OPERATING INSTRUCTIONS

TMS/TMM88 Dynamic SAE J1939

Inclination sensors with SAE J1939 interface

SICK
Sensor Intelligence.

Described product

1- and 2-dimensional inclination sensors:

TMS88D

TMM88D

Manufacturer

SICK AG
Erwin-Sick-Str. 1
79183 Waldkirch
Germany

Legal information

Original document

This document is an original document of SICK AG.

Contents

1 About this document 4
1.1 Purpose of this document 4
1.2 Explanation of symbols 4

2 Safety information 5
2.1 Improper use 5
2.2 Intended use 5
2.3 Requirements for the qualification of personnel 5

3 Overview 6

4 Technical data 7
4.1 Technical data for TMS/TMM88D 7

5 Transport and storage 9
5.1 Transport 9
5.2 Transport inspection 9
5.3 Storage 9

6 Mounting 10

7 Connection 11

8 SAE J1939 interface 12
8.1 Protocol data unit 12
8.2 Parameter group number 13
8.3 Device name and address 13
8.4 Process data (transmit PGNs) 14
8.5 Sensor configuration 17

1 About this document

1.1 Purpose of this document

These operating instructions are intended to give technical personnel working for the machine manufacturer or machine operator instructions on the mounting, electrical installation, commissioning, and operation of the TMS/TMM88 inclination sensors.

These operating instructions do not provide information on operating the machine in which an inclination sensor is integrated. For information about this, refer to the operating instructions of the specific machine.

1.2 Explanation of symbols

Warnings in these operating instructions are labeled with symbols. The warnings are introduced by signal words that indicate the extent of the danger. These warnings must be observed at all times and care must be taken to avoid accidents, personal injury, and material damage.

DANGER
... indicates a situation of imminent danger, which will lead to a fatality or serious injuries if not prevented.

WARNING
... indicates a potentially dangerous situation, which may lead to a fatality or serious injuries if not prevented.

CAUTION
... indicates a potentially dangerous situation, which may lead to minor/slight injuries if not prevented.

NOTICE
... indicates a potentially harmful situation, which may lead to material damage if not prevented.

NOTE
... highlights useful tips and recommendations as well as information for efficient and trouble-free operation.

2 Safety information

2.1 Improper use

The TMS/TMM88 inclination sensors do not constitute safety components according to the EC Machinery Directive (2006/42/EC). The inclination sensors must not be used in explosion-hazardous areas. Any other use that is not described as intended use is prohibited. Any use of accessories not specifically approved by SICK AG is at your own risk.

WARNING
Danger due to improper use!

Any improper use can result in dangerous situations.

Therefore, observe the following information:

- Inclination sensors should be used only according to intended use specifications.
- All information in these operating instructions must be strictly observed.

2.2 Intended use

The TMS/TMM88 inclination sensors are measuring devices consisting of an electronic sensor and integrated evaluation electronics. The tasks for which the measuring devices are designed include recording inclinations in solar thermal energy, photovoltaics or heavy-duty vehicle applications.

SICK AG assumes no liability for losses or damage arising from the use of the product, either directly or indirectly. This applies in particular to use of the product that does not conform to its intended purpose and is not described in this documentation.

2.3 Requirements for the qualification of personnel

The personnel who work on and with the device must be suitably authorized, trained, and sufficiently qualified. Skilled personnel refers to the following:

- A member of staff who has received specialist training, which is backed up by additional knowledge and experience.
- A member of staff who knows the relevant technical terms and regulations.
- A member of staff who can appraise the work assigned to them, recognize potential hazards, and take suitable safety precautions.

Table 1: Skilled personnel qualifications

Task	Qualification
Mounting	• Technical training • Knowledge of current workplace safety regulations
Electrical installation	• Electrotechnical training • Knowledge of the current electrotechnical workplace safety regulations • Knowledge of the operation and control of the sensor in the particular application
Commissioning, configuration, and operation	• Technical training • Knowledge of the operation and control of the sensor in the particular application

3 Overview

Properties

- 1-dimensional inclination sensor with measuring range: 360°
- 2-dimensional inclination sensor with measuring range: 90° (X/Y)
- Convenient parameterization via SAE J1939 or the PGT-12-Pro
  - Intelligent sensor fusion filter, configurable to the target application
  - Configurable vibration suppression
- High sampling rate and bandwidth
- High resolution (0.01°)
- Static accuracy independent of the sensor position
- Compensated cross sensitivity
- UV-resistant, impact-resistant plastic housing
- Large input voltage range (8 to 36 V)
- Low current consumption
- Suitable for industrial use:
  - Temperature range: –40 °C to +80 °C
  - Enclosure rating: IP67/69

The 1-dimensional TMS88D inclination sensor is used to measure inclinations in the 360° range. The TMM88D 2-dimensional inclination sensor is used to measure inclinations in 2 ranges (X/Y) of ±90°. To ensure high levels of accuracy, the sensor is calibrated at the factory.

The compact and rugged design makes the sensor an ideal solution for measuring angles in harsh environments. It is compatible for use in all manner of applications in automotive engineering and industry. Any accelerations that arise, for example as a result of braking or driving through curves, are reliably filtered by an integrated fusion filter.

All parameters can be adjusted easily via a digital interface (see "SAE J1939 interface", page 12).

Areas of application

- Agricultural and forestry machinery
- Construction machinery and special-purpose vehicles
- Solar thermal energy and photovoltaics
- Automated guided vehicle systems
- Crane and lifting technology

4 Technical data

Note

NOTE
This chapter contains an extract of the technical data. For full details, see the TMS/TMM88 Dynamic product information (8023359).

4.1 Technical data for TMS/TMM88D

Table 2: Technical data

General parameters for the dynamic inclination sensor[1]	**TMS88D**		**TMM88D**	
Number of measuring axes	1		2	
Measuring ranges	360°		±90°	
Resolution	0.01°			
Static accuracy	±0.3° (typical)	±0.5° (maximum)	±0.3° (typical)	±0.5° (maximum)
Dynamic accuracy	±0.5° (typical)			
Duration of interfering acceleration suppression (configurable)	100 to 10000 ms			
Temperature coefficient (zero point)	±0.01°/K (typical)			
General parameters for the IMU[2]	**Acceleration sensor**		**Gyro sensor**	
Measuring ranges	±8 g		±250 °/s	
Resolution	0.244 mg		0.00875 °/s	
In run bias stability	–		6°/h (typical)	
Angular random walk (ARW)	–		0.2 °/√h	
Temperature coefficient (zero point)	0.2 mg/K (typical)		0.005 °/s/K (typical)	
General parameters				
Sampling rate	200 Hz			
Operating temperature	-40 °C to +80 °C			
Properties				
Data transmission rates	10k, 20k, 50k, 100k, 125k, 250k, 500k, 800k bit/s, 1 Mbit/s Automatic detection			
Functions	Polling of angle, cyclic and synchronized transmission, parameterization, sensor fusion filter, digital low pass filter (critically damped or Butterworth, 8th order), configuration via a digital interface			
Electrical parameters				
Supply voltage	8 to 36 V DC			
Current consumption	15 mA @ 24 V			
Maximum output current	350 mA			
Mechanical parameters				
Electrical connection	2 x sensor plug connectors, 5-pin M12 (male connector - female connector, looped through)			
Enclosure rating	IP67/69			

General parameters for the dynamic inclination sensor[1]	TMS88D	TMM88D
Dimensions / Weight	Large plastic housing: 66 mm x 90 mm x 36 mm / approx. 200 g	

1 All specified angular accuracies apply after a run-in time of 10 min. at 25 °C, absolute calibration accuracy (at 25 °C): ±0.05°

2 All specified accuracies apply after a run-in time of 10 min. at 25 °C

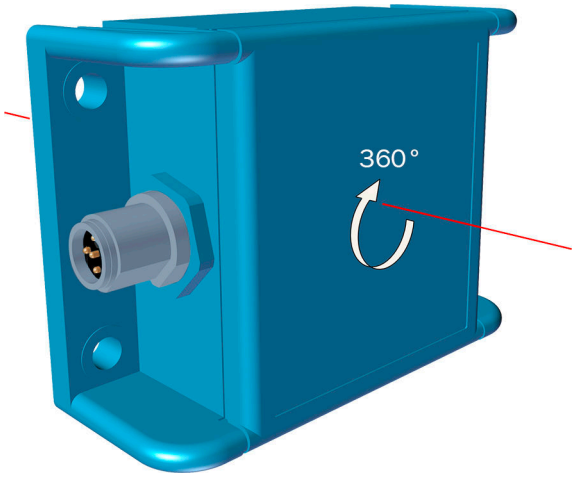

Figure 1: TMS88D measuring axis (large plastic housing)

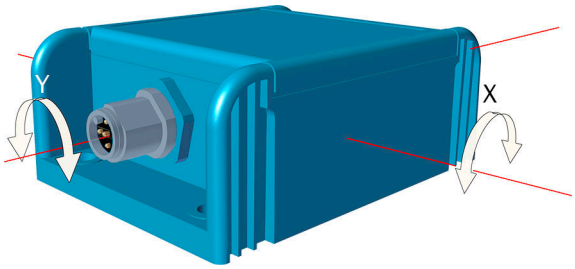

Figure 2: TMM88D measuring axes (large plastic housing)

5 Transport and storage

5.1 Transport

For your own safety, please read and observe the following notes:

NOTE

Damage to the device due to improper transport.

- The device must be packaged for transport with protection against shock and damp.
- Recommendation: Use the original packaging as it provides the best protection.
- Transport should be performed by trained specialist staff only.
- The utmost care and attention is required at all times during unloading and transportation on company premises.
- Note the symbols on the packaging.
- Do not remove packaging until immediately before you start mounting.

5.2 Transport inspection

Immediately upon receipt in Goods-in, check the delivery for completeness and for any damage that may have occurred in transit. In the case of transit damage that is visible externally, proceed as follows:

- Do not accept the delivery or only do so conditionally.
- Note the scope of damage on the transport documents or on the transport company's delivery note.
- File a complaint.

NOTE

Complaints regarding defects should be filed as soon as these are detected. Damage claims are only valid before the applicable complaint deadlines.

5.3 Storage

Store the device under the following conditions:

- Recommendation: Use the original packaging.
- Do not store outdoors.
- Store in a dry area that is protected from dust.
- So that any residual damp can evaporate, do not package in airtight containers.
- Do not expose to any aggressive substances.
- Protect from sunlight.
- Avoid mechanical shocks.
- For storage periods of longer than 3 months, check the general condition of all components and packaging on a regular basis.

6 Mounting

Layout of the fixing holes

The holes for screw-mounting the sensor are located in the baseplate of the inclination sensor (dimensions in mm).

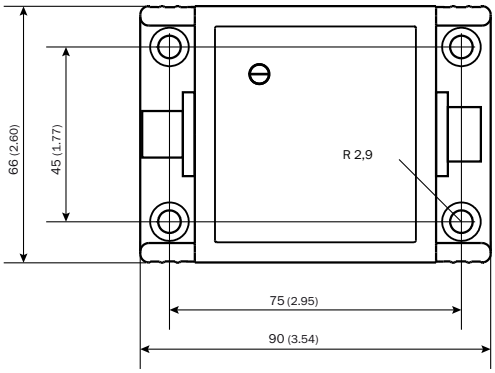

Figure 3: Fixing holes, large plastic housing

NOTICE

There is a risk of damage to the housing if inadequate lifting accessories are used!

- Use suitable washers for plastic housings.

7 Connection

Plug connector pin assignment

The TMS/TMM88D inclination sensors are equipped with a standard 5-pin M12 round male connector (A-coded) and also have a 5-pin M12 female connector (A-coded). The pin assignment corresponds to CiA DR-303-1.

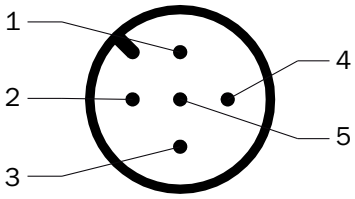

Table 3: CANopen M12 male connector pin assignment

Pin	Signal	Pin assignment
1	CAN_SHLD	Screen
2	CAN_V+	Supply voltage (+24 V)
3	CAN_GND	GND / 0 V / V-
4	CAN_H	CAN_H bus cable
5	CAN_L	CAN_L bus cable

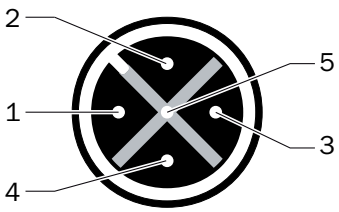

Table 4: CANopen M12 female connector pin assignment

Pin	Signal	Pin assignment
1	CAN_SHLD	Screen
2	CAN_V+	Supply voltage (+24 V)
3	CAN_GND	GND / 0 V / V-
4	CAN_H	CAN_H bus cable
5	CAN_L	CAN_L bus cable

Bus terminator

NOTE
The inclination sensors do not have an internal terminator.

8 SAE J1939 interface

This chapter contains general information about using the CAN protocol with extended 29-bit CAN identifiers. This 29-bit CAN frame format is the only format allowed for J1939 CAN messages. Standard 11-bit CAN frames can, however, also be used in the network.

8.1 Protocol data unit

The protocol data unit provides a framework for organizing the key information that is sent with every CAN data frame. The extended CAN data frame used in the SAE J1939 protocol is composed of seven fields. The 29-bit identifier is composed of six fields.

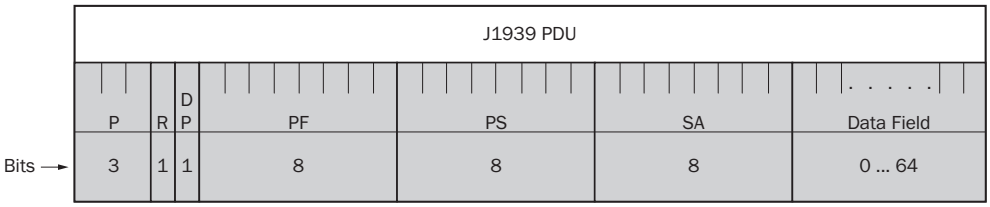

Figure 4: Extended CAN data frame definition

P – Priority

These three bits are used to optimize message latency for transmission (3 bits).

R – Reserved

Always 0 (1 bit).

DP – Data Page

Only 0 is used (1 bit).

PF – PDU Format

This field is used to specify the parameter group number (PGN). Parameter group numbers identify or label information that require one or more CAN data frames to transmit them. The PDU Format is the middle byte of the parameter group number.

PS – PDU Specific

This field depends on the value of PDU Format, and contains either a destination address or a group extension, depending on PDU Format. If the value of the PDU Format field is less than 240, the PDU Specific field contains a destination address. If the value of the PDU Format field is between 240 and 255, the PDU Specific field contains a group extension value. PDU2 format messages are global messages.

Table 5: PDU definition

	PDU Format field	PDU Specific field
PDU1 format	0 - 239	Destination address
PDU2 format	240 - 255	Group extension

Specific Destination Address (DA)

This field defines the specific address to which the message is being sent. All other destinations should ignore this message. In the case of the global destination address (255), all devices are required to listen and respond as message recipients.

Group Extension (GE)

The Group Extension field provides 4069 parameter groups per page.

Source Address (SA)

There should only be one device on the network with a given source address. The Source Address field therefore ensures the CAN identifier is unique, as required by CAN.

Data field

The J1939 protocol data unit (PDU) can contain up to 8 bytes, as per the definition of the CAN data frame.

8.2 Parameter group number

The PGN uniquely identifies the parameter group (PG) that is being transmitted in the message. Every PG (grouping of specific parameters) has its own specific definition comprising the assignment of each parameter within an 8-byte data field (size in bytes, location of the LSB), and the transmission rate and priority of the message.

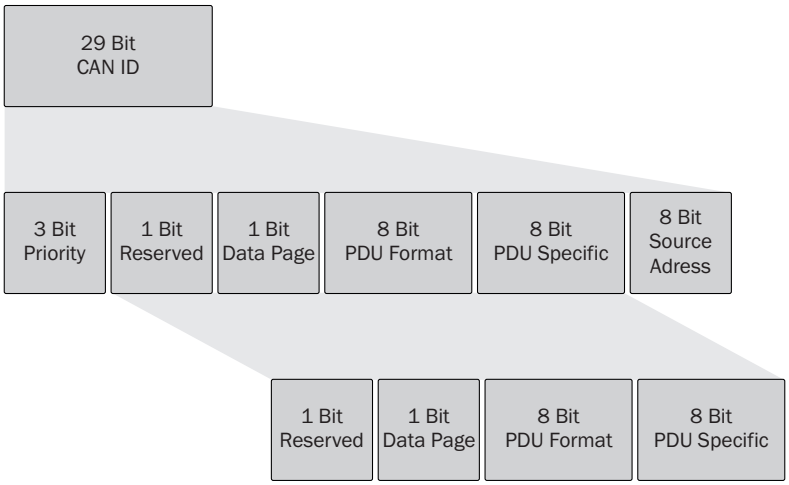

Figure 5: Parameter group number

Generally speaking, a distinction can be made between messages that are exchanged between two nodes by direct addressing (PDU format 1), and broadcast messages that are send to all nodes on the bus (PDU format 2).

The PDU format values 00h to EFh are reserved for point-to-point messages; the PGN also contains the destination address. Broadcast messages are sent with PDU format values from F0h to FFh. The Group Extension field increases the number of available broadcast messages. The inclination sensor uses PDU format 2 broadcast messages to send process data (angle values, raw data, see "Process data (transmit PGNs)", page 14). Direct addressing in PDU format 1 and using the Proprietary A PGN is supported for configuration purposes (see "Sensor configuration", page 17).

8.3 Device name and address

With the factory settings, the sensor starts up with address 128d (80h). Dynamic address allocation is supported. On startup, the sensor transmits an appropriate address claim message containing the address used. This message contains the 64-bit device name by means of which the sensor can be uniquely identified. The priority on the bus is also determined based on the name.

The 64-bit device name contains the following fields:

- Arbitrary Address Capable, support for dynamic address allocation (1 bit)
- Industry Group (3 bits)
- Vehicle System Instance (4 bits)
- Vehicle System (7 bits)
- Function (8 bits)
- Function Instance (5 bits)
- ECU Instance (3 bits)
- Manufacturer Code (11 bits)
- Identity Number (21 bits)

The Manufacturer Code represents the ident number for SICK Stegmann GmbH (value: 885 decimal).
The Identity Number corresponds to the J1939 serial number of the sensor.

The following fields of the device name are predefined as factory defaults:

- Manufacturer Code: 885 (SICK Stegmann GmbH)
- Identity Number: J1939 serial number of the sensor
- Industry Group: 0
- Vehicle System: 0
- Function: 145 (Inertial Sensor)

The remaining ranges can be modified by the user via the configuration protocol (see "Sensor configuration", page 17).

8.4 Process data (transmit PGNs)

To send measurement data, the sensor supports PGN 61459 (Slope Sensor Information) and PGN 61481 (Slope Sensor Information 2) for transmitting angle values, as well as PGN 61482 (Angular Rate Information) and PGN 61485 (Acceleration Sensor). Proprietary B messages (broadcast) are also available for other output formats.

The device supports 9 different parameter groups (TxPGNs):

- TxPGN1 61459 Slope Sensor Information
- TxPGN2 61481 Slope Sensor Information 2 (extended range)
- TxPGN3 61482 Angular Rate Information
- TxPGN4 61485 Acceleration Sensor
- Proprietary B TxPGN5 65280 Longitudinal, Lateral Inclination Value or Axial Inclination Value (Z-Axis)
- Proprietary B TxPGN6 65281 Pitch & Roll Euler Angles
- Proprietary B TxPGN7 65282 Quaternion
- Proprietary B TxPGN8 65283 X, Y, Z Acceleration
- Proprietary B TxPGN9 65284 X, Y, Z Yaw Rate

Activation/deactivation of sending, the cycle time and priority of messages, and the LSB of the PGN number in the case of Proprietary B PGNs can be set using configuration messages. By default, TxPGNs 2 (Slope Sensor Information 2) and 5 (Inclination Value) are activated with a cycle time of 10 ms.

Note regarding the following tables:
The LSB of the PGN number for Proprietary B messages can be configured by the user.

Table 6: Transmit PGN 1 - 61459 Slope Sensor Information

PGN	Name	SPN Name	SPN Position (Bit)	SPN Width (Bit)	Resolution	Offset	Data Ranges
61459	Slope Sensor Information	Pitch Angle	0	16	0.002°/bit	-64	-64 to +64.51°
		Roll Angle	16	16	0.002°/bit	-64	-64 to +64.51°
		Pitch Rate	32	16	0.002°/s/bit	-64°/s	-64 to +64.51°/s
		Pitch Angle Status	48	2	4 states	0	0 to 3
		Roll Angle Status	50	2	4 states	0	0 to 3
		Pitch Rate Status	52	2	4 states	0	0 to 3
		Sensor Fusion Status	54	2	4 states	0	0 to 3
		Latency	56	8	0.5 ms/bit	0	0 to 125 ms

Table 7: Transmit PGN 2 - 61481 Slope Sensor Information 2

PGN	Name	SPN Name	SPN Position (Bit)	SPN Width (Bit)	Resolution	Offset	Data Ranges
61481	Slope Sensor Information 2	Pitch Angle (ext. range)	0	24	1/32768°/bit	-250°	-250 to +252° (-90 to +90°)
		Roll Angle (ext. range)	24	24	1/32768°/bit	-250°	-250 to +252°
		Pitch Angle Sensor Fusion	48	2	4 states	0	0 to 3
		Pitch Angle Status	50	2	4 states	0	0 to 3
		Roll Angle Sensor Fusion	52	2	4 states	0	0 to 3
		Roll Angle Status	54	2	4 states	0	0 to 3
		Latency	56	8	0.5 ms/bit	0	0 to 125 ms

Table 8: Transmit PGN 3 – 61482 Angular Rate Information

PGN	Name	SPN Name	SPN Position (Bit)	SPN Width (Bit)	Resolution	Offset	Data Ranges
61482	Angular Rate Information	Pitch Rate (ext. range)	0	16	1/128°/s/bit	-250°/s	-250 to +250°/s
		Roll Rate (ext. range)	16	16	1/128°/s/bit	-250°/s	-250 to +250°/s
		Yaw Rate (ext. range)	32	16	1/128°/s/bit	-250°/s	-250 to +250°/s
		Pitch Rate Status	48	2	4 states	0	0 to 3
		Roll Rate Status	50	2	4 states	0	0 to 3
		Yaw Rate Status	52	2	4 states	0	0 to 3
		Latency	56	8	0.5 ms/bit	0	0 to 125 ms

Table 9: Transmit PGN 4 – 61485 Acceleration Sensor

PGN	Name	SPN Name	SPN Position (Bit)	SPN Width (Bit)	Resolution	Offset	Data Ranges
61485	Acceleration Sensor	Lateral Acceleration (y-axis)	0	16	0.01 m/s^2/bit	-320 m/s^2	-80 to +80 m/s^2
		Longitudinal Acceleration (x-axis)	16	16	0.01 m/s^2/bit	-320 m/s^2	-80 to +80 m/s^2
		Vertical Acceleration (z-axis)	32	16	0.01 m/s^2/bit	-320 m/s^2	-80 to +80 m/s^2
		Lateral Acceleration Status	48	2	4 states	0	0 to 3
		Longitudinal Acceleration Status	50	2	4 states	0	0 to 3
		Vertical Acceleration Status	52	2	4 states	0	0 to 3
		Supported Output Rate	54	2	4 states	0	0 to 3

Table 10: Transmit PGN 5 - Angle Output for TMM88D

PGN	Name	SPN Name	SPN Position (Bit)	SPN Width (Bit)	Resolution	Offset	Data Ranges
65280	Proprietary B TxPGN3 Perpendicular Angles	Longitudinal Inclination Value (x-axis)	0	16	0.01°/bit	0	-90 to +90°
		Lateral Inclination Value (y-axis)	16	16	0.01°/bit	0	-90 to +90°

Table 11: Transmit PGN 5 - Angle Output for TMS88D

PGN	Name	SPN Name	SPN Position (Bit)	SPN Width (Bit)	Resolution	Offset	Data Ranges
65280	Proprietary B TxPGN3 Perpendicular Angles	Inclination value, axial	0	16	0.01°/bit	0	-180 to +180°

Table 12: Transmit PGN 6 - Euler Angles

PGN	Name	SPN Name	SPN Position (Bit)	SPN Width (Bit)	Resolution	Offset	Data Ranges
65281	Proprietary B TxPGN4 Euler Angles	Pitch	0	16	0.01°/bit	0	-90 to +90°
		Roll	16	16	0.01°/bit	0	-180 to +180°

Table 13: Transmit PGN 7 – Quaternion

PGN	Name	SPN Name	SPN Position (Bit)	SPN Width (Bit)	Resolution	Offset	Data Ranges
65282	Proprietary B TxPGN5 Quaternion	Quaternion Scalar Part w	0	16	1/30000 / bit	0	-1.0 to +1.0
		Quaternion Vector Part x	16	16	1/30000 / bit	0	-1.0 to +1.0
		Quaternion Vector Part y	32	16	1/30000 / bit	0	-1.0 to +1.0
		Quaternion Vector Part z	48	16	1/30000 / bit	0	-1.0 to +1.0

Table 14: Transmit PGN 8 – Acceleration

PGN	Name	SPN Name	SPN Position (Bit)	SPN Width (Bit)	Resolution	Offset	Data Ranges
65283	Proprietary B TxPGN6 Acceleration	Acceleration, X-Axis	0	16	1/4096 g / bit	0	-8 g to +8 g
		Acceleration, Y-Axis	16	16	1/4096 g / bit	0	-8 g to +8 g
		Acceleration Z-Axis	32	16	1/4096 g / bit	0	-8 g to +8 g

Table 15: Transmit PGN 9 – Yaw Rate

PGN	Name	SPN Name	SPN Position (Bit)	SPN Width (Bit)	Resolution	Offset	Data Ranges
65284	Proprietary B TxPGN7 Yaw Rate	Yaw Rate, X-Axis	0	16	7/800°/s / bit	0	-250 to +250°/s
		Yaw Rate, Y-Axis	16	16	7/800°/s / bit	0	-250 to +250°/s
		Acceleration Z-Axis	32	16	7/800°/s / bit	0	-250 to +250°/s

8.5 Sensor configuration

Proprietary A PGN 61184 (point-to-point) is used to configure the sensor. The structure of the data part of the message is as follows:

Table 16: Structure of the Data Part of the Message

D0	D1	D2	D3	D4	D5	D6	D7
INDEX[1]		CMD[2]	STATUS[3]	DATA0[4]	DATA1[4]	DATA2[4]	DATA3[4]

1 Parameter Index (see table 17, page 17)
2 Command (0x01: Read, 0x02: Write)
3 Status (only valid in sensor response, see table 20, page 20)
4 Data part 0 to 4 bytes (valid length depends on the format of the relevant index)

Table 17: Configuration parameters

Index	Parameter	Formats	Value	Access
0x1000	Vendor ID	UNS32	-	ro
0x1001	Product ID	UNS32	-	ro
0x1002	Product revision	UNS32	-	ro
0x1003	Serial number	UNS32	-	ro
0x1004	Firmware version	UNS16	-	ro
0x1005	Device ID	UNS32	-	
0x1100	Device state	UNS8	-	ro
0x2000	CAN baud rate	UNS16	0: Autobaud 250 (default) 10, 20, 50, 100, 125, 500, 800, 1000	rw
0x2001	Device address	UNS8	128 (default)	rw
0x2002	Automatic busoff recovery	UNS8	0 (default) deactivated 1 activated	rw
0x2010	Arbitrary address capable	UNS8	0: address claiming deactivated 1: address claiming activated (default)	rw
0x2011	Industry group	UNS8	0	ro
0x2012	Vehicle system instance	UNS8	0 to 15 (default: 0)	rw
0x2013	Vehicle system	UNS8	0	ro

Index	Parameter	Formats	Value	Access
0x2014	Function	UNS8	145	ro
0x2015	Function instance	UNS8	0 to 31 (default: 0)	rw
0x2016	ECU instance	UNS8	0 to 7 (default: 0)	rw
0x2100	Digital filter type	UNS16	0: deactivated 1: Butterworth filter 2: critically damped (default)	rw
0x2101	Digital filter limit frequency	UNS16	100 to 25000 mHz default: 5000 mHz	rw
0x2110	Enable sensor fusion	UNS8	0: sensor fusion deactivated 1: sensor fusion activated (default)	rw
0x2111	Sensor fusion interference suppression time	UNS16	100 to 10000 ms default: 5000 ms	rw
0x2120	Dynamic gyro offset correction	UNS8	0: deactivated 1: activated (default)	rw
0x2121	Perform gyro offset correction	UNS8	Writing 1 performs the offset correction and saves the calculated values. The process takes approx. 2 s.	wo
0x2122	Dynamic offset correction level	UNS8	Value range: 1 to 10 (default: 3) 1: slightly dynamic 10: very highly dynamic	rw
0x2200	Automatic zero point offset for X (TxPGN 5 only)	UNS8	Set zero for X angle 0: Reset offset (absolute measurement) 1: Set zero (relative measurement)	wo
0x2201	Zero point offset for X (TxPGN 5 only)	INT16	Zero point offset for X	rw
0x2202	X-axis inversion	UNS8	0: X-axis not inverted 1: X-axis inverted	rw
0x2210	Automatic zero point offset for Y (TxPGN 5 for TMM88D only)	UNS8	Set zero for Y angle 0: Reset offset (absolute measurement) 1: Set zero (relative measurement)	wo
0x2211	Zero point offset for Y (TxPGN 5 for TMM88D only)	INT16	Zero point offset for Y	rw
0x2212	Y-axis inversion (TMM88D only)	UNS8	0: Y-axis not inverted 1: Y-axis inverted	rw
0x2300	Save parameters	VSTR	Write 'SAVE' (45564153h) to permanently save the configuration	wo
0x2301	Load parameters	VSTR	Write 'LOAD' (44414F4Ch) to load the parameters out of non-volatile memory	wo
0x2302	Load parameter defaults	VSTR	Write 'CLR' (524C43h) to restore the factory settings	wo
0x2303	Perform reset	VSTR	Write 'RST' (545352h) to perform a device reset	wo
Configuration TxPGNs				
0x3000	TxPGN1 Cycle Time PGN 61459 Slope Sensor Information	UNS16	0: deactivated (default) 10 to 10000 ms cycle time	rw

Index	Parameter	Formats	Value	Access
0x3001	TxPGN1 Priority PGN 61459 Slope Sensor Information	UNS8	0 to 7 (default: 3)	rw
0x3010	TxPGN2 Cycle Time PGN 61481 Slope Sensor Information 2	UNS16	0: deactivated (default) 10 to 10000 ms cycle time	rw
0x3011	TxPGN2 Priority PGN 61481 Slope Sensor Information 2	UNS8	0 to 7 (default: 3)	rw
0x3020	TxPGN3 Cycle Time PGN 61482 Angular Rate Information	UNS16	0: deactivated (default) 10 to 10000 ms cycle time	rw
0x3021	TxPGN3 Priority PGN 61482 Angular Rate Information	UNS8	0 to 7 (default: 3)	rw
0x3030	TxPGN4 Cycle Time PGN 61485 Acceleration Sensor	UNS16	0: deactivated (default) 10 to 10000 ms cycle time	rw
0x3031	TxPGN4 Priority PGN 61485 Acceleration Sensor	UNS8	0 to 7 (default: 3)	rw
0x3040	TxPGN5 Cycle Time PGN 65280 Perpendicular Angles	UNS16	0: deactivated 10 to 10000 ms cycle time default: 10 ms	rw
0x3041	TxPGN5 Priority PGN 65280 Perpendicular Angles	UNS8	0 to 7 (default: 3)	rw
0x3042	TxPGN5 Group Extension PGN 65280 Perpendicular Angles	UNS8	0x00 to 0xFF default: 0x00	rw
0x3050	TxPGN6 Cycle Time PGN 65281 Euler Angles	UNS16	0: deactivated (default) 10 to 10000 ms cycle time	rw
0x3051	TxPGN6 Priority PGN 65281 Euler Angles	UNS8	0 to 7 (default: 3)	rw
0x3052	TxPGN6 Group Extension PGN 65281 Euler Angles	UNS8	0x00 to 0xFF default: 0x01	rw
0x3060	TxPGN7 Cycle Time PGN 65282 Quaternion	UNS16	0: deactivated (default) 10 to 10000 ms cycle time	rw
0x3061	TxPGN7 Priority PGN 65282 Quaternion	UNS8	0 to 7 (default: 3)	rw
0x3062	TxPGN7 Group Extension PGN 65282 Quaternion	UNS8	0x00 to 0xFF default: 0x02	rw
0x3070	TxPGN8 Cycle Time PGN 65283 X, Y, Z Acceleration	UNS16	0: deactivated 10 to 10000 ms cycle time default: 10 ms	rw

Index	Parameter	Formats	Value	Access
0x3071	TxPGN8 Priority PGN 65283 X, Y, Z Acceleration	UNS8	0 to 7 (default: 3)	rw
0x3072	TxPGN8 Group Extension PGN 65283 X, Y, Z Acceleration	UNS8	0x00 to 0xFF default: 0x03	rw
0x3080	TxPGN9 Cycle Time PGN 65284 X, Y, Z Yaw Rate	UNS16	0: deactivated 10 to 10000 ms cycle time default: 10 ms	rw
0x3081	TxPGN9 Priority PGN 65284 X, Y, Z Yaw Rate	UNS8	0 to 7 (default: 3)	rw
0x3082	TxPGN9 Group Extension PGN 65284 X, Y, Z Yaw Rate	UNS8	0x00 to 0xFF default: 0x04	rw
Process data				
0x5000	Read angle values	UNS32	Outputs angles, cf. Transmit PGN 3	ro
0x5001	Read temperature	INT8	Temperature in °C	ro

NOTE

To permanently save the parameters, send the “SAVE” command (Index 0x2300). When the write operation occurs, the CAN baud rate and device address are stored in the non-volatile memory but are not immediately active. To activate the new parameters, the sensor must be restarted.

8.5.1 J1939 Communication Examples

Table 18: Reading the firmware version of the sensor using address 128

	CAN identifier	D0	D1	D2	D3	D4	D5	D6	D7
		INDEX		CMD	STATUS	DATA0	DATA1	DATA2	DATA3
Request	0x0CEF8001	0x04	0x10	0x01	0x00	0x00	0x00	0x00	0x00
Reply	0x0CEF0180	0x04	0x10	0x01	0x00	0x01	0x00	0x00	0x00

Table 19: Activating the sensor fusion function using address 128

	CAN identifier	D0	D1	D2	D3	D4	D5	D6	D7
		INDEX		CMD	STATUS	DATA0	DATA1	DATA2	DATA3
Request	0x0CEF8001	0x10	0x21	0x02	0x00	0x01	0x00	0x00	0x00
Reply	0x0CEF0180	0x10	0x21	0x02	0x00	0x01	0x00	0x00	0x00

8.5.2 Explanation of the status byte

Table 20: Status byte

Value	Meaning
0x00	OK, command successful
0xF0	Invalid index
0xF1	Invalid parameter, outside value range
0xF2	EEPROM read/write error

8023376/14IT/LF_07/2019-06-27/en

Australia
Phone +61 (3) 9457 0600
1800 33 48 02 – tollfree
E-Mail sales@sick.com.au

Austria
Phone +43 (0) 2236 62288-0
E-Mail office@sick.at

Belgium/Luxembourg
Phone +32 (0) 2 466 55 66
E-Mail info@sick.be

Brazil
Phone +55 11 3215-4900
E-Mail comercial@sick.com.br

Canada
Phone +1 905.771.1444
E-Mail cs.canada@sick.com

Czech Republic
Phone +420 2 57 91 18 50
E-Mail sick@sick.cz

Chile
Phone +56 (2) 2274 7430
E-Mail chile@sick.com

China
Phone +86 20 2882 3600
E-Mail info.china@sick.net.cn

Denmark
Phone +45 45 82 64 00
E-Mail sick@sick.dk

Finland
Phone +358-9-25 15 800
E-Mail sick@sick.fi

France
Phone +33 1 64 62 35 00
E-Mail info@sick.fr

Germany
Phone +49 (0) 2 11 53 01
E-Mail info@sick.de

Hong Kong
Phone +852 2153 6300
E-Mail ghk@sick.com.hk

Hungary
Phone +36 1 371 2680
E-Mail ertekesites@sick.hu

India
Phone +91-22-6119 8900
E-Mail info@sick-india.com

Israel
Phone +972-4-6881000
E-Mail info@sick-sensors.com

Italy
Phone +39 02 27 43 41
E-Mail info@sick.it

Japan
Phone +81 3 5309 2112
E-Mail support@sick.jp

Malaysia
Phone +603-8080 7425
E-Mail enquiry.my@sick.com

Mexico
Phone +52 (472) 748 9451
E-Mail mario.garcia@sick.com

Netherlands
Phone +31 (0) 30 229 25 44
E-Mail info@sick.nl

New Zealand
Phone +64 9 415 0459
0800 222 278 – tollfree
E-Mail sales@sick.co.nz

Norway
Phone +47 67 81 50 00
E-Mail sick@sick.no

Poland
Phone +48 22 539 41 00
E-Mail info@sick.pl

Romania
Phone +40 356-17 11 20
E-Mail office@sick.ro

Russia
Phone +7 495 283 09 90
E-Mail info@sick.ru

Singapore
Phone +65 6744 3732
E-Mail sales.gsg@sick.com

Slovakia
Phone +421 482 901 201
E-Mail mail@sick-sk.sk

Slovenia
Phone +386 591 78849
E-Mail office@sick.si

South Africa
Phone +27 (0)11 472 3733
E-Mail info@sickautomation.co.za

South Korea
Phone +82 2 786 6321
E-Mail info@sickkorea.net

Spain
Phone +34 93 480 31 00
E-Mail info@sick.es

Sweden
Phone +46 10 110 10 00
E-Mail info@sick.se

Switzerland
Phone +41 41 619 29 39
E-Mail contact@sick.ch

Taiwan
Phone +886-2-2375-6288
E-Mail sales@sick.com.tw

Thailand
Phone +66 2 645 0009
E-Mail marcom.th@sick.com

Turkey
Phone +90 (216) 528 50 00
E-Mail info@sick.com.tr

United Arab Emirates
Phone +971 (0) 4 88 65 878
E-Mail info@sick.ae

United Kingdom
Phone +44 (0)17278 31121
E-Mail info@sick.co.uk

USA
Phone +1 800.325.7425
E-Mail info@sick.com

Vietnam
Phone +65 6744 3732
E-Mail sales.gsg@sick.com

Further locations at **www.sick.com**

SICK AG | Waldkirch | Germany | www.sick.com

SICK
Sensor Intelligence.