow of the measured values through these filters.

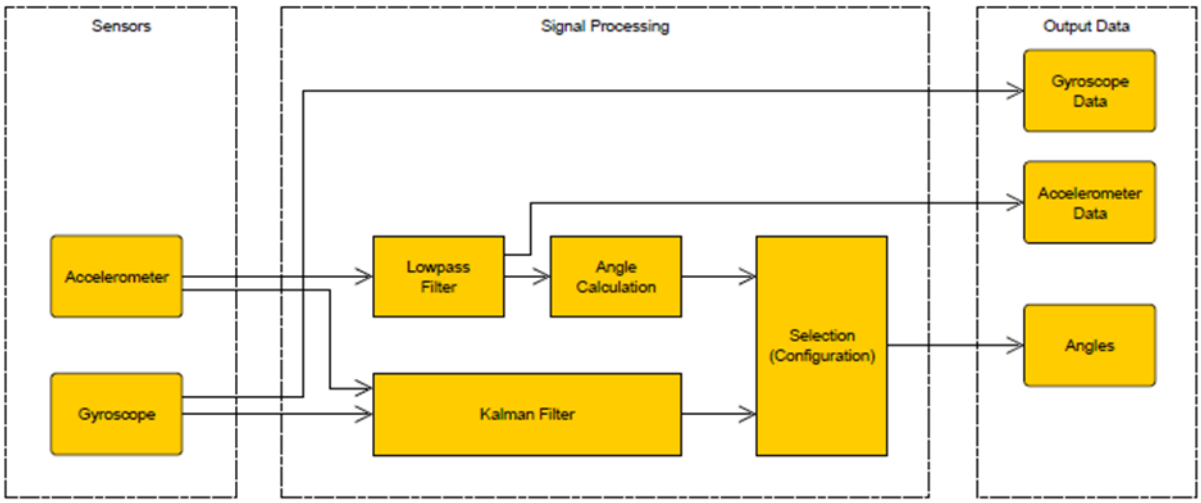


Fig. 2: Sensor data flow

Depending on the sensor configuration, the angles are calculated by the Kalman filter using accelerometer and gyroscope data or by an algorithm. This only uses the low-pass filtered accelerometer data.

5.1.1 Low-Pass Filter

The tilt data can be filtered with digital low-pass filters. The IMS360 is equipped with two adjustable low-pass filters for signal correction:

- Critical Damped Filter 8. Ordnung
- 8th order Butterworth filter

The following table shows the filter characteristics in comparison:

Critical Damped Filter	Butterworth Filter
Universal filter	Specific applications
Short response time	Higher attenuation
Short delay time	The attenuation starts just above the set cut-off frequency
No overshoot	Overshoot

Table 5 Filter characteristics

5.1.2 Critical Damped Filter

The Critical Damped Filter is suitable for most requirements due to its short response time. If the output signal is overlaid with noise or interference, the optimal setting is determined by gradually lowering the cut-off frequency fG to the limit of the response time t_R .

For this type of filter, the response time is:

$$t_R = \frac{1}{f_G}$$

The lowest adjustable cut-off frequency is 0.1 Hz and should be tested if the response time t_R is not relevant to the application. A cut-off frequency of 2000 mHz is preset at the factory.

5.1.3 Butterworth Filter

Due to its characteristics, the Butterworth filter tends to overshoot during jumps in the input signal. The filter should be used where there are no or only minor mechanical shocks and vibrations. This is especially important if the sensor works in a control loop. The filter can be used well to reduce low-frequency interference, which is caused by vibrations, for example. This is achieved by the greater separation of passing frequency and cut-off frequency.

5.1.4 Kalman Filter

5.1.4.1 General Information

The Kalman filter combines the sensor data from the accelerometer and gyroscope to achieve the following goals.

- Fast filter response: The output of the Kalman filter responds immediately with a negligible delay to a change in sensor orientation.
- Good attenuation of the influence of the acceleration components in addition to the gravitational force on the calculated angles.

The following diagram shows the behavior of the Kalman filter and the low-pass filter of a sensor rotated from -45° to +45°. You can see that the Kalman filter reacts immediately, while the low-pass filter has a delay of about 0.2 seconds.

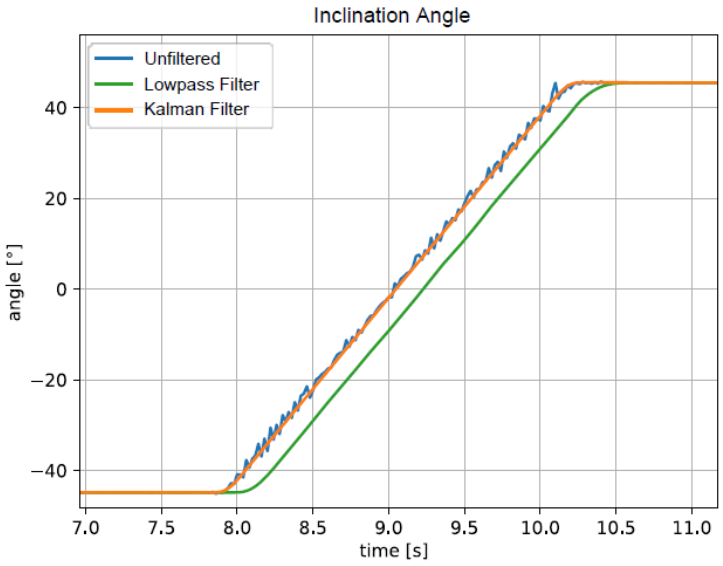


Fig. 3: Filter Type Latency

The following diagram shows the response of the Kalman filter and the low-pass filter to vibrations acting on the sensor.

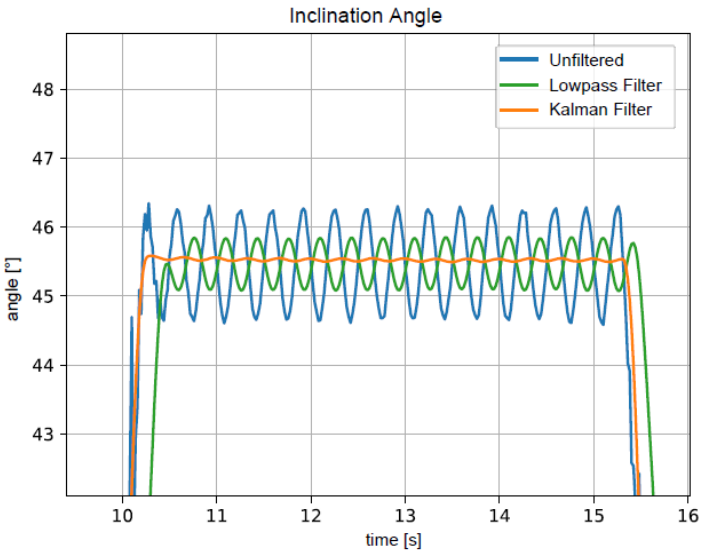


Fig. 4: Filter Type Vibration Suppression

The following filter configurations were used:

- Low-pass Filter: Critical damped, fc = 3.0 Hz
- Kalman Filter Parameter: R = 10.0, Q = 0.001

5.1.4.2 Configuration

For the configuration of the Kalman filter, the parameters R (measurement noise) and Q (system state transition noise) are used. These two floating-point values are defined by the mantissa M and the exponent E. Mantissa and exponent are each two signed integer8 numbers. The value of the parameters is calculated as follows.

$$x = M \times 10^{E}$$

Examples:

The value 0.001 (1 x 10-3) is set as follows:

1.Byte	2.Byte
E	M
FDh (-3d)	1h (1d)

The value of 10 (1 x 101) is set as follows:

1.Byte	2.Byte
E	M
1h (1d)	1h (1d)

Usually, it is sufficient to adjust the parameter Q and leave the parameter R at its default value of 10.0. Changes in the filter behavior due to modifications of the parameter Q can also be achieved to the same extent by changing the parameter R. When parameter R is set to its default value of 10.0, useful values for parameter Q are usually in the range of 0.01 to 0.0001 (exceptions in special applications cannot be ruled out). As a rule, it is sufficient to change the exponent E of parameter Q to adapt the behavior of the Kalman filter to the application. Smaller values of Q cause the gyroscope to have a stronger influence on the angular value, but this also increases the static error due to the gyro offset error. At the same time, disturbing acceleration components caused by vibrations and shocks are suppressed to a greater extent.

The dynamics of the filter (signal delay) are not affected by the Q and R parameters.

5.2 Selecting the correct filter

Deciding which filter to use for a particular application depends on the requirements of the application.

The following table provides support in selecting a filter.

Request	Preferred filter
High static accuracy	Low-Pass Filter
High noise reduction	Butterworth
Use in control loops	Critical damped oder Kalman Filter
Vibration suppression	Kalman Filter
Fast filter response	Kalman Filter

Table 6: Selecting the right filter

6 Communication via CANopen

The basis for the IMS360 inclination sensor is the CANopen communication profile CiA 301 and the device profile for inclination sensors CiA 410. The details necessary to better understand how it works are contained in this documentation. If more detailed information is required, we recommend the corresponding technical literature on CAN or CANopen and the user information of the controller used and the CANopen master.

6.1 Process data exchange

6.1.1 Process Data Object (PDO)

Process data objects (PDO) are used for the rapid exchange of process data. A maximum of 8 bytes of payload data can be transmitted in a PDO. These can be dynamically mapped and are transmitted in three possible operating modes.

The IMS360 supports Transmit PDO services TPDO1, TPDO2, TPDO3 and TPDO4.

6.1.2 Transmit-PDO (from IMS360 to Master)

A PDO transfer from the IMS360 to the bus master (TPDO) can be initiated by various events:

- Asynchronous transmission, controlled by the internal device timer
- Synchronous transmission, in response to a SYNC message
- Event-driven transfer, in response to a change in value

The operating modes for PDO transmission are set with the standardized TPDO communication parameters in the objects 1800h to 1803h. Within these TPDO communication parameters, the transmission type, blocking time and event time can be adjusted.

The TPDO can be enabled or disabled by setting the valid flag (bit 31) in the PDO COB ID. Only when the TPDO is disabled can the mapping of the PDO data be configured. The TPDO communication parameters of all 4 TPDOs can be stored in persistent memory.

6.1.3 TPDO Mapping

The data of the TPDO is defined with the standardized TPDO mapping parameters in the objects 1A00h to 1A03h. This allows the parameters that are transmitted with the individual TPDO to be set for specific applications.

Index	Subindex	Parameter	Max Number of Bits	Input Value
3000h	01h	Status-Byte ST0	8	30000108h
3010h	01h	Acceleration Value X Axis	16	30100110h
	02h	Acceleration Value Y Axis	16	30100210h
	03h	Acceleration Value Z Axis	16	30100310h
3011h	00h	Acceleration HiRes X Axis	32	30110020h
3012h	00h	Acceleration HiRes Y Axis	32	30120020h
3013h	00h	Acceleration HiRes Z Axis	32	30130020h
3020h	01h	Gyroscope Value X Axis	16	30200110h
	02h	Gyroscope Value Y Axis	16	30200210h
	03h	Gyroscope Value Z Axis	16	30200310h
3021h	00h	Gyroscope HiRes X Axis	32	30210020h
3022h	00h	Gyroscope HiRes Y Axis	32	30220020h
3023h	00h	Gyroscope HiRes Z Axis	32	30230020h
6110h	00h	Slope long32	32	61100020h
6120h	00h	Slope lateral32	32	61200020h
6511h	00h	Device temperature	8	65110008h

Table 7: TPDO Mapping

Before the mapping parameters can be set, the TPDO must be deactivated and the first entry of the object (subindex 0) must be set to 0. After the mapping parameters have been changed, the first entry of the object must be set to the number of mapped objects (maximum 8) and the TPDO must be re-enabled.

The TPDO mapping parameters of all 4 TPDOs can be stored in persistent memory. (see 1010h: Store Parameter)

Example:

The TPDO2 is supposed to output the value of the gyroscope X,Y,Z.

Step	Description
1	Disable TPDO2 Object: 1801h 01h Data: 800001B2h
2	Set the number of mapped objects to 0 Object: 1A01h 00h Data: 00000000h
3	Set a mapped object Object: 1A01h 01h Data: 30200110h Object: 1A01h 02h Data: 30200210h Object: 1A01h 03h Data: 30200310h
4	Set number of mapped objects (here in example 3) Object: 1A01h 00h Data: 00000003h
5	Enable TPDO2 Object: 1801h 00h Data: B2010000h
6	Set TPDO2 cycle time to a value > 0 (if asynchronous transmission is set.) Object 1801h 05h Data: 00000064h

6.2 Node Monitoring

6.2.1 Emergency-Dienst (EMCY)

In the event of a malfunction, the status of the bus subscriber is transmitted via 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 been resolved. The cause of the fault is stored in the fault buffer (see object 1003h: Pre-defined Error Field). An emergency object is sent only once per error event. If a cause of the fault has been eliminated, this is signalled by sending an emergency message with the error code 0000h (No Error). If there are several faults and one cause of the fault is eliminated, the error code 0000h is also output, but the still existing fault state is indicated 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)				

6.2.2 Emergency Error Code:

Description	Error Code
Cause of malfunction eliminated	0000h
Supply voltage	3100h
Longitudinal value out of range	5010h
Lateral value out of range	5020h
CAN Overflow	8110h
CAN in Error Passive Mode	8120h
Communication restored after Bus Off	FF14h
CANopen device-specific	FF00h
Longitudinal sensor is defective	FF01h
Lateral sensor is defective	FF02h

Table 8: Emergency Error Code

The identifier of the Emergency object is set to 80h +Node-Id, but can be changed with the object 1014h (). The transmission of an emergency message is only possible in the NMT status "OPERATIONAL" or "PRE-OPERATIONAL". The transmission of the emergency messages can be disabled by setting the COB ID valid bit 31 to 1.

6.2.3 Heartbeat

The master monitors the state of the slave device via the heartbeat protocol. The device automatically sends its NMT status cyclically. The IMS360 is a heartbeat producer, it does not receive or process heartbeat protocols itself. The cycle time of the heartbeat message is set via the object 1017h. The heartbeat protocol is disabled when the cycle time is 0h.

The heartbeat message consists of the COB ID and an additional byte. The current NMT state is stored in this byte.

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 fixed to 700h + node ID and cannot be changed. Heartbeat messages are sent in the NMT status "OPERATIONAL", "PRE-OPERATIONAL" or "STOPPED".

6.3 Layer Setting Service (LSS)

Layer Setting Service (LSS) is a special method described in CiA 305 that is used to retrieve and configure various parameters (node ID, baud rate, and identity object 1018h).

Each device must have a unique NSSO number, which is made up of the entries in object 1018h.

- Vendor-ID: 0000 0195h
- Product code: 0001 869Fh
- Revision number: 0000 0000h
- Serial number: xxxx xxxxh (respective serial number of the device)

In order to be able to use the full 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 starting, the device is in the LSS waiting state. To enable the configuration, one or all devices must be placed in the LSS configuration state. If the LSS master expects a response to its command, only one LSS slave needs to be switched to LSS configuration mode.

There are two NSSO services available:

- LSS (rx) (LSS Master IMS360): 7E5h
- LSS (tx) (IMS360 LSS Master): 7E4h

These NSSO identifiers cannot be changed!

A message always consists of 8 bytes. Byte 0 contains the command (Command – Specifier cs), followed by max. 7 data bytes unused data bytes are reserved and must be filled with 00h.

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

Services	LSS waiting	LSS configuration
Configure node-ID	No	And
Store configuration	No	Yes
LSS address anfordern	No	Yes
Request Node ID	No	And

7 List of objects

The object directory is a list of the accessible functions and parameters of a device. It is the interface between the application program and the device. Each row in the directory's list represents a communication object that is accessible through a specific 16-bit index and an 8-bit sub-index.

7.1 Object overview

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

Name	Description	see page
1000h: Device Type	Device profile and encoder type.	18
1001h: Error Register	Current error state of the device.	19
1003h: Pre-defined Error Field	The object stores the 8 most recent error states.	19
1005h: COB-ID SYNC	Settings for the COB ID of the SYNC object	20
1008h: Manufacturer device name	Device name in ASCII notation	20
1005h: COB-ID SYNC	Specifies the hardware version of the device.	20
100Ah: Manufacturer Software Version	Specifies the software version of the device	20
1010h: Store Parameter	Object for non-volatile saving of settings.	21
1011h: Restore Parameter	Factory reset object.	22
1014h: COB-ID Emergency Message	COB ID of the emergency object.	24
1017h: Producer Heartbeat Time	Heartbeat cycle time	24
1018h: Identity Object	contains the manufacturer number	24
1800h: 1. Transmit PDO Parameter	Settings for the 1st TPDO	25
1801h: 2. Transmit PDO Parameter	Settings for the 2nd TPDO	27
1802h: 3. Transmit PDO Parameter	Settings for the 3rd TPDO	29
1803h: 4. Transmit PDO	Settings for the 4th TPDO	30

Name	Description	see page
3220h: Slope Lateral Zero Offset (Inclination Y Axis)	Specifies the lateral slope value	51
6000h: Resolution	Specifies the resolution of the longitudinal and lateral slope values	52
6110h: Slope Longitudinal (Inclination X Axis)	32-bit Longitudinal Axis Tilt Value	52
6111h: Slope Long Operating Parameter (Inclination X Axis)	Specifies the interpretation of the 32-bit longitudinal value	52
6120h: Slope Lateral (Inclination Y Axis)	32-bit lateral axis tilt value	53
6121h: Slope Lateral Operating Parameter (Inclination Y Axis)	Specifies the interpretation of the 32-bit lateral value	53
6511h Device Temperature6511h: Device Temperature	Provides the temperature of the inclinometer	53

Table 9: Object overview

7.2 Object Description

7.2.1 1000h: Device Type

The object 1000h indicates the device profile number.

Subindex	00h			
Description	Information about device profile and device type			
Access	ro			
Data type	UNSIGNED 32			
Default	1-axis: 0703019Ah 2-axis: 0704019Ah			
EEPROM	no			
Data content	Device Profile Number		Transducer Type	
	Byte 0	Byte 1	Byte 2	Byte 3
	9Ah	01h	03h / 04h	07h

019Ah (= 410d): CANopen Device Profile for Inclinometers

Type:

0703h: 1-Axis

0704h: 2-Axis

7.2.2 1001h: Error Register

Object 1001h indicates the error status of the device.

Subindex	00h	
Description	Current error condition	
Access	ro	
Data type	UNSIGNED 8	
Default	0h	
EEPROM	no	
Data content	Bit	Meaning
	0	set bit indicates the occurrence of any error condition
	4	set bit indicates communication error on the CAN bus (passive or bus off)
	7	Manufacturer-specific (Sensorfehler)
	1 ... 3, 5 ... 6	Not used

Faults and errors are signalled by an emergency message at the moment they occur.

7.2.3 1003h: Pre-defined Error Field

In object 1003h, the 8 most recently occurring error states are archived (see chapter6.2.2).

- The entry under subindex 0 indicates the number of stored errors.
- The current error state is always stored in subindex 01h. Previous error messages move forward in the position by one sub-index.
- The entire error list is cleared by writing the value 0h at subindex 00h.
- The entries in the error list have the format as in chapter6.2.2 described.

Subindex	00h
Description	Number of saved error messages
Access	rw
PDO Mapping	no
Data type	UNSIGNED 8
Default	0h
EEPROM	yes

Subindex	01h ... 10h
Description	Error messages encountered
Access	ro
PDO Mapping	no
Data type	UNSIGNED 32
Default	0h
EEPROM	yes

7.2.4 1005h: COB-ID SYNC

The COB ID of the SYNC object is set via object 1005h

Subindex	00h
Description	Defines the COB ID of the synchronization object (SYNC)
Access	rw (can only be written in the "Pre-Operational" state)
PDO mapping	no
Data type	UNSIGNED 32
Default	80h
EEPROM	yes

7.2.5 1008h: Manufacturer Device Name

The object 1008h specifies the device name. Since this consists of 7 bytes of data, a normal transfer is required to read the SDO.

Subindex	00h					
Description	Device Name in ASCII Notation					
Access	Visible String					
PDO-Mapping	no					
Data type	UNSIGNED 32					
Default	IMS360					
EEPROM	no					
Data content	Read:					
	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
	49h ("I")	4Dh ("M")	53h ("S")	33h ("3")	36h ("6")	30h ("0")

7.2.6 1009h: Manufacturer Hardware Version

Object 1009h specifies the hardware version.

Subindex	00h
Description	Hardware version in ASCII notation
Access	const
PDO-Mapping	no
Data type	Visible_String
Default	-
EEPROM	no
Data content	The hardware version is encoded in one byte and represents the revision number.

7.2.7 100Ah: Manufacturer Software Version

Subindex	00h

Description	Software version in ASCII notation
Access	const
PDO-Mapping	no
Data type	Visible_String
Default	-
EEPROM	no
Data content	The software version is encoded in three bytes and is divided into major version (MA), minor version (MI) and release number (REL) of the software.

7.2.8 1010h: Store Parameter

With this object, parameters are transferred to the EEPROM so that they are present in a voltage failure-proof manner. Depending on the selection of which subindex is accessed, different parameter groups are stored. The string "save" must be sent as data content.

Subindex	00h
Description	displays the largest supported sub-index
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	4h
EEPROM	no

Subindex	01h			
Description	Saving User Parameters			
Access	rw			
PDO-Mapping	no			
Data type	UNSIGNED 32			
Default	1h			
EEPROM	no			
Data content	To write:			
	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 save parameters independently		
	Bit 0	1: Device saves parameters on command		

7.2.9 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 must be performed. If the restored parameters are to be permanently available, they must then be accessed via the object 1010h: Store Parameter can be saved.

Subindex	00h
Description	displays the largest supported sub-index
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	4h
EEPROM	no

Subindex	01h			
Description	Set all user parameters to factory settings			
Access	rw			
PDO-Mapping	no			
Data type	UNSIGNED 32			
Default	1h			
EEPROM	no			
Data content	To write:			
	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 default parameters to be loaded		

Subindex	02h			
Description	only set communication parameters to factory settings (1000h ... 1FFFh, CiA 301)			
Access	rw			
PDO-Mapping	no			
Data type	UNSIGNED 32			
Default	1h			
EEPROM	no			
Data content	To write:			
	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 default parameters to be loaded		

Subindex	03h			
Description	only set application parameters to factory settings (6000h ... 9FFFh, CiA 406)			
Access	rw			
PDO-Mapping	no			
Data type	UNSIGNED 32			
Default	1h			
EEPROM	no			
Data content	To write:			
	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 default parameters to be loaded		

Subindex	04h			
Description	only set manufacturer-specific parameters to factory settings (2000h ... 5FFFh)			
Access	rw			
PDO-Mapping	no			
Data type	UNSIGNED 32			
Default	1h			
EEPROM	no			
Data content	To write:			
	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 default parameters to be loaded		

Subindex	05h			
Description	Set all parameters to factory settings			
Access	rw			
PDO-Mapping	no			
Data type	UNSIGNED 32			
Default	5h			
EEPROM	no			
Data content	To write:			
	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 default parameters to be loaded

7.2.10 1014h: COB-ID Emergency message

The COB ID of the Emergency object is set with the object 1014h.

Subindex	00h
Description	Defines the COB ID of the Emergency Object (EMCY)
Access	rw (writable in the PreOperational State)
PDO-Mapping	no
Data type	UNSIGNED 32
Default	80h+ node ID
EEPROM	yes

7.2.11 1017h: Producer Heartbeat Time

The 1017h object is used to set the "Heartbeat Time" cycle time for the heartbeat protocol. The cycle time is given in milliseconds.

Subindex	00h
Description	defines the cycle time of the heartbeat monitoring service
Access	rw
PDO-Mapping	no
Data type	Unsigned16
Default	0
EEPROM	yes
Data content	0d, 10d ... 65535d (0h, Ah ... FFFFh); the numerical value corresponds to a multiple of 1 ms. A value of 0h disables the service.

7.2.12 1018h: Identity Object

Object 1018h indicates the manufacturer identification number (vendor ID).

Subindex	00h
Description	displays the largest supported sub-index
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	4h
EEPROM	no

Subindex	01h

Description	Manufacturer identification number (vendor ID) issued by CiA for SIKO GmbH
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	1869Fh
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	0h
EEPROM	no

Subindex	04h
Description	Serial Number
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 32
Default	1h
EEPROM	yes

7.2.13 1800h: 1. Transmit PDO Parameter

The communication parameters for TPDO1 are set via the object 1800h.

Subindex	00h
Description	displays the largest supported sub-index
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	5h
EEPROM	no

Subindex	01h
Description	COB ID of TPDO1
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	180h + 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	1h (1d) ... F0h (240d)	PDO is sent after 1d... 240d SYNC messages received
	FCh (252d) FDh (253d)	The device will only respond to RTR requests if RTR bit 30 is enabled in the COB ID.
	FEh (254d) FFh (255d)	PDO has asynchronous properties (PDO is sent depending on the "event timer").

Subindex	03h
Description	Inhibit Time
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 16
Default	0
EEPROM	and

Subindex	04h (is not used, access attempt generates error message)
Description	reserved
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	0
EEPROM	no

Subindex	05h
Description	Event timer for TPDO2
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 16
Default	0
EEPROM	yes
Data content	Writing the value 0h will disable the service. If the value is changed while the timer is running, the change will not be applied until the next timer operation.

7.2.14 1801h: 2. Transmit PDO Parameter

The communication parameters for TPDO2 are set via the object 1801h.

Subindex	00h
Description	displays the largest supported sub-index
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	5h
EEPROM	no

Subindex	01h
Description	COB ID of TPDO2
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	80000280h + 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	1h (1d) ... F0h (240d)	PDO is sent after 1d... 240d SYNC messages received
	FCh (252d) FDh (253d)	The device will only respond to RTR requests if RTR bit 30 is enabled in the COB ID.
	FEh (254d) FFh (255d)	PDO has asynchronous properties (PDO is sent depending on the "event timer").

Subindex	03h
Description	Inhibit Time
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 16
Default	0
EEPROM	and

Subindex	04h (is not used, access attempt generates error message)
Description	reserved
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	0
EEPROM	no

Subindex	05h
Description	Event timer for TPDO2
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 16
Default	0
EEPROM	yes
Data content	Writing the value 0h will disable the service. If the value is changed while the timer is running, the change will not be applied until the next timer operation.

7.2.15 1802h: 3.Transmit PDO Parameter

The communication parameters for TPDO3 are set via the object 1802h.

Subindex	00h
Description	displays the largest supported sub-index
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	5h
EEPROM	no

Subindex	01h
Description	COB ID of TPDO3
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	80000380h + 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	1h (1d) ... F0h (240d)	PDO is sent after 1d... 240d SYNC messages received
	FCh (252d) FDh (253d)	The device will only respond to RTR requests if RTR bit 30 is enabled in the COB ID.
	FEh (254d) FFh (255d)	PDO has asynchronous properties (PDO is sent depending on the "event timer").

Subindex	03h
Description	Inhibit Time
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 16
Default	0
EEPROM	yes

Subindex	04h (is not used, access attempt generates error message)
Description	reserved
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	0
EEPROM	no

Subindex	05h
Description	Event timer for TPDO3
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 16
Default	0
EEPROM	yes
Data content	Writing the value 0h will disable the service. If the value is changed while the timer is running, the change will not be applied until the next timer operation.

7.2.16 1803h: 4.Transmit PDO Parameter

The communication parameters for TPDO4 are set via the object 1803h.

Subindex	00h
Description	displays the largest supported sub-index
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	5h
EEPROM	no

Subindex	01h
Description	COB ID of TPDO4
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	80000480h + 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	1h (1d) ... F0h (240d)	PDO is sent after 1d... 240d SYNC messages received
	FCh (252d) FDh (253d)	The device will only respond to RTR requests if RTR bit 30 is enabled in the COB ID.
	FEh (254d) FFh (255d)	PDO has asynchronous properties (PDO is sent depending on the "event timer").
Subindex	03h	
Description	Inhibit Time	
Access	rw	
PDO-Mapping	no	
Data type	UNSIGNED 16	
Default	0	
EEPROM	yes	

Subindex	04h (is not used, access attempt generates error message)
Description	reserved
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	0
EEPROM	no

Subindex	05h
Description	Event timer for TPDO4
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 16
Default	0
EEPROM	no
Data content	Writing the value 0h will disable the service. If the value is changed while the timer is running, the change will not be applied until the next timer operation.

7.2.17 1A00h: 1. Transmit PDO Mapping Parameter

Object 1A00h determines the objects that will be mapped on the first transmit PDO (TPDO1).

Subindex	00h
Description	displays the largest supported sub-index
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	8h
EEPROM	yes

Subindex	01h
Description	Mapping Entry 1
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	61100020h (Slope long32 object 6010h, sub-index 00h, 32bit)
EEPROM	yes

Subindex	02h
Description	Mapping Entry 2
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	61200020h (Slope lateral32 object 6020h, sub-index 00h, 32bit) – Nur bei 2 Achsen sensor
EEPROM	yes

Subindex	03h
Description	Mapping Entry 3
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	04h
Description	Mapping Entry 4
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

7.2.18 1A01h: 2. Transmit PDO Mapping Parameter

Object 1A01h determines the objects that will be mapped on the first transmit PDO (TPDO2).

Subindex	00h
Description	displays the largest supported sub-index
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	8 a.m.
EEPROM	yes

Subindex	01h
Description	Mapping Entry 1
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	02h
Description	Mapping Entry 2
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	03h
Description	Mapping Entry 3
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	04h
Description	Mapping Entry 4
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	05h
Description	Mapping Entry 5
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	06h
Description	Mapping Entry 6
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	07h
Description	Mapping Entry 7
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	08h
Description	Mapping Entry 8
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

7.2.19 1A02h: 3. Transmit PDO Mapping Parameter

Object 1A02h determines the objects that will be mapped on the first transmit PDO (TPDO3).

Subindex	00h
Description	displays the largest supported sub-index
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	8 a.m.
EEPROM	yes

Subindex	01h
Description	Mapping Entry 1
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	02h
Description	Mapping Entry 2
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	03h
Description	Mapping Entry 3
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	04h
Description	Mapping Entry 4
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	05h
Description	Mapping Entry 5
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	06h
Description	Mapping Entry 6
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	07h
Description	Mapping Entry 7
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	08h
Description	Mapping Entry 8
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

7.2.20 1A03h: 4. Transmit PDO Mapping Parameter

Object 1A03h determines the objects that will be mapped on the first transmit PDO (TPDO4).

Subindex	00h
Description	displays the largest supported sub-index
Access	const
PDO-Mapping	no
Data type	UNSIGNED 8
Default	8 a.m.
EEPROM	yes

Subindex	01h
Description	Mapping Entry 1
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	02h
Description	Mapping Entry 2
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	03h
Description	Mapping Entry 3
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	04h
Description	Mapping Entry 4
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	05h
Description	Mapping Entry 5
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	06h
Description	Mapping Entry 6
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	07h
Description	Mapping Entry 7
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

Subindex	08h
Description	Mapping Entry 8
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	0
EEPROM	yes

7.2.21 2000h: Logistic Data

Subindex	00h
Description	displays the largest supported sub-index
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8
Default	3h
EEPROM	no

Subindex	01h
Description	Includes the serial number of the sensor
Access	ro
PDO-Mapping	no
Data type	Visible String
Default	-
EEPROM	no

Subindex	02h
Description	Includes the version number of the sensor (The version number is also on the nameplate after the product name (IMS360_)
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 32
Default	-
EEPROM	no

Subindex	03h						
Description	Includes the device ID of the sensor						
Access	ro						
PDO-Mapping	no						
Data type	Visible String						
Default	IMS360						
EEPROM	no						
Data Content	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	
	49h ("I")	4Dh ("M")	53h ("S")	33h ("3")	36h ("6")	30h ("0")	

7.2.22 2001h: Baudrate

The object 2001h sets the baud rate of communication

Subindex	00h
Description	Baudrate des CAN-Bus
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 32
Default	1E848h (125kbit/s)
EEPROM	yes
Data content	1E848h: 125 kbit/s (default) 3D090h: 250 kbit/s 7A120h: 500 kbit/s C3500h: 800 kbit/s F4240h: 1000 kbit/s

7.2.23 2002h: Node ID

Object 2002h sets the node ID.

Subindex	00h
Description	Node ID
Access	Wr
PDO-Mapping	No
Data type	UNSIGNED 8
Default	32h
EEPROM	yes
Data content	01h ... 7Eh

7.2.24 2010h: Controller Settings

Object 2003h requests controller-specific commands.

Subindex	00h
Description	displays the largest supported sub-index
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8
Default	2h
EEPROM	no

Subindex	01h
Description	Set Controller
Access	where
PDO-Mapping	No
Data type	UNSIGNED 8
Default	0h
EEPROM	no
Data content	01h: Reset of the Controllers

7.2.25 2020h Internal Values

The Object 2020h provides internal analogue diagnostic values.

Subindex	00h
Description	displays the largest supported sub-index
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8
Default	1h
EEPROM	no

Subindex	01h
Description	Contains the currently measured supply voltage with a resolution of 1 mV
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 32
Default	-
EEPROM	no

7.2.26 20FFh: Version of Layout

Object 20FFh contains the layout version of the standard SDOs currently in use.

Subindex	00h

Description	Version des Layouts
Access	ro
PDO-Mapping	No
Data type	UNSIGNED 16
Default	1h
EEPROM	no

7.2.27 3000h: Status

Object 3000h contains status information of the sensor

Subindex	00h
Description	displays the largest supported sub-index
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8
Default	5h
EEPROM	no

Subindex	01h	
Description	Status Byte ST0	
Access	ro	
PDO-Mapping	yes	
Data type	UNSIGNED 8	
Default	0h	
EEPROM	no	
Data content	**Bit**	**Description**
	3 … 7	Reserved
	2	0: At least one setting deviates from the factory setting. 1: Factory settings are active.
	1	0: No error 1: Error in the sensor, which prevents reliable calculation of the angular values and no longer ensures compliance with the specification. A set bit is an indication of a hardware problem.
	0	0:1-axis sensor (360°) 1: 2-axis sensor (±90°)

Subindex	02h
Description	Status Byte ST1
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8

Default	0h
EEPROM	no

Subindex	03h
Description	Status Byte ST2
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8
Default	0
EEPROM	no

Subindex	04h
Description	Status Byte ST3
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8
Default	0
EEPROM	yes

Subindex	05h
Description	Status Byte ST4
Access	ro
Data type	UNSIGNED 8
Default	0h
EEPROM	no

7.2.28 3010h: Acceleration Values

Subindex	00h
Description	displays the largest supported sub-index
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8
Default	3h
EEPROM	no

Subindex	01h
Description	Acceleration of raw value X-axis (resolution is 0.001 g; 1 g = 9.81 m/s²)
Access	ro
PDO-Mapping	Yes

Data type	Integer 16
Default	0h
EEPROM	no
Data content	-32768 ... +32767

Subindex	02h
Description	Acceleration of the raw value of the Y-axis (resolution is 0.001 g; 1 g = 9.81 m/s²)
Access	ro
PDO-Mapping	yes
Data type	INTEGER 16
Default	0h
EEPROM	no
Data content	-32768 ... +32767

Subindex	03h
Description	Acceleration of the raw value of the Z-axis (resolution is 0.001 g; 1 g = 9.81 m/s²)
Access	ro
PDO-Mapping	yes
Data type	INTEGER 16
Default	0h
EEPROM	no
Data content	-32768 ... +32767

7.2.29 3011h: Acceleration HiRes X axis

Object 3011h contains the acceleration value of the X-axis

Subindex	00h
Description	Acceleration HiRes X-axis (resolution is 0.001 g; 1 g = 9.81 m/s²)
Access	ro
PDO Mapping	yes
Data type	Integer 32
Default	0h
EEPROM	no
Data content	2,147,483,648 ... +2,147,483,647

7.2.30 3012h: Acceleration HiRes Y axis

Object 3012h contains the acceleration value of the Y-axis

Subindex	00h

Description	Acceleration HiRes Y-axis (resolution is 0.001 g; 1 g = 9.81 m/s²)
Access	ro
PDO Mapping	yes
Data type	Integer 32
Default	0h
EEPROM	no
Data content	2,147,483,648 ... +2,147,483,647

7.2.31 3013h: Acceleration HiRes Z axis

Object 3013h contains the acceleration value of the Z-axis

Subindex	00h
Description	Acceleration HiRes Z-axis (resolution is 0.001 g; 1 g = 9.81 m/s²)
Access	ro
PDO Mapping	yes
Data type	Integer 32
Default	0h
EEPROM	no
Data content	2,147,483,648 ... +2,147,483,647

7.2.32 3020h: Gyro Values

Object 3020h contains raw values of the gyroscope of all three axes

Subindex	00h
Description	displays the largest supported sub-index
Access	ro
PDO-Mapping	no
Data type	INTEGER 16
Default	3h
EEPROM	no

Subindex	01h
Description	Raw value X-axis (resolution is 0.1 degrees per second)
Access	ro
PDO-Mapping	yes
Data type	INTEGER 16
Default	0h
EEPROM	no
Data content	-32768 ... +32767

Subindex	02h
Description	Raw value Y-axis (resolution is 0.1 degrees per second)
Access	ro
PDO-Mapping	yes
Data type	INTEGER 16
Default	0h
EEPROM	no
Data content	-32768 ... +32767

Subindex	03h
Description	Raw value Z-axis (resolution is 0.1 degrees per second)
Access	ro
PDO-Mapping	yes
Data type	INTEGER 16
Default	0h
EEPROM	no
Data content	-32768 ... +32767

7.2.33 3021h: Gyro HiRes X axis

Object 3021h contains the gyroscope value of the X-axis

Subindex	00h
Description	Gyroscope HiRes X-axis (resolution is 0.001 degrees per second)
Access	ro
PDO-Mapping	yes
Data type	INTEGER 32
Default	0h
EEPROM	no
Data content	-2,147,483,648 ... +2,147,483,647

7.2.34 3022h: Gyro HiRes Y axis

Object 3022h contains the gyroscope value of the Y-axis

Subindex	00h
Description	Gyroscope HiRes Y-axis (resolution is 0.001 degrees per second)
Access	ro
PDO-Mapping	yes
Data type	INTEGER 32
Default	0h
EEPROM	no
Data content	-2,147,483,648 ... +2,147,483,647

7.2.35 3023h: Gyro HiRes Z axis

Object 3022h contains the gyroscope value of the Z-axis

Subindex	00h
Description	Gyroscope HiRes Z-axis (resolution is 0.001 degrees per second)
Access	ro
PDO-Mapping	yes
Data type	INTEGER 32
Default	0h
EEPROM	no
Data content	-2,147,483,648 ... +2,147,483,647

7.2.36 3100h: CAN settings

Object 3100h stores the structure of the CAN configuration.

Subindex	00h
Description	displays the largest supported sub-index
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8
Default	2h
EEPROM	no

Subindex	01h
Description	CAN protocol (parameter changes take effect only after saving the configuration and restarting the sensor)
Access	rw
PDO-Mapping	yes
Data type	UNSIGNED 8
Default	2h
EEPROM	yes
Data content	1h: SAE J1939 protocol (see SAE J1939 user manual for detailed information) 2h: CANopen protocol

Subindex	02h
Description	Automatic Bus-Off Recovery
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 8
Default	1h

EEPROM	yes
Data content	0h: Disabled (Automatic bus-off recovery is disabled – sensor remains in bus-off; Power-Off-On-Cycle or Reset required) 1h: Enabled (Automatic bus-off recovery is enabled – sensor automatically exits bus-off status)

7.2.37 3110h: Filter Configuration

Within the object 3110h, a type for the low-pass filter can be set or sensor fusion with the Kalman filter can be activated.

Subindex	00h
Description	displays the largest supported sub-index
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8
Default	2h
EEPROM	no

Subindex	01h
Description	Low pass filter type
Access	rw
PDO-Mapping	No
Data type	UNSIGNED 8
Default	2h
EEPROM	yes
Data content	00h: Filter disabled 01h: Butterworth filter 8th order 02h: Critical damped filter 8th order

Subindex	02h
Description	Sensor fusion filter (The parameter is only adjustable if the sensor supports sensor fusion)
Access	rw
PDO-Mapping	yes
Data type	UNSIGNED 8
Default	0h
EEPROM	yes
Data content	00h: Low-pass filter; Angle calculation based on the low-pass filtered acceleration values 01h: Sensor fusion filter (Kalman filter); Angle calculation based on acceleration values and gyroscope values

7.2.38 3111h: Low Pass Filter Frequency

Object 3111h contains the cut-off frequency of the digital low-pass filter.

Subindex	00h
Description	Low-pass filter frequency in MHz
Access	rw
PDO-Mapping	no
Data type	UNSIGNED 16
Default	7D0h (2000d)
EEPROM	yes
Data content	Butterworth filter enabled: 100 MHz ... 25000 MHz Critically attenuated filter: 100 MHz ... 8000 MHz

7.2.39 3112h: Kalman Filter Parameters

Object 3112h contains the parameters Q and R of the Kalman filter (sensor fusion).

Subindex	00h
Description	displays the largest supported sub-index
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8
Default	4h
EEPROM	no

Subindex	01h
Description	Parameter Q Mantissa
Access	rw
PDO-Mapping	yes
Data type	INTEGER 8
Default	1h
EEPROM	yes
Data content	1 ... +127

Subindex	02h
Description	Parameter Q Exponent
Access	rw
PDO-Mapping	no
Data type	INTEGER 8
Default	1h
EEPROM	and
Data content	-10 ... +10

Subindex	03h
Description	Parameter R Mantissa
Access	rw
PDO-Mapping	no
Data type	INTEGER 8
Default	1h
EEPROM	yes
Data content	1 ... +127

Subindex	04h
Description	Parameter R Exponent
Access	rw
PDO-Mapping	yes
Data type	INTEGER 8
Default	1h
EEPROM	yes
Data content	-10 ... +127

7.2.40 3120h: Sensor Configuration

Object 3120h contains the configuration of the sensor.

Subindex	00h
Description	displays the largest supported sub-index
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8
Default	1h
EEPROM	no

Subindex	01h
Description	Defines the sensor's range of values
Access	rw
PDO-Mapping	no
Data type	INTEGER 8
Default	Depends on the preselected function
EEPROM	yes
Data content	00h: 1-axis sensor (0... 360°) 01h: 2-axis sensor (±90°)

7.2.41 3200h: Auto Zero

Object 3200h sets the zero point of the specified axis(s) to the current position by writing a valid value to this object.

Subindex	00h
Description	Set Zero Point to Current Position
Access	where
PDO-Mapping	no
Data type	INTEGER 8
Default	-
EEPROM	no
Data content	01h: Sets the first axis (X-axis) to 0 at the current position 02h: Sets the second axis (Y-axis) to 0 at the current position (only applies to 2-axis sensors) 03h: Sets the first and second axes to 0 at the current position (only applies to 2-axis sensors)

7.2.42 3210h: Slope long zero offset (Inclination X axis)

Object 3210h specifies the slope value for the zero point setting of the longitudinal slope. Access to this object via SDO is intended to set the zero point value of the longitudinal slope directly. The calculated application offset triggered by the automatic zeroing of the longitudinal slope is specified in this object.

If the zero point value is not 0, the slope long32 value (6110h) is shifted by this zero point value.

Subindex	00h
Description	Slope Long Zero Offset (The value must be specified in angular degrees with the resolution specified in the 6000h data object.)
Access	rw
PDO-Mapping	no
Data type	INTEGER 32
Default	-
EEPROM	yes
Data content	-2,147,483,648 ... -2,147,483,647

7.2.43 3220h: Slope Lateral Zero Offset (Inclination Y axis)

Object 3220h specifies the slope value for the zero setting of the lateral slope. Access to this object via SDO is intended to set the zero point value of the lateral slope directly. The calculated application offset triggered by the automatic zeroing of the lateral slope is specified in this object.

If the zero point value is not 0, the slope lateral32 value (6110h) is shifted by this zero point value.

Subindex	00h
Description	Lateral Zero Offset of the Slope (The value must be specified in angular degrees with the resolution specified in the 6000h data object.)
Access	rw
PDO-Mapping	no
Data type	INTEGER 32
Default	-
EEPROM	yes
Data content	-2,147,483,648 ... -2,147,483,647

7.2.44 6000h: Resolution

Object 6000h indicates the resolution of objects such as Slope Long32 (6110h) and Slope Lateral32 (6120h).

Subindex	00h
Description	The resolution is set to 0.01°.
Access	const
PDO-Mapping	no
Data type	UNSIGNED 16
Default	10
EEPROM	no

7.2.45 6110h: Slope Longitudinal (Inclination X Axis)

Object 6110h provides the 32-bit slope value of the longitudinal axis.

Subindex	00h
Description	Slope long32 (The value is given in angular degrees with the resolution specified in the object 6000h.)
Access	ro
PDO-Mapping	yes
Data type	INTEGER 32
Default	-
EEPROM	no

7.2.46 6111h: Slope Long Operating Parameter (Inclination X Axis)

Object 6111h specifies the interpretation of the Slope-Long32 value. If scaling is disabled, the Slope-Long32 value must be equal to the physically measured angle.

Subindex	00h
Description	Slope long32 Operating Parameter
Access	ro
PDO-Mapping	no

Data type	UNSIGNED 8
Default	0h
EEPROM	no

7.2.47 6120h: Slope Lateral (Inclination Y Axis)

Object 6120h provides the 32-bit slope value of the lateral axis.

Subindex	00h
Description	Slope lateral32 (The value is given in angular degrees with the resolution specified in object 6000h.)
Access	ro
PDO-Mapping	yes
Data type	INTEGER 32
Default	-
EEPROM	no

7.2.48 6121h: Slope Long Operating Parameter (Inclination X Axis)

Object 6121h specifies the interpretation of the Slope-Lateral32 value. If scaling is disabled, the Slope-Lateral32 value must match the physically measured angle.

Subindex	00h
Description	Slope lateral32 Operating Parameter
Access	ro
PDO-Mapping	no
Data type	UNSIGNED 8
Default	0h
EEPROM	no

7.2.49 6511h: Device Temperature

Object 6511h provides the temperature of the inclination sensor. The temperature value is not calibrated. An absolute temperature measurement or the use of the value for further control is not recommended.

Subindex	00h
Description	Device temperature with a resolution of 0.1°C
Access	ro
Data type	INTEGER 8
Default	-
EEPROM	no

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