

Your Global Automation Partner



# B...N...-QR20-IOL...

## Inclinometer with IO-Link Interface

Instructions for Use



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# 1 About these instructions

These instructions for use describe the structure, functions and the use of the product and will help you to operate the product as intended. Read these instructions carefully before using the product. This is to avoid possible damage to persons, property or the device. Retain the instructions for future use 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 used

The following symbols are used in these instructions:



### **DANGER**

DANGER indicates a dangerous situation with high risk of death or severe injury if not avoided.



### **WARNING**

WARNING indicates a dangerous situation with medium risk of death or severe injury if not avoided.



### **CAUTION**

CAUTION indicates a dangerous situation of medium risk which may result in minor or moderate injury if not avoided.



### **NOTICE**

NOTICE indicates a situation which may lead to property damage if not avoided.



### **NOTE**

NOTE indicates tips, recommendations and useful information on specific actions and facts. The notes simplify your work and help you to avoid additional work.



### **CALL TO ACTION**

This symbol denotes actions that the user must carry out.



### **RESULTS OF ACTION**

This symbol denotes relevant results of actions.

## 1.3 Other documents

Besides this document, the following material can be found on the Internet at [www.turck.com](http://www.turck.com):

- Data sheet
- Commissioning manual IO-Link devices
- IO-Link parameters manual
- EU Declaration of Conformity (current version)

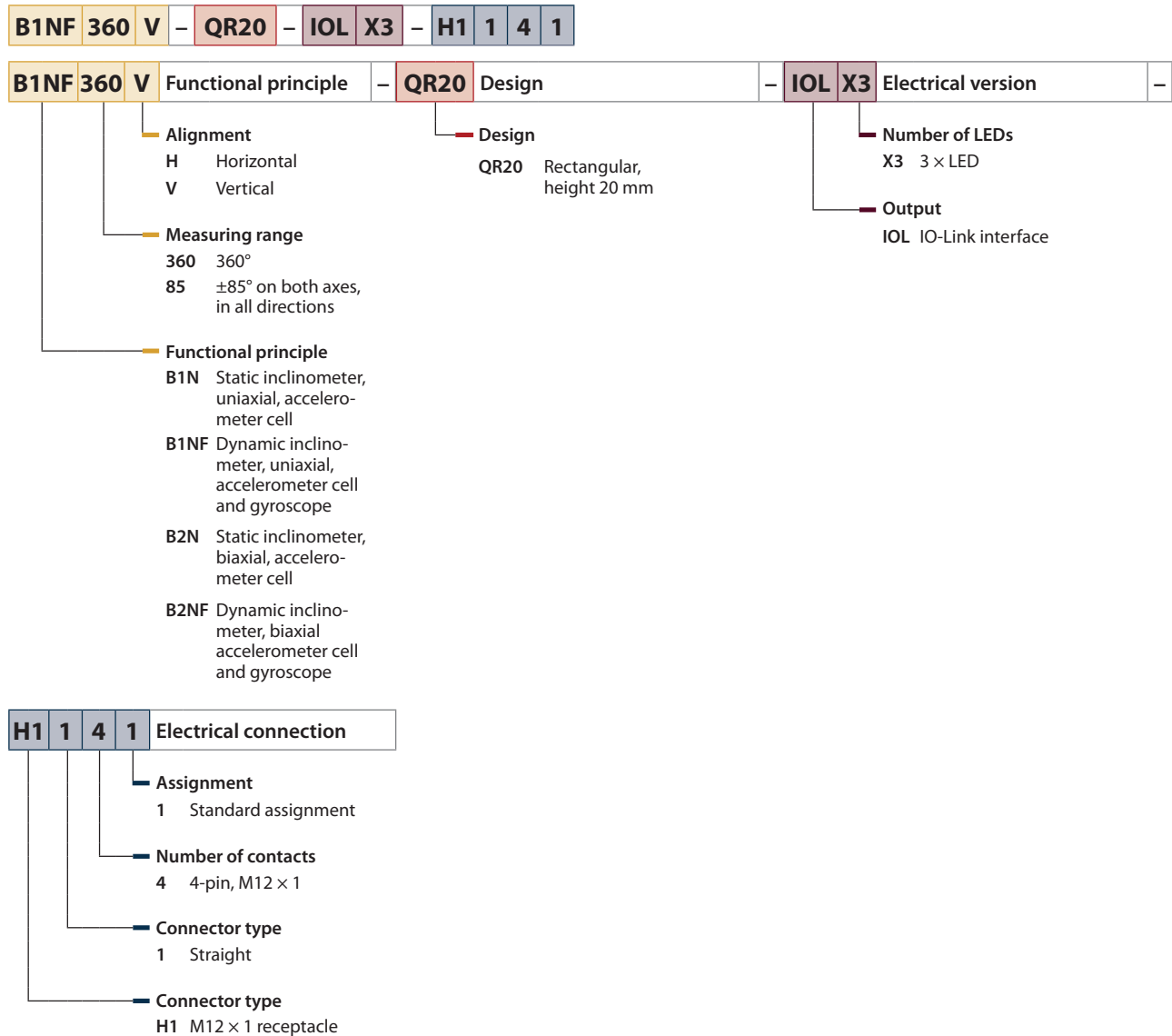
## 1.4 Feedback about these instructions

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](mailto: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 scope of delivery includes:

- Inclinometer
- Quick Start Guide

## 2.3 Turck service

Turck supports you with your projects, from initial analysis to the commissioning of your application. The Turck product database under [www.turck.com](http://www.turck.com) contains software tools for programming, configuration or commissioning, data sheets and CAD files in numerous export formats.

The contact details of Turck subsidiaries worldwide can be found on p. [► 24].

## 3 For your safety

The product is designed according to state-of-the-art technology. However, residual risks still exist. Observe the following warnings and safety notices to prevent damage to persons and property. Turck accepts no liability for damage caused by failure to observe these warning and safety notices.

### 3.1 Intended use

The inclinometers of the B...N...-QR20-IOL... series determine the inclination angle in relation to the set center position and output this value as IO-Link process data. The inclinometers also output the temperature as acyclic data.

The devices may 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 industrial areas. When used in residential areas, take measures to avoid radio interference.
- The device may only be assembled, installed, operated, parameterized and maintained by professionally-trained personnel.
- The device may only be used in accordance with 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 of the B...N...-QR20... are provided with a 4-pin M12 plug connector for connecting the sensor cable. 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 IO-Link.

### 4.1 Device overview

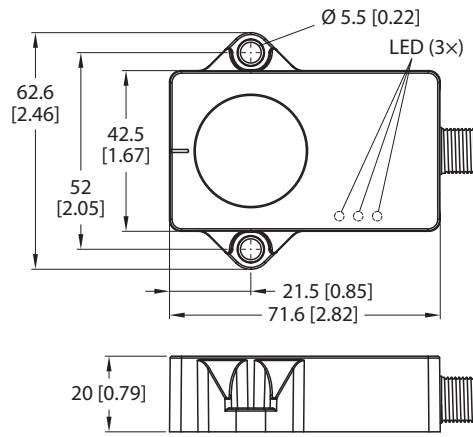


Fig. 1: Dimensions

#### 4.1.1 Indication elements

The B1N... devices are provided with a green and a yellow LED. The green LED indicates the operating voltage and the device status. The yellow LEDs are lit when the spirit level function is active.

The B2N... devices are provided with a green and two yellow LEDs. The green LED indicates the operating voltage and the device status. The yellow LEDs are lit when the spirit level function is active.

### 4.2 Properties and features

- Angle measurement (1-axis devices): 0...359.9°, resolution 0.01°
- Angle measurement (2-axis devices): ±85°, resolution 0.01°
- Accelerometer cell
- Temperature measurement from -40...+85 °C, resolution 1 °C
- Protection type IP68/IP69K
- Protection against rapid temperature fluctuations
- Communication via IO-Link
- 18...30 VDC
- Spirit level function

The dynamic inclinometers (B...NF...-QR20...) are also provided with the following features:

- Gyroscope sensor

## 4.3 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  $0.01^\circ$ . 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  $0.01^\circ$ . 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.

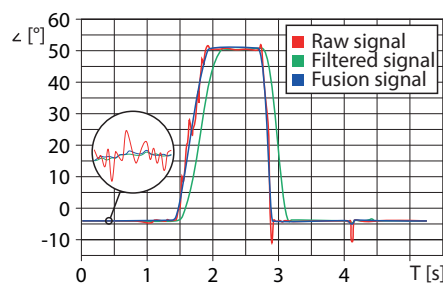


Fig. 2: Fusion algorithm – minimizing interfering acceleration

### 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.

## 4.4 Functions and operating modes

The devices are provided with an IO-Link interface and can be set via an IO-Link master or FDT frame (e.g. PACTware).

### 4.4.1 IO-Link mode

The devices must be connected to an IO-Link master for operation in IO-Link mode. If the port is configured in IOL mode, bidirectional IO-Link communication is provided between the IO-Link master and the device. For this the device is integrated in the controller level via an IO-Link master. The communication parameters are exchanged first of all; the cyclic data exchange of the process data (process data objects) then starts.

#### 4.4.2 Measurement axes

The measurement axis of the 1-axis inclinometers covers the angle range from 0...359.9°.

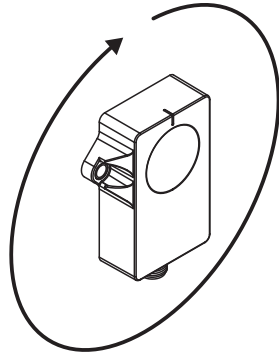


Fig. 3: One measurement axis

The 2-axis inclinometers cover the angle range of  $\pm 85^\circ$  on two axes in all directions. This results in an unmeasurable angle of  $10^\circ$  per  $180^\circ$ .

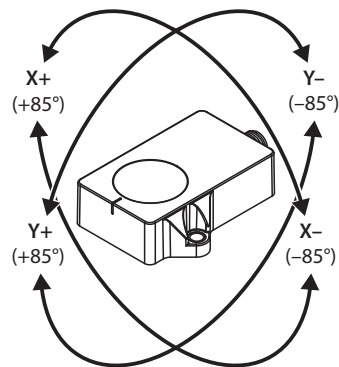
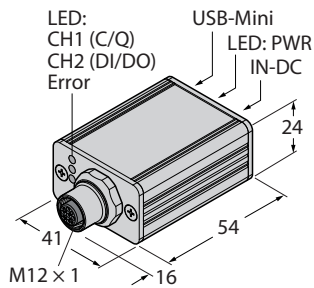
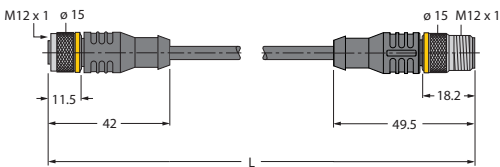
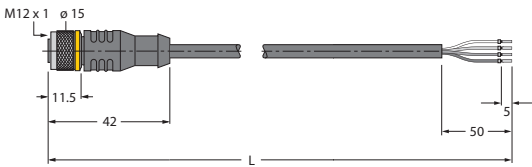


Fig. 4: Two measurement axes

#### 4.4.3 Temperature measurement

The inclinometers can output the temperature as acyclic data. The measurement range is  $-40 \dots +85^\circ\text{C}$  with a resolution of  $1^\circ\text{C}$ . The measurement has an accuracy of  $\pm 3^\circ\text{C}$ .

4.5 Technical accessories

Dimension drawing	Type	ID	Description
	USB-2-IOL-0002	6825482	IO-Link adapter V1.1 with integrated USB interface
	RKC4T-2-RSC4T/TXL	6625604	Connection cable, M12 female connector, straight, 3-pin, M12 male connector, straight, 3-pin, cable length: 2 m, sheathing material: PUR, black; cULus approval; other cable lengths and types available, see <a href="http://www.turck.com">www.turck.com</a>
	RKC4T-2/TXL	6625500	Connection cable, M12 female connector, straight, 3-pin, cable length: 2 m, sheathing material: PVC, black; cULus approval; other cable lengths and types available, see <a href="http://www.turck.com">www.turck.com</a>

## 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.

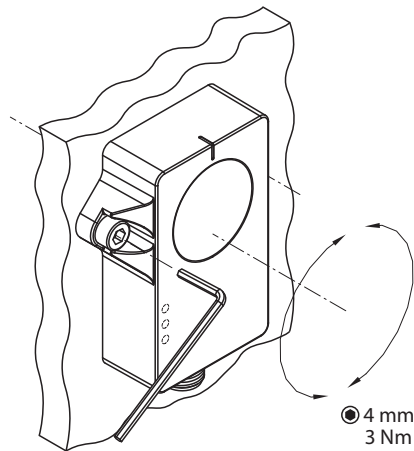


Fig. 5: B1N...V... – vertical installation

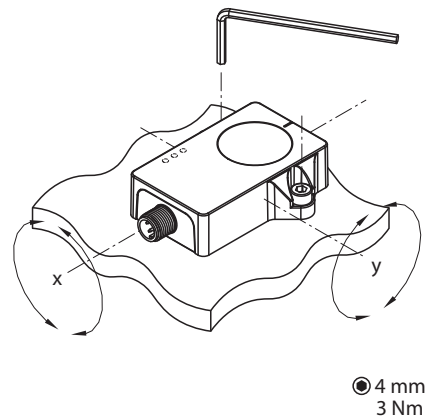


Fig. 6: B2N...H... – horizontal installation

## 6 Connection

- ▶ Connect the female connector of the connection cable to the male connector of the sensor.
- ▶ Connect the open end of the connection cable to the power supply and/or processing units.

### 6.1 Wiring diagram

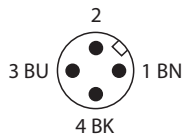


Fig. 7: Pin assignment

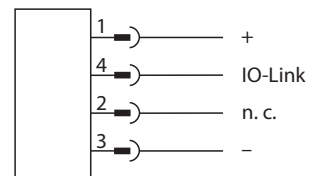


Fig. 8: Wiring diagram

## 7 Commissioning

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

### 7.1 Commissioning aid – spirit level

The LEDs act as a spirit level when the inclinometer is aligned. The two yellow LEDs are lit when the position of the inclinometer is within a window of  $\pm 0.5^\circ$  around the center. The LEDs flash at an increasing frequency the closer the sensor approaches the center position.

One LED flashes with 1-axis movements. Both LEDs flash with 2-axis movements.

The spirit level function can be deactivated via IO-Link. The function is active by default.

## 8 Operation

### 8.1 LED display

LED indication	Meaning
Green	Device is operational
Green flashing	IO-Link communication active
Yellow	Spirit level function – Center position reached ( $\pm 0.5^\circ$ )
Yellow flashing (increasing frequency)	Spirit level function – Approaching the center position
Yellow flashing (decreasing frequency)	Spirit level function – Leaving the center position
Running light (yellow, green, yellow)	Self-test running



## 9 Setting

### 9.1 Settable functions and features

Parameter	Meaning
Reset device	The command restarts the device. Communication is interrupted momentarily.
Reset application	The function resets application parameters. Communication is not interrupted and the sensor is switched to a predefined state. Identification parameters are not affected by this command.
Restore factory setting	The function restores the device to the factory setting. The device is restarted after the reset. Communication is interrupted.
Spirit level	The spirit level function can be deactivated or activated. The spirit level function is active by default.
Self-test	The operation of the measurement cell is tested. The three LEDs light up repeatedly in sequence as a running light. Do not move the device or subject it to vibration. The self-test takes approx. 10 s. No process data can be read during the self-test.
Rotation direction	The function can set the rotation direction of the axis or axes. In the default setting, the process values of the sensors increase to indicate a clockwise direction. The parameter setting enables the increasing process values of the sensors to indicate a counterclockwise direction.
Determining center position	The function enables the current inclination to be defined as a new measuring range center. The teach function is triggered at bit 0 for the X axis and bit 1 for the Y axis. Teach on 1-axis devices is activated via bit 2. On 2-axis devices, the taught measuring range center must not deviate from the physical zero point by more than 30°.
Configuring process data	<p>The process data is structured in accordance with the IO-Link Smart Sensor Profile. On 1-axis sensors the angle value is transferred twice and the value is inverted once. A 16-bit value with an accuracy of 0.01° is transferred for the angle of each axis. The angle information can be output as follows:</p> <p><b>Signed:</b> 16-bit angle information is output for each measurement axis. In <b>Signed</b> representation one bit is used to indicate the sign. The remaining 15 bits represent the angle information in 0.01° increments. The numbers are output as two's complement values.</p> <p><b>Unsigned:</b> 16-bit angle information with a resolution of 0.01° increments is output for each measurement axis. In the factory setting, this configuration is active.</p>

Parameter	Meaning
Filters	<p>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 sensor data items are weighted differently in the various filters. The different weighting of the sensor data can compensate for disadvantages in the measurement process.</p> <p>Very slow and slow filters can compensate for fast interfering acceleration in the application. The filters are suitable for applications with slow and precise movements, where coarse, external disturbances can occur. Repetitive, rapid movements can accumulate and distort the filter.</p> <p>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.</p> <ul style="list-style-type: none"><li>■ <b>Static inclinometers:</b><ul style="list-style-type: none"><li>■ Balanced (factory setting)</li><li>■ Slow</li></ul></li><li>■ <b>Dynamic sensors:</b><ul style="list-style-type: none"><li>■ Balanced</li><li>■ Very slow</li><li>■ Slow</li><li>■ Fast</li><li>■ Very fast (factory setting)</li></ul></li></ul>

## 9.2 Setting via IO-Link

The devices can be set via a PC with an FDT frame application (e.g. PACTware). All the required Turck software components can be downloaded via the Turck Software Manager:

- PACTware
- IODD
- DTM for USB-2-IOL-002 IO-Link adapter
- IODD DTM Configurator

The Turck Software Manager can be downloaded free of charge from [www.turck.com](http://www.turck.com).

The USB-2-IOL-002 USB IO-Link adapter (ID 6825482) is required for connecting to the PC.

A 3-pin standard sensor cable (e.g. RKC4T-2-RSC4T/TXL, ID 6625604) is required for connecting the sensor to the USB-2-IOL-002 IO-Link adapter.

Further information on setting the devices via IODD with a configuration tool is provided in the IO-Link commissioning manual.

## 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 must not be repaired 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

Returns to Turck can only be accepted if the device has been equipped with a Decontamination declaration enclosed. The decontamination declaration can be downloaded from <https://www.turck.de/en/retoure-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 correctly and must not be included in general household garbage.

## 14 Technical data

### 14.1 Technical data B1N...-QR20-IOLX3-H1141

Type	B1N360V-QR20-IOLX3-H1141	B1NF360V-QR20-IOLX3-H1141
ID	100025084	100020900
Measuring range	360°	
Number of measuring axes	1	
Repetition accuracy	≤ 0.2°	≤ 0.1°
Linearity deviation	< ±0.2 %	< ±0.15 %
Temperature drift	0.02°/K	
Resolution	0.01°	
Ambient temperature	-40...+85 °C	
Temperature changes (EN 60068-2-14)	-40...+85 °C; 20 cycles	
Operating voltage	18...30 VDC	
Ripple	≤ 10 % U <sub>ss</sub>	
Insulation test voltage	≤ 0.5 kV	
Wire break / reverse polarity protection	Yes	
Communication protocol	IO-Link	
Current consumption	< 50 mA	
Communication mode	COM 3 (230.4 Kbaud)	
Minimum cycle time	1.3 ms	
Function Pin 4	IO-Link	
<b>Design</b>	Rectangular, QR20	
Dimensions	71.4 × 62.5 × 20 mm	
Housing material	Plastic, Ultem	
Electrical connection	Male connector, M12 × 1	
Vibration resistance (EN 60068-2-6)	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
Type of protection	IP68/IP69K	
MTTF	548 years in accordance with SN 29500 (Ed. 99) 40 °C	
<b>Operating voltage indication</b>	1 × LED, green	
<b>Measuring range indication</b>	2 × LED, yellow	

## 14.2 Technical data B2N...-QR20-IOLX3-H1141

Type	B2N85H-QR20-IOLX3-H1141	B2NF85H-QR20-IOLX3-H1141
ID	100025086	100020901
Measuring range	$\pm 85^\circ$	
Number of measuring axes	2	
Repetition accuracy	$\leq 0.2^\circ$	$\leq 0.1^\circ$
Linearity deviation	$< \pm 0.2 \%$	$< \pm 0.15 \%$
Temperature drift	$0.02^\circ/\text{K}$	
Resolution	$0.01^\circ$	
Ambient temperature	$-40 \dots +85^\circ\text{C}$	
Temperature changes (EN 60068-2-14)	$-40 \dots +85^\circ\text{C}$ ; 20 cycles	
Operating voltage	18...30 VDC	
Ripple	$\leq 10 \% U_{ss}$	
Insulation test voltage	$\leq 0.5 \text{ kV}$	
Wire break / reverse polarity protection	Yes	
Communication protocol	IO-Link	
Current consumption	$< 50 \text{ mA}$	
Communication mode	COM 3 (230.4 Kbaud)	
Minimum cycle time	1.3 ms	
Function Pin 4	IO-Link	
<b>Design</b>	Rectangular, QR20	
Dimensions	$71.4 \times 62.5 \times 20 \text{ mm}$	
Housing material	Plastic, Ultem	
Electrical connection	Male connector, M12 $\times$ 1	
Vibration resistance (EN 60068-2-6)	20 g; 5 h/axis; 3 axes	
Shock resistance (EN 60068-2-27)	150 g; 4 ms $\frac{1}{2}$ sine	200 g; 4 ms $\frac{1}{2}$ sine
Type of protection	IP68/IP69K	
MTTF	548 years in accordance with SN 29500 (Ed. 99) $40^\circ\text{C}$	
<b>Operating voltage indication</b>	1 $\times$ LED, green	
<b>Measuring range indication</b>	2 $\times$ LED, yellow	

## 15 Turck subsidiaries – contact information

<b>Germany</b>	Hans Turck GmbH & Co. KG Witzlebenstraße 7, 45472 Mülheim an der Ruhr <a href="http://www.turck.de">www.turck.de</a>
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<b>China</b>	Turck (Tianjin) Sensor Co. Ltd. 18,4th Xinghuazhi Road, Xiqing Economic Development Area, 300381 Tianjin <a href="http://www.turck.com.cn">www.turck.com.cn</a>
<b>France</b>	TURCK BANNER S.A.S. 11 rue de Courtalin Bat C, Magny Le Hongre, F-77703 MARNE LA VALLEE Cedex 4 <a href="http://www.turckbanner.fr">www.turckbanner.fr</a>
<b>Great Britain</b>	TURCK BANNER LIMITED Blenheim House, Hurricane Way, GB-SS11 8YT Wickford, Essex <a href="http://www.turckbanner.co.uk">www.turckbanner.co.uk</a>
<b>India</b>	TURCK India Automation Pvt. Ltd. 401-403 Aurum Avenue, Survey. No 109 /4, Near Cummins Complex, Baner-Balewadi Link Rd., 411045 Pune - Maharashtra <a href="http://www.turck.co.in">www.turck.co.in</a>
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<b>Canada</b>	Turck Canada Inc. 140 Duffield Drive, CDN-Markham, Ontario L6G 1B5 <a href="http://www.turck.ca">www.turck.ca</a>
<b>Korea</b>	Turck Korea Co, Ltd. B-509 Gwangmyeong Technopark, 60 Haan-ro, Gwangmyeong-si, 14322 Gyeonggi-Do <a href="http://www.turck.kr">www.turck.kr</a>
<b>Malaysia</b>	Turck Banner Malaysia Sdn Bhd Unit A-23A-08, Tower A, Pinnacle Petaling Jaya, Jalan Utara C, 46200 Petaling Jaya Selangor <a href="http://www.turckbanner.my">www.turckbanner.my</a>



<b>Mexico</b>	Turck Comercial, S. de RL de CV Blvd. Campestre No. 100, Parque Industrial SERVER, C.P. 25350 Arteaga, Coahuila <a href="http://www.turck.com.mx">www.turck.com.mx</a>
<b>Netherlands</b>	Turck B. V. Ruiterlaan 7, NL-8019 BN Zwolle <a href="http://www.turck.nl">www.turck.nl</a>
<b>Austria</b>	Turck GmbH Graumannsgasse 7/A5-1, A-1150 Wien <a href="http://www.turck.at">www.turck.at</a>
<b>Poland</b>	TURCK sp.z.o.o. Wroclawska 115, PL-45-836 Opole <a href="http://www.turck.pl">www.turck.pl</a>
<b>Romania</b>	Turck Automation Romania SRL Str. Siriului nr. 6-8, Sector 1, RO-014354 Bucuresti <a href="http://www.turck.ro">www.turck.ro</a>
<b>Russian Federation</b>	TURCK RUS OOO 2-nd Pryadilnaya Street, 1, 105037 Moscow <a href="http://www.turck.ru">www.turck.ru</a>
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