TURCK

Your Global Automation Partner

B…N…-QR20…CNX4 Inclinometer with CANopen interface

Instructions for Use

Contents

1 About these instructions

These instructions describe the setup, functions and use of the product and help you to operate the product according to its intended purpose. Read these instructions carefully before using the product. This will prevent the risk of personal injury and damage to property. Keep these instructions safe during the service life of the product. If the product is passed on, pass on these instructions as well.

1.1 Target groups

These instructions are aimed at qualified personal and must be carefully read by anyone mounting, commissioning, operating, maintaining, dismantling or disposing of the device.

1.2 Explanation of symbols

The following symbols are used in these instructions:

	**DANGER** DANGER indicates a hazardous situation with a high level of risk, which, if not avoided, will result in death or serious injury.
	**WARNING** WARNING indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in death or serious injury.
	**CAUTION** CAUTION indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in moderate or minor injury.
	**NOTICE** CAUTION indicates a situation which, if not avoided, may cause damage to property.
	**NOTE** NOTE indicates tips, recommendations and important information about special action steps and issues. The notes simplify your work and help you to avoid additional work.
▶	**MANDATORY ACTION** This symbol denotes actions that the user must carry out.
⇨	**RESULT OF ACTION** This symbol denotes the relevant results of an action.

1.3 Other documents

Besides this document, the following material can be found on the Internet at www.turck.com:

- Data sheet
- EU Declaration of Conformity (current version)

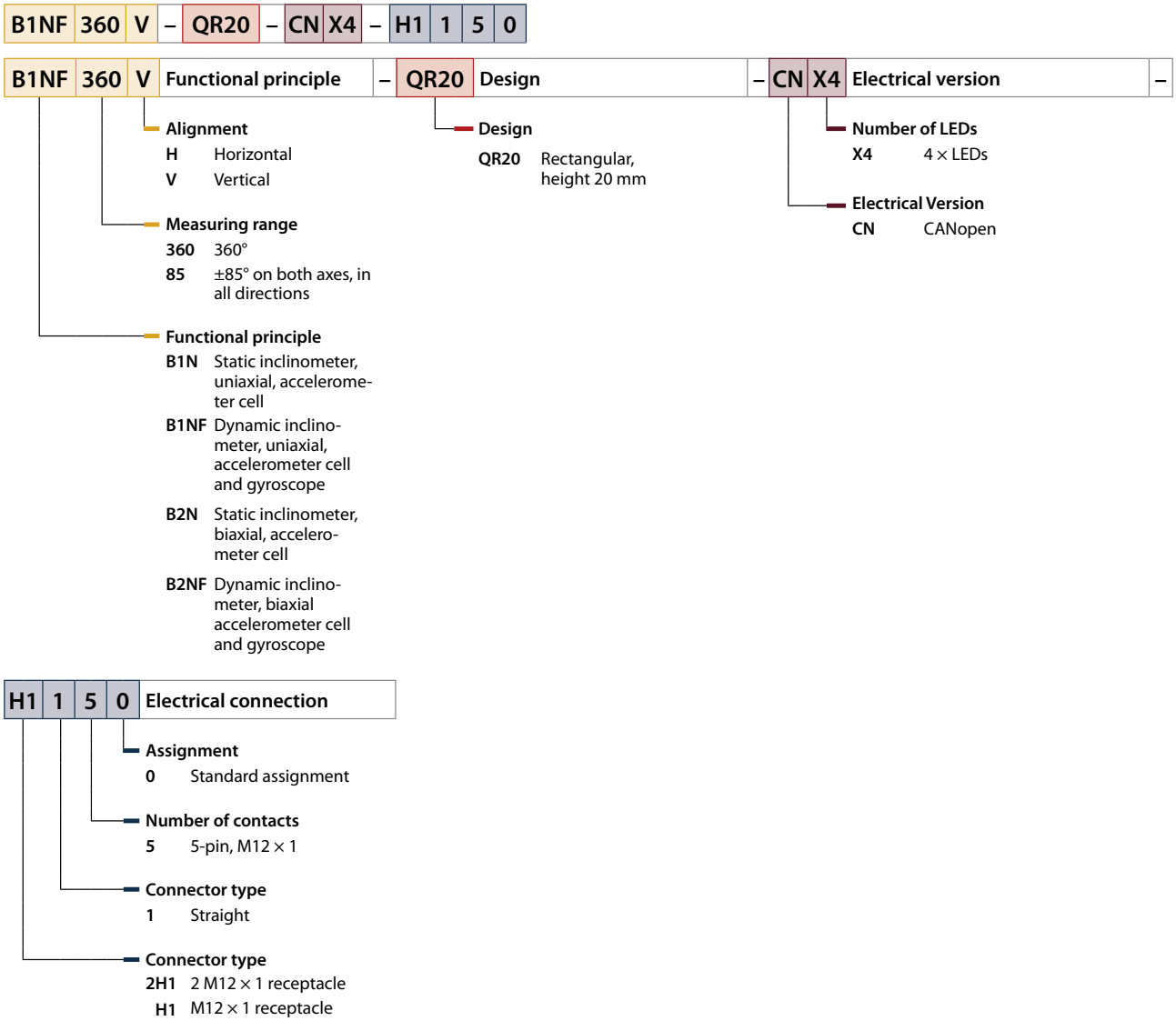
1.4 Feedback about these instructions

We make every effort to ensure that these instructions are as informative and as clear as possible. If you have any suggestions for improving the design or if some information is missing in the document, please send your suggestions to techdoc@turck.com.

2 Notes on the product

2.1 Product identification

These instructions apply to the following inclinometers:



2.2 Scope of delivery

The delivery consists of the following:

- Inclinometer

2.3 Turck service

Turck supports you in your projects – from the initial analysis right through to the commissioning of your application. The Turck product database at **www.turck.com** offers you several software tools for programming, configuring or commissioning, as well as data sheets and CAD files in many export formats.

For the contact details of our branches worldwide, please see page [▷ 40].

3 For your safety

The product is designed according to state of the art technology. Residual hazards, however, still exist. Observe the following safety instructions and warnings in order to prevent danger to persons and property. Turck accepts no liability for damage caused by failure to observe these safety instructions.

3.1 Intended use

The inclinometers in the B…N…-QR20-CNX4… product series determine the inclination angle and output it via the CANopen interface.

The device must only be used as described in these instructions. Any other use is not in accordance with the intended use. Turck accepts no liability for any resulting damage.

3.2 Obvious misuse

- The devices are not safety components and must not be used for personal or property protection.

3.3 General safety instructions

- The device meets the EMC requirements for the industrial areas. When used in residential areas, take measures to prevent radio frequency interference.
- The device must only be fitted, installed, operated, parameterized and maintained by trained and qualified personnel.
- Only use the device in compliance with the applicable national and international regulations, standards and laws.
- Only operate the device within the limits stated in the technical specifications.

4 Product description

The inclinometers in the B…N…-QR20… product series have a 5-pin M12 connector or two 5-pin M12 connectors for connecting to a CANopen interface. The housing is made from plastic and is a fully potted and sealed unit with protection to IP68/IP69K. The sensors are protected from temperature fluctuations.

The device functions can be set via a CANopen interface.

4.1 Device overview

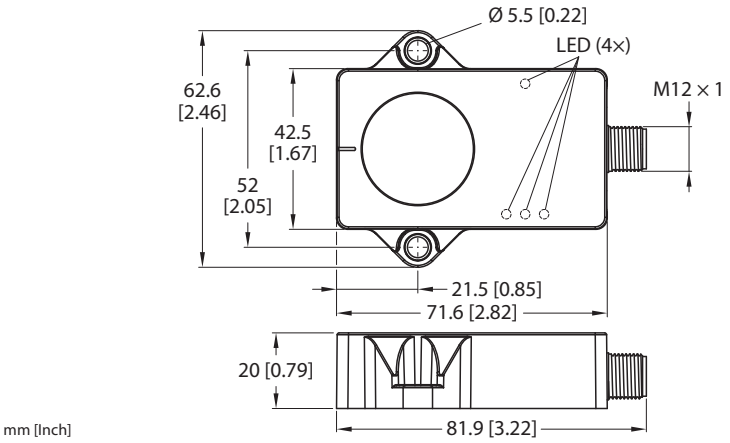


Fig. 1: Dimensions B…N…H1150

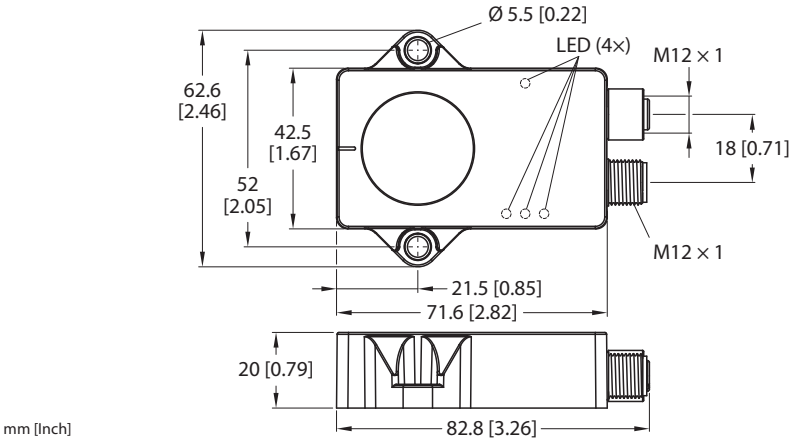


Fig. 2: Dimensions B…N…2H1150

4.1.1 Indication elements

The devices have one green (RUN), one red (ERR) and two yellow LEDs (spirit level function) (see LEDs [▶ 14]).

To assist with commissioning, the spirit level function can be activated via CANopen using object 0x2200 (see [▶ 29]). The yellow LEDs are lit when the spirit level function is active.

4.2 Operating principle

Static inclinometers

The inclinometers use an accelerometer cell for angle measurement and output angles according to the measurement axis or axes. The resolution is 0.01°. The earth's gravity is used as the reference. If the angle in relation to gravity changes, this is detected by the accelerometer cell. The signal is processed and linearized in order to output an angle.

Dynamic inclinometers

The dynamic inclinometers use an accelerometer cell and a gyroscope sensor for angle measurement. The devices output angles according to the measurement axis or axes. The resolution is 0.01°. A fusion algorithm calculates the inclination from the acceleration values and rotation rate values. The fusion algorithm minimizes the effects of vibration and interfering acceleration. The sensor can thus also output a stable signal in dynamic applications. The signal is processed and linearized in order to output an angle.

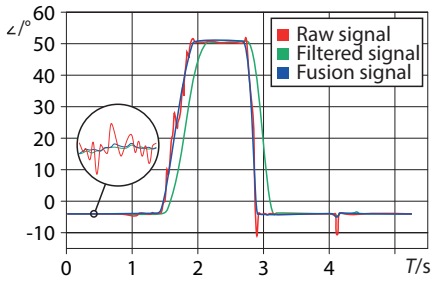


Fig. 3: Fusion algorithm – minimizing interfering acceleration

Temperature measurement

The temperature is measured by means of an integrated temperature measurement cell. The temperature measured can deviate from the ambient temperature due to different electrical operating conditions in the sensor.

4.3 Functions and operating modes

The devices can be set via a CANopen interface.

4.3.1 Output function

The device is equipped with a standardized CANopen interface in accordance with CiA DS-301 and a device profile in accordance with CiA 410. Various device functions can be set and parameterized by using the control software (see "Setting" section). All measured values and parameters can be accessed via the object directory.

4.3.2 Condition on delivery

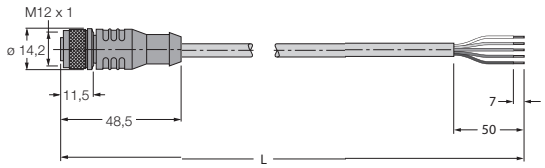
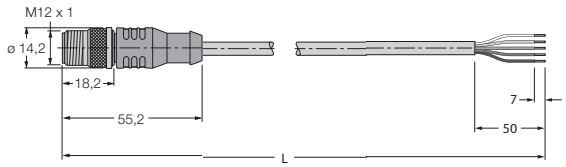
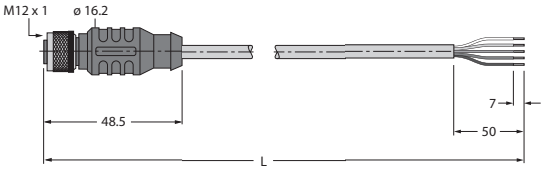
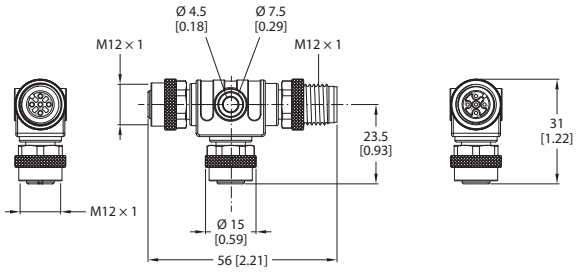
The inclinometer has the following basic settings when delivered:

- Node ID: 0x0A
- Transmission rate 500 kbit/s
- Internal terminating resistor switched off
- TPDO1 active
- TPDO1 synchronous mode, COB-ID 80

4.3.3 Terminating resistor

A bus terminating resistor can be switched on and off via the CANopen interface.

4.4 Technical accessories

Dimension drawing	Type	ID	Description
	RKC5701-5M	6931034	Bus cable for CAN (DeviceNet, CANopen), M12 female connector, straight, A-coded, cable length 5 m, jacket material: PUR, anthracite, open end; other cable lengths and versions available, see www.turck.com
	RSC5701-5M	6931036	Bus cable for CAN (DeviceNet, CANopen), M12 male connector, straight, A-coded, cable length 5 m, jacket material: PUR, anthracite, open end; other cable lengths and versions available, see www.turck.com
	RKC 572-2M	U5311-02	Bus cable for CAN (DeviceNet, CANopen), M12 female connector, straight, A-coded, cable length 2 m, jacket material: PVC, gray, open end; other cable lengths and versions available, see www.turck.com
	RKC 572-xM/ S3117	U-54470	Bus cable for CAN (DeviceNet, CANopen), M12 female connector, without drain connection to pin 1 on BUS, straight, A-coded, cable length 2 m, jacket material: PVC, gray, open end; other cable lengths and versions available, see www.turck.com
	FSM-2FKM57	6622101	T-splitter without cable for CAN (DeviceNet, CANopen), M12 adapter, 5-pin

5 Installing

Depending on the sensor type, the sensors can be installed vertically (B1N…V…) or horizontally (B2N…H…).

In order to implement redundant measurement systems, several sensors can be installed next to each other without any gaps. Multiple sensors have no mutual effect on angle measurement. The maximum tightening torque of the screws is 3 Nm.

- Clean the installation surface and the surrounding area.
- Position the potted side of the device on an even surface so that the potting compound is covered.
- Fasten the device with two screws.
- After the overhead installation of 2-axis sensors: Carry out the center point teach function.

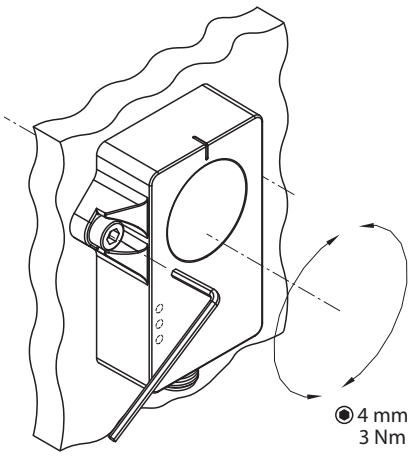


Fig. 4: B1N…V… — vertical installation

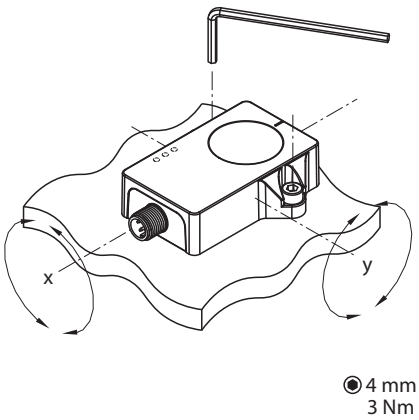


Fig. 5: B2N…H… — horizontal installation

6 Connection

The device has a 5-pin M12 × 1 connector (H1150) for a CANopen input or two 5-pin M12 × 1 connectors (2H1150) for a CANopen input and a CANopen output.

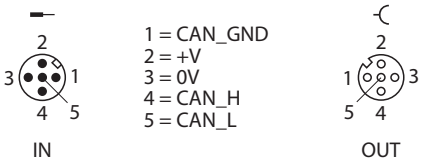


Fig. 6: Pin assignment

- ▶ Connect the device to a controller or a fieldbus device as shown in "Wiring diagram."

7 Commissioning

After connecting and switching on the power supply, the device is automatically ready for operation.

7.1 Commissioning aid – spirit level

The yellow LEDs act as a spirit level for the alignment of the inclinometer. The two yellow LEDs are lit when the position of the inclinometer is within a window of ±0.5° around the center point. The LEDs flash at an increasing frequency the nearer the sensor gets to the center point.

On one-axis devices, one LED flashes. On two-axis devices, both LEDs flash.

The spirit level function can be activated using object 0x2200. The function is deactivated by default.

8 Operation

8.1 LED display

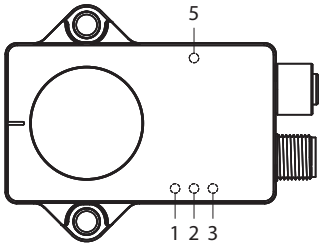


Fig. 7: LED positions

LED	Display	Meaning
Position 1	Yellow	Spirit level function for one-axis inclinometers
Position 2	Green	RUN
Position 3	Yellow	Spirit level function for two-axis inclinometers
Position 5	Red	ERR

LED	Display	Meaning
ERR	Off	The device is working properly
	Red	CAN controller switched off by bus
	Red flashing	Configuration incorrect
	Red flashing × 1	Warning limit fault signal
	Red flashing × 2	Guard event (NMT slave or master) or heartbeat event occurred
RUN	Off	Pre-operational mode, data transfer being prepared
	Green	Operational mode, device ready for operation
	Green flashing × 1	Stopped mode, data transfer stopped
	Green flashing × 3	Software update of the device

9 Setting

The device can be set via the CANopen interface.

NOTE
All non-described objects serve as additional information and can be removed from the device profile CiA 410.

9.1 Settable functions and features

Parameter	Meaning
Restore factory settings	The function restores the device to the factory setting. Node ID and bit rate are excluded.
Spirit level	The spirit level function can be deactivated or activated. The spirit level function is deactivated by default.
Filter	Different filters can be set for static and dynamic inclinometers. A fusion algorithm calculates the inclination from the acceleration values and rotation rate values. The setting for the filter parameters changes significant areas of the fusion algorithm. The individual items of sensor data are weighted differently in the various filters. The different weighting of the sensor data can compensate for disadvantages in the measurement process. The slow filter can compensate for fast interfering acceleration in the application. The filter is suitable for applications with slow and precise movements where major external interference may occur. Repetitive, rapid movements can accumulate and distort the filter. Very fast and fast filters provide greater accuracy for rapid movements in the application. The filter can be more easily affected by fast interfering acceleration. Repetitive movements cannot accumulate and distort the filter. ■ **Static inclinometers:** ■ Balanced (factory setting) ■ Slow ■ **Dynamic sensors:** ■ Balanced ■ Slow ■ Fast ■ Very fast (factory setting)

9.2 Setting the communication profile

9.2.1 Object 0x1000: Device type

The device type is specified via the object.

0x1000	VAR	Device type	Unsigned32	RO	M

Value	Meaning
0x0001019A	One axis with 16-bit resolution
0x0002019A	Two axes with 16-bit resolution

9.2.2 Object 0x1001: Error register

Device errors are displayed in the error register.

0x1001	VAR	Error register	Unsigned8	RO	M

Sub-index	Bit	Fault signal
0x00	0	No error
	1	Current
	2	Voltage
	3	Temperature
	4	Communication
	5	Device-specific
	6	Reserved (always 0)
	7	Turck-specific

9.2.3 Object 0x1005: COB-ID SYNC (specify COB-ID for SYNC message)

The object specifies the COB-ID for the SYNC message. It also specifies whether the device is an emitter or receiver of SYNC objects.

0x1005	VAR	COB-ID SYNC	Unsigned32	RW	O

Bit	Value	Meaning
0…10		Identifier (11 bits), standard ID: 0x80
11…29		Reserved for devices with a 29-bit identifier
30	0	Device does not generate a SYNC message
31	1	Device is a receiver for SYNC messages

9.2.4 Object 0x1008: Manufacturer device name

The object contains the type designation of the device.

0x1008	VAR	Product name	Visible string	RO	O

Example: B1N360V-QR20-CNX4-2H1150

9.2.5 Object 0x1009: Manufacturer hardware version

The object contains the hardware version number.

0x1009	VAR	Manufacturer hardware version	Visible string	RO	O

Data content:

e.g. "HW-12718801 -" in ASCII code

Hardware version (127xxxxx) with revision index (-, A, B, etc.)

9.2.6 Object 0x100A: Firmware version (software version)

The object contains the software version number.

0x100A	VAR	Firmware version	Visible string	RO	O

Data content:

e.g. "SW-1.0.0.1" in ASCII code

9.2.7 Object 0x1010: Store parameters

0x1010	ARRAY	Store parameters	Unsigned32	RW	O

Read access to the CANopen device indicates whether values can be saved (Data: 0x01 = save possible).

Bit	Value	Meaning
0	1	Device supports the loading of standard values.
31	Reserved	

- Sub-index 0x01: Save all parameters.

When the command "save" is written, the parameters are saved in the nonvolatile memory (EEPROM).

Data content for write access (save = 0x65766173):

Bit	Value	Meaning
0	0x73	ASCII code for **s**
1	0x61	ASCII code for **a**
2	0x76	ASCII code for **v**
3	0x65	ASCII code for **e**

If write access is written incorrectly, the device responds via the "Abort Transfer Service" service data object with code 0800 002xh.

If saving write access fails, the device responds with code 0x00000606 via the "Abort Transfer Service" service data object.

9.2.8 Object 0x1011: Restore manufacturer settings (load standard values)

This command deletes the parameters in the working memory and replaces them with standard values (the manufacturer's values as were configured upon delivery of the inclinometer).

0x1011	RECORD	Restore manufacturer settings	Unsigned32	RW	O

Multiple parameter groups are distinguished:

- Sub-index 0x00: Contains the highest sub-index supported.
- Sub-index 0x01: "Restore all parameters" refers to all parameters that can be restored.

Example: Restore all parameters

All parameters in the device RAM are reset to their standard values when the command 0x64616F6C (load) is written under sub index 0x01.

Read access to the sub-index indicates whether the default values can be loaded.

Bit	Value	Meaning
0	1	Device supports the loading of standard values.
31	Reserved	

Data content for write access (load = 0x64616F6C):

Bit	Value	Meaning
0	0x6C	ASCII code for **l**
1	0x6F	ASCII code for **o**
2	0x61	ASCII code for **a**
3	0x64	ASCII code for **d**

If write access is written incorrectly, the device responds via the "Abort Transfer Service" service data object with code 0800 002xh.

If saving write access fails, the device responds with code 0x00000606 via the "Abort Transfer Service" service data object.

9.2.9 Object 0x100C: Guard time (set query interval)

The object indicates the interval at which the device is queried.

0x100C	VAR	Guard time	Unsigned16	RW	O

Sub-index	Value	Meaning
0x00	0x0000	Query interval is deactivated
	0x0001…0xFFFF	Selected value must be ≥ 1 ms

Default: 0x0000

9.2.10 Object 0x100D: Lifetime factor (monitoring of object nodes)

The object specifies a multiplier according to which the connection between the guarding master and the object node to be monitored is considered to be interrupted. Lifetime factor multiplied by guard time.

0x100D	VAR	Lifetime factor	Unsigned8	RW	O

Sub-index	Value	Meaning
0x00	0x00	Lifetime factor is deactivated
	0x01…0xFF	Factor

9.2.11 Object 0x1016: Consumer heartbeat time (heartbeat cycle)

The object indicated the expected heartbeat cycles.

Sub-index	Bit	Meaning
0x01…0x02	0…15	Heartbeat time in ms
0x03	16…23	Node ID
0x04	24…32	Reserved

Default: 0x04

9.2.12 Object 0x1017: Producer heartbeat time (specify heartbeat cycle)

The object specifies the heartbeat cycle.

0x1017	VAR	Consumer heartbeat time	Unsigned32	RW	O

Sub-index	Value	Meaning
0x00	0x0000	Heartbeat cycle is deactivated
	0x0001…0xFFFF	Selected value must be ≥ 1 ms

Default: 0x0000

- ▶ Activate the function: Specify time in the range of 1…32,767 ms.
- ▶ Deactivate the function: Enter time **0**.

- Value range: 0…32767_{dec} (corresponds to 0…32,767 ms)
- Default value: 0_{dec}

NOTE
A "heartbeat producer" transmits the message cyclically at intervals of the set time.

The content of the data byte corresponds to the status of the CAN node:

Status of the CAN node	Content of the data byte
Pre-operational	0x7F
Operational	0x05
Stopped	0x04

9.2.13 Object 0x1018: Identity object (device identification)

The device identification can be read via the object.

0x1018	RECORD	Device identification	Identity	RO	O

Sub-index	Meaning
0x00	Number of entries (default: 0x04)
0x01	Turck vendor ID
0x02	Product code
0x03	Software revision number
0x04	Device series number

9.2.14 Overview of transmission types

The PDO is synchronously and cyclically sent for values between 1…240. The number of the transmission type corresponds to the number of SYNC pulses required for sending PDOs.

For transmission type 254, the event is triggered by the application. Transmission type 255 is triggered by the device profile. For transmission types 254 and 255, a time-controlled event timer (1…65535 ms) can be set.

Code (decimal)	Transmission type			
	Cyclic	Acyclic	Synchronous	Asynchronous
0		X	X	
1…240	X		X	
241…251	Reserved			
252 (not supported)			X	
253 (not supported)				X
254				X
255				X

Meanings of decimal codes for transmission types:

Code (decimal)	Meaning
0	Synchronous (0x00), after SYNC (only for value changes since the most recent SYNC)
1…240	Cyclically synchronous (0xEF), value is sent after SYNC
241…251	Reserved
252…253	Not supported
254	Manufacturer, asynchronous (0xFE) Device timer ≠ 0: Value is sent after a value change Device timer = 0: Value is sent at the end of the cycle time Combination with inhibit timer possible
255	Asynchronous (0xFF) Device timer ≠ 0: Value is sent at the end of the cycle time

9.2.15 Object 0x3001: TPDO1+2 event driven send (event-triggered transmission)

The object is used to set whether TPDO1 and TPDO2 are sent again in the event of angle changes.

0x3001	VAR	Event Driven Send	Unsigned16	RO	O

Sub-index	Value	Default	Meaning
0x00	–	0x03	Number of supported sub-indices (read-only)
0x01	0x00		Event-oriented transmission deactivated
	0x01		Event-oriented transmission activated
0x02	0x05…0x3E8 (angle in value/100°)	0x64	Minimal change in the angle of the longitudinal axis
0x03	0x05…0x3E8 (angle in value/100°)	0x64	Minimal change in the angle of the transverse axis

9.2.16 Object 0x1800: TPDO1 parameter (asynchronous)

The object contains the parameters for the process data object TPDO1. In the standard setting, this service is used to output the process data of the inclinometer asynchronously.

0x1800	RECORD	TPDO1 communication parameter (process data object 1)	PDO_ COMMUNICATION_ PARAMETER	RW	M/O

One-axis devices — data content:

Bit length	Meaning
16	Slope long16 (z-axis)
16	Not Assigned

See also [▶ 25].

Two-axis devices — data content:

Bit length	Meaning
16	Slope long16 (x-axis)
16	Slope lateral16 (y-axis)

See also [▶ 27].

Sub-index	Meaning
0x00	Number of supported sub-indexes Read only Default: 0x05
0x01	COB-ID Read only Default: 0x0000 0180 + node number
0x02	Transmission type Value range: 0x01…0xF0 (cyclical, example: 0x03 = for every third synchronization) Value 0xFE: event-specific Default: 0x01
0x03	Inhibit time, minimum waiting time before the selected PDO can be resent Default value = 0x00 (no inhibit time) Value range: 0x0000…0xFFFF (10…65530_{dec}, corresponds to 1…6553 ms) Only exact millisecond values are permitted. Intermediate values are rounded up.
0x04	Reserved
0x05	Event timer Value range: 0x0000…0xFFFF (100…65535, corresponds to 100…65,535 ms) 0: no data output Default value: 0x00 (100_{dec})

9.2.17 Object 0x1801: TPDO2 parameters (synchronous, cyclical)

The object contains the parameters for the process data object TPDO2. In the standard setting, this service is used to output the process data of the inclinometer synchronously.

0x1801	RECORD	TPDO2 communication parameter (process data object 2)	PDO_COMMUNICATION_PARAMETER	RW	M/O

One-axis devices — data content:

Bit length	Meaning
16	Slope long16 (z-axis)
16	Not Assigned

See also [▶ 25].

Two-axis devices — data content:

Bit length	Meaning
16	Slope long16 (x-axis)
16	Slope lateral16 (y-axis)

See also [▶ 27].

Sub-index	Meaning
0x00	Number of supported sub-indexes Read only Default: 0x05
0x01	COB-ID Read only Default: 0x0000 0280 + node number
0x02	Transmission type Value range: 0x01…0xF0 (cyclical, example: 0x03 = for every third synchronization) Value 0xFE: event-specific Default: 0x01
0x03	Inhibit time, minimum waiting time before the selected PDO can be resent Default value = 0x00 (no inhibit time) Value range: 0x0000…0xFFFF ($10…65530_{dec}$, corresponds to 1…6553 ms) Only exact millisecond values are permitted. Intermediate values are rounded up.
0x04	Reserved
0x05	Event timer (setting in Object 0x6200) Value range: 0x0000…0xFFFF (100…65535, corresponds to 100…65,535 ms) 0: no data output Default value: 0x00 (100_{dec})

9.3 Creating variable PDO mapping

The content of the transmit PDOs can be configured according to the application using the variable PDO mapping of the different objects.

The mapping can be created using two procedures:

- The characteristics of the PDOs (transmission type, inhibit time, event time) can be individually configured using object 0x1800FF.
- Multiple PDOs up to max. 64 bits can be transferred in a CAN telegram. The PDOs are compiled in a mapping table from objects 0x1A00FF and 0x01FF. The max. data length of the CAN telegram is 64 bits (8 bytes). For example, two application object entries with 32 bits each or four entries with 16 bits each can be mapped in a table using a 64-bit CAN telegram.

Creating mapping tables

The combined size of the mapped objects within a PDO mapping table (Object 0x1A00FF) must not exceed 64 bits. The same transmission type, inhibit time and event time must be set for all mapped objects within a PDO mapping table (Object 0x1A00FF).

Example: Mapping tables for TPDO1 and TPDO2

0x1800 mapping table TPDO 1 ■ Position value ■ Position raw value		**0x1801 mapping table TPDO 2** ■ Position value ■ Speed value ■ Alarms	
COB-ID 0x1800, 0x01	xxxxxxxx	COB-ID 0x1801, 0x01	xxxxxxxx
Transmission type 0x1800, 0x02	255 asynchronous	Transmission type 0x1801, 0x02	254 synchronous
Inhibit time 0x1800, 0x03	0	Inhibit time 0x1801, 0x03	0
Event time 0x1800, 0x05	100	Event time 0x1801, 0x05	0
Mapping object 1 0x1A00, 0x01	Position value 32 bits	Mapping object 1 0x1A00, 0x01	Position value 32 bits
Mapping object 2 0x1A00, 0x01	Position raw value 32 bits	Mapping object 2 0x1A01, 0x02	Speed value 16 bits
Mapping object 3 0x1A00, 0x01	No entry, 64 bits used	Mapping object 3 0x1A01, 0x03	Alarms 16 bits
Mapping object 4 0x1A00, 0x01	No entry, 64 bits used	Mapping object 4 0x1A01, 0x04	No entry, 64 bits used

Sample of an entry in the mapping table:

The mapped PDO consists of three application object entries of different lengths:

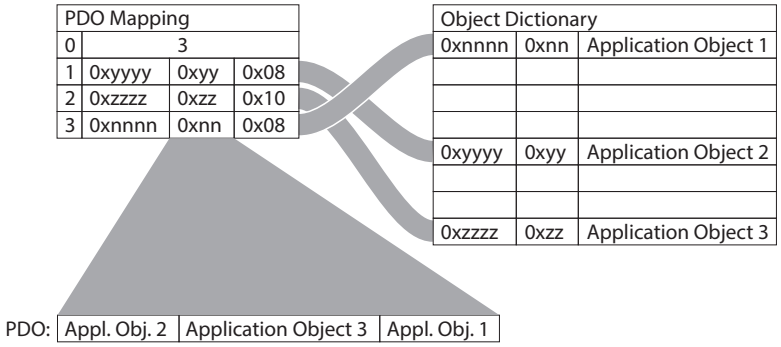


Fig. 8: PDO mapping

Application object 2 is using 1 byte in the transmitter PDO (0x08). This is followed by application object 3 with a length of 16 bits (0x10 = 2 bytes) and then finally application object 1 with a length of 1 byte. A total of 32 bits are used in this PDO.

9.3.1 Object 0x1A00: TPDO1 Mapping Parameter

Up to four application objects can be transferred in a PDO. The maximum data length is 64 bits. PDO mapping is only possible with objects 0x6000…0x6FFF.

0x1A00	RECORD	TPDO1 mapping parameter	PDO MAPPING	RW	M/O

Data content:

Sub-index	Meaning
0x00	Number of supported sub-indexes Read only Value range: 0x00…0xFF
0x01	First application object Default: 0x6010 0010 (inclination x-axis)
0x02	Second application object Default: 0x6020 0010 (inclination y-axis)
0x03	Third application object Default: no entry
0x04	Fourth application object Default: no entry

9.3.2 Object 0x1A01: TPDO2 Mapping Parameter

Up to four application objects can be transferred in a PDO. The maximum data length is 64 bits. PDO mapping is only possible with objects 0x6000…0x6FFF.

0x1A01	RECORD	TPDO2 mapping parameter	PDO MAPPING	RW	M/O

Data content:

Sub-index	Meaning
0x00	Number of supported sub-indexes Read only Value range: 0x00…0xFF
0x01	First application object Default: 0x3103 0110 (gyroscope x-axis)
0x02	Second application object Default: 0x3103 0210 (gyroscope y-axis)
0x03	Third application object Default: 0x3103 0310 (gyroscope z-axis)
0x04	Fourth application object Default: no entry

9.3.3 TPDO1+2 mapping values

Value	Meaning
0x6010 0010	Inclination value slope long16
0x6020 0010	Inclination value slope lateral16
0x3103 0110	Gyroscope x-axis
0x3103 0210	Gyroscope y-axis
0x3103 0310	Gyroscope z-axis
0x3102 0110	Acceleration x-axis
0x3102 0210	Acceleration y-axis
0x3102 0310	Acceleration z-axis
0x5000 0010	Temperature

9.3.4 Default setting for the mapping of transmit PDOs

The device supports variable mapping from all four transmit PDOs.

PDO	TPDO1	TPDO2	TPDO3	TPDO4
Mapping object	0x1A00	0x1A01	0x1A02	0x1A03
Transmission type object: 0x1800FF, 0x02	0x255 **Position** in set time cycles	**Position** in the event of a SYNC request (0x80)	**Position** in the event of a value change	**Speed** in set time cycles
Object of the measured value	0x6004	0x6004	0x6004	0x6030
Sub-index	0x00	0x00	0x00	0x01
Data length	0x20 (32 bits)	0x20 (32 bits)	0x20 (32 bits)	0x10 (16 bits)
Mapping	0x60040020	0x60040020	0x60040020	0x60300110

9.3.5 PDO mapping in accordance with CiA (from CANopen version 4)

The default assignment of process data objects (default mapping) meets the requirements of the CiA. For special application cases, the assignment can be changed via the variable mapping. With variable mapping, the application objects (input and output data) of the PDOS can be assigned freely via mapping tables. Only the following procedure is permitted from CANopen version 4 onwards.

- Lock PDO: Set Object 0x1800 and subsequent objects, sub index 1, COB-ID, and bit 31 to **1**. (Data: e.g. 0x4000 019B → 0xC000 019B)
- Set the number of mapping entries in Object 0x1A00 and subsequent objects, and subindex 0 to **0**. (Data: e.g. 0x01 → 0x00. In this example, 1 entry is changed to 0 entries.)
- Change Object 0x1A00 and subsequent objects, and sub index 1(…8) (Data: e.g. 0x6004 0020 → 0x600C 0020)
- Set the number of mapping entries in Object 0x1A00 and subsequent objects, and sub index 0 to **1**, **2**, **3**…. (Data: e.g. 0x00 → 0x01. In this example, one entry is selected.)
- Release PDO: Set Object 0x1800 and subsequent objects, sub index 1, COB-ID, and bit 31 to **0**. (Data e.g. 0xC000 019B → 0x4000 019B)

9.4 Setting device parameters (one-axis and two-axis devices)

9.4.1 Object 0x2000: Node ID (change the node address)

The node address can be changed via the object.

0x2000	VAR	Node ID	Unsigned8	RW	M

- Specify the node address in object 0x2000: specify the value of 0x01…0x7F ($1…127_{dec}$).

Default: 0x0A

NOTE
The node number 0 is reserved and must not be used by any nodes.

9.4.2 Object 0x2001: Bit rate (set bit rate)

The transmission rate is set without an LSS service via the object.

0x2001	VAR	Bit rate	Unsigned8	RW	M

Sub-index	Value	Data	Transmission rate
0x00	0x00	1000	1000 kbps
	0x01	800	800 kbps
	0x02	500	500 kbps
	0x03	250	250 kbps
	0x04	125	125 kbps

Default: 0x02

9.4.3 Object 0x2102: CANBus termination (switching the terminating resistor on and off)

A 120-Ω terminating resistor for terminating the bus can be switched on and off via the object.

0x2102	VAR	Terminator resistor	Unsigned8	RW	M

- Value 0x00 = 0: Termination inactive
- Value 0x01 = 1: Termination active
- Default: 0x00

9.4.4 Object 0x2200: Spirit level (activate/deactivate spirit level)

The object activates or deactivates the spirit level function.

0x2200	VAR	Level	Unsigned8	RW	M/O

Sub-index	Value	Meaning
0x00	0x00	Deactivated
	0x01	Activated

Default: 0x00

9.4.5 Object 0x3000: Digital filter

Different filters can be set for static and dynamic inclinometers. A fusion algorithm calculates the inclination from the acceleration values and rotation rate values. The setting for the filter parameters changes significant areas of the fusion algorithm. The individual items of sensor data are weighted differently in the various filters. The different weighting of the sensor data can compensate for disadvantages in the measurement process. The slow filter can compensate for fast interfering acceleration in the application. The filter is suitable for applications with slow and precise movements where major external interference may occur. Repetitive, rapid movements can accumulate and distort the filter. Very fast and fast filters provide greater accuracy for rapid movements in the application. The filter can be more easily affected by fast interfering acceleration. Repetitive movements cannot accumulate and distort the filter.

0x3000	VAR	Digital filter	Unsigned16	RW	M/O

Dynamic inclinometers (B…NF):

Sub-index	Value	Meaning
0x00	0x01	Slow
	0x02	Balanced
	0x03	Fast
	0x04	Very fast

Default: 0x04

Static inclinometers (B…N):

Sub-index	Value	Meaning
0x00	0x01	Slow
	0x02	Balanced

Default: 0x02

9.4.6 Object 0x3004: Operating hours counter

The object indicates the operating hours.

0x3004	VAR	Operating hours counter	Unsigned32	RO	M/O

Sub-index	Value range	Meaning
0x00	0x0000 0000…0xFFFF FFFF	Deactivated

9.4.7 Object 0x3102: Acceleration (indicate acceleration)

The object indicates the acceleration force of the axes.

0x3102	VAR	Acceleration	Unsigned8	RO	M/O

Sub-index	Value range	Default	Meaning
0x00	–	0x03	Number of supported sub-indices (read-only)
0x01	0x0000…0xFFFF	–	Acceleration x-axis
0x02	0x0000…0xFFFF	–	Acceleration y-axis
0x03	0x0000…0xFFFF	–	Acceleration z-axis

9.4.8 Object 0x3103: Gyroscope (set inclination axes)

The inclination axes can be set via the object:

0x3103	VAR	Gyroscope	Unsigned8	RO	O

Sub-index	Value range	Default	Meaning
0x00	–	0x03	Number of supported sub-indices (read-only)
0x01	0x0000…0xFFFF	–	Gyroscope x-axis
0x02	0x0000…0xFFFF	–	Gyroscope y-axis
0x03	0x0000…0xFFFF	–	Gyroscope z-axis

9.4.9 Object 0x5000: Device temperature

The object indicates the temperature of the sensor (sub-index 0x00).

NOTE
Temperatures above 128 °C are displayed as 128 °C.

0x5000	VAR	Device temperature	Integer8	RO	M/O

9.4.10 Object 0x6000: Resolution (set resolution)

The resolution can be changed via the object.

0x6000	VAR	Digital filter	Unsigned16	RW	M/O

Sub-index	Value	Meaning
0x00	0x0A	0.01°
	0x64	0.1°
	0x3E8	1°

Default: 0x0A

NOTE
If the resolution is changed, adjust the following values:
0x6010: Inclination value slope long16
0x6012: Preset value slope long16
0x6013: Offset value slope long16
0x6014: Offset value of gradient difference slope long16
0x6020: Inclination value slope lateral16
0x6022: Preset value slope lateral16
0x6023: Offset value slope lateral16
0x6024: Offset value gradient difference slope lateral16

9.4.11 Object 0x6010: Slope long16 (inclination value)

The object indicates the inclination in degrees, depending on the selected resolution in 0x6000.

0x6010	VAR	Slope long16	Integer16 (2 axes) Unsigned16 (1 axis)	RO	M/O

Sub-index	Value range	Default	Meaning
0x00	0x0000…0xFFFF	–	Inclination value slope long16

9.4.12 Object 0x6011: Slope long16 operating parameter

The object indicates the calculated inclination value when scaling is activated or deactivated.

If scaling is activated, the value is output as follows:
Longitudinal inclination = physically measured angle + offset value of the gradient difference + offset value of the longitudinal inclination.
If scaling is deactivated, the longitudinal inclination is output equal to the physical measuring angle.

0x6011	VAR	Slope long16 operating parameter	Unsigned8	RW	O

Sub-index	Bit	State	Meaning
0x00	0	0	Inversion deactivated
		1	Inversion activated
	1	0	Scaling deactivated
		1	Scaling activated
	2…4	–	Reserved
	5…7	–	Manufacturer-specific

Default: 0x00

9.4.13 Object 0x6012: Slope long16 preset value

NOTE
The preset value is only effective when scaling is activated.
Activate scaling under 0x6011.

The current inclination value can be adjusted to a preset value via the object. This enables the zero position of the device to be compared to the machine zero point, for example.

0x6012	VAR	Slope long16 preset value	Integer16	RW	O

Sub-index	Value range	Default	Meaning
0x00	0x0000…0xFFFF	0x00	Preset value slope long16

9.4.14 Object 0x6013: Slope long16 offset (offset value)

The object can be used to set the offset value (preset value minus the physically measured angle minus the gradient difference) in degrees, depending on the selected resolution in 0x6000.

0x6013	VAR	Slope long16 offset	Integer16	RW	O

Sub-index	Value range	Default	Meaning
0x00	0x0000…0xFFFF	0x00	Offset value slope long16

9.4.15 Object 0x6014: Differential slope long16 offset (offset value of the gradient difference)

The object can be used to set the offset value of the gradient difference in degrees, depending on the selected resolution in 0x6000.

0x6014	VAR	Differential slope long16 offset	Integer16	RW	O

Sub-index	Value range	Default	Meaning
0x00	0x0000…0xFFFF	0x00	Offset value of gradient difference slope long16

9.5 Setting device parameters (two-axis devices)

9.5.1 Object 0x6020: Slope lateral16 (inclination value)

The object indicates the inclination in degrees, depending on the selected resolution in 0x6000.

0x6020	VAR	Slope lateral16	Integer16	RO	O

Sub-index	Value range	Default	Meaning
0x00	0x0000…0xFFFF	–	Inclination value slope lateral16

9.5.2 Object 0x6021: Slope lateral16 operating parameter

The object indicates the calculated slope value of the transverse axis when scaling is activated or deactivated.

If scaling is activated, the value is output as follows:
Transverse inclination = physically measured angle + offset value of the gradient difference + offset value of the transverse inclination.
If scaling is deactivated, the transverse inclination is output equal to the physical measuring angle.

0x6021	VAR	Slope lateral16 operating parameter	Unsigned8	RW	O

Sub-index	Bit	State	Meaning
0x00	0	0	Inversion deactivated
		1	Inversion activated
	1	0	Scaling deactivated
		1	Scaling activated
	2…4	–	Reserved
	5…7	–	Manufacturer-specific

Default: 0x00

9.5.3 Object 0x6022: Slope lateral16 preset value

NOTE
The preset value is only effective when scaling is activated.
Activate scaling under 0x6021.

The current inclination value can be adjusted to a preset value via the object. This enables the zero position of the device to be compared to the machine zero point, for example.

0x6022	VAR	Slope lateral16 preset value	Integer16	RO	O

Sub-index	Value range	Default	Meaning
0x00	0x0000…0xFFFF	0x00	Preset value slope lateral16

9.5.4 Object 0x6023: Slope lateral16 offset (offset value)

The object can be used to set the offset value (preset value minus the physically measured angle minus the gradient difference) in degrees, depending on the selected resolution in 0x6000.

0x6023	VAR	Slope lateral16 offset	Integer16	RW	O

Sub-index	Value range	Default	Meaning
0x00	0x0000…0xFFFF	0x00	Offset value slope lateral16

9.5.5 Object 0x6024: Differential slope lateral16 offset (offset value of the gradient difference)

The object can be used to set the offset value of the gradient difference in degrees, depending on the selected resolution in 0x6000.

0x6024	VAR	Differential slope lateral16 offset	Integer16	RW	O

Sub-index	Value range	Default	Meaning
0x00	0x0000…0xFFFF	0x00	Offset value of gradient difference slope lateral16

9.6 Network management

The device supports the simplified network management (minimum boot-up) concept specified in the profile for "minimum capability devices."

The status diagram in accordance with DS301 shows the different node statuses and their respective network commands. The network master controls the commands via NMT services. The node status is also indicated by the LEDs.

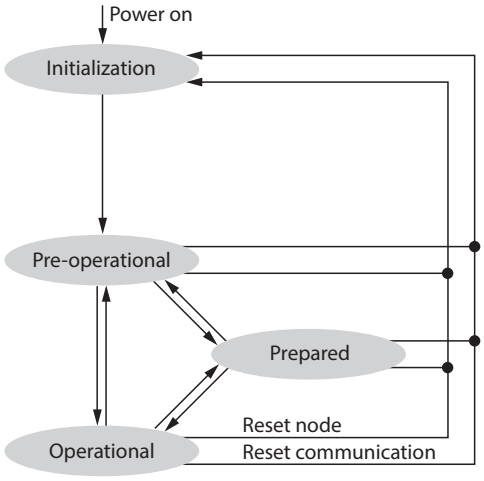


Fig. 9: Status diagram in accordance with DS 301

Initialization

After a reset or after the supply voltage is switched on, the node will be in the "Initialization" status. Once the reset or initialization cycle is completed, the node automatically switches to the "Pre-operational" status.

Pre-operational

In the pre-operational status, the CAN nodes can be activated via SDO messages or with NMT commands in the standard identifier. The device parameters or communication parameters can be programmed.

Operational

The node is active. Process values are issued via the PDOs. The NMT commands can be evaluated.

"Prepared" or "stopped"

The node is not active. SDO and PDO communication is not possible. The node can be set via the NMT commands to the "Operational" and "Pre-operational" statuses.

10 Troubleshooting

If the device does not function as expected, first check whether ambient interference is present. If there is no ambient interference present, check the connections of the device for faults.

If there are no faults, there is a device malfunction. In this case, decommission the device and replace it with a new device of the same type.

11 Maintenance

The device is maintenance-free. Clean with a damp cloth if required.

12 Repair

The device is not intended for repair by the user. The device must be decommissioned if it is faulty. Observe our return acceptance conditions when returning the device to Turck.

12.1 Returning devices

If a device has to be returned, bear in mind that only devices with a decontamination declaration will be accepted. This is available for download at
https://www.turck.de/en/return-service-6079.php
and must be completely filled in, and affixed securely and weather-proof to the outside of the packaging.

13 Disposal

The devices must be disposed of properly and do not belong in the domestic waste.

14 Technical data

14.1 Technical data B1N…-QR20-CNX4-…

Type	B1N360V-QR20-CNX4-H1150	B1NF360V-QR20-CNX4-H1150	B1N360V-QR20-CNX4-2H1150	B1NF360V-QR20-CNX4-2H1150
ID	100046441	100046442	100046427	100046428
Measuring principle	Acceleration	Combination of gyroscopes and accelerometers	Acceleration	Combination of gyroscopes and accelerometers
Resolution	16-bit			
Measuring range	0…360°			
Number of measuring axes	1			
Repetition accuracy	≤ 0.05 % of full scale	≤ 0.03 % of full scale	≤ 0.05 % of full scale	≤ 0.03 % of full scale
Linearity deviation	≤ 0.2 %	≤ 0.15 %	≤ 0.2 %	≤ 0.15 %
Temperature drift	≤ ± 0.006 %/K			
Minimum resolution	≤ 0.01°			
Electrical data				
Operating voltage	8…36 VDC			
Residual ripple	≤ 10 % U_{ss}			
Insulation test voltage	≤ 0.5 kV			
Wire breakage/ reverse polarity protection	Yes			
Communication model	CANopen			
Node ID	1…127; factory setting: 10			
Transmission rate	125/250/500/1000 kbps, factory setting: 500 kbps			
Current consumption	< 80 mA			
Design	Rectangular, QR20			
Dimensions	71.4 × 62.5 × 20 mm			
Housing material	Plastic, Ultem			
Electrical connection	Connector, M12 × 1, 5-pin, CAN in		Two connectors, M12 × 1, 5-pin, CAN in, CAN out	
Ambient conditions				
Ambient temperature	-40…+85 °C			
Temperature changes (EN 60068-2-14)	-40…+85 °C; 20 cycles			
Vibration resistance (EN 600068-2-6)	20 g; 5 h/axis; 3 axes			
Shock resistance (EN 60068-2-27)	150 g; 4 ms ½ sine	200 g; 4 ms ½ sine	150 g; 4 ms ½ sine	200 g; 4 ms ½ sine
Protection class	IP68/IP69K			
MTTF	339 years acc. to SN 29500 (ed. 99) 40 °C			
Operating voltage indicator	LED, green			
CANopen status	Green/red			
Measuring range indication	LED, yellow			

14.2 Technical data B2N…-QR20-CNX4-…

Type	B2N85H-QR20-CNX4-H1150	B2NF85H-QR20-CNX4-H1150	B2N85H-QR20-CNX4-2H1150	B2NF85H-QR20-CNX4-2H1150
ID	100046443	100046444	100046429	100046440
Measuring principle	Acceleration	Combination of gyroscopes and accelerometers	Acceleration	Combination of gyroscopes and accelerometers
Resolution	16-bit			
Measuring range	-85…85°			
Number of measuring axes	2			
Repetition accuracy	≤ 0.01 % of full scale	≤ 0.06 % of full scale	≤ 0.01 % of full scale	≤ 0.06 % of full scale
Linearity deviation	≤ 0.2 %	≤ 0.15 %	≤ 0.2 %	≤ 0.15 %
Temperature drift	≤ ± 0.012 %/K			
Minimum resolution	≤ 0.01°			
Electrical data				
Operating voltage	8…36 VDC			
Residual ripple	≤ 10 % U_{ss}			
Insulation test voltage	≤ 0.5 kV			
Wire breakage/ reverse polarity protection	Yes			
Communication model	CANopen			
Node ID	1…127; factory setting: 10			
Transmission rate	125/250/500/1000 kbps, factory setting: 500 kbps			
Current consumption	< 80 mA			
Design	Rectangular, QR20			
Dimensions	71.4 × 62.5 × 20 mm			
Housing material	Plastic, Ultem			
Electrical connection	Connector, M12 × 1, 5-pin, CAN in		Two connectors, M12 × 1, 5-pin, CAN in, CAN out	
Ambient conditions				
Ambient temperature	-40…+85 °C			
Temperature changes (EN 60068-2-14)	-40…+85 °C; 20 cycles			
Vibration resistance (EN 600068-2-6)	20 g; 5 h/axis; 3 axes			
Shock resistance (EN 60068-2-27)	150 g; 4 ms ½ sine	200 g; 4 ms ½ sine	150 g; 4 ms ½ sine	200 g; 4 ms ½ sine
Protection class	IP68/IP69K			
MTTF	339 years acc. to SN 29500 (ed. 99) 40 °C			
Operating voltage indicator	1 × LED, green			
CANopen status	Green/red			
Measuring range indication	1 × LED, yellow			

15 Turck branches — contact data

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